Terroir and Reputation: The Economics of British Columbia Wine Industry in Three Essays.

by

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Abstract

Terroir and collective reputations are two principal and interconnected elements believed to influence wine price and sales. In this dissertation, I examine the role of terroir (measurable features of the grape land) and collective reputation (eligibility for Vintners Quality Alliance, VQA) in determining the price, volume, and revenue of wine sales in British Columbia (BC). My research is highly relevant because this New World wine-producing region is currently altering its terroir-based geographical organization and sub-regional collective reputation, and plans to introduce new appellations and sub-appellations.

My first chapter provides an empirical overview of the BC wine industry including market structure, market shares, and regulations. My first analytical chapter on terroir consists of using hedonic regression to connect wine prices and terroir. By matching grape and wine production at a micro level, I examine how agronomic characteristics of grape land affect the price of wine due to variation in grape quality. In this analysis, I make an extensive use of a detailed dataset consisting of vineyards' terroir characteristics. In my second analytical chapter of collective reputation, I use a three-stage endogenous dummy variable regression model to identify the average effect of VQA status on the average volume share, the average revenue share, and the average price of wine.

I find somewhat limited evidence that vineyards' natural elements are important determinants of the price of BC wine. In my hedonic regression, the factors that seem to matter more are wine variety and brand. I also find that a relatively large number of wine brands represent VQA and that VQA certification positively influences the volume of sales for BC-made wines. My results also show that VQA certification has an insignificant impact on the average price and the average sales revenue of BC-made wines. Therefore, my results imply that VQA certification allows rent dissipation via over-certification. This over-certification allows arbitraging away of producers' rents.

Lay Summary

In this dissertation, I research the BC wine industry. I analyze the influence of natural endowments of vineyards also known as terroir in the formation of wine prices for BC VQA wines. I also verify how VQA certification influences the average volume, average revenue, and average price for BC-made wines. The results of my research suggest that terroir has limited importance in the formation of wine prices for BC VQA wines. In my research, I also prove that while VQA certification has a positive influence on the average volume of wine sales, it shows an insignificant impact on the average price and average sales revenue. This dissertation contributes to wine economics, especially to literature that analyzes the influence of terroir and regional reputation on the formation of wine prices.

Preface

This dissertation is an original, unpublished intellectual product of the author, Katarzyna Pankowska.

Table of Contents

List of Tables

List of Figures

List of Equations

List of Abbreviations

AAFC	Agriculture and Agri-Food Canada
BC	British Columbia
BCLDB	British Columbia Liquor Distribution Branch
BCWI	British Columbia Wine Institute
BCWA	British Columbia Wine Authority
CR	Concentration Ratio
CUSFTA	Canada-US Free Trade Agreement
GDD	Growing Degree Days
GI	Geographic Indication
GIS	Geographic Information System
HSI	Heat Summation Index
IV	Instrumental Variable
NAFTA	North American Free Trade Agreement
OLS	Ordinary Least Squares
PARC	Pacific Agri-Food Research Centre
PPAR	Potential Photosynthetically Active Radiation
RUE	Radiation Use Efficiency
US	United States
VQA	Vintners Quality Alliance

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Many people in various ways assisted in the successful completion of this dissertation. It is not possible to list them all, but below you can find an attempt to do so.

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Lastly, I would like to thank my family and friends who stayed with me when I was implementing this crazy research idea and were forgiving when I had to cancel my participation in social gatherings, just because I had to clean my pricing data or suddenly go to the Okanagan to verify row directions in vineyards. Therefore, my thanks are allocated to the following people: My husband, Artur Stanisz, who has consistently been supporting me and who has been patiently waiting for my Ph.D. finale and my "return to living," as he calls it; My sister, Ewelina Bednarek, and my brother-in-law, Wojciech Bednarek, for providing their home in Port Moody as a useful escape from my reality;

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Dedication

I dedicate this dissertation to my grandmother, Zofia Sacha, a small-scale farmer from Sufczyn, Poland. I have never seen her growing vinifera, but I am sure that with her farming wisdom and skills she would have made an excellent grape grower. That strong and independent woman full of rare qualities always believed in me, offering support and encouragement for my scholarly endeavours. All those years spent on her farm not only shaped my personality and my future, but they were also the best time of my life. She proved to me that it is not required to have an extensive formal education to be wise, make a positive influence in the world and be remembered well. But it is necessary to have an open mind, unstoppable hunger for knowledge, strength to openly stand against evil, and courage to cultivate human decency regardless of circumstances. I sincerely doubt that I could get this type of schooling and wisdom from any school or university degree. So it is to you, Grandma, and I am sorry for not becoming a real doctor as you always suggested.

"Anyone who tries to make you believe that
he knows all about wines is obviously a fake."
[Leon Adams, *The Commonsense Book of Wines*]

Chapter 1: Introduction

1.1. Background

Wine is a complex commodity from production, marketing, and analytical perspectives. On the production side, its creation involves a multi-step process that starts at the agronomic level, where the interplay between a vineyard's natural endowments, also known as terroir,[1] and a winemaker's specific management decisions jointly impact the quality of the final product. The importance of terroir in the winemaking process tends to be emphasized further via development of a collective reputation associated with a given wine region. The collective reputation, in turn, is built via the establishment of wine appellations and sub-appellations that divide wine regions into smaller, terroir-dependent sub-regional wine-producing units. On the marketing side, terroir and collective regional recognition, together with individual and brand-specific reputation, form the basis for wine marketing, with wine marketing strategies and sales built through the establishment of a wine's esteem. The underlying concept behind terroir recognition and collective reputation implies that wines produced in different areas encompass distinct taste characteristics because their primary input, grapes, is sourced from vineyards with varying natural attributes. Also, what tends to be insinuated is that different wine regions possess different winemaking traditions and skills. All this implies that both region-specific terroir and winemaking skills influence wine taste and quality.

[1] *"Terroir"* comes from a French word "*terre*," meaning "land." The term itself has various definitions. Some define terroir as natural endowments of the vineyard (soil, elevation, climate, etc.). Others also include elements like "experience" that wine-producing villages offer to wine tourists, idyllic landscape, specific architecture, history, local know-how, etc. (Gergaud & Ginsburgh, 2008).

However, it is possible that regional, terroir-dependent wine differentiation in the form of wine appellations or sub-appellations is not solely established to emphasize differences in terroir or winemaking know-how (and therefore in wine taste and quality) but to bring to wine an additional level of heterogeneity and enable other marketing avenues. Analyses that point out the marketing role of terroir and appellations have been previously pursued in the literature. They sought to investigate the influence of terroir specifics on prices of vineyards (Cross, Plantingan, and Stavins (2011)) or to find out if site attributes of vineyards influence prices of Bordeaux wines (Gergaud and Ginsburgh (2008)).

The role of terroir and collective reputation remains a compelling research topic in wine economics. This type of the investigation can be especially interesting and relevant in the case of young wine industries that are still growing and trying to establish long-term expansion paths. One such wine industry that is in the process of official legalization of new appellations and sub-appellations is in BC, and constitutes the main research topic in this dissertation. Of specific interest in this thesis are interactions between wine pricing and terroir, as well as the influence of collective reputation on wine pricing, volume share, and revenue share for BC's locally sourced and made wines.

While wine production, marketing, and analytical complexity are likely to introduce systematic obstacles, they also bring an invitation to face the challenge. This invitation can be especially tempting when one analyzes the economics of terroir and collective reputation of a relatively small, unknown, sparsely researched, young and still developing wine industry like the one located in BC.

1.2. Research Problem and Research Questions

The BC wine industry is a rare example among young wine industries in the world because of its strongly manifested attachment to the concept of terroir and weak grape-based wine industry specialization. This positions BC as a New World wine-producing region by the label and as an Old World wine-producing region by its love affair with terroir. The importance of terroir in the production of grapes is undeniable. But the actual

influence of terroir elements on the pricing of BC-sourced and made wines, as well as the impact of BC's appellation (VQA) on pricing, the volume of wine sales, and sales revenue, remain a bit enigmatic. Therefore, the primary goal of this dissertation is to find answers to these two research questions:

Research question 1: Does terroir influence the pricing of BC VQA wines from the Okanagan and Similkameen Valleys? (Chapter 3)
Research question 2: What is the average impact of VQA certification on the average volume, average revenue and average price of wines produced by the estate wineries from the Okanagan and Similkameen Valleys of BC? (Chapter 4).

1.3. Research Rationale

The fact that the BC wine region is currently in the process of policy changes and aims for the introduction of new appellations (four) and sub-appellations (16) constitutes the first research rationale for this dissertation. This new policy will probably be implemented by January 1, 2019.[2] Therefore, it is interesting to analyze what the current relationships are between terroir, collective reputation, wine pricing, and wine sales to be able to envision what might happen in the BC wine industry when the new policy comes to life.

Also, the BC wine industry is very young and developing.[3] While in the literature the relationships between wine pricing, terroir, and reputation in the Old World wine-producing regions are frequently analyzed; it seems to be less the case with young and relatively small wine regions. Therefore, it is likely that the research presented in this dissertation will be able to shed some light on dynamics between terroir, reputation, wine pricing, and wine sales in the world's youngest wine-producing regions.

[2] In fact, one of these sub-appellations, the Golden Mile Bench sub-appellation, was established in 2015. For simplicity the total number of sub-appellations that will be officially set up by January 1, 2019, is used here (hence 16 instead of 15 sub-appellations).
[3] The origins of the BC wine industry go as far back as the 19th century, but the modern BC wine industry started to develop in the late 1980s/early 1990s. Chapter 2, Subsection 2.1.1 below presents more information on this topic.

Finally, the research on the BC wine region is sparse. This fact brings an opportunity to find answers to some important terroir- and reputation-related questions that have not been addressed but might be of interest to academia, local policymakers and the BC wine industry.

1.4. Dissertation Outline and Content

This dissertation is divided into three separate but thematically interconnected chapters.
In the next Chapter 2, I present an overview of the Canadian and BC wine industry. The primary goal of this chapter is to bring forward some important specifics of the BC wine industry that help set the stage for the empirical analyses of chapters three and four that follow. Therefore, in this chapter, I outline a short history of the BC wine industry highlighting the joint role of Canadian federal and provincial governments in setting wine policies in BC. Additionally, I describe the most significant past policies that helped shape and modernize the BC wine industry, such as "the great pull out" law which resulted in the government subsidized re-planting of *Vitis labrusca* grapevines with *Vitis vinifera*, which helped establish the BC wine industry in its current form. I also discuss the most recent wine policy developments in Canada and BC, which provides an understanding of the current wine policy climate at the national and provincial levels. This discussion includes the most recent markup formula change for liquor products that was officially brought to life in BC by the British Columbia Liquor Distribution Branch (BCLDB) on April 1, 2015. I also outline the most current wine industry proposal and plebiscite (2016) that aim to introduce new wine appellations (four) and sub-appellations (16) in BC by January 1, 2019. Also, I outline the basic characteristics of the BC wine industry regarding grape acreage, grape varieties and a number of wineries in various sub-regions of BC. What these statistics point towards is that the BC wine industry is heterogeneous and not specialized in the production of any particular grape or wine type.
Via the use of the BCLDB wholesale scanner wine sales data set for years 2011–2015 I show descriptive statistics for all wine sales (domestic and imports) in the entire province of BC. Also, I establish the number and division of domestically produced wine brands sold in the BC market between 2011 and 2015, and estimate brand shares (volume and

value) for BC-produced wines, with emphasis put on the BC VQA wines. My estimations of the BC VQA brand shares show that while in the BC wine market there are numerous VQA brands, five companies grasp about 59% of the volume and about 52% of the value of the VQA wines sold in BC in years 2011–2015. Also, my calculations of the Herfindahl-Hirschman Index (HHI) prove that in years 2011–2013 a moderate level of industry concentration characterized the BC wine market, but in years 2014–2015 the BC wine industry showed the HHI values characteristic for a competitive industry.

In Chapter 3, I study how terroir elements influence the pricing of selected BC VQA wines from the Okanagan and Similkameen Valleys of BC. The BCLDB scanner wholesale level data set maintains a basis for the analysis in this chapter. I use data on sales of selected BC VQA wines present in the BC market between 2011 and 2015. Then, I match each of these wines with self-collected micro level data (winery level data from 33 wineries) on exact locations of vineyards that sourced the grapes used to produce these VQA wines (71 different vineyards located within the Okanagan and Similkameen Valleys of BC). Additional information regarding natural elements (terroir) specific for each of these 71 vineyards like soil type, average elevation, row direction, vineyard aspect, distance to the lake, as well as temperature during the growing season enriches this data set. The terroir-specific variables come about because of actual verification of the location of these 71 vineyards using Google Earth satellite imagery or by physical visits on these plots. The climate variable is self-constructed using the Environment Canada (EC) temperature database. The combination of all these data sets (in the form of a panel data set with N=6785 observations on BC VQA wines) allows the inclusion of terroir elements that are unique for each of the vineyards that supplied grapes used in the production of selected BC VQA wines in the hedonic pricing modelling of this chapter. The results of my analysis show that terroir elements have somewhat limited importance in the formation of prices of the BC VQA wines, with soil, average elevation, row direction, and climate showing some significant results. What seems to be more important in the formation of wine prices for these wines are grape variety and the winery brand.

In Chapter 4, I estimate the impact of VQA certification on the average volume share, average prices, and average revenue share of wines sold in BC in years 2011–2015. The data set used in this analysis also comes from the BCLDB scanner wholesale level data set for years 2011–2015 and consists of all wholesale wine sales pursued by BC wineries located in the Okanagan and Similkameen Valleys that possess estate location. For this analysis, I transformed the available panel data set into a cross-sectional data set with N=3450 observations on different wines with monthly wine sales on a per wine basis for various VQA and non-VQA wines (straight average over each SKU). The modelling process in this chapter follows the three-stage procedure developed by Woolridge (2010, Subsection 21.4.1, page 937) and consists of an approach that corrects for the inclusion of an endogenous dummy variable. The VQA certification constitutes the endogenous dummy variable in my modelling setup that calls for a correction procedure.

In the stage one of the endogenous dummy variable method, the binomial probit model, I use two types of indicator variables as my instruments for the VQA certification. They are winery age (four indicator variables) and a set of indicator variables for proposed sub-appellations, based on the estate winery location (15 indicator variables).

Other explanatory variables used in stage 1 of this procedure include all explanatory variables that are later used in stages 2 and 3 and come from my wine sales data set: wine colour, wine variety, reserve, sweetness, alcohol content, and a proxy control for winery capacity. I then use fitted values of the VQA certification obtained in stage 1 of this procedure as instruments in stages 2 and 3. In stages 2 and 3 I employ the Two Stage Least Squares (2SLS) method, to estimate a set of three different regressions, with three different dependent variables: the logarithm of the share of the average volume of wine sales, the logarithm of the average price and the logarithm of the average revenue share. The explanatory variables in the 2SLS modelling stage include wine colour, wine variety, reserve, sweetness, alcohol content, and a proxy control for winery's capacity. The fitted values of the VQA certification obtained in stage 1 of this procedure (binomial probit) are used here as an instrument for the VQA indication. The results obtained in Chapter 4 show that after controlling for the endogeneity of the VQA certification, there exists a positive influence of VQA certification on the share of the average volume of wine sales.

At the same time, the impact of VQA certification on the average price and the average sales revenue of BC-made wines remains insignificant.

Finally, in Chapter 5 of this dissertation, I summarize my findings, discuss limitations, and form recommendations for further research.

Chapter 2: Overview of the Canadian and British Columbia Wine Industry

This chapter presents an overview of the Canadian and BC wine industry. Specifically, in Section 2.1 I give an introduction to a short history of the wine industry in Canada and BC. In Section 2.2 I outline the organization and governance of liquor-related policies at the national and provincial level. In Section 2.3 I present the most recent liquor and wine policy developments in BC. In Section 2.4 I outline important wine sales statistics for BC in years 2011–2015, for all wines sold in the province (produced domestically and imported). In Section 2.5 I define types of locally made wines, present classes of BC VQA wines sold in BC, outline wine sales statistics, show estimated brand shares for the BC VQA wines sold in BC in years 2011–2015, and verify the level of industry concentration. Finally, in Section 2.6 I present conclusions.

2.1. Introduction

The fact that Canada domestically grows *Vitis vinifera* and produces various types of table wines may come to some as a surprise, yet it is true. The geographic location and common association of Canada with a cold climate, the relatively small size of the Canadian wine industry (especially in comparison to wine giants like France or the United States (US), for example) are the main reasons why the industry still lacks international exposure. Because of that, to the average wine consumer in the world, Canada still is not known as being able to grow vinifera and supply domestically made table wines. If anybody in the world happens to know that Canada produces wines, it is usually because of ice wines. Canadian ice wines remain the most frequently recognized in the world as being Canadian-made and associated with Canada (Canadian Vintners Association Website statistics accessed on December 5, 2016: http://www.canadianvintners.com/info-centre/wine-statistics/).

Regardless of this still rather low level of world recognition for Canada-made wines, the Canadian wine industry shows a dynamic growth. The most recent, comprehensive wine industry economic study, "*The economic impact of the wine and grape industry in Canada, 2015"* prepared by A Frank, Rimerman + Co. LLP and published in March 2017, estimated the full economic impact of the wine and grape industry in Canada in the year 2015 to be about CAD 9.04 billion. The report shows that the full economic impact of the wine and grape industry in Ontario, the biggest wine-producing Canadian province, was at the level of about CAD 4.4 billion. In the same year, in BC the economic impact reached about CAD 2.8 billion (Frank, Rimerman + Co. LLP, 2017).

In comparison to total world wine production, the production volume of Canadian wines remains insignificant, and Canada is considered a small wine producer, with total production volume accounting for about 0.5% of all world wine production of about 28.2 billion litres. Regarding exports to the global marketplace, in 2015 Canada exported about 72.9 million litres of wine valued at about CAD 73.9 million, with premium wine (non-bulk) maintaining about 1.8 million litres of the total volume, valued at CAD 32.8 million. This was a significant increase in the volume of wine exports from past years, with a 237% increase between 2011 and 2015, as well as in the value of exports, which increased by 101% over the same period. Regardless of this growth in wine exports, Canada is still only ranked as the 27th biggest wine exporter in the world (by value of wine exports) (Canadian Vintners Association Website accessed on December 5, 2016: http://www.canadianvintners.com/info-centre/wine-statistics/).

Six Canadian provinces produce wine: Ontario, British Columbia, Quebec, Nova Scotia, New Brunswick and Prince Edward Island. Traditionally the highest volumes are generated in Ontario. British Columbia is Canada's second biggest wine-producing region. Currently, Canadian winemaking provinces show no specialization in any specific wine or grape variety. This lack of specialization and the practice of producing comparatively low volumes of numerous wine types make Canadian wine production

dispersed, negatively influencing international recognition of Canada as a wine-producing country.[4]

2.1.1. From plonk to Decanter's platinum Pinot Noir[5]

Although modest in size, the beginnings of Canadian winemaking can be traced as far back as the first half of the 19th century. The Canadian wine industry is a young one, and Canada belongs to the group of New World wine-producing countries. The birth of the wine industry in Canada is attributed to retired German corporal Johann Schiller who received land near Toronto and started to cultivate grapevines and sell wine to his neighbours. While the first vineyards in the province of BC were planted at the Oblate Mission of Father Charles Pandosy near Kelowna in 1860 (The Canadian Encyclopedia),[6] the first winery in BC started to operate much later, in 1931[7] (BCWI, accessed on April 1, 2017: http://www.winebc.com/discover-bc/okanagan-valley).

Initially, BC cultivated grapevines belonged to the variety *Vitis labrusca*, a native species known as more suitable for BC and Canada due to its ability to withstand harsh winters. At that time, many agronomists doubted there was potential for *Vitis vinifera* cultivation resulting in labrusca as the primary grapevines species option for Canada in general and BC in particular. The lack of substantial domestic supply of vinifera, considered as superior for winemaking, was one of the reasons why the first BC-made wines were not

[4] Canada remains a wine-producing country with no specialization in specific wines based on grape type like Malbec, for example, that is a crown grape/wine type associated with Mendoza in Argentina. The Canadian wine production approach is frequently called a "fruit salad" approach, where many different wineries produce many different wine types. The Canadian wine regions do not specialize in the cultivation of any particular grape variety. This fact negatively influences recognition of Canadian wines and the Canadian wine regions in export markets. Nevertheless, some BC wine industry members claim that such an approach is better for the BC wine industry in mitigating risks associated with the specialization that could negatively influence the survival rate of wineries in situations when there is a drop in prices for a particular wine type, for example.

[5] Plonk is a derogatory name for wine of low quality, with high alcohol content. Such wine was produced in BC before the modernization of the wine industry in the early 1990s. The Platinum Decanter award was given to Mission Hill (a BC winery) for its Pinot Noir in 2013. Mission Hill's Pinot Noir was considered the best in the world in 2013. The link below presents more information on this topic. Accessed on April 1, 2017: http://www.missionhillwinery.com/media/24718/Decanter_Trophy-PressRelease2013.pdf

[6] The BC Wine Institute Website lists 1859 as the year of planting of first grapevines in BC. Accessed on April 1, 2017: http://www.winebc.com/wines/wine-101).

considered premium and superior quality. These wines had high alcohol content and usually constituted a component for port or sherry.

2.1.2. Government intervention and "the great pull out"

The groundbreaking change in the BC wine industry came because of free trade agreements in the late 1980s and early 1990s, especially the Canada-US Free Trade Agreement (CUSFTA) negotiated in 1987 (ratified in 1989) and the North American Free Trade Agreement (NAFTA) that came to life in 1994. These trade agreements enforced and allowed industry modernization and development. At the time of ratification of these trade agreements, predictions for the future of the BC wine industry were very pessimistic. Many suggested that opening borders for trade with the US would end the BC wine industry, as it wouldn't be able to compete with premium quality wines from California. But, these gloomy predictions about the inevitable deterioration of the BC wine industry did not come to fruition. Instead, the BC provincial government came to the rescue, introducing the British Columbia Wine Act (Bill 58-1990) that reformed the whole BC wine industry. Among many rules brought in that act, probably the most important one was the fact that the BC government offered a subsidy to all grape growers in the province of BC that were willing to remove labrusca grapevines and replace them with vinifera plants superior for premium wine production. This government initiative is called in the BC wine industry as "the great pull out." When the government introduced this support, a group of BC grape growers decided to accept the payment [8] and leave the industry. Others stayed and switched to vinifera cultivation. The grape growers that decided to stay received a subsidy of CAD 8,100 per acre for replacing labrusca with vinifera plants. "The great pull out" diminished the number of industry participants and made the BC wine industry more compact and profitable. This policy enforced changes in the sector size and ordered replanting of grapevines. There were also some other elements that influenced industry development: the introduction of the BC Wine Act and quality norms for BC-made wines (VQA) as well as the establishment of the BC Wine Institute

[8] Those that decided to exit the industry also received payment. The government spent about CAD 27 million for this purpose (Hira, 2013).

(BCWI). All these elements jointly modernized the BC wine industry and made it more suitable to compete with other modern wine industries in the world (Hira, 2013).

2.2. Liquor Policies in Canada and British Columbia

In this section, I outline details regarding Canadian liquor laws. While in Subsection 2.2.1 I discuss alcohol policies at the national level, in Subsection 2.2.2 I describe details about BC liquor laws at the provincial, BC level.

2.2.1. Liquor policies in Canada

Canadian liquor laws are multidimensional and complex. Because of the Canadian national organization, with federal and provincial governments that jointly govern in each province or territory, Canadian liquor policies are geographically heterogeneous. While each of the Canadian provinces or territories is left with autonomy for the organization of its internal management of liquor distribution and development of regionally specific alcohol policies, at the national level, federal laws bind all Canadian regions. Regarding jurisdiction that overlooks all alcohol related issues like liquor control, distribution and sales, each of the 13 Canadian provinces and territories have a liquor board or commission. The prerogatives of these liquor boards or commissions differ regionally, but they cooperate at the federal level in unifying the vision for the Canadian liquor status quo at the national level. Table 2.1 below presents details on the 13 Canadian liquor commissions and boards. The joint mandate of all Canadian liquor boards and commissions is to:

1. *"Promote and encourage frank, open and ethical practices concerning the control, purchase and/or sale of alcoholic beverages;*
2. *Co-operate with all provincial, territorial and federal agencies concerned with the control, sale and taxation of alcoholic beverages;*
3. *Improve the provinces' and territories' systems of control and distribution of alcoholic beverages by co-operation and free flow of information among the*

members of the Association and by regular meetings or conferences of the members of the Association and comparable jurisdictions outside Canada" (Canadian Association of Liquor Jurisdictions website, accessed on April 15, 2017: http://www.calj.org/AboutUs.aspx).

Table 2.1. Canadian liquor commissions and boards, April 2017.

Province/Territory	**Board/Commission**
Alberta	Alberta Gaming and Liquor Commission (AGLC)
British Columbia	British Columbia Liquor Distribution Branch (BCLDB)
Ontario	Liquor Control Board of Ontario (LCBO)
Manitoba	Manitoba Liquor & Lotteries
Northwest Territories	Northwest Territories Liquor Commission
Newfoundland and Labrador	Newfoundland and Labrador Liquor Corporation
New Brunswick	New Brunswick Liquor Corporation
Nova Scotia	Nova Scotia Liquor Corporation
Nunavut	Nunavut Liquor Commission
Prince Edward Island	Prince Edward Island Liquor Control Commission
Saskatchewan	Saskatchewan Liquor and Gaming Authority
Québec	Société des alcools du Québec
Yukon	Yukon Liquor Corporation

(Source: Canadian Association of Liquor Jurisdictions website accessed on April 15, 2017: http://www.calj.org/CALJMembers.aspx)

The regional differences in Canadian liquor laws can be profound and significantly influence the level of board or commission's engagement in alcohol management within each province. Alberta, for example, has a fully privatized liquor industry and the sole role of the AGLC is to regulate the manufacture, importation, sale, purchase, possession, storage, transportation, and consumption of liquor in the province, oversee the industry and collect markup from alcohol sales. In Alberta, privately owned retail stores and licensed premises are in charge of all retail alcohol sales. British Columbia in turn, has a mixed private-public liquor distribution model with the BCLDB being a sole purchaser of alcohol within BC and from outside the province, by the federal Importation of

Intoxicating Liquors Act (BCLDB Website accessed on April 1, 2017: http://www.bcldb.com/about/who-we-are)

2.2.2. Liquor policies in British Columbia

All alcohol produced and sold in the province of BC must comply with numerous federal and BC specific policies. At the national level, the Importation of Intoxicating Liquors Act contains the primary liquor rules.[9] Other federal laws concerning wine include the Canada Agricultural Products Act,[10] Consumer Packaging and Labelling Act,[11] Food and Drugs Act (Food and Drugs Regulations Part B-Alcoholic Beverages).[12] As Section 2.2.1 above implies, the BC Liquor Distribution Act additionally enforces federal liquor laws. This act, together with the Importation of Intoxicating Liquors Act, outlines the BCLDB's mandate. The BC Liquor Distribution Act gives the BCLDB an exclusive right to purchase liquor for resale and reuse in the province of BC. This fact makes the BCLDB one of the biggest alcohol purchasers in the world. Besides being the sole buyer and reseller of all liquor in BC, the BCLDB also runs its own liquor stores, BC Liquor Stores (as of April 2017, there were 198 stores in the province).[13] Therefore, the BCLDB also remains one of the biggest liquor retailers in BC. The BCLDB is responsible for reporting all liquor sales in the province. All alcohol producers and sellers, including all wine producers are required by law to report their direct sales information to the BCLDB.[14]

[9]Source: https://www.canlii.org/en/ca/laws/stat/rsc-1985-c-i-3/latest/rsc-1985-c-i-3.html accessed on December 5, 2016.
[10]Source: http://laws-lois.justice.gc.ca/eng/acts/C-0.4/), accessed on 5, December 2016.
[11]Source: http://laws-lois.justice.gc.ca/eng/acts/C-38/index.html), accessed on 5, December 2016.
[12]Source:http://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._870/page-160.html#s-B.16.100), accessed on December 5, 2016.
[13]Source: http://m.bcliquorstores.com/m/stores), accessed on 5, December 2016.
[14]Since 2013, the Direct Sales Web-Reporting (DSWR) –Internet based reporting is being used. (BCLDB Website accessed on April 15, 2017: http://www.bcldb.com/about/who-we-are)

2.3. Recent Developments in Wine Policies in BC

In this section, I outline details regarding the developments in the BC liquor policies. While in Subsection 2.3.1 I describe the BC's liquor markup formula that was in place before April 1, 2015, in Subsection 2.3.2 I discuss the most recent change in the BC's liquor markup method. In Subsection 2.3.3 I outline details regarding the most current wine specific policy developments in the province of BC.

2.3.1. Liquor wholesale pricing in BC up to April 1, 2015

Before April 2015 wine wholesale prices in BC were based on a formula where the retail price of wine, as seen in the government run liquor stores constituted a basis for the wholesale price formation. The official BCLDB markup method at that time included a 117% of markup on the first CAD 10.25 of the wholesale cost of wine plus 51% of markup on the remaining value. From that wine price, various retailers received different levels of discounts. In British Columbia, five classes of wine retailers were getting the following discounts off the government-run liquor stores' retail price:

1. Independent wine stores: 30% discount off the LDB display price,
2. Private liquor stores: 16 % discount off the LDB display price,
3. Rural agency stores: 10 % discount off the LDB display price,
4. VQA wine stores: 30% discount off the LDB display price,
5. Restaurants and bars: 0% discount off the LDB display price.

The BCLDB wholesale pricing calculators available to all wine suppliers in BC were used to establish wholesale prices for wines in BC. The wine vendors were using these official calculators to input their primary costs. The BCLDB calculator automatically applied the BCLDB markup formula to come up with a liquor store display price. This price before 2015 constituted a wholesale price in BC to which retailer-specific discounts were applied (as described above) (BCLDB website accessed on December 15, 2016: http://www.bcldb.com/files/BCWI%20presentation%20-%20Doing%20Business%20with%20the%20LDB%20-%2016Nov16.pdf).

The BCLDB employs the theory of Social Reference Pricing (SRP). The SRP states that if prices of alcohol are set high, society consumes less alcohol. The SRP for BC wines is connected to minimum wine prices. Currently these minimum prices (including tax) are:

- CAD 7.20/litre if wine size is <10 litres
- CAD 6.45/litre if wine size is >10 litres

(CALJ website accessed on July 24, 2017: http://calj.org/Articles/Publications/tabid/106/ArticleId/42/Minimum-Pricing-in-Canadian-Alcohol-Jurisdictions.aspx

The main issue associated with the official wine markup formula prior to 2015 was that on lower-priced products (that were a subject of the SRP policy, as per minimum price threshold presented above), the BCLDB official wholesale price was frequently higher than the price that would be offered by the producer. It is likely that these SRP price floors were binding mainly for wines from the category Cellared in Canada (CIC) (made from mixes of domestic and foreign wines or grape juice). These wines belong to the group of the least expensive BC-made wines (at retail), and they are likely candidates for the SRP price floors. The level of costs of production for BC-made wines can additionally support this statement. As mentioned above, the costs of production of other BC wines that are produced in BC and are made from 100% BC-grown grapes tend to be much higher. Lee Cartier, in his report on the BC wine industry, estimates that the average cost per litre of BC VQA wine was at the level of about CAD 5.91. At the same time, the average cost per litre of CIC wine was at the level of about CAD 3.20 (Cartier, 2013).

2.3.2. Liquor wholesale pricing in BC after April 1, 2015

On April 1, 2015, a new liquor wholesale pricing formula was officially implemented in the province of BC. The aim of this new method for the calculation of wholesale liquor prices was to simplify the old way, which was based on the application of complicated and retailer-specific discounts. The new formula introduced a standard rate for all

commercial vendors in BC. Table 2.2 below outlines differences between the old and new pricing method.

Table 2.2. Old versus new BCLDB wholesale pricing formula, April 2017.	
Old BC wholesale prices formula	**New BC wholesale prices formula (April 1, 2015)**
Discount off display price Liquor Distribution Branch Price Less PST and GST[15] **=Retail Price** Less applicable wholesale discount **=Wholesale Price for that Customer Type, plus GST**	Duty paid costs plus mark-up **=Wholesale Price (tax excluded), plus GST**

(Source: BCLDB Website accessed on April 1, 2017: http://www.bcldb.com/files/Wholesale_Pricing_Changes-Overview.pdf)

The detailed calculations involved in the formation of the new wholesale price markup formula are presented in detail in Figure A.1 in Appendix A: Chapter 2.

Together with the new wholesale price markup model, the BCLDB introduced some additional operating changes:

1. Eligible grocery stores were allowed to sell BC VQA wines[16],
2. BCLDB-run liquor stores expanded hours of operation,
3. Refrigeration was introduced to the government-run liquor stores.

There were no changes to the BC VQA program, and BC VQA wines are still exempt from the BCLDB markups. There were also no significant changes in pricing for the hospitality industry.

As was the case with the old markup formula (before April 2015), under the new pricing formula, the BCLDB provides for BC wine vendors wholesale pricing calculators where wine suppliers input their primary costs and the BCLDB calculator automatically applies the BCLDB markup method. The new markup formula is based on the graduated markup

[15]PST (Provincial Sales Tax) and GST (Goods and Services Tax) are two charges present in BC.

[16]The BC VQA wines (BC Vintners Quality Alliance wines) are wines that are 100% BC-made. The full description of conditions that need to be met for VQA wines is outlined in detail in Subsection 2.5.1 below. This element of the policy change that concerns BC VQA wine sales in grocery stores like Save-On-Foods, for example, has already caused opposition, especially in the US. The US wine industry claims that the introduction of BC VQA wines in grocery stores in BC is not following ratified free trade agreements, especially NAFTA. While the BCLDB argues that its policy does not introduce preferential treatment for BC-made wines and the volumes of sales of these wines in grocery stores are minimal, the US wine industry claims the opposite. On January 18, 2017, the US government filed a formal complaint to the World Trade Organization. More details here in this link accessed on January 20, 2017: https://ustr.gov/about-us/policy-offices/press-office/press-releases/2017/january/Challenges_Canadian_Trade_Measures_That_Discriminate_Against_US_Wine.

calculated in the following way: supplier cost plus 89% wholesale level tax on the first CAD 11.75 wholesale cost + 27% markup on the remaining cost. The price of wine calculated in this way constitutes the wholesale price of wine. As of 2015, the wholesale pricing is the same for all retailers and retailer specific discounts are no longer in place (as per BCLDB website accessed on December 15, 2016: http://www.bcldb.com/files/BCWI%20presentation%20-%20Doing%20Business%20with%20the%20LDB%20-%2016Nov16.pdf).
For more details, please refer to Figure A.1 in Appendix A: Chapter 2 and the text that follows under that figure.

2.3.3. The BC wine industry turning point

In November 2015, a significant development in the BC wine industry took place. The BC Wine Appellation Task Group constituted of members of the BC wine industry and coordinated by the BC Wine Institute board, in partnership with the BC Minister of Agriculture as well as the BC Wine Authority (BCWA), prepared a set of recommended changes to regulations of BC Wines of Marked Quality and delivered it to the BC Ministry of Agriculture. The recommendations from the BC Wine Appellation Task Group (Table A.1 Appendix A: Chapter 2 outlines these results in detail) were further reviewed and revised, resulting in final recommendations presented on April 28, 2016. The BC wine industry plebiscite that took place between May 20 and July 1, 2016, followed the release of the revised version of recommendations. The results of this vote are also presented in Table A.1, in Appendix A: Chapter 2.

Participation in the plebiscite was not solely the prerogative of wineries that were current members of the BCWA, but instead, all producers of BC-made grape wines were asked to participate. All licensed wineries in BC could not only participate in this plebiscite, but they were encouraged to do so. About 71% of all licensed wineries operating in BC at that time (180 wineries out of 252 total) voted, making the results of the plebiscite valid and binding.

The official results of the plebiscite were delivered to the BC Ministry of Agriculture on July 8, 2016, with a request for rapid processing of these recommendations and introduction of proper policies. As of October 2017, the post-plebiscite recommendations have not been officially amended into binding legal rules and await the completion of the legislative process, but it is expected that this new policy will be formally introduced on January 1, 2019.

The most significant change coming from this wine industry proposal concerns the introduction of new appellations (four) and sub-appellations (16) (BCWI BC Wine Industry Plebiscite on Recommended Changes to the British Columbia Wines of Marked Quality Regulation as Proposed by the BC Wine Appellation Task Group, accessed on August 1, 2016: http://bcwinetaskgroup.ca/wp-content/uploads/2016/06/Plebiscite-Cover-Letter.pdf

When fully implemented these policies will likely open a new chapter in the history of the BC wine industry, making it more transparent as well as more oriented towards wine origin and wine quality. It is also likely that in the future the BC wine industry will put more emphasis on the varietal specialization of sub-regions (sub-appellations). But it remains to be seen what kind of influence the new policies will have on the future of the BC wine industry and how they will impact its numerous players.

While we must wait to see how these new policy developments will affect the wine industry in BC, several BC wine comparative statistics for the period 2011–2015 are presented and discussed in the next sections of this chapter, which will help to set a stage for the analyses in Chapters 3 and 4.

2.3.4. Status quo in the BC wine industry

Currently, six main wine-producing areas compose the BC wine industry (with five of them recognized officially as Geographic Indications (GI)), with a total of 299 wineries:

1. The Okanagan Valley GI, with 172 licensed wineries,
2. The Similkameen Valley GI, with 19 licensed wineries,
3. The Fraser Valley GI, with 36 licensed wineries,
4. The Vancouver Island GI, with 37 licensed wineries,
5. The Gulf Islands GI, with 13 licensed wineries,

Emerging regions (Lillooet (1), Kootenays (6), Shuswap (10), Thompson Valley (4), Northern BC-fruit winery (1)) account for 22 wineries[17] (BC Wine Institute Website accessed on May 17, 2017: http://www.winebc.com/discover-bc).[18]

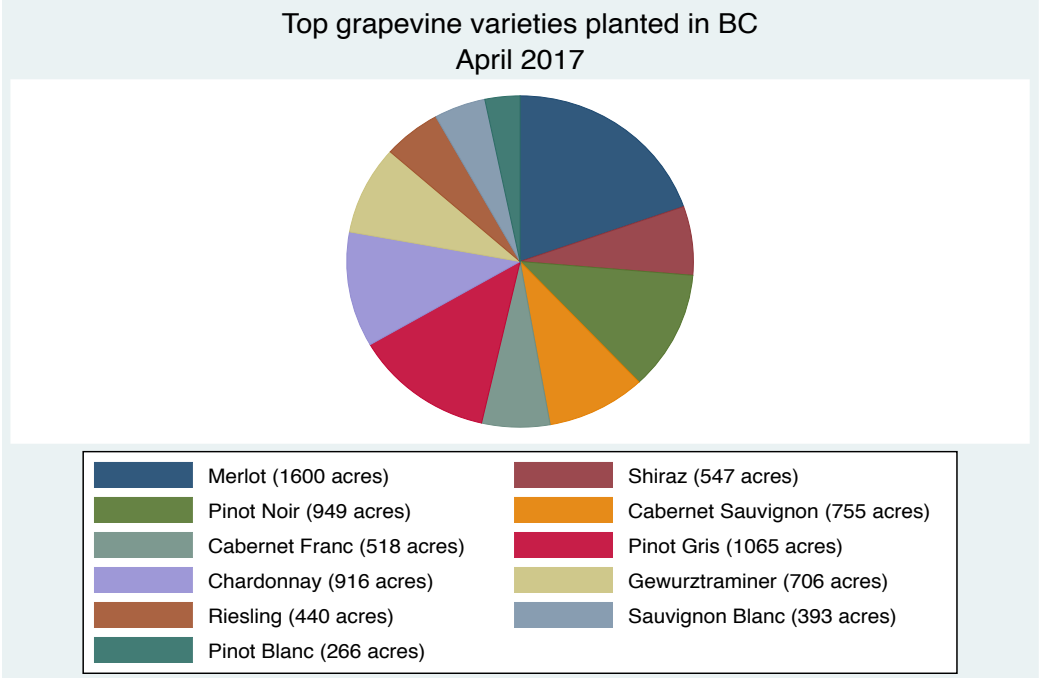
Out of these six regions, the Okanagan Valley constitutes British Columbia's biggest grape-growing area, with over 80% of the total grape acreage in the whole province coming from there.

Regarding grape varieties, red grape varieties constitute about 52% of all vines grown in BC; the remaining 48% are white varieties. Figure 2.1 below lists the top planted varieties in BC, together with their acreage. Overall, the most commonly grown grape varieties in BC include Pinot Gris and Merlot (BC Wine Institute Website accessed on May 17, 2017: http://www.winebc.com/wines/varietals).

[17]The number of wineries is somewhat flexible as they go out of business or merge with other wineries. This number of wineries was taken on May 17, 2017, from the BC Wine Institute website: http://www.winebc.com/discover-bc/okanagan-valley.

[18]Not all these wineries are grape wineries. Some are fruit wineries. The BC Wine Institute lists the number of all licensed facilities, including those that produce non-vinifera made wines.

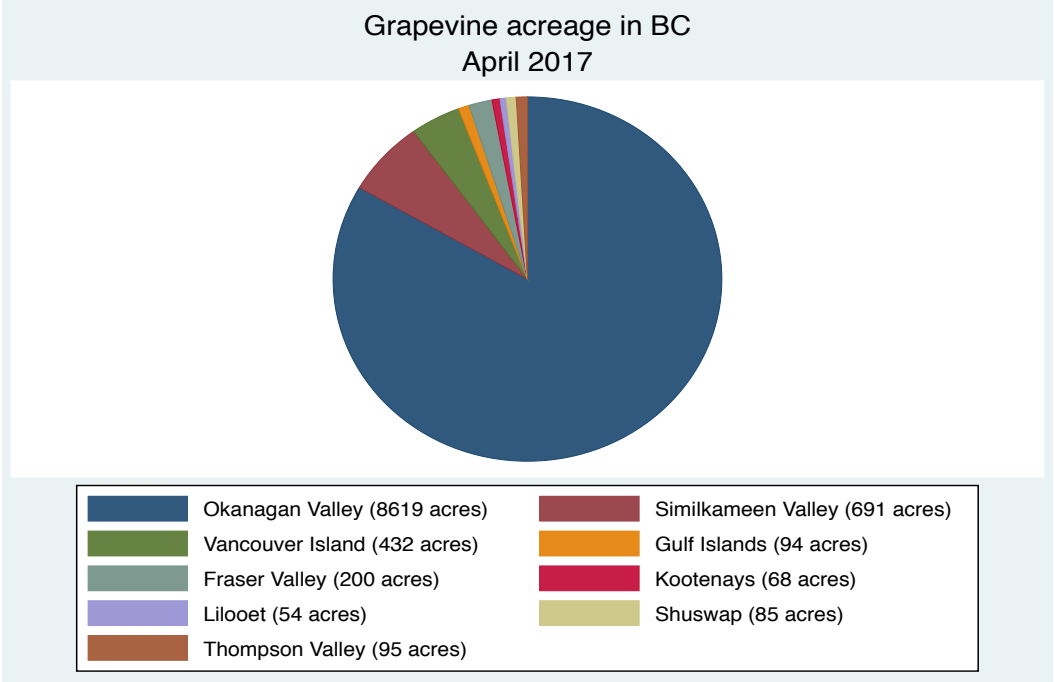
Figure 2.1. Top grapevine varieties planted in BC, April 2017.



Source: BC Wine Institute Website accessed on April 1, 2017: http://www.winebc.com/wines/varietals

Regarding the BC's total planted acreage of grapevine (per sub-region), as of April 2017, the following grape planting statistics hold:

Figure 2.2. Grapevine acreage in BC, April 2017.



Source: BC Wine Institute Website accessed on April 1, 2017:http://www.winebc.com/wines/varietals

2.4. Selected Statistics for Wines Sold in the BC Market

In this section, I outline several descriptive statistics related to wholesale wine sales within the province of BC between years 2011–2015. In Subsection 2.4.1 I describe the volume and value of all wines traded in BC (domestic and imports), and in Subsection 2.4.2 I present the composition of wine sales regarding wine colour, and show the volume and value of sales for Canadian-made wines.

2.4.1. Total volume and value of wine sales in the BC market between 2011-2015

Wine sales in the BC market consist of sales of domestic (Canadian- and BC-made wines) and wine imports. Between years 2011–2015[19] the total volume of wines sold in the province of BC was at the level of about 300 million litres, with red, white and rosé wines maintaining respectively about 54.2%, 43.3%, and 2.5% of the total volume of wine sales in the province. The domestic wine supply in that period was mainly from BC and Ontario and maintained on average about 52% of the total volume of all wines sold in BC (about 156 million litres). The supply of imported wines (about 144 million litres or about 48% of the total volume of wines sold in the province of BC) came from about 20 different wine-producing countries (depending on the year). As the statistics show, there is an overall increasing trend in the volume of wine sales in BC. Figure 2.3 below presents the volume of sales for domestic and imported wines found in the province of BC in years 2011–2015.

The total value of wine sales in the BC market in 2011–2015 was at the level of about CAD 4.6 billion (real value, 2015=base year).[20] Canadian wines captured on average about 46% of this total value of all wine sales in BC. Figure 2.4 below presents the value of all wine sales in BC in years 2011–2015.

[19]Data used for the analysis in this chapter comes from the BCLDB and consists of wholesale scanner data for April 1, 2011 to March 31, 2015. Canadian and BC wines include wines recognized in Canada as "Cellared in Canada (CIC)." As mentioned in section 2.3.1 above, these wines are made from a mix of Canadian and foreign grapes (or grape juice).

[20]The CPI deflator was calculated using Statistics Canada Table 326-001, http://www5.statcan.gc.ca/cansim/a26?id=3260021 accessed on January 15, 2016.

Figure 2.3. Total volume of wines sold in BC (Canadian and imports), 2011-2015 (in '000L).

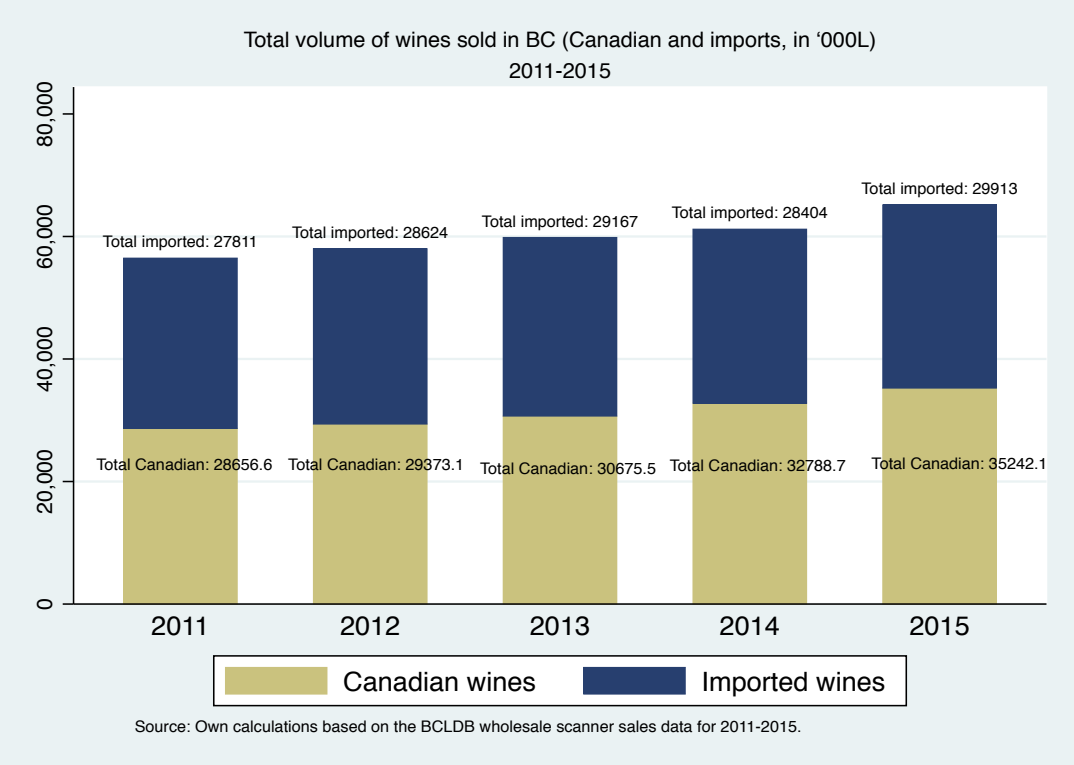
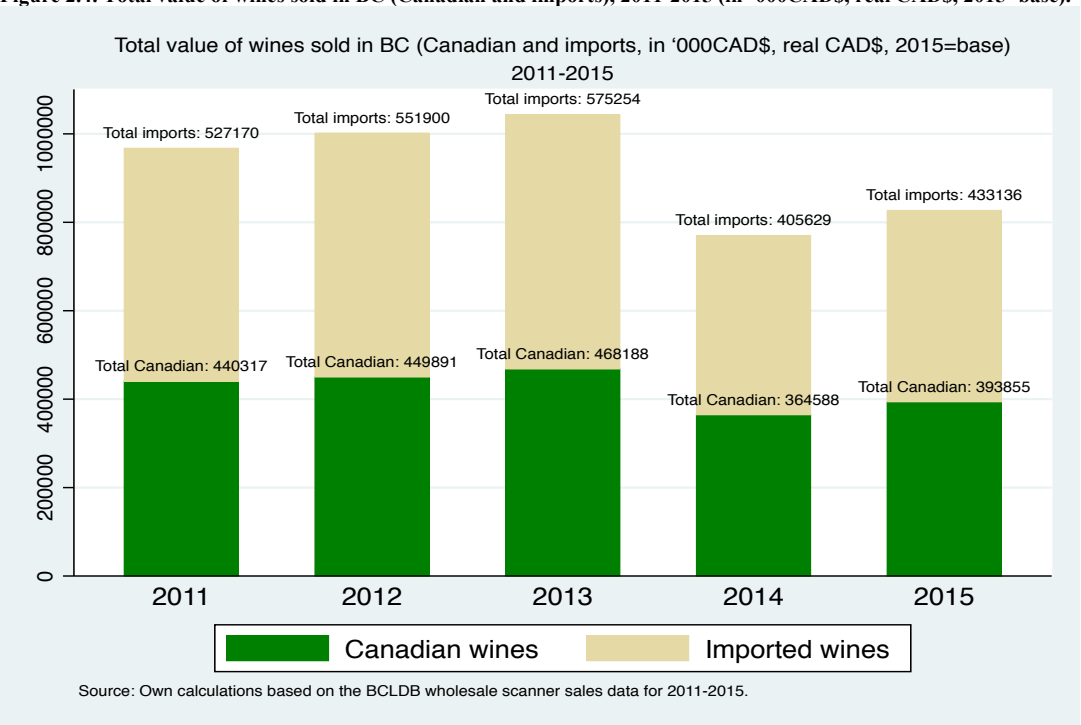


Figure 2.4. Total value of wines sold in BC (Canadian and imports), 2011-2015 (in '000CAD$, real CAD$, 2015=base).[21]

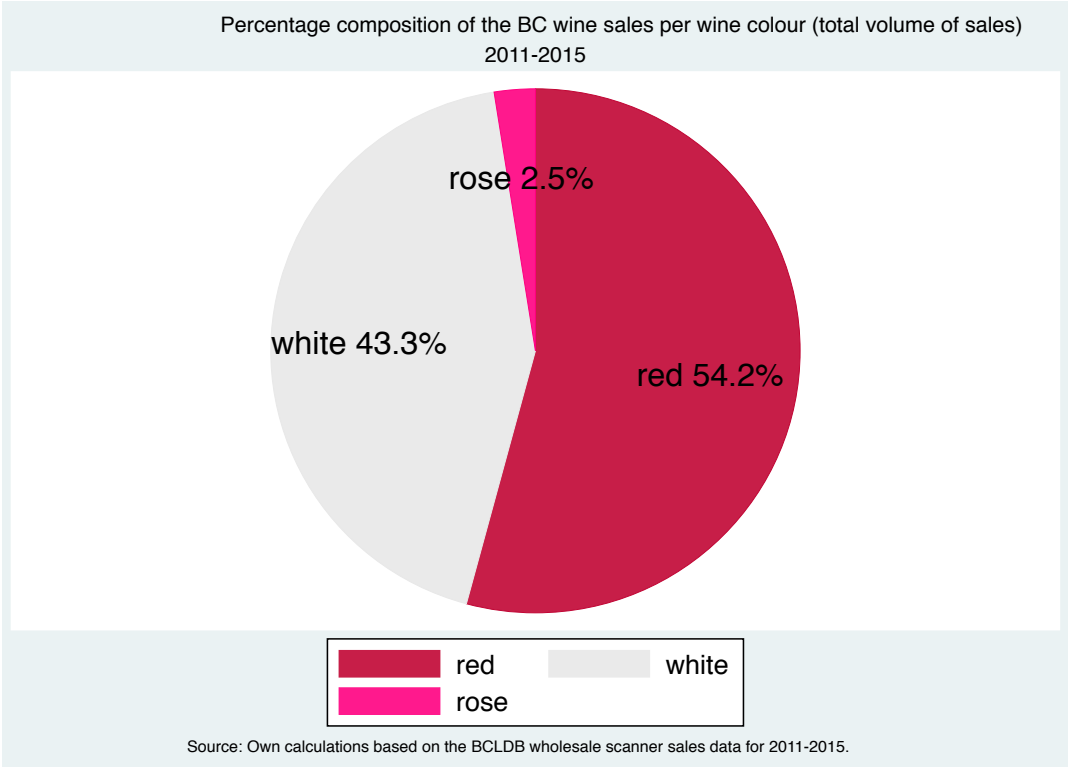


[21]In Figure 2.4 the visible decrease in the total value of wines sold in BC in years 2014 and 2015 is associated with the change in the liquor markup formula (as discussed in Section 2.3 above).

2.4.2. The composition of wine sales, per wine colour, in the BC market in years 2011–2015

The composition of all wine sales (domestic and imports) in the BC market in 2011–2015, per wine colour, is presented in Figure 2.5 below.

Figure 2.5. Percentage composition of BC wine sales per wine colour (total volume of wine sales), 2011-2015.



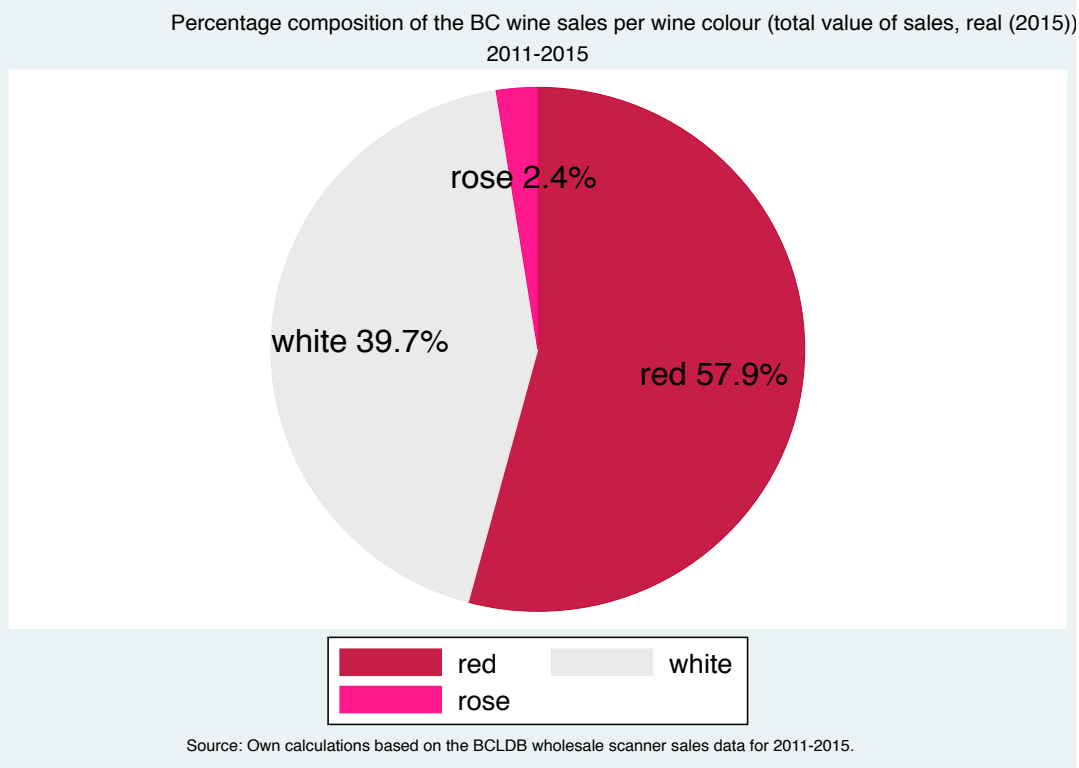
Between years 2011–2015 Canadian-made wines maintained on average about 43.7% of the total volume of red wine sales, about 62.5% of the total volume of white wine sales, and about 53% of the total amount of rosé wine sales in BC.

The total value of wine sales in the BC market between 2011–2015 was at the level of about CAD 4.6 billion (real value, 2015=base year).[22] Canadian wines captured on average about 46% of this total value of all wine sales in BC.

[22] Note: The CPI deflator was calculated using Statistics Canada Table 326-001, http://www5.statcan.gc.ca/cansim/a26?id=3260021 accessed on January 15, 2016.

Regarding the average percentage share in the value of wine sales per wine colour, the composition of wine sales in the province of BC between 2011 and 2015 is as presented in Figure 2.6 below.

Figure 2.6. Composition of BC wine sales per wine colour (total value of wine sales), 2011-2015.



Canadian wines took on average about 37.8% of the total value of red wines sales, about 57.6% of the total value of sales of white wines, and about 57.6% of the total value of sales of rosé wines.

Between 2011 and 2015 the total volume of Canada-made wines sold in BC[23] was at the level of about 156 million litres (valued at about CAD 2.1 billion (real value, 2015=base year). About 99.8% of all Canadian wines sold in the province of BC in 2011–2015 were classified as wines bottled in the province of BC. The remaining 0.2% was classified as wines bottled elsewhere in Canada or outside Canada.

[23] Canadian-made wines include those made in BC, as well as those made in other Canadian provinces.

Because the BC locally made wines maintain the primary interest of the analysis pursued in this chapter as well as in the next chapters, a closer look at the classification of these wines and their sales statistics follows in the next sections of this chapter.

2.4.3. Canadian wine brands and their significance in the BC wine market.

In the BCLDB wholesale scanner sales pricing data for years 2011–2015[24] all identified Canadian wine brands that were present in the BC wine market at that time were divided into six categories,[25] as per Figure 2.7 below. Table A.2 in Appendix A: Chapter 2 contains all identified Canada-made wine brands found in the BC wine sales between 2011 and 2015.

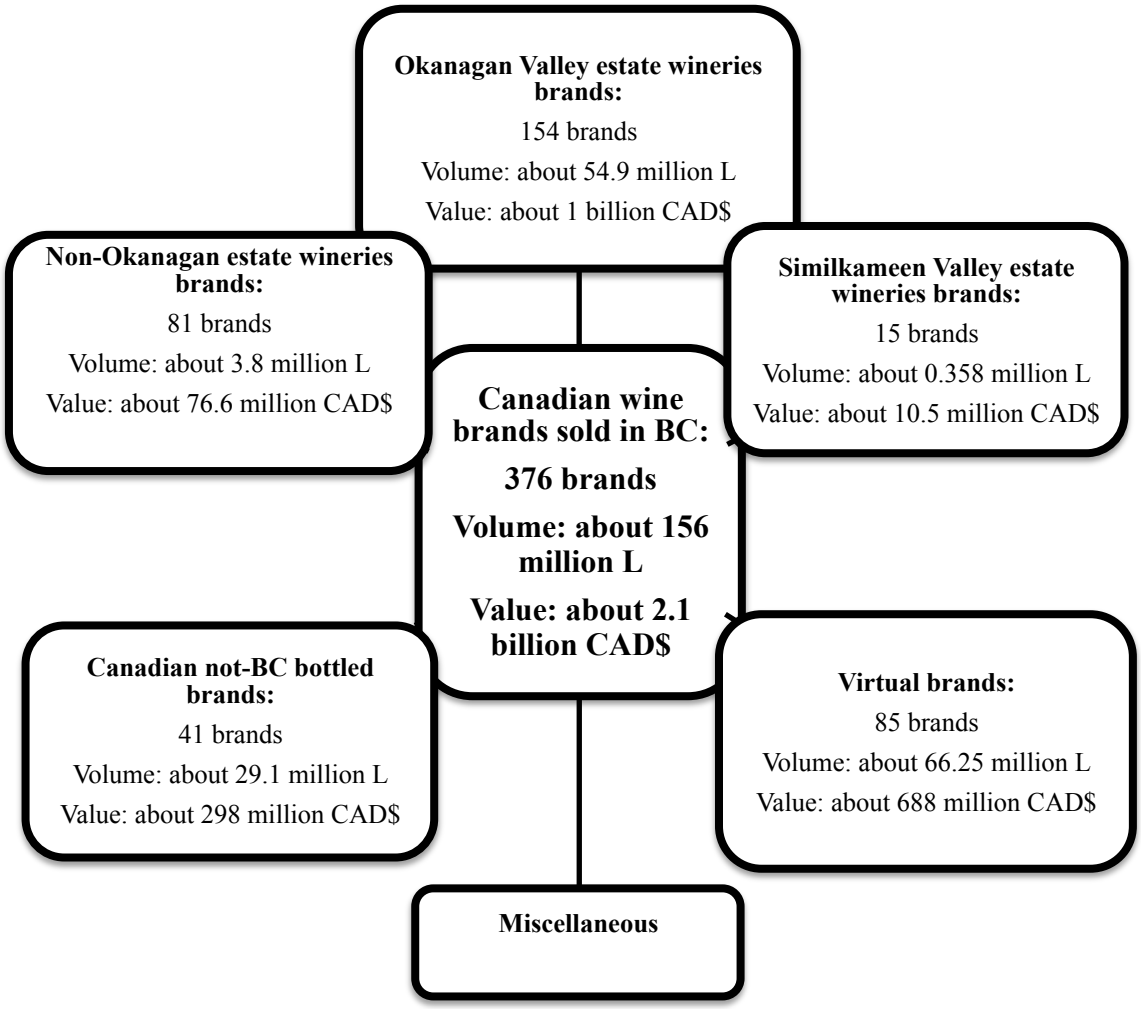
Please note the following:

1. The BC Virtual brands are brands that stated that they possessed the estate location, but the brand's website was listing a P.O. Box or a store in Vancouver as the place of the estate winery https://www.artisanwineshop.ca, for example.).
2. The Canadian, non-BC bottled brands include names from Ontario, for instance, that in the raw scanner data set were listed as "bottled elsewhere in Canada."
3. Miscellaneous these are entries that didn't contain a brand name or an estate winery but were reading: "Pinot Noir" or "Gewürztraminer," for example. This category also contains all identified hospitality brands and private labels (e.g., Four Seasons, Sheraton, etc.).

[24] This data includes all wine sales, so private labels (e.g., wines made specifically for restaurant or hotel and sold as a "house wine" for example) are also included here. In the volume and value sales statistics presented below, the sales from the fruit wineries are included.

[25] The identification of these brands was pursued with the use of available sources, e.g., Internet search, visits to liquor stores, etc.

Figure 2.7. Classification and number of domestic wine brands sold in the province of BC in 2011-2015.[26]



Source: Own calculations based on the BCLDB wholesale scanner sales data for 2011-2015.

The available sales data set proves that wine brands and wineries in BC are on the constant move. While new brands and wineries enter the BC wine market, others disappear because they go out of business, swap hands or pursue strategic rebranding and change their names. This element added to the task of brand identification. Not all brands that were identified and listed in Table A.3 in Appendix A: Chapter 2 were present in the data set in all years 2011–2015. Also, there is a chance that there were some additional

[26] All values are listed in Canadian dollar (CAD $), real 2015=base year. The CPI deflator was calculated using Statistics Canada Table 326-001: http://www5.statcan.gc.ca/cansim/a26?id=3260021 accessed on January 15, 2016.

brands that could not be identified and were put in the group "Miscellaneous" because they could not be assigned to any of the defined groups of names.

2.5. BC VQA Wines and Brands in the BC Wine Market

In this section, I present statistics related to BC-made wines and brands that were present in the BC market in years 2011–2015. In Subsection 2.5.1 I define classes of the BC-made wines. In Subsection 2.5.2 I give sales statistics for the BC-made wines (VQA and non-VQA). In Subsection 2.5.3 I present volume and value of sales statistics for BC VQA wines. Finally, in Subsection 2.5.4 I show the most significant BC VQA brands and the most important market players that contributed to sales of BC VQA wines in the province of BC in years 2011–2015. In this section I also calculate the industry concentration index (Herfindahl-Hirschman Index (HHI)).

2.5.1. Classification of BC made wines

There are two main classes of table wines produced within the province of BC: BC VQA wines and BC non-VQA wines, also known as Wines of Distinction or BC Wines of Marked Quality.[27] The VQA certification is considered in BC a wine appellation. Table 2.3 below presents definitions regarding what conditions must be met to achieve either wine status, BC VQA or BC Wine of Distinction.

[27] Note: As mentioned earlier, in BC there is a third class of wines called Cellared in Canada (CIC) wines. They are made from mixes of domestic and foreign grapes, grape juice or wine. CIC wines are excluded from the analyses in Chapters 3 and 4.

Table 2.3. BC VQA versus BC non-VQA wines.	
BC VQA Wines	**BC Wines of Distinction/ BC Wines of Marked Quality** [28]
1. Be a BC wine of distinction	Be produced entirely from grapes of the varieties that meet the requirements of section 19: Grape varieties of 100% Vitis labrusca must not be used in BC wines of distinction;
2. Be made from one or more of the grape varieties listed in Table 1 or Table 2 of Schedule 5 of this regulation: BC Regulation 79/2005 (O.C.186/2005) not from any other grape varieties	Be produced entirely from fresh grapes, grape juice and grape must derived from grapes grown in British Columbia;
3. Pass a taste test assessment, administered by the authority	Be entirely fermented, processed, blended and finished in British Columbia
4. Meet the other requirements for certification as a BC VQA wine in accordance with this regulation: • 100% British Columbia grapes • 95% of grapes must come from specific region mentioned on the label • 85% of grapes must come from the vintage stated on the label • 85% of grapes must be the stated varietal	Be certified in accordance with this regulation
	Be prepared on the premises of the practice standards certificate holder

Source: http://www.bclaws.ca/civix/document/id/loo97/loo97/11_79_2005, accessed on December 5, 2016.

In other words, the main difference between BC VQA wines and BC Wines of Distinction (Wines of Marked Quality) comes from the fact that while BC VQA wines go through a panel of expert tastings before they obtain a right to VQA recognition, BC Wines of Distinction do not. Also, there are some additional requirements related to grape origin and VQA certification (please refer to Table 2.3, cell 4, above).

Even though the BC Wines of Distinction do not possess VQA recognition on their labels, they are still allowed to differentiate from other non-locally made (CIC) wines and indicate on their labels that they are a "Product of British Columbia."
(BC Laws website: http://www.bclaws.ca/civix/document/id/loo97/loo97/11_79_2005, accessed on December 5, 2016).

[28] As per: http://www.bclaws.ca/Recon/document/ID/freeside/11_79_2005 accessed on December 5, 2016.

2.5.2. Sales statistics for BC VQA wines for 2011-2015[29]

For years 2011–2015 the total volume of BC VQA wines sold in the BC market was at the level of about 45 million litres, which maintained the total value of about CAD 981 million (real value, 2015=base year). Figure 2.8 below shows a yearly progression of the volume of sales of BC VQA versus BC non-VQA wines in years 2011–2015. There is an apparent increasing trend in the amount of sales of BC VQA as well as BC non-VQA wines in the province of BC.

Figure 2.9, below presents the value of sales for BC VQA versus BC non-VQA wines between 2011 and 2015. A noticeable element on this graph is a drop in the total value of sales starting in 2014. The new wholesale price model that began to be implemented before it was officially announced on April 1, 2015 (BCLDB phasing in of the new pricing model) caused this drop in the value of sales. As explained in Section 2.3 above, the new pricing model introduced by the BCLDB brought a unified wholesale price for all wholesale buyers and replaced the old pricing model that was built around the idea of inclusion of various, specific discounts for different classes of wholesale vendors.

Regarding wine colour, the BC VQA red, white, and rosé wines maintained respectively an average share of about 43.3%, 53.9%, and 2.8% of the total volume of all BC VQA wine sales in the province of BC.

[29] These statistics concern only BC VQA wines that were bottled in BC. The data set also contains VQA brands bottled elsewhere in Canada and outside of Canada. Such wines were excluded from these statistics.

Figure 2.8. Volume of BC VQA versus BC non-VQA wines sold in BC in 2011-2015.

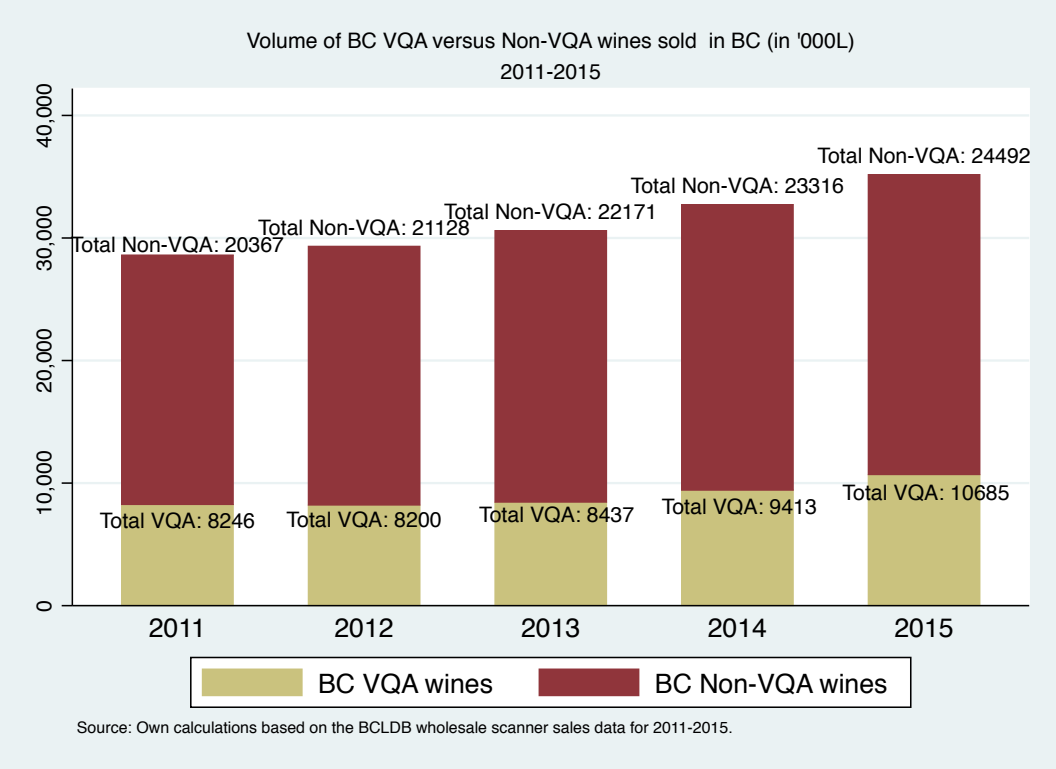
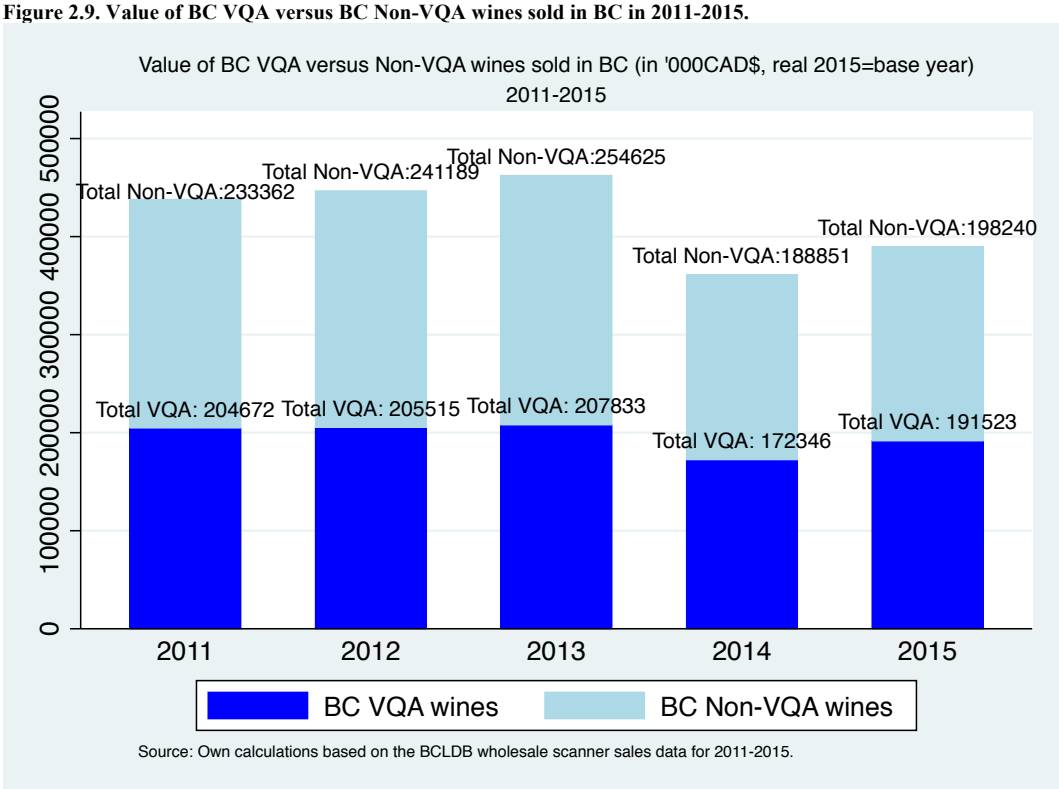


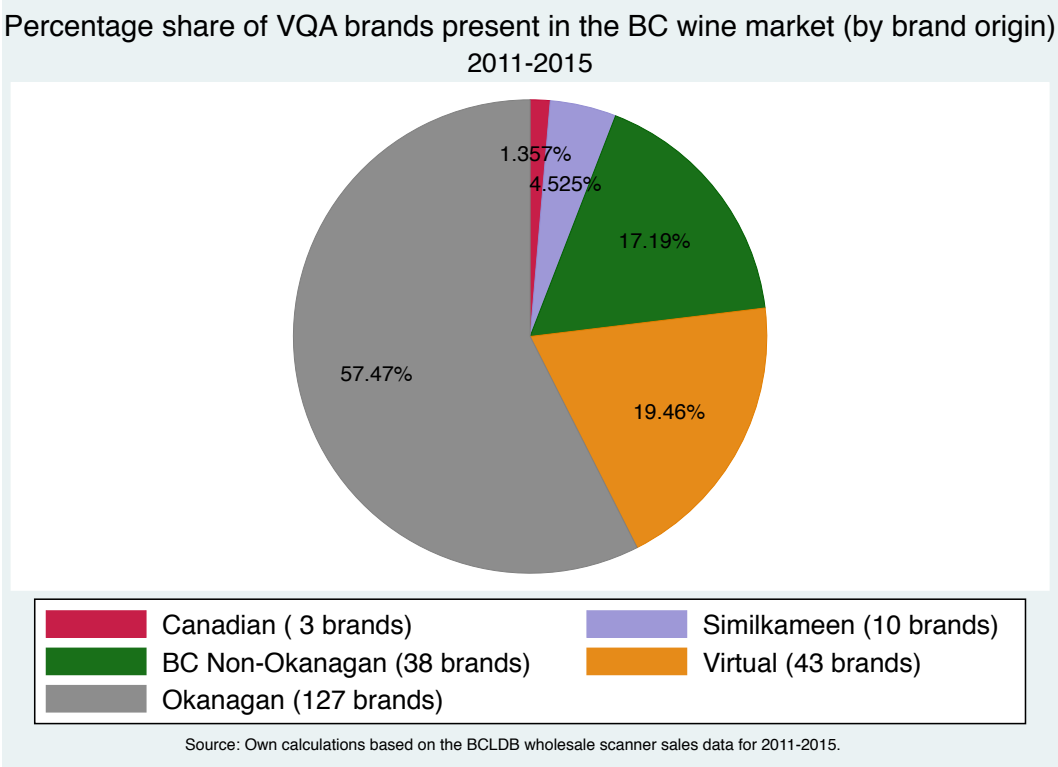
Figure 2.9. Value of BC VQA versus BC Non-VQA wines sold in BC in 2011-2015.



2.5.3. VQA brand categories present in the BC wine market in years 2011-2015

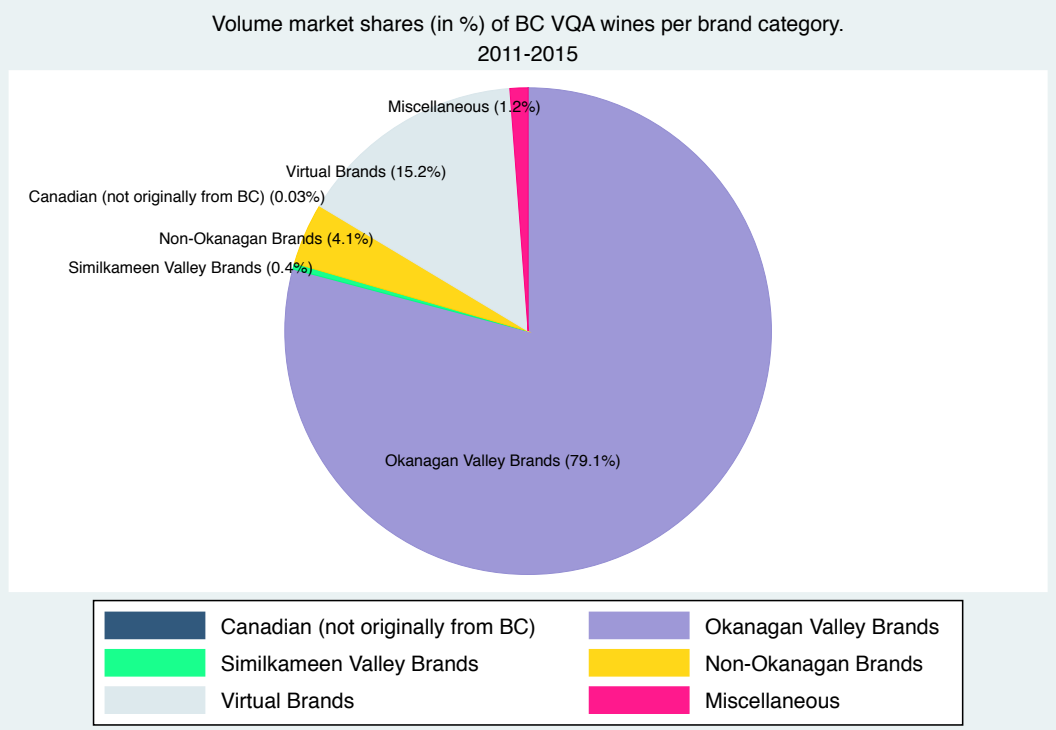
The available BCLDB wine data set for years 2011–2015 allows the identification of 221 brands that were supplying VQA wines. Not all of them were present in sales in the whole period of 2011–2015. Figure 2.10 below shows all identified groups of brands, together with a number of brands in each category

Figure 2.10. VQA brands present in the BC wine market in 2011-2015.



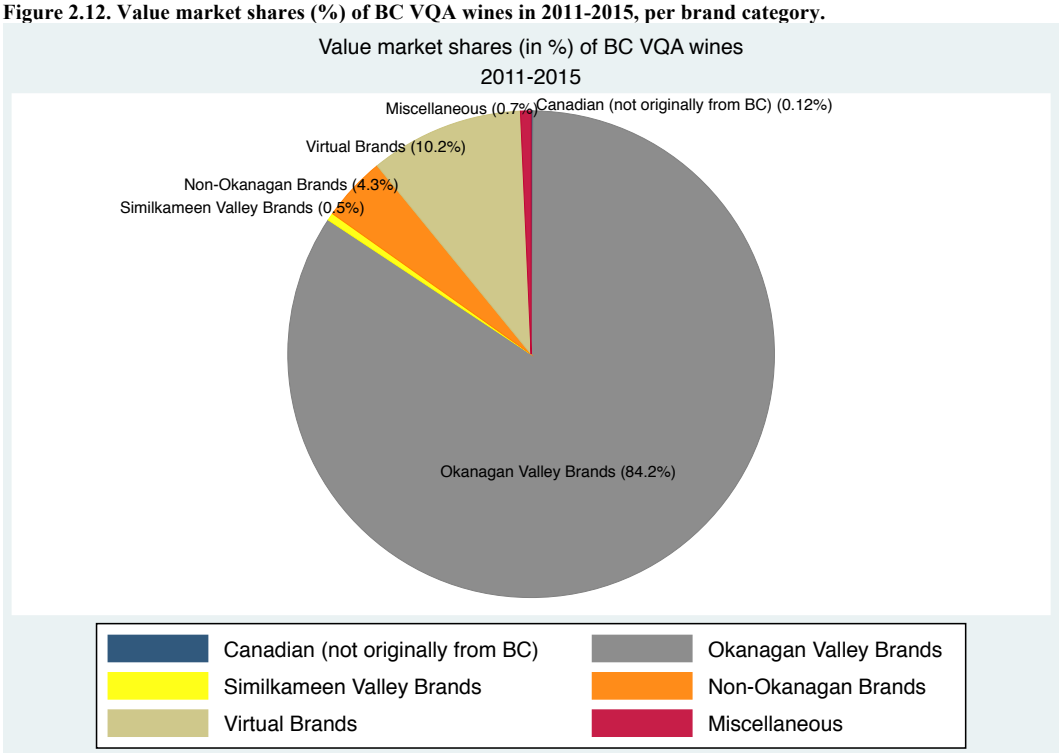
The full list of VQA brands that were sold in the BC wine market between 2011 and 2015 can be seen in Table A.3, in Appendix A: Chapter 2. The VQA brands that were identified in the available data set grasped the following average market shares (volume and value), as per Figures 2.11 and 2.12 below.

Figure 2.11. Volume market shares (%) of BC VQA wines in 2011-2015, per brand category.



Source:Own calculations based on the BCLDB wholesale scanner sales data for 2011-2015.

Figure 2.12. Value market shares (%) of BC VQA wines in 2011-2015, per brand category.



Source: Own calculations based on the BCLDB wholesale scanner sales data for 2011-2015.

2.5.5. The most important BC VQA brands present in the market in 2011-2015

While there was 221 BC VQA (BC bottled) wine brands identified in the analyzed data set, not all of them had the same weight regarding the volume and value of sales. Figures 2.13 and 2.14 below show the most significant BC VQA wine brands (based on market share (volume and value of sales).

Figure 2.13. Share of the total volume of sales of BC VQA wines sold in BC in 2011-2015, per top brands.

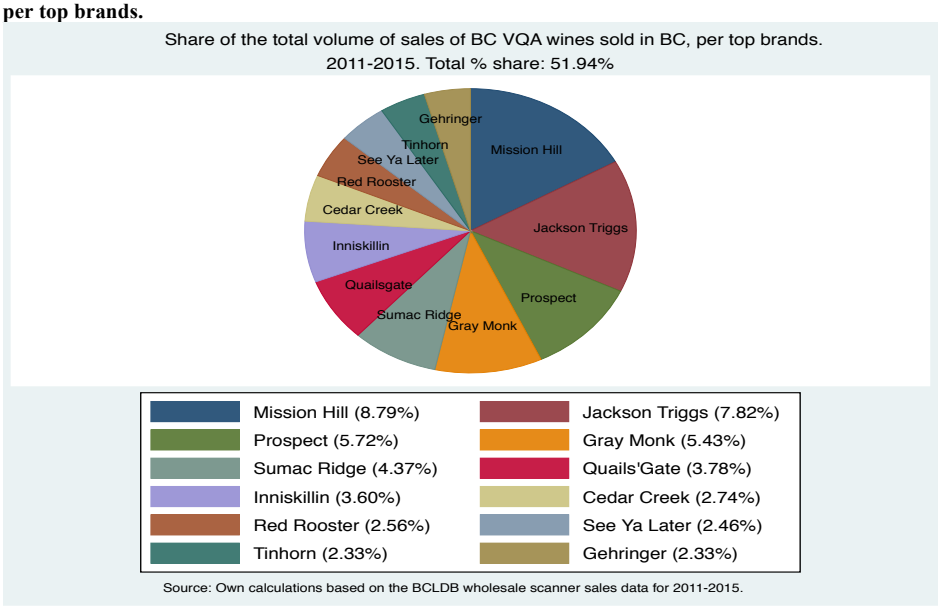
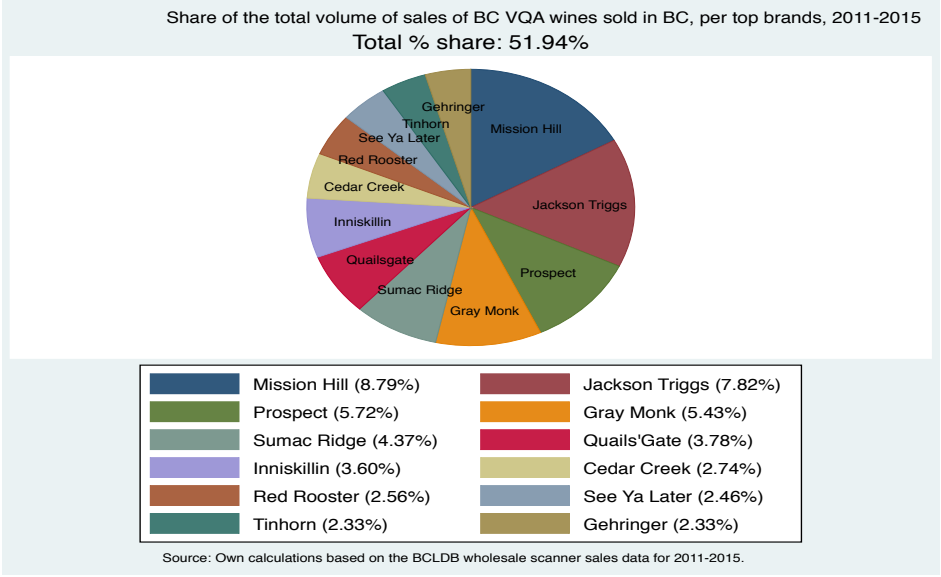


Figure 2.14. Share of the total value of sales of BC VQA wines sold in BC in 2011-2015, per top brands.



Knowing that in the BC market individual wineries/companies own more than one brand, the largest suppliers of BC VQA wines in years 2011–2015 are presented in Figures 2.15 and 2.16 below:[30]

Figure 2.15. The biggest players in the BC VQA market in 2011-2015 in terms of the % share in the total volume of sales of BC VQA wines.

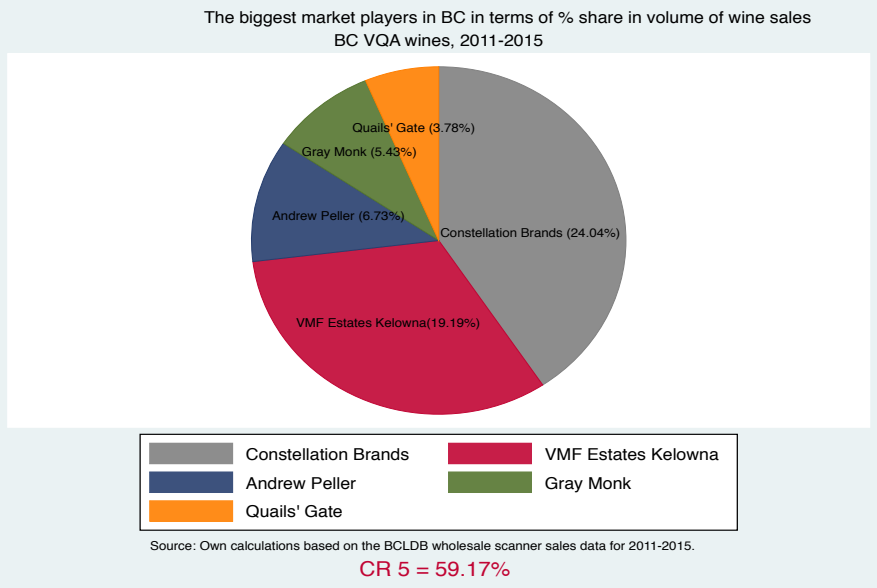
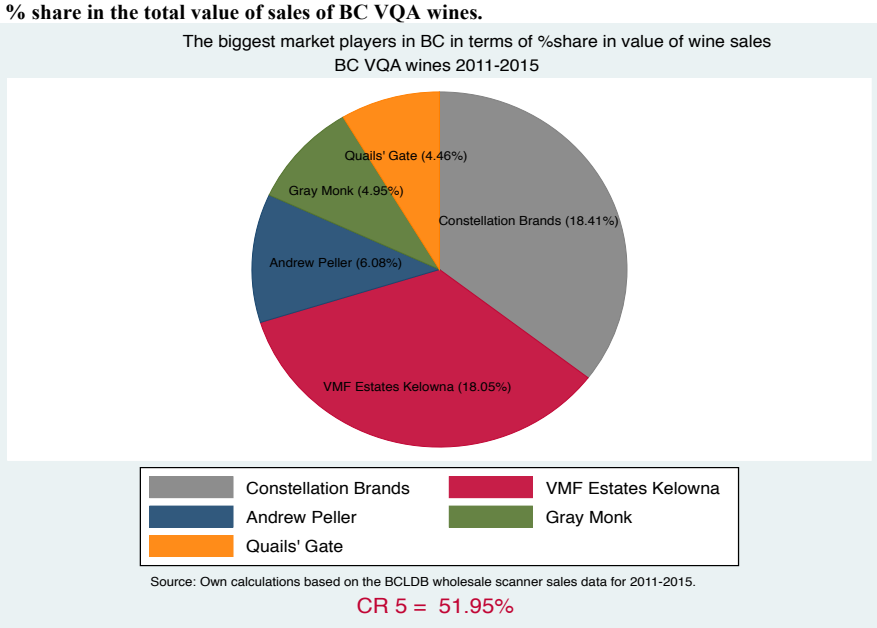


Figure 2.16. The biggest players in the BC VQA market in 2011-2015 in terms of the % share in the total value of sales of BC VQA wines.



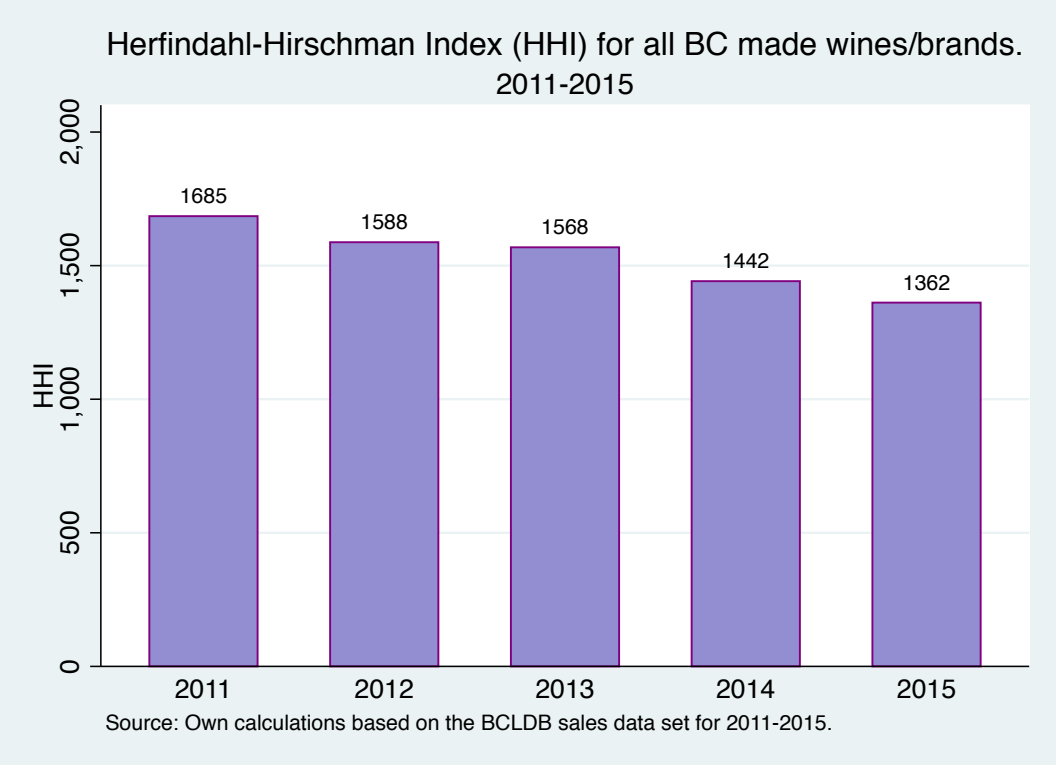
[30] Please keep in mind that there is a fraction of the unidentified entries in the available data set (Miscellaneous entries). Some of these entries might belong to listed companies, but they could not be identified. This element might influence final shares of the market and reshuffle the order, for example.

2.5.6. Herfindahl-Hirschman Index (HHI)

To assess the level of market concentration in the BC wine industry, the standard measure of market concentration, the Herfindahl-Hirschman Index (HHI) is calculated. The HHI maintains a typical measure for market concentration used by the US Department of Justice and sets guidelines for horizontal mergers. The index is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers (as per the US Justice website: https://www.justice.gov/atr/herfindahl-hirschman-index accessed on July 25, 2017).

The HHI for the BC wine industry was calculated on a yearly basis for years 2011–2015. BC's total domestic wine production including VQA and non-VQA wines are treated in these calculations as the market based on which individual market shares for BC wine brands are calculated. Figure 2.17 below shows the results obtained from the calculations of the HHI.

Figure 2.17. Herfindahl-Hirschman Index (HHI) for all BC made wines/brands.



The standard definition of the HHI gives the following classification for market concentration:

- HHI up to 1500 indicates a competitive industry,
- HHI between 1500 and 2500 indicates industry moderately concentrated,
- HHI above 2500 indicates industry highly concentrated.

(as per the US Justice website: https://www.justice.gov/atr/herfindahl-hirschman-index accessed on July 25, 2017).

As the Figure 2.17 above shows, the BC wine industry was moderately concentrated in years 2011–2013, and in years 2014–2015 it reached the level of the HHI that suggests a competitive industry.

2.6. Conclusion

In this section, I present the summary of the analysis pursued in Chapter 2. Specifically, in Subsection 2.6.1 I outline conclusions and research limitations, and in Subsection 2.6.2 I form recommendations for further studies.

2.6.1. Conclusions

The overview of the Canadian and BC wine industry pursued in this chapter leads to several conclusions.

First, Canada is a New World wine-producing country with a young wine industry located in six provinces, with Ontario and BC being the biggest wine suppliers of domestically produced wines. In the world market, Canada is still known from a comparatively small wine production and exports. Canada and BC are not associated with the cultivation of any specific grape variety and production of any particular wine type (except ice wines).

As my research in this chapter proved, the Canadian and BC liquor and wine industry are government-controlled at both national and provincial levels. The BC wine industry shows a high degree of heterogeneity that is visible at numerous levels. The industry

shows multiple classes of wine producers (e.g., estate wineries from different areas within BC, various BC virtual brands) and numerous categories of wine types (VQA, Non-VQA: BC Wine of Distinction, or Cellared in Canada).
The analysis pursued in this chapter also shows that the concentration ratio for the five biggest VQA suppliers, CR5, is at the level of 59% (volume) and 52% (value).
The results of the HHI show that overall for the years 2011–2013 the BC wine industry was moderately concentrated, but in years 2014–2015 its concentration decreased reaching the HHI levels that point towards a competitive industry.

The main research limitation of this chapter comes from the available scanner pricing data obtained from the BCLDB. The nature of this data set didn't allow the identification of all sales entries. Therefore, it was necessary to construct the group called "Miscellaneous" that included the unidentified winery and brand entries (e.g., entries that did not point towards winery/brand but presented only wine variety: Gewürztraminer, Pinot Noir, etc.). This element could have affected the estimations of brand shares. Fortunately, this group of unidentified entries (about 1.2% of the total volume of BC VQA wine sales) was relatively small, so its effect on brand shares should be minimal.

2.6.2. Recommendations

The obvious suggestion that arises from the analysis in Chapter 2 is to pursue more in-depth research on BC virtual brands (BC VQA and non-VQA virtual brands). This group of wines sold in the province of BC constitutes a significant volume of wine sales and has a substantial impact on the BC wine market. The virtual brands are usually hard to identify with a particular location for the winery (if any) or with an actual producer of such wine. Their labels tend to disclose very little information regarding the producer of such wine. As my research in this chapter unveiled, some of the most notable market players in the province of BC (like the VMF Estates Kelowna or Constellation Brands, for example) own some of these virtual brands. More details on this topic can be seen in Appendix A: Chapter 2, Table A.3.

Chapter 3: Does Terroir Matter for BC-made Wines?

In this chapter, I pursue an empirical analysis of terroir versus wine pricing for the selected BC VQA wines produced in the Okanagan and Similkameen Valleys of BC. Specifically, in Section 3.1 I present an introduction to this chapter and research rationale. In Section 3.2 I discuss relevant literature. In Section 3.3 I examine data sources and outline methods for construction of variables. In Section 3.4 I present methodology and empirical model specification. In Section 3.5 I show regression results and discussion. In Section 3.6 I discuss robustness checks. Finally, in Section 3.7 I form conclusions, explore research limitations and develop recommendations for further studies.

3.1. Introduction

Not long ago, in a Decanter article from August 2016, Steven Spurrier, a British wine expert and merchant, said that for him wine was about 3 Ps: the place, the people and the product (Decanter, August 3, 2016). Spurrier made this statement about his very recent visit to the BC Wine Country, where he had a chance to taste regional wines and familiarize himself with the Okanagan's approach to winemaking. For Steven Spurrier, as well as for many other wine professionals and enthusiasts that visit this Canadian wine region, the BC Wine Country is puzzling. The mystery lies in a clear juxtaposition of the classification of British Columbia as a New World[31] wine-producing region, while its winemaking and vineyard management approach bears a striking resemblance to a winemaking philosophy that is characteristic of Old World wine-producing countries.

In the winemaking universe, two main directions are shaping the credo for wine production in each wine region. The first one concerns particular geographic location, a

[31]The New World wine-producing countries include countries that are located outside of the traditional wine-producing regions of France, Spain, Italy, Germany, Portugal, Hungary and the Middle East. The New World wine-producing countries include the US, Argentina, Chile, Australia, New Zealand, South Africa, Canada.

vineyard that produces grapes used in the winemaking process, and its terroir,[32] as well as local winemaking traditions and craftsmanship. This connection frames the Old World wine-producing countries' winemaking model. The winemaking giants like France, Spain or Italy, for example, tend to use this modus operandi.

The second approach puts more emphasis on grape variety, regional recognition based on specific wine and grape type, together with associated wine science and wine sophistication at its centre. This winemaking model helps create a flagship grape variety that generates the basis for a region's winemaking recognition in the world. This second strategy distinguishes the New World wine-producing countries like Argentina, for example, with its principal grape variety, Malbec, Chile with its crown variety, Carménère, or Australia with its Shiraz.

While the classification of British Columbia as a New World wine-producing, region can't be considered as a mistake because its wine industry is relatively young when compared to the Old World wine-producing regions, with a rather short track record of about 25 years or so in modern grapevines cultivation and winemaking, some doubts may quickly arise. A troubling element is that BC is still rather far from establishing a flagship grape variety, which is a defining approach for the New World wine-producing regions. Instead, to date, the BC winemaking industry does everything, except grape-based specialization. The BC winemakers produce many wine types coming from numerous grape varieties. The BC Wine Institute (BCWI) proudly states on its website that there are over 60 different grape varieties cultivated in BC (BC Wine Institute Website accessed on May 17, 2017: http://www.winebc.com/wines/varietals). Given the comparatively small acreage of the BC wine region, which adds up to a bit over 10 thousand acres of planted grapevines, it is quite an assortment of grape varieties. Again, this points towards a lack of wine industry specialization.

[32] "*Terroir"* comes from a French word "*terre*," meaning, land. The term itself has various definitions. Some define terroir as natural endowments of the vineyard (soil, elevation, climate, etc.). Others also include elements like "experience" that wine-producing villages offer to wine tourists, idyllic landscape, specific architecture, history, local know-how, etc. (Gergaud & Ginsburgh, 2008). In this dissertation, terroir is understood as natural endowments of the vineyard (soil, elevation, climate, aspect, etc.).

What the BC wine industry tends to do instead of the conventional New World wine region approach of grape variety specialization, is to emphasize the role of a vineyard, especially its terroir. Or at least this is what the BC industry typically targets in its marketing campaigns. This approach is also visible in the latest developments on the policy side, including the most recent wine industry plebiscite (May 20–June 1, 2016). In this plebiscite, one of the main matters under industry voting was the establishment of new appellations (four new appellations proposed) and sub-appellations (16 new sub-appellations proposed for the Okanagan Valley).[33] The proposal for the establishment of new appellations and sub-appellations that were confirmed in the plebiscite, with 98% approval rate for new designations and 64% approval rate for sub-appellations sets British Columbia as an outlier among New World wine-producing regions. Instead of concentrating on variety specialization, the BC wine industry seems to be choosing the terroir-based winemaking road established by France and Italy.
(BCWA Website accessed on August 1, 2016: http://bcwinetaskgroup.ca/wp-content/uploads/2016/06/Plebiscite-Cover-Letter.pdf).

What is interesting about these new policy developments is a current situation in wine production in BC, with a movement to continue the status quo that contradicts the newest appellations-related efforts. Currently, many BC wineries produce wines from grapes that do not necessarily come from the same location as their estate wineries. This means that their grapes and, therefore, wines come from different "sub-appellations," even if these sub-appellations currently do not have an official demarcation or names. Because of the lack of strict policies and associated controls regarding wine labelling that coincides with the actual origin of grapes used in the winemaking process, a winery from the Okanagan Valley, for example, can produce wines from grapes coming from different locations within the whole of BC.[34] A notable exception concerns the BC VQA wines, where 95%

[33]Appellations of origin are country-region specific. In France, for example, there is Appellation d'Origin Controllee (AOC), in the US, there are American Viticultural Areas (AVA) in British Columbia Canada, there is Vintners Quality Assurance (VQA). Appellations (and sub-appellations) of origin allow geographical identification for wines and prevent producers from beyond the appellation to make false claims about the origin of their wines. They also aim to distinguish different terroirs.
[34]The official wine policy states that BC-made wines must be produced from BC-grown grapes, but this is as far as it goes regarding terroir-related specification of grape origin for BC-made wine. The exceptions are BC VQA wines.

of grapes used in wine production must come from the location stated on the label. For example, if a winemaker says on the wine label that it is a VQA Okanagan Valley wine, then 95% of grapes used for its production must come from the Okanagan Valley. But even in the case of BC VQA wines and their stricter definition of grapes' origin, the idea of terroir in BC is still somewhat diluted.

The issue comes from the simplest element, the definition of terroir. Choosing its most straightforward specification, terroir is defined as the natural endowments of a vineyard: soil, climate, aspect, elevation, etc. But using this definition in the Okanagan Valley, BC's biggest wine-producing region raises some serious doubts. The Okanagan Valley stretches about 155 km North to South and is about 9–16 km wide (Hira, 2013). The climate, as well as soil specifics and other natural elements, differ in various locations along this 155 km stretch. Consequently, there must be differences in terroir as one moves from one vineyard to the other within the Okanagan Valley. Therefore, even in the case of BC VQA wines that state that they come from the Okanagan Valley and must be produced with 95% of grapes coming from that particular region, the idea of terroir becomes a fuzzy concept. Since the Okanagan Valley is characterized by multiple, location specific climates, soils, etc., it hosts different terroirs. Currently, in the BC Wine Country, it is rather a rule than an exception that wineries source their grapes from various locations that are not necessarily located in proximity to their estates. This brings wines produced from grapevines grown on different terroirs and in different sub-appellations under an umbrella of one winery label (brand).

Knowing that specifics of vineyard terroir are associated with grape quality (Winkler et al., 1974, among many). The quality of grapes, in turn, is correlated with quality of the wine (Ramirez, 2008). And being aware that quality of the wine is associated with its price (Noev, 2005, among many), an interesting research question arises naturally:

Does terroir influence the pricing of BC VQA wines from the Okanagan and Similkameen Valleys?

Therefore, the purpose of the analysis pursued in this chapter is to examine how terroir elements influence the wine price formation of BC VQA wines produced in the Okanagan and Similkameen Valleys. To do this, I analyze wine prices and sales of selected BC VQA wines, in connection to terroir specifics that characterize vineyards that sourced grapes for these wines.

I organized the analysis in this chapter in the following way: in Section 3.2 I present an overview of relevant literature; in Section 3.3 I outline data sources and methods for construction of necessary variables; in Section 3.4 I describe methodology and specification of the empirical model; in Section 3.5 I present and discuss empirical results; in Section 3.6 I pursue some robustness checks. Finally, in Section 3.7 I form conclusions, research limitations, and recommendations for further studies.

3.2. Literature Overview

A famous champagne producer, Johan Joseph Krug (1800–1866) once said:
"(...) a good wine comes from good grape, good vats, a good cellar and a gentleman who is able to coordinate the various ingredients" (as quoted in Gergaud & Ginsburgh, 2008). There is an ongoing discussion in the wine industry, as well as in wine literature, regarding what makes a good wine. Some claim that production of premium wine depends on terroir (Ramirez, 2008; Ashenfelter, 2008; Ashenfelter, Ashmore, and Lalonde, 1995; Ashenfelter and Storchmann, 2008, among many). These statements to large extent confirm what has been observed in the Old World wine-producing regions where wineries have been marketing their wines with a strong attachment to the idea of terroir and its significance in the winemaking process. Others argue that terroir might be more marketing or reputation than an actual concept related to wine quality (Cross, Plantinga, and Stavins, 2011). These latter claims sympathize with the approach of New World winemaking regions, where specialization and strong regional connection to a particular grape variety and wine type replaced the idea of terroir.

Despite all these arguments and differences in opinions, it is widely recognized that winemaking is a very sophisticated and fragile process that starts with terroir and its soil components, slope, sun exposure, and microclimate. Then the fruits of terroir's characteristics, the wine yielding grapes, are accompanied by certain management practices and winemaking knowledge to make the final product (Gergaud and Ginsburgh, 2008). The only puzzling element that remains in this discussion is the extent to which each, terroir and winemaking art, contributes to the quality and marketing success of wine, and these items are not very easy to quantify. As much as the characteristics of terroir are exogenous, to some extent static and hard to change because each terroir is naturally endowed with certain specific natural elements,[35] management practices are dynamic because they can be learned and possibly improved over time. There is also another factor that comes enters this equation: marketing efforts that lead to a wine brand's recognition. The recognition can be gained via individual wine awards and ratings by wine experts, marketing efforts (advertisement, social media, in-store promotions, etc.), wine tourism, appellations of origin and individual terroir recognition, as well as collective, region-specific reputations known as collective reputations (Schamel and Anderson, 2003; Costanigro, McCluskey and Goemans, 2010).

For some time now, wine literature has been oscillating around the idea of geographical location and terroir, yielding analyses that research different wine regions in the world. From the numerous scholarly publications that studied directly or indirectly the concept of wine pricing versus terroir, a few that seem to be directly relevant for the analysis presented in this chapter are discussed in more detail below.

In 2003, Schamel and Anderson estimated hedonic price functions for premium wines from Australia and New Zealand, and found out that the local reputation of wines from both countries differed over time. They also established that there was a significant effect of sensory wine quality ratings on wine price premia. Ashenfelter and Storchmann (2010) examined the effects of climate change on vineyard prices in the Mosel Valley finding

[35]Climate-related terroir elements (e.g., temperature, precipitation, etc.) are an exception here, as they can vary between vintage years.

those specific site characteristics like slope, orientation, soil type, altitude, and solar radiation influenced vineyards and grape quality. These analyses could suggest that pricing of the BC-made wines could possibly be connected to terroir specifics that in turn influence wine sensory characteristics.

On the contrary, Gergaud and Ginsburgh (2008) analyzed Bordeaux appellations and found out that site attributes of vineyards in the Haute-Medoc appellation did not affect wine prices. Also, Cross, Plantingan, and Stavins (2011) examined the value of terroir via hedonic analysis of vineyard sales in the Willamette Valley of Oregon. In their analysis, the authors regressed the prices of the vineyards located in the Willamette Valley on the measurable vineyard attributes, e.g., slope, aspect, elevation, soil type, as well as on appellation, to estimate the value of terroir in the Willamette Valley. They found that appellations strongly influenced prices for vineyards in the Willamette Valley, and that the specifics of terroir were not as important for vineyard prices. Their research discovered that the concept of terroir mattered economically, but the reality of terroir while proxied by location attributes was not significant.

These two analyses, contrary to Schamel and Anderson (2003) and Ashenfelter and Storchmann (2010), suggest that terroir could have no influence on pricing for BC-made wines.

While all these scholarly publications have brought to critical elements that helped shape the empirical analysis outlined in the next sections of this chapter, the research by Cross, Plantingan, and Stavins (2011) remains the most significant source of inspiration for the analysis of this chapter.

3.3. Data Sources and Construction of Variables

In this section, I provide an overview of all data sources and methods employed for the construction of necessary variables used in the empirical analysis of this chapter. This section is composed of two subsections: in Subsection 3.3.1 I discuss all data sources used in the empirical analysis, and in Subsection 3.3.2 I explain the rationale behind the

construction of necessary terroir variables and outline in detail methods used for their creation.

3.3.1. Data sources

The analysis pursued in this chapter investigates the connection between prices of selected BC VQA wines from the Okanagan and Similkameen Valleys of BC and the terroir that yielded grapes used in their winemaking process. In this analysis I used the following data sources:

1. The British Columbia Liquor Distribution Branch (BCLDB) wholesale pricing scanner data for BC VQA wines.

   This data set consists of monthly sales of all BC VQA wines in the province of BC [36] in the period between April 1, 2011, and March 31, 2015. The variables present in this data set and used in the analysis of this chapter include wine prices (wholesale), volume of sales, time of sales (year), winery brand name, alcohol content, wine (grape) variety, and vintage year.

2. The exact location of vineyards that sourced grapes for the selected BC VQA wines and are present in the BCLDB pricing data set as described in point 1 above.

   I self-collected this data from the BC wineries that produce VQA wines and agreed to deliver data on the exact location of vineyards that supplied grapes used to make selected VQA wines. The process of data collection consisted of the following steps:

   a) I constructed a list of all BC wineries that produce VQA wines, based on the BCLDB scanner pricing data set mentioned in point 1 above.
   b) I obtained contact details for wineries from two sources:

[36] This wine data includes sales that occurred via all government and private liquor stores, wineries, restaurants, etc. in the whole province of BC. From all BC VQA wine sales in BC all "private label wines" were excluded. Private label wines are wines that are ordered directly from a winery by hotels, restaurants, or other establishments and they are used within these facilities only. These are often hotels' "house wines," for example. Additionally, all ice wines were also excluded from the analysis. Wines specified as "late harvest" are included in the analysis of this chapter.

- The Pacific Agricultural Research Centre (PARC) Summerland wineries contact list,
- Self-extracted from the official wineries mailing list of the British Columbia Wine Institute (BCWI) website or wineries websites.

c) On August 15, 2015, I contacted all wineries for which I had available contact details (via mail and email). Several wineries replied and either agreed to cooperate or requested more clarifications and then decided to participate in this research. Unfortunately, many wineries that I contacted did not respond to this initial contact letter/email.

d) Due to a rather low reply rate to the initial email/mail from August 15, 2015, I visited all wineries during the second week of March 2016 and presented the opportunity to cooperate in this research. During these field visits, certain wineries agreed to cooperate, but many were closed for the low season. I contacted the wineries that were closed during field visits again via email and presented them with the initial letter describing the purpose and details of this research. Appendix B: Chapter 3 contains the text of the original study invitation letter.

e) Out of all contacted wineries, 33 agreed to participate in this research.[37] The wineries that decided to be a part of this study were given (either physically during visits in wineries or via email) a list of their VQA wines that are present in the BCLDB pricing data set. Wineries provided addresses, Geographic Information System (GIS) coordinates or names of specific vineyards for all VQA wines found in the BCLDB pricing data set. To control for specific terroir elements like soil, elevation, aspect, row direction, distance to lake and climate, it was important to know the origin of grapes only for wines that were produced from a single vineyard. Wines produced from the same variety of grapes, but coming from multiple vineyards, as well as all blends (wines that were derived from multiple grape varieties) and ice wines were excluded from the data set analyzed in this chapter.

[37]All 33 wineries that agreed to participate in this project are estate wineries meaning that they possess a physical location for their estate winery and brand.

f) In the next step, I verified the location of vineyards using the Google Earth Pro version 7.1.5.1557 satellite imagery, to ensure that grapes were present on the provided vineyards. In the case when the satellite image was unclear, I physically visited the vineyard during additional research trips in June 2016 and made sure that grapes were planted on a given plot.

g) In the last step, I matched the BCLDB pricing data set on BC VQA wines (as described in point 1 above) with vineyard data provided from wineries. This task resulted in the construction of a panel data set that matched each of the selected BC VQA wines with the exact location of a vineyard that sourced grapes used to produce that wine.

3. Environment Canada (EC) historical data set on temperatures.

To obtain a control for climate on each vineyard, I extracted the EC data set on minimum and maximum daily temperatures. I did this in the following way:

a) I assigned each of the vineyards for which the location was provided by the winery (as described in point 2 above) to the closest weather station in the area. I based the assessment of the nearest weather station on the distance between said vineyard and the weather station. I measured this distance in a straight line, using the Google Earth Pro version 7.1.5.1557 software.

b) After I assigned vineyards to the proper weather stations, I extracted the vintage years for all wines from the BCLDB pricing data set (the match of wine-vintage was ensured). I extracted the temperature data only for vintage years presented in the BCLDB pricing data set.

c) Finally, I extracted the EC temperature data only for the months that constitute grapevines growing season in BC: April 1-October 31 (seven months total).[38]

4. "Atlas of Suitable Grape Growing Locations in the Okanagan and Similkameen Valleys of British Columbia."

[38]In the case where the closest weather station to the vineyard was missing data for a particular vintage year, I took the temperature data from the second closest weather station (assigned by using a straight line in the Google Earth Pro version 7.1.5.1557 software/satellite imagery).

The information about soil type present in each of the vineyards was obtained from the "Atlas of Suitable Grape Growing Locations in the Okanagan and Similkameen Valleys of British Columbia" and accompanying soil maps. This atlas and maps are publicly available on the BC Ministry of Environment website.[39]

5. Google Earth Pro version 7.1.5.1557 software.

The information regarding several terroir-specific variables necessary for the analysis in this chapter I extracted via physical examination of satellite imagery of provided vineyard locations. As a result, I obtained the following variables using Google Earth Pro version 7.1.5.1557 satellite imagery:

a) Row direction of grapevines present in the vineyard;
b) Aspect of the vineyard;
c) Average elevation of the vineyard (measured in row direction);
d) Distance to the closest lake (shortest distance measured in a straight line).

The first two variables: row direction and aspect of the vineyard I additionally physically and randomly checked for a sample of vineyards during research trips to the area in June 2016 (I checked 20% of all vineyards from the data set, a total of 14 vineyards).

The final panel data set composed from available data sets and used in the analysis of this chapter consists of variables coming from all five data sources, as described above. In the final panel, I matched each of the selected BC VQA wines with terroir variables characteristic for the origin of grapes used in the wine's production. I additionally enriched this data set with terroir variables that I constructed specifically for the analysis in this chapter. The Subsection 3.3.2 below presents these variables, together with detailed methods for their construction.

[39]Source: https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=25881 accessed on December 5, 2015.

3.3.2. Construction of additional variables

As I mentioned in previous sections, the leading concept for this chapter is rooted in the idea of terroir and its role in the formation of prices for BC VQA wines produced in the Okanagan and Similkameen Valleys. To pursue analysis in this chapter, a choice of a formal definition of terroir was necessary. Based on a literature review and consultations with the wine industry (winemakers from BC and PARC Summerland), for the analysis in this chapter the concept of terroir was specified in the following way:

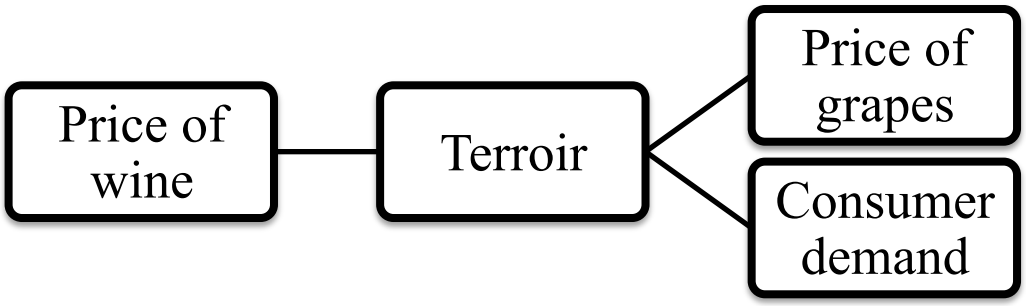
Terroir is defined as land and climate variables that are unique to a given location where the grapevines are being grown to make wine. Therefore, terroir incorporates the following two groups of variables:

1. Climate variables;
2. Topographic variables.

Both groups of terroir variables, climate, and topographic variables represent production inputs that yield key wine ingredients, the grapes. These terroir-specific elements are important because they are directly correlated with the quantity and quality of grapes grown in a vineyard. They help assess which vinifera cultivars are the best choice for that location, considering a vineyard's natural endowments. Indirectly, they also influence the selection of wines produced from the varieties planted on a plot. The climate and land variables not only jointly characterize terroir, endowing it with location-specific natural elements, but they are also essential for the future success or failure of a winemaking process and consequently the financial prosperity of a winemaker (Winkler et al., 1974; Hellman, 2003). For example: if a vineyard is populated with an inappropriate variety of grapevines, e.g., a variety given the climate and land combination present on a vineyard doesn't reach maturity before harvest), it will affect the winemaking process and as a consequence the quality of the wine. Knowing that a uniqueness of wine regarding its flavor and other quality traits like acidity, sweetness, body, etc. distinguishes fine wines from poor ones, the match of terroir-grapevine variety comes with consequences that affect the quality of the wine (Hellman, 2003).

From an economic standpoint, the relationships between terroir specifics that influence grape quality, wine quality and therefore wine price can be seen from two perspectives, as per Figure 3.1 below. All these elements affect wine price via terroir.

Figure 3.1. Terroir versus wine pricing.



First, the link between superior terroir and implied higher-grade of grapes, hence better quality of wine priced at a premium could arise because of more inelastic demand for these wines (demand side). It would suggest that consumers are willing to pay a price premium for wines coming from certain sub-appellations (distinct terroir) because they associate these wines with favoured sensory characteristics. Therefore, if normal market conditions hold and if grapes are cultivated on preferred terroir resulting in the production of high-quality grapes, the quality of grapes should influence the quality of wine (its specific and valued sensory attributes) and consequently wine price. This link constitutes the first way in which terroir variables can affect the process of wine price formation.

Terroir can also impact wine price via production costs (supply side). It is possible that grapes cultivated on terroir that is deemed superior are given more attention because it is anticipated that they will be used to produce high-end/boutique wines. This element, in turn, can translate into increased vineyard management costs that are passed on to grape buyers in the form of higher prices for these grapes (if a winemaker buys grapes for the production of its wines), or directly on to consumers in the shape of higher prices for

wines produced from these grapes (if the winemaker grows its own grapes). For example, because individual terroir is considered superior in the production of quality grapes, the work at such a vineyard is 100% manual and the use of mechanical equipment is minimal. This element suggests higher labour costs and therefore higher costs of production for grapes cultivated on that terroir. Because of increased labour costs, the wines produced from these grapes are priced at a premium.

It is not easy to disentangle the impact that these two groups of variables have on the formation of wine prices for wines produced in the Okanagan and Similkameen Valleys of BC, as they can have individual or joint influence. But matching terroir elements with sales data for specific wines that were produced from grapes grown under specific terroir conditions can help isolate the power of natural terroir elements on wine pricing.

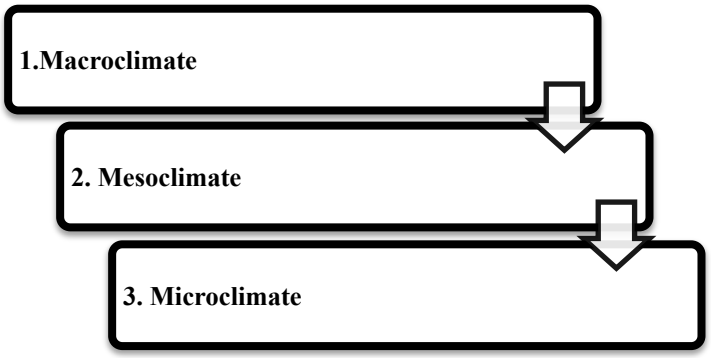
Now that I have established the definition of terroir and its possible role in the formation of wine prices, my next step is to investigate two groups of terroir elements: climate and topographic variables. Both groups are analyzed separately from a winemaking science-based perspective. In the next two subsections (3.3.2.1 and 3.3.2.2), I discuss the most suitable and scientifically supported variables that belong to these two groups. I describe and explain the background for each climate or topographic terroir variables and outline detailed methods used in their construction. Then I use these variables in the empirical model presented in Section 3.4.

3.3.2.1. Terroir variables

Group 1: climate variables

A proper assessment of a vineyard's climate is one of the most important elements in grape cultivation and the winemaking process, but it remains one of the most difficult tasks. The problem arises from the multilevel definition of climate and the necessity of distinguishing various levels of climatic heterogeneity. The definition of a vineyard's climate can be constructed and understood on at least three primary levels, as presented in Figure 3.2 below.

Figure 3.2. Levels of a vineyard's climate.



The three primary climate levels are:

1. Macroclimate: a general type of climate associated with latitude and longitude-dependent world climatic zones.
2. Mesoclimate: the regional climate linked to a particular vineyard and location, which has distinctive regional differences in general climatic patterns related to terrain and topography.
3. Microclimate: the climate present on a particular plot that results from direct interactions between soil and the grapevine's canopy (Hellman et al., 2003).

The wine-related literature employs various measures to capture a vineyards' particular climate, but most of them evolve around the concept of the available heat. The available heat measures usually include one of two heat variables: temperature or amount of sunlight that reaches the vineyard. Examples of the rationale for using these climate measures in the literature include numerous publications in the American Journal of Enology and Viticulture (for example: Spayd et al., 2002; Berqvist et al., 2001), as well as Winkler et al. (1974), Hellman et al. (2003), Schlenker (2006), to name a few). The use of the temperature variable is methodologically straightforward and in the grapevine-related literature usually involves the construction of a Heat Summation Index (HSI) or Growing Degree Days (GDD) index (also known as Winkler's Index). These indices can be derived directly from the observations on mean daily temperatures coming from local weather stations and their summation over the growing period. The amount (and type) of sunlight is not as easy to measure and is more problematic because it requires

computational intensive calculation algorithms that are widely borrowed from physics and earth sciences. The available sunlight is usually measured via daily extraterrestrial solar radiation and a Radiation Use Efficiency (RUE) formula[40] (Ashenfelter & Storchmann, 2010) or a Potential Photosynthetically Active Radiation (PPAR) algorithm (Failla et al., 2004). While both available heat measures—temperature and amount of sunlight—are possible to use in empirical analysis of this chapter, for reasons explained below, the temperature-based variable (see heat variable below) was considered a superior one and chosen for the empirical modelling in this chapter.

Heat variable

As I mentioned above, I considered both climate measures—temperature and amount of sunlight—as potential variables for the empirical analysis of this chapter, but I chose the temperature variable as it proved to be superior for use when analyzing BC VQA wines produced in the Okanagan and Similkameen Valleys. The main reasons for the superiority of the temperature variable over the measure of the available sunlight radiation in the analysis of this chapter are as follows:

1. Vineyards used in the analysis of this chapter are located within Latitude: 49°0'27.04" N and 49°57'16.31" N; and Longitude: 119°21'12.87" W and 119°48'36.94" W.
2. This indicates that they are situated in a relatively small area, which suggests that there would be only small differences in available sunlight. Knowing that solar radiation depends mainly on the latitude and longitude, cloud cover in the area and individual topographical characteristics of a vineyard like a vineyard's aspect (Aschenfelter and Storchmann, 2010), the inclusion of a measure of the solar radiation may not be the optimal choice for the analysis in this chapter.
3. The algorithms used for the calculation of solar radiation differ, are complicated, and their estimates may be imprecise. A large part of the solar radiation that

[40]The radiation Use Efficiency (RUE) measures the mass accumulation in a gram of dry matter per $MJ^{-1}m^{-2}$of intercepted solar radiation. RUE differs for different crops, but tends to be similar across the same species of plants.

reaches the surface is diffused because of the cloud cover present at a given time and place. The data that would allow putting a control on cloud cover is not readily available for BC vineyards. Therefore, the calculation of solar radiation would need to be based on a strong assumption of no cloud cover over the vineyards (Aschenfelter and Storchmann, 2010). This hypothesis would naturally lead to a measurement error and would inevitably cause imprecise estimates in the models of this chapter.

4. Agronomic research shows that temperature variation around mean influences the growth of grapevine plants. The way in which temperature varies on any given day and between days and months impacts the plant's overall health, well-being, yield size and crop quality (Rayne & Forest, 2016; White et al. 2006; Berquist et al., 2001). This fact suggests that a temperature measurement is a better way to control for the quality of grapes that can be influenced by extreme temperatures, which can impact the region studied given its northerly location.

While points 1-3 above describe the rationale for excluding the solar radiation measurements in the analysis of this chapter, the use of standard mean-based temperature indices (HSI or GDD) to control for climate at a given vineyard is also problematic. The standard HSI and GDD temperature indices are a poor measure not only in capturing diurnal variations in temperature around the mean but also because they are not suitable for achieving any other changes in temperatures, e.g., weekly or monthly. The omission of temperature variations can cause a serious problem in the analysis pursued in this chapter, that aims to investigate how various elements of terroir like climate influence wine pricing of BC VQA wines. Since the quality of grapes depends on weather, and it has been scientifically proven that extreme temperatures can have a detrimental effect on the quality of grapes (especially a grapevine's fruit), it is important to control for temperature variations that influence the quality of grapes (Rayne & Forest, 2016; White et al. 2006; Berquist et al., 2001). Therefore, following on grapevine-related agronomic knowledge, in this chapter I assumed the following regarding the relationships between grapevine development and temperature:

1. The physiological development of the vine is highly dependent on temperature, and extreme heat can damage grapes.

2. The linkage between temperature and vine growth is dynamic, rather complex and not necessarily linear (Schlenker & Roberts, 2006; Brown, 2013). Therefore, it is assumed that the relationship between grapevine growth and temperature follows a classic nonlinear form of the S-shaped curve, as illustrated in Figure 3.3 below.

Figure 3.3. The relationship between heat and grapevine growth.

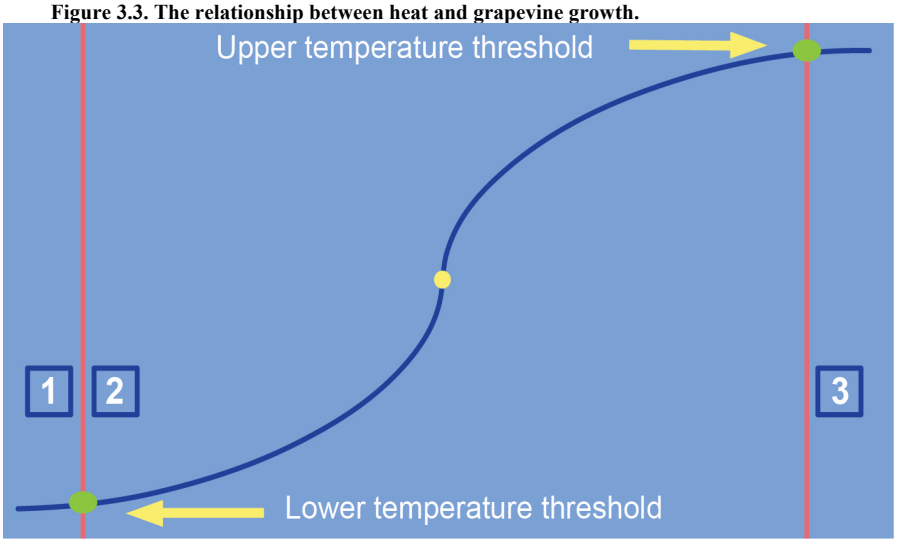


Figure 3.3: The green dots visible on Figure 3.3 show thresholds that together with red vertical lines divide the S-shaped curve into regions 1, 2 and 3. The area on the left, region 1 and the area on the right, region 3 show an environment with temperatures that are too low and too high, respectively for vinifera to thrive. The heat-induced development of vinifera occurs in the middle part of this figure, in the region 2 (Brown (2013), Winkler (1974), among many).

Agronomists claim that a plant's growth and development happen between specific temperature bounds: lower and upper thresholds, which on Figure 3.3 are represented by the area 2. Beyond the upper (or lower) temperature limit, which differs among plant species, heat (or cold) might have a detrimental influence on the plant's well-being (Schlenker et al., 2006; Rayne & Forest, 2016). In the case of grapes, it has been scientifically established that the growth of grapes starts at a temperature of about 10°C while a detrimental heat influence is associated with a temperature of about 35°C and higher (Rayne & Forest, 2016; Hellman et al., 2004).

Therefore, for the analysis in this chapter, a heat variable is constructed. This variable controls for the frequency of the occurrence of temperatures within outside the temperature bounds (lower and upper bound). These bounds are derived based on the minimum and maximum temperatures present within each month of the grape growing season in BC. The specifics regarding the construction of the heat variable are outlined below.

Construction of the heat variable

I constructed the heat variable in the following way:

1. I extracted from the EC database daily minimum and maximum temperatures for each month of the grapes growing season in BC (April 1–October 31) and each weather station assigned to the vineyard (based on the smallest straight-line distance, as described in Subsection 3.1.1).
2. Then I calculated and assigned the average temperature for each month, in each vintage year, for all weather stations matched with specific vineyards in the data set.
3. From the average temperature for each month I subtracted one standard deviation to form a minimum temperature bound or added one standard deviation to create a maximum temperature bound.
4. Then I assigned the frequency of occurrence of temperatures that belonged to each of the temperature bounds. For example: if a minimum temperature bucket

for April was established at the temperature less than 8°C (<8°C) and if the average temperature in that month, in Kelowna was 6°C, one frequency observation was recorded in the data.

5. Finally, I set the comparison bound for temperatures ad hoc as the middle interval. For example: if a minimum temperature bucket for April was set at temperatures less than 8°C (<8°C) and a maximum temperature bucket was set at temperatures more than 20°C (>20°C), then the reference (comparison) interval consisted of temperatures in the interval [8°C, 20°C].

3.3.2.2. Terroir variables

Group 2: topographic variables

The topography of a vineyard is essential for a proper development of grapes and therefore for wine quality. This influence comes from the interactions between temperature, soil, and canopy that interfere with the mesoclimate of the vineyard (Hellman, 2003). The most important topographic elements include soil type, elevation, and slope. The elevation and slope influence grape quality via topographic moderations in the mesoclimate of the vineyard that can be affected by the steepness of the slope or site elevation (absolute and relative). The soil, on the other hand, has a direct influence on grape quality, mainly via its mineral composition that is also able to affect the taste of the wine. The soil-type-dependent water holding capacity is another element that proves to be crucial for grape vigour and can influence grape and wine quality.

For the empirical analysis in this chapter, I investigated five possible topographic variables: soil type, average elevation, aspect, row direction, and distance to the lake.

I excluded the slope variable due to the lack of a good quality measure for slope on vineyards that are present in the available data set.

Soil variable

Soil remains one of the most important topographic elements of terroir. Its type defines the availability of nutrients and water holding capacity. Both these factors are the most important variables not only for the future well-being of grapes but also for the choice of important vineyard management strategies: trellising system, rootstock and vine spacing. In the case of grapevines, soils characterized by moderate fertility are more beneficial for the cultivation of grapes than highly fertile soils, as moderately fertile soils allow better management of the vine canopy (Hellman et al., 2003; Winkler et al., 1974). Among many soil types that allow cultivation of grapes, there is no single soil type that is superior and able to guarantee the highest quality of grapes, hence the best wines. The most important element related to the quality of soil used for grapes cultivation is its good internal drainage (Hellman, 2013). Also, as some research shows, sandy and gravelly soils might be more desirable for grape cultivation (FAO Agribusiness Handbook, 2009). More details regarding the actual construction of the soil variable can be found below.

Construction of the soil variable

The matching of the soil type at each of the vineyards was pursued via comparison of the exact geographical location of the vineyard using Google Earth Pro version 7.1.5.1557, with a soil map of the Okanagan and Similkameen Valleys of British Columbia, as outlined in the *"Atlas of Suitable Grape Growing Locations in the Okanagan and Similkameen Valleys of British Columbia"* prepared by the Association of British Columbia Grape Growers (1984) (accessed on December 15, 2015: https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=25881)
The soils in this atlas include 14 soil types, with soils classified in the following way:

Table 3.1. Soil classes.	
Classification in terms of suitability for grapevines cultivation	**Soil class**
Well-suited	1, 2, 3, 4
Moderately well-suited	5, 6, 7, 9
Poorly suited	10, 11
Not suited	8, 12, 13, 14

After matching of vineyards with soil maps, I identified and matched with proper vineyards the following groups of soils:

Table 3.2. Soils well-suited for grape cultivation.	
Soil Type	**Description**
Type 1	It is a well-drained soil, with medium to fine textured stream deposited fan material. Subsoil: gravelly sandy loam, gravelly silt loam or silt loam.
Type 2	It is a well to rapidly- drained soil, with medium to moderately coarse texture stream deposited fluvial fan materials.
Type 3	Soil type 3: It is a well -drained soil, with medium to moderately coarse textured unsorted till deposits. Occurs on slopes 10-30%.
Type 4	It is a well-drained medium textured soil with medium to moderately fine textured glaciolacustrine sediments. Occurs on slopes 2-9%. Weak to moderate salinity.

Table 3.3. Soils moderately well-suited for grape cultivation.	
Soil Type	**Description**
Type 5	It is a well-drained soil developed on veneers of coarse textured melt water stream deposits overlaying moderately fine silt and clay sediments. Occurs on slopes 5-30%. Weak salinity.
Type 6	It is mostly rapidly drained soil with coarse textured melt water streams, fluvial fans or recent stream deposits. Low water holding capacity, mainly sands. Occurs on slopes up to 30%.
Type 7	It is rapidly drained soil with coarse textured melt water streams, stream deposited fans, or recent stream deposits. Gravels, sands and cobbles. Low water holding capacity. Occurs on slopes up to 30%.
Type 9	It is a moderately well-drained soil with moderately fine to fine textured silts and clays. Gravel-free. Slow infiltration, low aeration and relatively cool soil temperature. Occurs on slopes 2-9%.

To pursue the analysis in this chapter, I grouped all soil types into two classes that formed two indicator variables:

1. Indicator variable 1: well-suited (includes soil types 1, 2, 3, and 4, as described above),
2. Indicator variable 2: moderately well-suited (includes soil types 5, 6, 7, and 9, as described above).

I coded the soil type dummy variables in the data set according to this method: Indicator variable "well-suited" 1 =1 if the soil at a vineyard is well suited and zero otherwise. Indicator variable "moderately well-suited" =1 if the soil at the vineyard is moderately well suited and zero otherwise.

Average elevation variable

The elevation of a vineyard is important mainly from the vineyard temperature standpoint (Hellman et al., 2003; Winkler et al., 1974; Failla et al., 2004). The scientific research shows that the mean temperature drops by about 0.5°C–0.6°C for each 100 metres of an increase in elevation (FAO Agribusiness Handbook, 2009). Due to this elevation-dependent temperature drop, vineyards located at higher elevations may observe lower temperatures. This element, in turn, can negatively influence grape maturation and consequently the quality of the wine. Experiments pursued on the interactions between grapes and elevation gain show that there is an observed average bud break delay of 2.3 days for an increase in elevation of 100 metres. This relationship affects the ripeness of grapes and their readiness for harvest and, therefore, wine flavour, acidity, and other quality-related wine specifics (Failla et al., 2004). The method used for the construction of the average elevation variable is presented below.

Construction of the average elevation variable

Due to the lack of a precise measure of slope in vineyards and to put a control on the influence of altitude of the vineyard on grape quality, I constructed the average elevation variable. In the first step, I measured the average elevation using the Google Earth Pro

version 7.1.5.1557 software. I pursued the measurement of the average elevation in the direction of rows of grapes that were planted in a given vineyard. In the last step, I assigned each elevation to one of three groups. As a result, I created the following three indicator variables:

Table 3.4. Average elevation indicator variables.	
Indicator Variable	**Description**
avgelev1	Average elevation of [0-200 metres]
avgelev2	Average elevation of (200-400 metres]
avgelev3	Average elevation of (400 metres and up)

The coding of the average elevation indicator variables in the data set was pursued in the following way: Indicator variable [0–200m]=1 if the average elevation on a vineyard is in the interval [0–200] and zero otherwise, etc.

Aspect variable

While I excluded from the list of variables used in this chapter the measurement that controls for the amount of sunlight that reaches vineyards (due to its problematic likelihood of the measurement error), I decided to include another variable that can put a control on the direction of insolation that reaches vineyards. This is the variable called "aspect," which is a compass direction of a vineyard towards the sun. The insolation is important for the vineyard and therefore the quality of grapes because of the influences that sunlight has on the photosynthetic processes and the overall well-being of grapevine plants. Scientific research has proven that grapevines that are exposed to sunlight show higher levels of total soluble solids, anthocyanins, and phenolics, and have lower titratable acidity, malate, juice pH, and berry weight, when compared to non-sunlight-exposed grapes (Berquist et al., 2001; Crippen & Morrison, 1986; Dokoozlian et al., 1996; Hale & Buttrose, 1974 to name a few). Since the exposure of grapevine plants towards sun can influence all these wine-taste-related elements, it can be concluded that there is a connection between sun exposure and the quality of the wine. Therefore, a control for the aspect on each of the vineyards in the data set is justified. The variable

aspect is considered as a topographic variable, even though it directly influences the mesoclimate of a given vineyard. The literature on this topic considers Southern (S), South-Eastern (SE) and South-Western (SW) aspects as preferable vineyard directions towards the sun in the Northern Hemisphere. Vineyards with North-Western (NW), Northern (N) and North-Eastern (NE) aspects are considered to have inferior facing for grape maturation and an overall negative influence on grape quality (Hellman et al., 2003). Further details regarding the construction of the aspect variable are presented below.

Construction of the aspect variable

As I mentioned above, the aspect variable shows a compass direction of a vineyard towards the sun. For the analysis in this chapter, I constructed the aspect variable via observation of the satellite images and sun-facing direction for each of the vineyards present in the data set. These observations were pursued using Google Earth Pro version 7.1.5.1557 satellite images. The process resulted in the creation of eight indicator variables that match vineyard directions towards sunlight:

Table 3.5. Aspect indicator variables.

Indicator Variable	Description
E	Eastern aspect
W	Western aspect
S	Southern aspect
SW	South-West aspect
SE	South-East aspect
NW	North-West aspect
NE	North-East aspect
FLAT	Undistinguishable aspect

In the available data set, the Northern (N) aspect direction wasn't observed.
The coding of aspect indicator variables in the data set was pursued according to this example: Indicator variable E=1 if the aspect on a vineyard is E and zero otherwise, etc.

Rows variable

The direction of rows on a plot is one of the most significant elements for the optimal functioning of a vineyard (Berquist et al., 2001). It not only influences the quality of grapes and therefore the quality of wine,[41] but row direction is also a fundamental business decision. Once rows are put in place on a vineyard, it is costly and labour intensive to make any changes in the way they are set on the plot. The decision about the direction of rows usually depends on the shape of the vineyard, its topography, microclimate and prevailing winds (Greenspan, 2008). Row direction is especially important in vineyards located on slopes steeper than 30%. In such cases, rows influence the ability to use machinery introducing the risk of machinery tipping over, especially when rows are directed down the slope instead of across the slope (Hellman et al., 2003). The scientific literature that concerns row direction claims that the North-South (NS) direction of rows is preferable in the Northern Hemisphere as in this orientation all grapes receive a similar amount of heat and sunlight, which in turn positively influences grape' quality (Hellman et al. 2003). This NS direction can additionally be improved in the case of vineyards located in the "cool climate" areas by tilting row direction by about 10–15 degrees West of North (Greenspan, 2008). The direction of rows is a justified variable for inclusion in the modelling of this chapter, as it can reinforce the availability of sunlight and its diurnal distribution across the canopy of a given vineyard. The availability of sunlight can influence the quality of grapes and, therefore, the quality of the wine. While row direction is a management decision of a winemaker or grape grower, in this chapter row direction is treated as a variable that reinforces and belongs to the Terroir Group 2

[41]Row-direction-dependent absorption of sunlight and heat facilitates or impedes the uniform maturation for grapes. The uniform maturation (ripening) of grapes positively influences the quality of the wine (especially wine flavour) as per Greenspan, 2008.

variables: topographic variables. It is argued that the direction of rows on a vineyard strongly depends on the topography of a vineyard and when it is chosen, it is usually unchanged because it requires pulling off grapevine plants and re-planting, which constitute expensive and radical management steps. The direction of rows influences access of sun rays to the vineyard and their diurnal distribution. This, in turn, affects the climate that is present in a given vineyard. More details regarding the actual construction of this variable are shown below.

Construction of the rows variable

The assignment of row direction to each of the vineyards presented in the data set was pursued via an inspection of satellite images of specific vineyards using the Google Earth Pro version 7.1.5.1557 software.[42] To capture the influence of row direction on the quality of grapes and therefore the quality of the wine, for the analysis in this chapter the following indicator variables on row direction were constructed:

Table 3.6. Row direction indicator variables.

Indicator Variable	Description
NS	North-South rows direction
EW	East-West rows direction
SE-NW	South East-North West direction
SW-NE	South West-North East direction

The coding of row direction in the data set was pursued according to this example: Indicator variable NS=1 if the direction of rows in a vineyard is NS and zero otherwise, etc.

[42]Many vineyards presented in the data set were also physically inspected and row direction was confirmed during numerous visits to the Okanagan and Similkameen Valleys.

Lake variable

The last topographic variable considered for the analysis in this chapter is the distance from a vineyard to the closest lake. The literature on the topic suggests that the distance to a lake can influence the mesoclimate of a particular vineyard. This power comes from the lake's ability to moderate nearby land temperatures due to the high heat capacity of the body of water (Cohen et al. 2012; Ashenfelter and Storchmann, 2010). This heat management ability of lakes is crucial for grapes, as the proximity to a lake can cool grapes during hot days and warm them up during colder nights, diminishing the possibility of plant stress that could affect the plants' optimal growth and the quality of fruit. The distance to the lake could also be an important variable if vineyards present in the data set were not equipped with irrigation systems. This influence would be associated directly with water availability in the vineyard. Since all vineyards in the data set used in this chapter are equipped with irrigation systems, the proximity to the lake is not as important regarding water availability as it could be. Further details related to the construction of this variable are explained below.

Construction of the lake variable

To put a control on a vineyard's distance from a large water reservoir like a lake, for example, a measure of the distance of the vineyard from the closest lake was established. I pursued the measure using Google Earth Pro version 7.1.5.1557. All measured values of distance to the lake were recorded and assigned to three range groups. Consequently, three indicator variables, one for each "distance group," were created (as per Table 3.7 below):

Table 3.7. Distance to lake from vineyard indicator variables.[43]	
Indicator Variable	**Description**
lake1	Distance from vineyard to lake: [67m-700m]
lake2	Distance from vineyard to lake: (700m-3000m]
lake3	Distance from vineyard to lake: (3000m and up)

The coding of the lake indicator variables in the data set was pursued according to this example: Indicator variable [67m, 700m] =1 if the distance of the vineyard to lake belongs to the interval [67m, 700m] and zero otherwise, etc.

Non-terroir variables

While most of the variables used in the analysis of this chapter are constructed and directly associated with the terroir of specific vineyards, there are also variables that come directly from the BCLDB data set. These latter variables are not terroir variables. These variables include alcohol content, variety, brand, and wine age. The alcohol variable is indirectly associated with terroir (climate) and puts control on the alcohol content of a specific wine. The variety variable controls for grape type/wine type (and for wine colour). The brand variable controls for wine label (winery). The wine age variable controls for the age of the wine. The wine age squared variable controls for a possible nonlinearity in the wine age. The year variable puts control on time trend.

[43]Because all vineyards present in data set are equipped with irrigation systems, the variable that could control for water scarcity and its possible detrimental effect on grapes quality on the plot was omitted in this analysis. For the same reason, I also excluded the variable controlling for rainfall. I assumed that due to the presence of irrigation system on the plot, each vineyard had an abundant water supply. Also, the field interviews with winemakers in the area and representatives of the Agriculture and Agri-Food Canada in Summerland (AAFC/PARC), a research body responsible for extension services in wine industry confirmed that extensive rainfall or unfavorable winds are not problematic in this research.

3.4. Methodology, Empirical Model Specification and Estimation Method

In this section, I provide an overview of the methodology used in the empirical analysis of this chapter, economic theory that rationalizes the choice of this method, and empirical model specification. Specifically, in Subsection 3.4.1 I discuss the methodology and its theoretical economic background, in Subsection 3.4.2 I outline details regarding the empirical model specification, and in Subsection 3.4.3 I present the estimation method.

3.4.1. Methodology

From an economic theory standpoint, the methodology I chose for the analysis in this chapter seems to belong to the stream known by economists as a hedonic price method. This type modelling approach goes as far back as 1928 when Fredrick V. Waugh pursued an analysis regarding the quality factors influencing the price of asparagus. Waugh published a research paper where he regressed the price of asparagus sold in the Boston market between May-July 1927 on three asparagus quality measures: colour, size of stalks, and uniformity of spears (as cited in Nerlove, 1995). Even though Waugh was the first to use the hedonic specification, the term "hedonic pricing method" is attributed to Court (1939) who applied this method to automobiles (as cited in Combris, Lecocq, and Visser, 1997). From that time, the methodology has gained momentum and has frequently been used to estimate consumers' valuation of certain quality attributes for many different consumer products, agricultural commodities, housing, and even air quality (Nerlove, 1995). The theoretical basis for the hedonic pricing method was laid by Sherwin Rosen, who in 1974 published a seminal paper: "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition" (Journal of Political Economy 82, 34–55). The hedonic method analyzes price-quality relationships, and as Rosen presented in his paper, it can be pursued from the consumers and producers' perspectives (Rose, 1974). The formal steps in the hedonic analysis include the use of the observations on prices of a differentiated good, together with attributes of the good, and a construction of a regression that estimates the hedonic price function. The regression results yield the implicit prices for the good's characteristics. The ratios of these implicit prices provide

the consumers' marginal rates of substitution among attributes (Rosen, 1974; Nerlove, 1995). The hedonic price method is not without its problems. The most commonly stated issue concerns the identification problem when one tries to draw inferences about consumer preferences from the hedonic regression. The problematic part is related to the fact that the quantities of attributes associated with each variety and the number of units sold are in general jointly determined by supply and demand (Rosen, 1974). The identification problem is not unique to the hedonic pricing method, but it is a problem of much other demand and supply modelling approaches, as price-quantity observations jointly represent demand and supply equilibria (Working, 1927).

Regardless of the identification issues, the hedonic pricing method is particularly popular and frequently employed for analyses in wine economics. Wine economists usually use the hedonic pricing method to estimate consumers' valuation of wine attributes, either sensory (aroma, acidity, etc.) or objective (wine origin, region, vintage, etc.), to find the implicit prices for these attributes. Examples of publications that use the hedonic pricing methodology in the analyses of wine include: Oczkowski (1994), Combris, Lecocq and Visser (1997), Landon and Smith (1997), Schamel and Anderson (2003), Noev (2005), Costanigro, McCluskey and Mittelhammer (2007), among many.

While in wine economics the estimation of the wine hedonic price function from the consumer side is very popular, it is much less common from the producer side. In the case of the methodology used in this chapter, the closest publication regarding the approach is from the research pursued by Cross, Plantinga, and Stavins (2011). In their analysis, the authors regressed the prices of vineyards located in the Willamette Valley (Oregon, US) on the measurable vineyard attributes, e.g., slope, aspect, elevation, soil type, as well as on appellation, to estimate what was the value of terroir in the Willamette Valley. They found out that prices for vineyards in the Willamette Valley were strongly determined by appellation, but not by the specifics of terroir.

In the analysis of this chapter I use the hedonic pricing methodology, but instead of a usually seen approach where the price of wine is regressed on the wine's various sensory (sweetness, aroma, etc.) and objective (vintage, variety, etc.) attributes, in this chapter I regress the price of wine on terroir elements associated with a specific wine that was produced from grapes grown on said terroir. As I described in the preceding section, I ensured the existence of the match of the wine price with the origin of grapes used in the process of wine production and specifics of the vineyard that yielded these grapes. It is likely that because of this modelling approach and because of the research on the BC wine region, which is sparse in this type of analyses, the analysis in this chapter constitutes a unique approach in wine hedonic literature.

3.4.1.1. Empirical model specification

In the classic hedonic pricing model, the price of a good is regressed on the good's attributes to find an implicit valuation of these attributes (implicit prices). I followed this methodology in the development of the empirical model for this chapter. The available data set that I constructed for this analysis includes two groups of variables that can be classified as per Figure 3.4 or Figure 3.5 below:

Figure 3.4. Division of variables used in the empirical model based on type of variable.

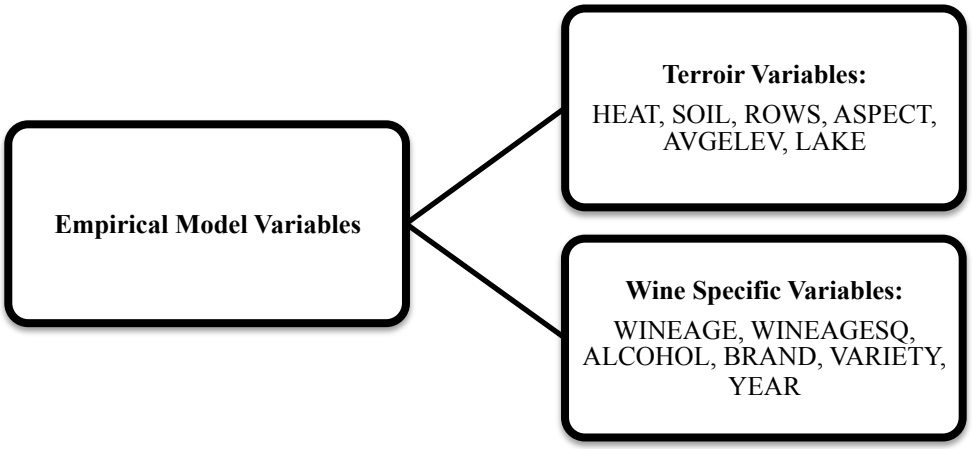
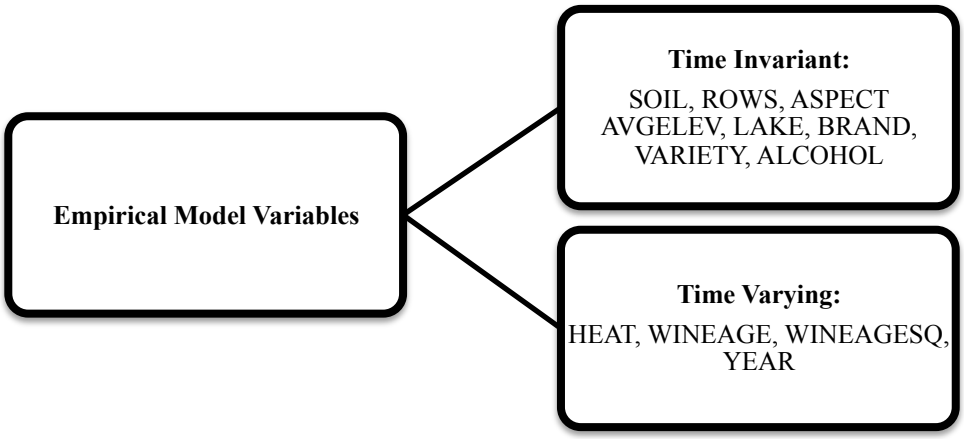


Figure 3.5. Division of variables used in the empirical model based on their variability over time.



3.4.1.2. Empirical model

Since the primary goal of the analysis pursued in this chapter is to establish if (and how) terroir elements influence the formation of wine prices in the case of the selected BC VQA wines produced in the Okanagan and Similkameen Valleys, the estimation of the hedonic pricing model, as per specification outlined below is employed:

$$y_{it} = \alpha + X'_{it}\beta + Z'_{it}\gamma + \varepsilon_{it}$$

Equation 3.1

Where:

y_{it} is a wholesale price of wine "i" in year "t" (in Canadian dollars), either in the level-level or log-level form as these two specifications are tested,

α is a regression intercept,

$\mathbf{X_{it}}$**'** is a matrix of explanatory variables including the following variables:

- WINEAGE: the age of wine based on the wine's vintage year and calculated in the following way: wine sales year minus wine vintage year = WINEAGE (a continuous variable);

- WINEAGESQ: squared WINEAGE, a variable constructed to control for a possible non-linearity in the WINEAGE (a continuous variable),
- BRAND: wine/winery brand (33 indicator variables),
- VARIETY: type of wine based on the grape variety e.g.: Merlot, Malbec, etc. (an indicator variable). Note: the variety also indicates the wine color: either red or white. Therefore, the variable "color" was excluded in this analysis because it would be redundant,
- ALCOHOL: wine alcohol content (a continuous variable organized in 3 groups (3 indicator variables),
- YEAR: year of wine sales (an indicator variable: 5 indicator variables for years 2011-2015). This is time effect/trend.

$\mathbf{Z_{it}}$**'** is matrix of explanatory variables associated with terroir and includes the following variables:

- AVGELEV: average elevation on the vineyard (a continuous variable organized in 3 groups (3 indicator variables),
- ASPECT: vineyard's direction towards sun (8 indicator variables),
- ROWS: rows' direction on the vineyard (4 indicator variables),
- LAKE: distance of a vineyard from the lake (3 indicator variables),
- HEAT: frequency of extreme temperatures in the upper and lower bound (continuous variable),
- SOIL: soil type (2 indicator variables),

β and γ are vectors of regression estimates,

ε_{it} is the regression error term, where $\varepsilon_{it} \approx$IID $(0, \sigma_v^{\,2})$.

3.4.2. Estimation method

The available sample of the selected BC VQA wines from the Okanagan and Similkameen Valleys of BC used in the analysis of this chapter consists of 252 different wines (different SKU numbers) together with their volumes of sales and wholesale prices observed between April 1, 2011 and March 31, 2015. The total data set used in the analysis is composed of N=6785 observations on prices and sales of these 252 wines (repeated monthly purchases of these wines over 2011–2015). The actual presence of these wines in the data set varies between years 2011 and 2015 as some wines go out of sales and others enter the market. All wines that are present in this data set have standard wine bottles with the volume of 0.75 litres, and they were produced by 33 different brands (estate wineries) located in the Okanagan and Similkameen Valleys of BC. The list of all wineries that participated in this research can be seen in Appendix B: Chapter 3, Table B.1 and Figure B.1. All wines used in this analysis are either red or white, with the age of wines between 0-15 years (16 vintages in total). There are 24 different grape varieties/wine types present in this data set. The origin of grapes used to produce these 252 wines can be traced to 71 different vineyards located in the Okanagan and Similkameen Valleys. All these 71 vineyards are mapped and presented in Appendix B: Chapter 3, Figure B.2.

Some of the vineyards coincide with the location of the estates of the 33 wineries (brands), but numerous are in different, sometimes quite distant areas in comparison to the location of the estate wineries. The 71 vineyards that supplied grapes to produce these wines are located within 14 different proposed sub-appellations (as per demarcation suggested by the BC Wine Appellation Task Group), plus one area (Similkameen Valley) that was not included in the sub-appellations proposal (called in the analysis of this chapter: “Beyond sub-appellations demarcation (Similkameen Valley)”). All wines present in this data set are associated with the same origin of grapes in years 2011–2015 meaning that if a wine A was produced from grapes coming from the vineyard X in 2011, the grapes from the same vineyard were used to produce this wine in the next years, 2012–2015. There was only one exception to this rule when the same SKU/wine between 2011 and 2015 was produced from grapes coming from two different vineyards.

Tables 3.8 and 3.9 below present additional summary statistics for this data. Table 3.10 below outlines the distribution of wines per origin of grapes used for their production.
Table 3.10 below outlines the distribution of wines per origin of grapes used for their production.

Due to changes in the wholesales pricing model that officially came to life in BC, in 2015, the BCLDB BC VQA wine scanner pricing and sales data available for this research is composed of two groups of pricing data:

1. 2011–2013 pricing data that shows prices constructed based on the pre-wholesale pricing model changes, with wholesale prices (Liquor Distribution Board (LDB) display prices) formed under the old pricing model.
2. 2014–2015 pricing data that shows wholesale prices created under the new wholesale pricing model.

To correct for these differences between these two pricing models, prices from 2011–2013 were adjusted by the Provincial Sales Tax (10%) to put them on a comparable level with prices from 2014–2015.
More details about the differences between these two groups of prices can be seen in Appendix B: Chapter 3, Figure B.3 and in comments under that chart

Table 3.8. Data descriptive statistics.

N=6785 obs. (252 wine SKU) Variables	Modalities	Mean	Standard Deviation	Minimum	Maximum
Price	continuous variable	19.49	8.59	9.61	90.66
Wineage	"	3.83	2.95	0	15
Brand	indicator variable			1	33
Variety	"			1	24
Year	"			2011	2015
Vineyard (source of grapes)				1	71

Table 3.9. Descriptive statistics continuation.

Variables	Frequency	Percent
Alcohol (total 3 groups)		
Alcohol below 12%	733	10.8
Alcohol [12-14%]	4523	66.66
Alcohol above 14%	1529	22.54
Sub-appellations (total 15)		
Alluvial fans and flood plains	22	0.32
East side mixed sediments	263	3.88
Glaciofluvial terraces	517	7.62
Golden Mile Bench	898	13.24
Kettled outwash and fans	896	13.21
Mission Creek terraces	589	8.68
Mixed sediments and fans	624	9.2
NE side lacustrine bench	687	10.13
SE side lacustrine bench	378	5.57
Sandy outwash lakeside terraces East side	298	4.39
Sandy outwash lakeside terraces West side	60	0.88
Sandy outwash terrace and deposits	123	1.81
West side lacustrine bench	46	0.68
West side mixed sediments	957	14.1
Beyond sub-appellations demarcation (Similkameen Valley)	427	6.29
TERROIR VARIABLES		
Soil (total 2 groups)		
Well-suited	3322	48.96
Moderately-well suited	3463	51.04
Rows (total 4 groups)		
North-South	2299	33.88
East-West	1887	27.81
Southeast-Northwest	1387	20.31
Southwest-Northeast	1221	18
Aspect (total 8 groups)		
East	391	5.76
Flat	2516	37.08
North-East	253	3.73
North-West	508	7.49
South	488	7.19
South-East	1177	17.35
South-West	743	10.95
West	709	10.45
Average Elevation (total 3 groups)		
Average elevation [0-200m]	2027	29.87
Average elevation (200-400m]	1432	21.11
Average elevation (400m and up)	3326	49.02
Distance to lake (total 3 groups)		
Distance to lake [67-700m]	1870	27.56
Distance to lake (700-3000m]	2396	35.31
Distance to lake (3000m and up)	2519	37.13
SKU #		**252**
N		**6785**

* All variables in this table are indicator variables.

Table 3.10. Distribution of wines (SKU#) per origin of grapes used for their production (total over the whole sample).

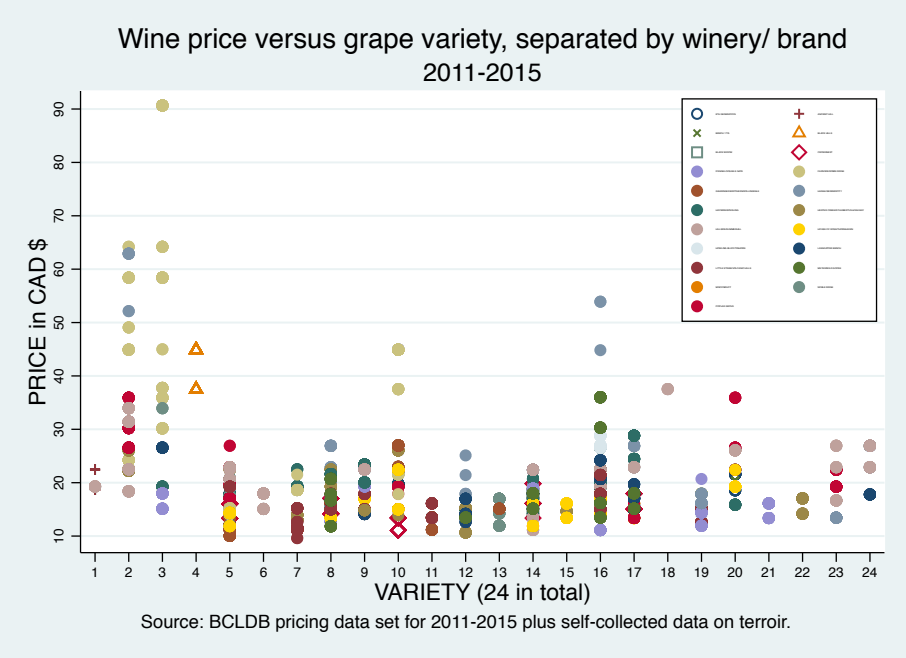
Proposed Sub-appellation	Number of SKU (Wines), which grapes came from specific sub-appellation
Alluvial fans and flood plains	3
East side mixed sediments	8
Glaciofluvial terraces	17
Golden Mile Bench	25
Kettled outwash and fans	34
Mission Creek terraces	17
Mixed sediments and fans	25
NE side lacustrine bench	30
SE side lacustrine bench	15
Sandy outwash lakeside terraces East side	19
Sandy outwash lakeside terraces West side	1
Sandy outwash terrace and deposits	4
West side lacustrine bench	1
West side mixed sediments	39
Beyond sub-appellations demarcation (Similkameen Valley)	15

*Note: There is one SKU (wine) that was produced between 2011-2015 from grapes coming from two different vineyards. Therefore, a total of SKU numbers in this table adds up to 253, not 252.

3.4.3. Scatter plots

To present more details regarding the available wine pricing data set, I created several scatter plots. They show additional relationships that characterize the BC VQA wine data set analyzed in this chapter. Below I show and discuss five of these scatter plots. The other plots I present in Appendix B: Chapter 3 (Figures B.4–B.8).

Figure 3.6. Price vs grape variety, separated by winery/brand.



This figure shows that there is a visible variability in the wholesale pricing across wine varieties and wine brands, but most varieties/brands in this data set tend to be located at the price level of CAD 10-30.

Figure 3.7. Price vs winery/brand, separated by grape variety.

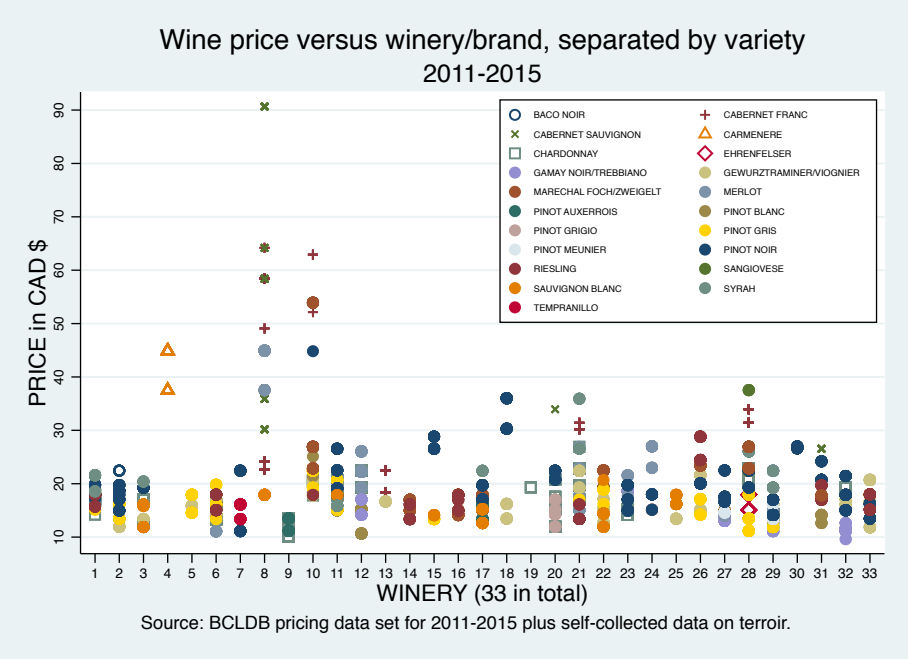


Figure 3.7 shows that there exists a variability in the wine pricing across grape varieties and brands, but it is not clear how the price of wine depends on the variety.

Figure 3.8. Price vs alcohol content, separated by grape variety.

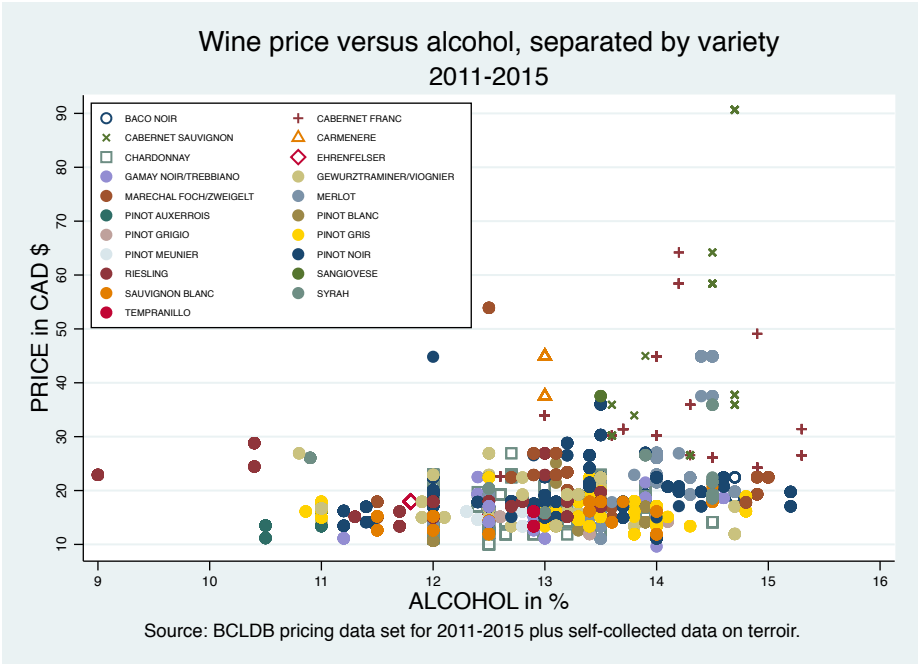


Figure 3.8 shows that there exists variability in the wine pricing versus alcohol content, but it is not entirely clear how the alcohol content influences wine prices.

Figure 3.9. Price vs distance to lake, separated by grape variety.

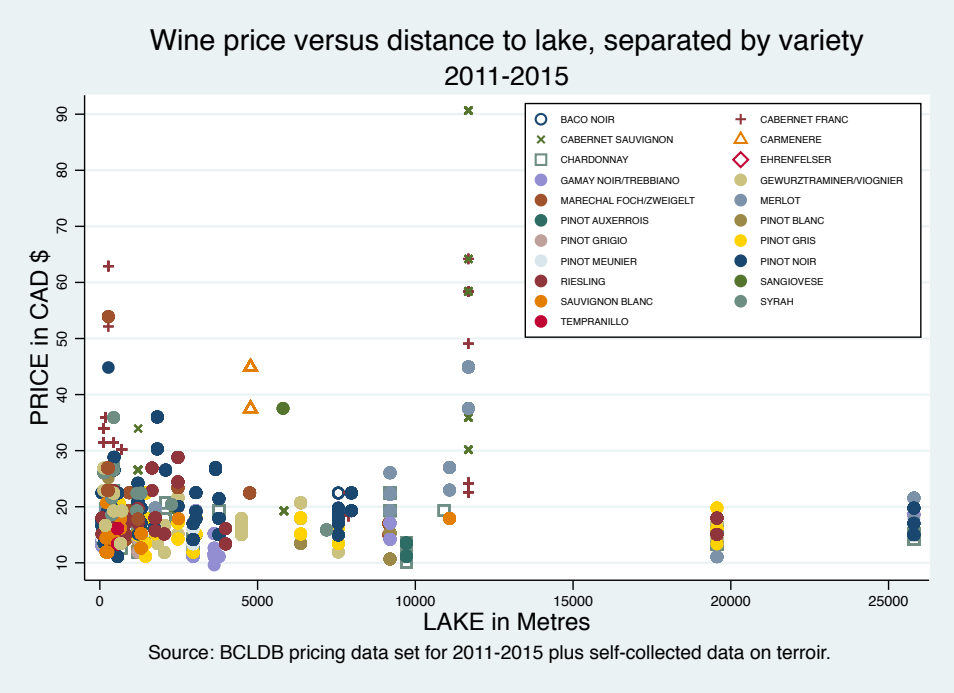


Figure 3.9 shows that most wineries in this sample source grapes from the vineyards that are located within 0–5000 metres (m) from the closest lake. These wines tend to have prices in the interval of CAD 10-30. But there exist wines that were made from grapes cultivated on the vineyards located more than 1000 m from the closest lake, and these wines tend to have much higher prices. This might suggest that the distance to the lake may not be a major factor in the pricing of BC-made wines.

Figure 3.10. Price vs average elevation on vineyard, separated by grape variety.

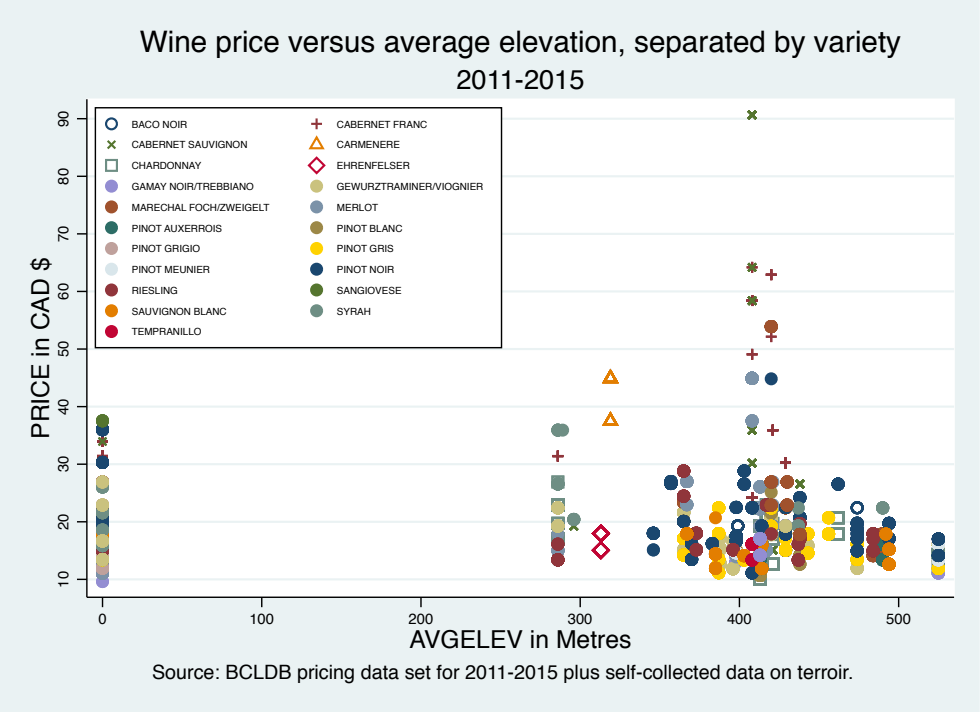


Figure 3.10 shows that most of the grapes used to produce the selected wines come from the vineyards that are located on the plots with the average elevation of 300–500m. There exists variability between the pricing, variety, and the average elevation, but it is not obvious how the average elevation influences the prices of wines.

3.4.4. Necessary assumptions for model estimation

To estimate the empirical model outlined in Subsection 3.4.1.2, I used the Ordinary Least Squares (OLS) estimation method with fixed effects. The two hedonic price equations were estimated: one with the dependent variable, the price of wine in the level form, and the other with the price of wine in the logarithmic form. The dependent variable, the price of wine, is not normally distributed (please refer to Figures B.9 and B.10 in Appendix B: Chapter 3); therefore, it is suspected that the model with the logarithmic transformation of the dependent variable might have a better fit. The independent variables consist of terroir and non-terroir (or time-varying versus time-invariant) variables, as described in Subsection 3.4.1.1 above.

Clustering of errors

I suspect that the specifics of the available for this chapter wine data require an assumption of correlated standard errors (SE). The available observations on wines are associated with different areas of the Okanagan and Similkameen Valleys (different proposed sub-appellations). I suspect that wines coming from the same proposed sub-appellation can be correlated in some unknown way (inter-group correlation) introducing correlation in the error term within that group. The assumption of correlated errors implies that the observations within group i are correlated in some unknown way inducing correlation in the error terms within group i, but that groups i and j do not have correlated errors. In the presence of correlated SE, the OLS estimates are still unbiased, but the SE may be quite wrong leading to incorrect inference in a surprisingly high proportion of finite samples. Therefore, in the estimation process, the clustering of SE based on the proposed sub-appellations is pursued. The proposed sub-appellations with their demarcation frontiers seem like a good choice for clustering variables for BC VQA wines. The boundaries of these proposed sub-appellations were chosen by the industry, with the help of the PARC Summerland (scientific background). This suggests that the elements that could induce clustering of errors like region-specific wine styles, grape production techniques, vineyard management, and region-specific winemaking know-how are enclosed by these proposed sub-regional boundaries. Therefore, the SE clustering on sub-appellations should mitigate problems associated with correlated errors. Additional scatter plots that visualize why clustering of SE based on sub-appellations is justified can be seen in Appendix B: Chapter 3, in Figures B11–B36.

3.4.5. Software used for model estimation

All empirical model specifications were estimated using Stata 13 Special Edition software. The results are presented and discussed in Section 3.5 below. The tables with full results from these specifications are shown in Appendix B: Chapter 3 (Tables B.4 and B.5).

3.5. Empirical Results and Discussion

In this section, I present results obtained from the empirical analysis and discuss their overall significance. Specifically, in Subsection 3.5.1 I outline tables containing significant regression results, and in Subsection 3.5.2 I discuss the significance of the results.

3.5.1. Regression results

As I mentioned above, for the empirical analysis in this chapter I implemented two forms of the empirical model specification:

1. Model 1: level-level—with the dependent variable, the price of wine in the level form,
2. Model 2: log-level—with the dependent variable, the price of wine in the logarithmic form.

The significant OLS estimates for terroir related variables, for both the level-level and log-level models, are presented in Tables 3.11 and 3.12 below. The results from the full specifications for these models can be seen in Appendix B: Chapter 3 (Tables B.4 and B.5). The specifications of each of these models, either in the level-level or log-level form present results coming from six regressions, with terroir variables being added in a sequence. Details regarding the specifications of these regressions are discussed in Subsection 3.5.2.1.

3.5.2. Discussion

3.5.2.1. General comments about regressions

For each of the two model specifications: level-level and log-level, six different regressions were implemented. In both cases the first regression is always a regression with price as a dependent variable, with the following independent variables: wine age, wine age squared, sales years, variety (24 indicator variables), brand (33 indicator variables), and alcohol content (two indicator variables). In the case of regressions 2-6, terroir variables are being added in a sequence to check how the model behaves.

Therefore:

1. Regression 2 has all the same variables as regression 1 plus soil (two indicator variables);
2. Regression 3 has all the same variables as regression 2 plus row direction (four indicator variables);
3. Regression 3 has all the same variables as regression 2 plus aspect (eight indicator variables);
4. Regression 4 has all the same variables as regression 3 plus average elevation (three indicator variables);
5. Regression 5 has all the same variables as regression 4 plus distance to lake (three indicator variables);
6. Regression 6 has all the same variables as regression 5 plus temperature bucket variables.

The discussion about results that follows in the next subsection concentrates on results obtained from the full model (as per regression 6 described above).

Table 3.11. Level-level model. SE clustered on proposed sub-appellations (15).

	(1) price	(2) price	(3) price	(4) price	(5) price	(6) price
year_2014	-2.961***	-2.971***	-3.163***	-3.132***	-3.231***	-2.523**
	(0.336)	(0.335)	(0.347)	(0.298)	(0.275)	(0.751)
year_2015	-2.818***	-2.806***	-3.037***	-3.014***	-3.075***	-2.327*
	(0.369)	(0.379)	(0.423)	(0.358)	(0.357)	(0.895)
soil well-suited		1.731	2.43	3.928*	4.524*	1.972+
		(1.130)	(1.632)	(1.720)	(1.760)	(1.101)
rows NS			-0.796	-2.577+	-2.682*	-2.319*
			(0.738)	(1.315)	(1.166)	(0.974)
aspect S				0.251	1.833	6.145+
				(3.287)	(3.513)	(3.212)
avgelev (200m-400m]					-2.32	-3.779*
					(1.834)	(1.570)
april<11C						0.304*
						(0.110)
april>19C						0.893**
						(0.271)
june>29C						0.294+
						(0.158)
july<25C						-0.624+
						(0.330)
july>33C						-0.542**
						(0.166)
august<24C						-0.458**
						(0.142)
october<10C						-0.404*
						(0.168)
may>11C						-0.617*
						(0.210)
june>15C						-0.776**
						(0.240)
july>18C						0.311*
						(0.117)
august<11C						-0.409**
						(0.134)
Constant	15.17***	14.46***	13.43***	13.11***	12.08**	30.40**
	(1.896)	(2.095)	(1.994)	(2.644)	(3.464)	(10.120)
N	6785	6785	6785	6785	6785	6785
R-sq	0.677	0.68	0.686	0.701	0.706	0.751
adj. R-sq	0.674	0.677	0.683	0.698	0.702	0.747

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

SE clustered on 15 sub-appellations.

These are results obtained after controlling for variety (24), brand (33) and year (5) fixed effects.

Comparison Groups: Soil: moderately well-suited, Rows: EW, Aspect: E,

Elevation: [0-200m], Heat: middle interval for each month.

Alcohol above 14%, Lake distance [67-700m], Elevation [0-200m].

Only results that yielded significant estimates in Model 6 are presented here.

Full results can be seen in Appendix B: Chapter 3, Table B.4. Wineries/brands were coded for privacy.

Table 3.12. Log-level model. SE clustered on proposed sub-appellations (15)

	(1) lnprice	(2) lnprice	(3) lnprice	(4) lnprice	(5) lnprice	(6) lnprice
year_2014	-0.168***	-0.168***	-0.174***	-0.173***	-0.179***	-0.160***
	(0.017)	(0.017)	(0.018)	(0.014)	(0.013)	(0.018)
year_2015	-0.162***	-0.161***	-0.168***	-0.167***	-0.169***	-0.151***
	(0.018)	(0.018)	(0.019)	(0.015)	(0.014)	(0.021)
rows NS			-0.0126	-0.08	-0.0829*	-0.0817*
			(0.028)	(0.051)	(0.033)	(0.028)
avgelev (200m-400m]					-0.197**	-0.229**
					(0.066)	(0.057)
april<11C						0.0104*
						(0.005)
april>19C						0.0321**
						(0.010)
july>33C						-0.0187**
						(0.006)
august<24C						-0.0115+
						(0.006)
october<10C						-0.0167*
						(0.006)
may>11C						-0.0237**
						(0.007)
june>15C						-0.0270*
						(0.010)
july>18C						0.00957+
						(0.005)
august<11C						-0.0147*
						(0.006)
Constant	2.747***	2.723***	2.681***	2.758***	2.776***	3.219***
	(0.089)	(0.099)	(0.087)	(0.100)	(0.098)	(0.263)
N	6785	6785	6785	6785	6785	6785
R-sq	0.745	0.747	0.751	0.768	0.78	0.815
adj. R-sq	0.742	0.744	0.749	0.766	0.777	0.812

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

SE clustered on 15 sub-appellations

These are results obtained after controlling for variety (24), brand (33) and year (5) fixed effects.

Comparison Groups: Soil: moderately well-suited, Rows: EW, Aspect: E,

Elevation: [0-200m], Heat: middle interval for each month.

Alcohol above 14%, Lake distance [67-700m], Elevation [0-200m], Heat: middle interval for each month.

Only results that yielded significant estimates in Model 6 are presented here.

Full results can be seen in Appendix B: Chapter 3, Table B.5. Wineries/brands were coded for privacy.

3.5.2.2. The overall fit of the models

The results coming from regressions with the full specification (Model 6) show that the model with the logarithmic transformation of the dependent variable proves to have a better fit than the model in the level-level form, with the adjusted R^2=0.81, versus adjusted R^2=0.75 in the case of the model with the dependent variable in the level form. The discussion about the significant regression estimates for each of these models is presented below.

3.5.2.3. Estimates on wineage and wineage squared

While the signs on the estimate for the variable wine age that controls for the age of wine have the expected positive signs (in the case of both models, level-level and log-level) because older wines tend to be sold with a price premium due to their scarcity and an investment potential, the estimates are insignificant at all conventional significance levels. The estimates on the wine age squared also have expected signs (negative), but they are also insignificant at all conventional significance levels. I included the wine age squared in the regressions to control for the possible nonlinearities that the age of wine could have on the price of wine. I expected its negative sign, as its role was to correct and adjust the value of the estimate on the wine age. The obtained results might suggest that the age of wine may not be an essential element in the formation of prices of BC VQA wines.

3.5.2.4. Estimates on the sales years

The sales years (five indicator variables) were included in the regressions to control for time trends. Two out of five years, years 2014 and 2015 yielded significant estimates. The significance of these estimates differs per model type, e.g., the estimate in the level-level model shows that year 2014 has a negative estimate that is significant at 1% and year 2015 has a negative estimate that is significant at 5%. In the case of the log-level

model, both years 2014 and 2015 have negative estimates that are highly significant (at 0.1%). The negative signs on these years were expected, as these are the years when the change in the wholesale pricing model came to life. The change in the pricing model has been discussed earlier in Chapter 2 of this dissertation, with some more details on this topic presented in Appendix B: Chapter 3 (Figure B.3). The new pricing model changed the method for the wholesale wine pricing in the province of BC. This, in turn, introduced changes in the level of wholesale prices for the BC VQA wines. In the modelling process of this chapter some adjustments were pursued e.g.: the Provincial Sales Tax of 10% was taken off the prices in years 2011–2013 to make them more levelled with the 2014–2015 prices, but it is not possible to trace what other changes in the wholesale prices of BC VQA wines were made, as prior to 2014 the pricing model was highly dependent on various, not apparently available to the public, discounts given to different wine market players in BC (or taxes assigned to various wine classes).

3.5.2.5. Estimates on wine varieties

The regressions estimates on the wine variety differ regarding signs and significance (on per variety basis) when compared to the base variety, the Gewürztraminer. Such results were largely anticipated. The white wine varieties like Gewürztraminer, for example, tend to be sold at a discount when compared to red wine varieties due to the perceived lower investment potential for white wines and a customary association of red wines with superior quality wines. The statistically significant estimates are present on 15 (in the case of both model specifications) out of 24 varieties (total). Table 3.13 below shows all statistically significant results on wine varieties.
Full results can be seen in Appendix B: Chapter 3, Tables B4 and B5.

Table 3.13. Grape/wine varieties significant estimates.

	price	lnprice
BACO NOIR	6.216***	0.306***
	(0.869)	(0.033)
CABERNET FRANC	7.573*	0.352**
	(2.800)	(0.103)
CABERNET SAUVIGNON	13.51***	0.434***
	(2.388)	(0.069)
EHRENFELSER	11.54*	0.412**
	(4.916)	(0.114)
GAMAY NOIR	3.459+	0.07
	(1.676)	(0.100)
MARECHAL FOCH	3.675***	0.148**
	(0.857)	(0.038)
MERLOT	3.921**	0.181**
	(1.036)	(0.047)
PINOT BLANC	-2.906*	-0.231**
	(1.202)	(0.069)
PINOT NOIR	5.266**	0.238***
	(1.284)	(0.055)
RIESLING	3.408*	0.110+
	(1.497)	(0.053)
SANGIOVESE	14.29**	0.656***
	(4.643)	(0.114)
SYRAH	6.632**	0.299**
	(2.173)	(0.099)
TEMPRANILLO	3.667	0.136*
	(2.231)	(0.057)
TREBBIANO	-3.025***	-0.190***
	(0.618)	(0.026)
VIOGNIER	2.876**	0.116*
	(0.867)	(0.049)
ZWEIGELT	6.881*	0.262**
	(2.324)	(0.077)

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

SE clustered on 15 sub-appellations

Comparison Grape/wine variety: Gewurztraminer.

Out of the 16 wine varieties that have significant estimates, only five varieties belong to the group of white wines (Ehrenfelser, Pinot Blanc, Riesling, Trebbiano, and Viognier). As expected all red varieties (with the statistically significant estimates) have positive signs on their regression estimates in comparison to Gewürztraminer. From the white varieties with statistically significant estimates, two varieties have negative signs on their estimates in comparison to Gewürztraminer: Pinot Blanc and Trebbiano. The other white wine varieties with statistically significant estimates Viognier, Riesling, and Ehrenfelser, have positive estimates in comparison to Gewürztraminer.

The statistical significance of estimates for the 16 out of 24 varieties that come from the estimated models might suggest that the grape variety is an important variable in the pricing of BC VQA wines produced in the Okanagan and Similkameen Valleys. Another observation that can be concluded from the obtained results may suggest that the "exotic-sounding" wines tend to have higher values on their estimates, e.g., Sangiovese or Ehrenfelser. This might be associated with the low planting acreage of these grapes in BC and therefore scarcity of BC VQA wines that are made from these grapes. Or, it can simply suggest that consumers enjoy foreign-sounding wine varieties, perceive them as unique, and are willing to pay a price premium for such wines. This behaviour, in turn, might be well known to BC VQA producers and they might use this knowledge to increase the price premia on such "exotic wines."[44]

3.5.2.6. Estimates on brand

The estimates on brands are primarily an empirical exercise, as it could not be predicted from theory what results would be obtained. The brand recognition in wine depends on many elements, and the quality of wine alone may not be the most important factor. Some of the most important factors influencing the recognition of the wine brand in the market include: a longevity of the brand in the market, with older brands having more chances to be valued higher; individual winery brand marketing skills (promotion strategies and advertisement channels); brand-specific taste of wines, volume of wines sold (e.g., a

[44] Certain winemakers from BC confirmed that the "exotic-sounding wines" are priced at a premium.

strong presence in the liquor stores that can suggest to consumers their recognition, hence superiority); a presence at hospitality venues e.g., wineries, hotels, restaurants, etc. that allow brand recognition via tourism. All these elements can mutually reinforce brand recognition in the market and, therefore, the valuation of wines produced by that brand.
Regarding the significance of the regression estimates on wine brands, the obtained results show that out of the 33 brands:

1. In the case of the level-level model, nine brands show significant results,
2. In the case of the log-level model, 12 brands show significant results.

The significance of estimates on brands varies per brand, as well as per model (level–level vs. log-level). The signs on brand estimates differ, too, when compared with the base brand, WINERY 22. This outcome was expected, as brands have different levels of recognition in the market and are associated with various locations, as well as a "different winery experience." Some of the brands/wineries present in this data set are estates with well-known restaurants or estates that are frequently visited by tourists. Others are very active promoters of their wines. Detailed results on the estimates for brands are presented in Table 3.14 below.

The general conclusion coming from the obtained estimates on wineries/brands suggests that the winery/brand recognition effects seem to constitute an essential element in the formation of prices of BC VQA wines. The obtained statistically significant estimates on brands are also rather significant in their magnitudes. Such results were anticipated, as individual brand recognition tends to constitute an essential element in the formation of wine prices.

Table 3.14. Brand significant estimates.

	price	lnprice
WINERY 2	-10.58*	-0.418**
	(4.209)	(0.117)
WINERY 4	27.69***	1.121***
	(2.894)	(0.118)
WINERY 6	-7.707*	-0.368**
	(2.679)	(0.122)
WINERY 7	-6.121	-0.267+
	(3.666)	(0.127)
WINERY 9	-9.406+	-0.449*
	(4.751)	(0.156)
WINERY 10	17.65***	0.606***
	(3.573)	(0.121)
WINERY 13	-5.933+	-0.230+
	(2.953)	(0.115)
WINERY 14	-6.601*	-0.286*
	(3.059)	(0.122)
WINERY 15	3.911*	0.194*
	(1.673)	(0.085)
WINERY 21	3.202	0.187*
	(1.999)	(0.076)
WINERY 26	4.005	0.361*
	(4.829)	(0.162)
WINERY 30	15.34***	0.692***
	(3.215)	(0.109)

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

SE clustered on 15 sub-appellations

Comparison Winery/brand: Winery 22

Wineries were coded for privacy.

3.5.2.7. Estimates on alcohol

The estimates of the alcohol levels: alcohol below 12% and on alcohol of [12-14%], in comparison to the alcohol level of [14% and up] are insignificant. This is true in the case of all six model specifications for both level-level and log-level models. This might suggest that the alcohol content in the case of BC VQA wines may not be a major factor in the formation of wine prices.

3.5.2.8. Estimates on terroir variables

The estimates on terroir variables are significant for the analysis of this chapter that aims to verify what the influences of terroir elements are on the pricing of BC VQA wines. All estimates on terroir variables used in the modelling process of this chapter are discussed below.

1. Soil: The estimate on the well-suited soils (in comparison to moderately well-suited soils) is positive and significant at 10% in the case of the level-level model type but is insignificant in the case of the log-level. The outcome when the well-suited soil has a positive impact on wine pricing was expected as soil that is well suited for grapes cultivation should have a positive influence on the quality of grapes (when compared to the moderately well-suited soils) and consequently on the quality of the wine.
2. Rows: The estimates on the row direction are all insignificant, except the NS row direction that in the case of both models (level-level and log-level) have a negative and significant estimate (at 5%), in comparison to the EW row direction (base group). This result is a bit puzzling as much of the literature points towards the NS direction of rows as a superior in the Northern Hemisphere when compared to all other row directions. Since the NS row direction is considered superior for grape cultivation, it should positively influence the quality of grapes and therefore the prices of wines made from such grapes. The obtained results show that it is not true in the case of BC VQA wines as the NS row direction yielded a negative estimate when compared to the EW row direction. The reasons for such status quo might be associated with the

perception that the EW row direction is superior. Most of the row installations in the 1970s and 1980s in California opted for that direction and perceived it as superior for the quality of grapes. Later, this perception changed, and now many grape growers claim that there is no reason to consider the EW rows direction as a superior for grape cultivation in the Northern Hemisphere (Greenspan, 2008). As the field interviews with BC winemakers revealed, numerous BC winemakers take a lot of knowledge about cultivation of grapes from California. It is possible that following California's example, BC winemakers consider the EW row direction as superior for grape cultivation and value it more in the wine pricing. This, in turn, might influence the negative sign in the estimates on the NS row direction in the model when compared to the EW row direction.

3. Aspect: All estimates on the aspect are statistically insignificant, except the S aspect in the case of the level-level model that is positive and significant at 10%. The direction of this estimate agrees with the expectations as south-facing vineyards are considered to be those that can produce higher quality grapes. But, as the results show, aspect seems to be largely an insignificant variable for the wine pricing of BC VQA wines.

4. Average elevation: The estimates on the average elevation are significant only in the case of the average elevation between (200–400m]. The sign is negative when compared to the elevation [0–200m] and significant at 5% in the case of the level-level model, and significant at 1% in the case of the log-level model. This may suggest that a lower elevation produces in the Okanagan and Similkameen Valleys better quality grapes. Grapes grown at lower elevations can mature on time, and there is a diminished risk for the occurrence of lower temperatures that are associated with higher elevations. This, in turn, could translate into a better quality of wines that come from grapes grown at lower elevations.

5. Lake: The estimates on the distance to a lake came out insignificant in all models' specifications, suggesting that the distance to a lake in the case of BC VQA wines has no influence on the formation of wine prices. One reason for this status quo might be that after it was controlled for climate (as per variable "heat" below) the proximity of the lake that could potentially mitigate climate influence on the

grapevines lost its significance. Since all BC vineyards are equipped with irrigation systems, the access to water that could also potentially impact the significance of the "lake" variable lost its potential.

6. Heat: The specifics of the construction of the heat variable that shows the frequency of the temperature occurrences within a given temperature bucket make estimates on the heat variable a bit more complicated to interpret. Therefore, a more detailed analysis of these estimates is pursued. The estimation results from both model specifications, the level-level and the log-level, are presented in Table 3.15. The discussion regarding these estimates is outlined below.

Table 3.15. Heat significant estimates.

	price	lnprice
april<11C	0.304*	0.0104*
	(0.110)	(0.005)
april>19C	0.893**	0.0321**
	(0.271)	(0.010)
june>29C	0.294+	0.0109
	(0.158)	(0.007)
july<25C	-0.624+	-0.015
	(0.330)	(0.012)
july>33C	-0.542**	-0.0187**
	(0.166)	(0.006)
august<24C	-0.458**	-0.0115+
	(0.142)	(0.006)
october<10C	-0.404*	-0.0167*
	(0.168)	(0.006)
may>11C	-0.617*	-0.0237**
	(0.210)	(0.007)
june>15C	-0.776**	-0.0270*
	(0.240)	(0.010)
july>18C	0.311*	0.00957+
	(0.117)	(0.005)
august<11C	-0.409**	-0.0147*
	(0.134)	(0.006)

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

SE clustered on 15 sub-appellations

Comparison group: middle heat interval for each month.

The heat variable is composed of two groups of temperature buckets:

1. The maximum temperature frequency buckets.

2. The minimum temperature frequency buckets.

In the case of both bucket groups, a middle-temperature interval maintains a comparison group for that class of heat variables (and is excluded from the regression to avoid perfect collinearity). For example: In the case of the maximum temperature buckets: two temperature buckets for October are used in both models (level-level and log-level): the bucket with the frequency of the occurrence of temperatures in the interval (-∞, 10°C) is called in the regressions: October <10, and the bucket with the frequency of the occurrence of temperatures in the interval (18°C, +∞)- is called in the regressions: October >18. The comparison interval [10°C, 18°C] is omitted from the regressions to avoid perfect collinearity.

The obtained regressions results show significant estimates only in a fraction of used temperature buckets. In the case of the maximum temperature frequency buckets, the significant results are observed for temperature buckets in April, June, July, August, and October. In the case of the minimum temperature frequency buckets, the significant results (in the case of both models, level-level and log-level) are for temperature buckets in May, June, July, and August. The magnitudes in the statistically significant estimates of temperature buckets are rather low, especially when compared to estimates obtained on brands or wine varieties. Nevertheless, these results suggest that the best growing conditions in terms of temperature for grapes in July in the Okanagan and Similkameen Valleys are in the interval of [25°C, 33°C], and temperatures that are above 33°C have a negative influence on grapevines and therefore a negative impact on wine prices. This result agrees with the literature that claims that there are negative effects of high temperatures on the quality of grapes. In the presence of high temperatures, grapes go through a heat stress and accumulate sugar at a higher rate, which in turn may lead to the higher alcohol contents for wines that are made from such grapes. This, in turn, may negatively affect the wine production process, wine quality, and wine prices.

3.5.2.9. Comparison of general results from regressions 1-6 (as described in the Subsection 3.5.2.1.)

Some interesting comments arise when I compare in sequence the results of all six regressions (either in the level-level or the log-level form), as presented in Tables B.4 and B.5 in Appendix B: Chapter 3. The explanatory power of regression 1 that regresses the price of wine (with price of wine in either the level-level or the log-level form) on the following independent variables: sales year, variety, brand, and alcohol shows an adjusted R2=0.67 (in the case of the level-level model) and R2=0.74 (in the case of the log-level model). Comparing these results to the regression 6, with the full model specification, including all terroir variables, with the adjusted R2=0.75 (level-level model) and R2=0.81 (log-level model), it can be noticed that the explanatory power of the volume, brand, and variety is rather high. It could suggest that the influence of terroir elements in the wine pricing of BC VQA wines might be relatively modest.

3.6. Robustness Checks

Following on results obtained from the analysis pursued in Chapter 2, Subsection 2.5.5 that showed that certain BC companies/wineries had high market shares in the BC VQA wine market, additional analysis is introduced in this section. The role of this analysis is to address concerns that market power in the BC wine market could influence results obtained in hedonic regressions (as per main specifications of this chapter that are presented in Section 3.5.2 above).

To pursue these "market power" robustness checks, I constructed two types of dummy variables for a company's significance in the BC market to control for potential market power. I called these dummies "capacity." Then, I included each of these two types of dummy variables separately in each of the regressions from main specifications of this chapter.

3.6.1. Construction of capacity dummy variables to control for possible market power

3.6.1.1. Capacity dummy variable 1:

I constructed this capacity dummy variable in the following way:
In the first step I calculated the individual winery's total sales revenue in years 2011–2015. I did this for each of the 33 wineries that were present in my data set. In the next step I assigned to each of these 33 wineries either the value of 1 (if the winery was among the top five market players in BC by sales revenue between 2011 and 2015) or the value of zero otherwise. In my data set there was only one winery that was assigned a value of 1 meaning that there was only one winery that belonged to the group of top five market players in BC.

3.6.1.2. Capacity dummy variable 2:

I constructed this capacity dummy variable in the following way:
In the first step I calculated the individual winery's total sales revenue in years 2011–2015. I did this for each of the 33 wineries that were present in my data set. In the next step I assigned to each of these 33 wineries either the value of 1 (if the winery was among the top 10 market players in BC by sales revenue between 2011 and 2015) or the value of zero otherwise. In my data set there were only three wineries that were assigned a value of 1 meaning that there were only three wineries that belonged to the group of top 10 market players in BC.

3.6.2. Results of the use of "market power dummy variables" and regressions

In the first set of robustness check regressions, I added to my main models (level-level and log-level) a dummy variable that controls for the fact that a winery was among the top five market players in BC in years 2011–2015. As I explained in subsection 3.6.1

above, this dummy variable was constructed based on a winery's total sales revenue between 2011 and 2015. All other explanatory variables remained the same as was the case in the main specifications of this chapter. Similarly, I clustered SE on 15 proposed sub-appellations. For details, please refer to Table B6 in Chapter 3: Appendix B.

In the second set of robustness check regressions, I constructed another dummy variable, but this time I controlled for the fact that a winery was among the top 10 market players in BC in years 2011–2015 (also based on a winery's total sales revenue between 2011 and 2015). All other explanatory variables remained the same as was the case in the main specifications of this chapter. I also clustered SE on 15 proposed sub-appellations. For details, please refer to Table B7 in Chapter 3: Appendix B).

In the second set robustness check regressions, I constructed another dummy variable, but this time I controlled for the fact that winery belonged to top 10 market players in BC in years 2011-2015 (also based on winery's total sales revenue between 2011-2015). All other explanatory variables remained the same as it was the case in the main specifications of this chapter. I also clustered SE on 15 proposed sub-appellations. For details, please refer to Table B7 in Chapter 3: Appendix B).

3.6.3. Robustness checks results

The results obtained in these robustness checks closely match the results that were obtained in the main specifications of this chapter (as per Tables 3.11 and 3.12 above). In both cases, the estimates on dummies for potential market power due to large capacity (either capacity dummy variable 1 or capacity dummy variable 2) are insignificant suggesting that the inclusion of these dummies had no impact on an intercept for prices.

Overall, the conclusions regarding the influence of terroir variables on the pricing of BC VQA wines are the same as were presented in the main specifications of this chapter (as per analysis presented in Section 3.5 above).

For full results coming from these additional regressions, please refer to Tables B6 and B7 in Appendix B: Chapter 3.

Additionally, Figures B17–B36 in Appendix B: Chapter 3 show comparison of scatters of distribution of terroir characteristics between wineries that ranked among the top five or top 10 biggest producers versus other wineries from my data set. These scatters show that there are no visible relationships between specifics of terroir and a winery's membership in the top five or top 10 biggest market players. The distribution of terroir specifics between different wineries does not show any distinctive patterns that could suggest that wineries belonging to the top five or top 10 group of market players in BC source their grapes from specific terroir from which no other wineries from my data sample are allowed to source their grapes.

3.6.4. Robustness checks limitations

These market power robustness checks have their limitations that are associated with the size of the available data set. The data set used for this analysis did not allow for inclusion of all interactions, as there was only one winery that ranked among the top five biggest market players and only three wineries that belonged to the top 10 market players in BC. Therefore, the available data set did not allow the full control for possible market power.

3.7. Conclusion

In this section I present conclusions, discuss research limitations, and form recommendations for further studies in this area. Specifically, in Subsection 3.7.1 I outline research limitations and form conclusions, and in Subsection 3.7.2 I make recommendations for further research.

3.7.1. Conclusions

The analysis pursued in this chapter sheds some light on relationships between terroir and wine pricing for BC VQA wines produced by the estate wineries located in the Okanagan and Similkameen Valleys of BC. This research constitutes the first scholarly attempt and analysis of this type coming from the BC wine region.
The results of the empirical analysis of this chapter point towards grape variety and wine brand as two important variables influencing prices of BC VQA wines from the Okanagan and Similkameen Valleys. Another observation suggests that "exotic-sounding" wine varieties seem to obtain higher price premia.

The obtained results also indicate that while there exist some terroir variables that show significant results, many terroir variables yielded insignificant estimates. This fact may suggest that terroir has limited importance in the formation of wine prices for BC VQA wines.

The BC VQA wines are marketed and considered by many BC wine industry representatives and consumers as premium quality wines because to receive VQA certification they must undergo a unique accreditation process. They are also advertised and marketed with a strong emphasis on the idea of local grape origin, particular geographic location, and terroir. It is widely assumed that because of this specific treatment the BC VQA wines are of higher quality. There is also an underlying assumption that BC VQA wines might be priced with price premia based on the specifics of terroir that supplied grapes used for their production. The analysis pursued in this chapter shows that the importance of terroir variables in the pricing of BC VQA wines may not be as large as one would have expected.

This research acknowledges some limitations. The most severe study limitation arises from the fact that the available dataset consists of a non-random sample of BC VQA wines coming from 33 estate wineries. Even though considerable efforts were undertaken to include all VQA wines produced by the Okanagan and Similkameen Valleys wineries

and repeated advertisements of this research were announced, only 33 wineries provided data on their VQA wines and the origin of grapes used for their production.

This research could also benefit from data on specific management practices used in the vineyards of the BC Wine Country, as well as from information regarding winemaking costs. Regrettably, such data was not available for this research.

Another limitation comes from the available pricing data set. There might be some results sensitivity associated with the change in the wholesale pricing formula that took place in 2015.

3.7.2. Recommendations

The repetition of similar research with the participation of all Okanagan and Similkameen wineries that produce BC VQA wines is advised. Such analysis could shed more light on terroir versus wine pricing relationships in the BC wine industry, bringing an extra robustness check for results obtained in this study. It could also help emerging BC wine regions (e.g., Kootenays, Lillooet-Lytton, Shuswap, Thompson Valley), the ones that will obtain new appellations, in suggesting factors that influence wine pricing in more established regions like the Okanagan Valley. These emerging regions and their winemakers could benefit from this knowledge, as it would help them in their strategic management and investment decisions. The knowledge about terroir-wine pricing dependencies is especially important in times when the new terroir-related wine policy changes, the new appellations, and sub-appellations are coming to the wine industry in British Columbia.

Chapter 4. Does VQA Certification Matter for BC-made Wines?

The purpose of the analysis pursued in this chapter is to investigate the role and importance of the BC VQA certification program. Specifically, I aim to establish what the influence of VQA certification is on the share of the average volume, the share of the average revenue, and the average price of wines produced by the estate wineries located in the Okanagan and Similkameen Valleys of BC. Therefore, in Section 4.1 I present an introduction to this chapter and research rationale. In Section 4.2 I discuss relevant literature. In Section 4.3 I present stylized facts and develop a conceptual framework. In Section 4.4 I show methodology, discuss the use of explanatory variables, outline model specification, and present estimation method. In Section 4.5 I discuss data sources and explain necessary data transformations. In Section 4.6 I present research results. Finally, in Section 4.7 I explore research limitations, form conclusions, and develop recommendations for further studies.

4.1. Introduction

Wine belongs to the group of consumer products that show a significant level of product heterogeneity. This heterogeneity reveals itself through wine's vertical and horizontal differentiation. This is why wine marketing and sales rely on numerous strategies that are built around two main reputation-related concepts: individual (wine brand) and collective (wine region) recognition. The establishment of individual reputation to a large extent remains in the hands of particular wine producers. It is directly associated with consumers' appreciation of the brand's unique quality of the wine. At the same time, the construction of collective reputation is usually set up on a broader level, bringing together and representing all wine producers in a specific geographic location (Schamel and Anderson (2003); Panzone and Simoes (2009), Landon and Smith, (1997), among many). The concept of geographic location that connects product origin with region-specific quality or taste has previously been recognized as an essential element able to influence business profitability or economic success. It remains valid in various areas of business,

but this concept is probably most frequently associated with Geographic Indications (GI) attached to food products like Parmigiano Reggiano or Roquefort Cheese (accessed on December 5, 2017: http://ec.europa.eu/trade/policy/accessing-markets/intellectual-property/geographical-indications/).

The common association of GI with food products is not the only area where the concept of geographic location finds its way into business and economics. Even Frank Underwood, one of the main characters in the Netflix original series "House of Cards," says*: "Power is a lot like real estate. It is all about location, location, location. The closer you are to the source, the higher your property value."* ("House of Cards", Season 1, Episode 1, 2013).

As distant as they may initially seem, Underwood's words are remarkably applicable to wine analyses as a geographic location in the case of wine is associated with the peculiarity of natural endowments of a vineyard (terroir) that supplies winemaking grapes. The connection between the uniqueness of terroir and terroir-implied grape exceptionality continues to be recognized as one of the most significant building blocks for many wine industries worldwide.

The British Columbia wine industry, which is the main research topic of this dissertation in general and this chapter in particular, also emphasizes the role of regional collective reputation in its development strategies. Historically, in the province of BC, it has been implemented via the introduction of the VQA certification program that constitutes BC's wine appellation.[45] The BC VQA appellation guarantees that wines labeled as BC VQA are made from 100% BC-grown grapes, with at least 95% of grapes coming from a stated sub-region (e.g., the Okanagan Valley, Similkameen Valley, Vancouver Island, etc.) and with at least 85% of grapes being of reported variety and vintage year. Also, to obtain VQA certification BC wines have to go through the quality-tasting panel (BCWI Website accessed on May 17, 2017: http://www.winebc.com/wines/bc-vqa). In the BC market, VQA-certified wines are perceived and advertised as superior quality products with a strong emphasis on their origin, terroir and local sourcing of grapes. The VQA

[45]VQA certification was officially introduced in 1990. Subsection 2.1.2 (ch. 2) has more details on this topic. The BC VQA certification is somewhat similar to appellations in the US (the American Viticultural Area (AVA)) or France (Appellation d'Origine Contrôlée (AOC)).

certification is also used for export markets where wines with this recognition represent products "made in BC"[46] (BCWI website: http://www.winebc.com). Therefore, this regional recognition also helps place the BC wine region on the map of the New World wine-producing areas.

The role of the VQA program does not end when the certification is granted, and a winemaker is allowed to put a VQA indication on its wine labels. Instead, VQA certification facilitates common marketing strategies bringing supplemental and more cost-efficient group marketing opportunities for its wine producers. More importantly, it also introduces for VQA-certified wines extra marketing channels. These additional sales channels include special VQA wine stores and more recently (starting from 2015) also certain supermarkets.[47]

A large number of BC estate wineries produce VQA wines,[48] but there exist wineries that produce only non-VQA wines, and numerous wineries produce both VQA and non-VQA wines. The choice regarding VQA certification of a specific wine or becoming a strictly VQA, non-VQA or mixed VQA and non-VQA wine-producing winery is a voluntary course of action by individual winemakers. It remains an important internal management decision that is based on a strategic, long-term development vision and it is influenced by expected benefits and costs that are associated with the adoption of this certification.

On the benefits side, VQA accreditation lends credibility to certified wines suggesting their superiority in comparison to wines that lack such recognition (non-VQA wines). This advantage of the VQA-certified wines could find its marketing realization in two forms: an increase in the wine price and an increase in the volume of sales.

[46]Exports of Canadian and BC wines remain low. Canada remains the 27th biggest world wine exporter in terms of value of wine exports. It is likely that this regional recognition is currently useful in export markets mainly in the case of icewines. This class of wines constitutes the most popular wine exports group in Canada. More details on this topic can be found in Chapter 2 of this dissertation.
[47]The policy that allows sales of BC VQA wines in certain supermarkets officially came to life on April 1, 2015. More details on this topic are presented in Chapter 2, Subsection 2.3.2 of this dissertation.
[48]BC VQA wines are also produced by virtual brands. The analysis in this chapter concerns only BC VQA wines produced by estate wineries. VQA wines produced by virtual brands are excluded.

Both the increased price and the increased volume of sales can be associated with consumer demand for VQA wines, that lies to the right of consumer demand for non-VQA wines.

The first possible source of VQA benefits, the one related to price premium, can accrue as a direct result of an association of VQA wines with quality products. Because of the requirement for a quality tasting component, VQA wines are advertised and perceived as superior-quality products in the flavour of a classic wine quality terminology used by sommeliers.[49] This element, in turn, can positively influence the prices for these wines, putting them in the price interval that they would not be able to achieve if VQA certification was not obtained. The ability to charge a price premium on VQA wines that are based on the underlying wine sensory and quality characteristics might also positively influence a winemaker's brand esteem. This, in turn, can bring additional long-term marketing advantages associated with the recognition of such wines as higher-quality products and a brand itself as the one supplying superior wines.

The second source of VQA benefits that can be linked either to an increased price or an augmented volume of wine sales can come about because of the identification of VQA wines as products that are locally sourced and made. This association tends to be helpful as a marketing tool in the "buy local" advertising campaigns. The positive influence of VQA certification on wine prices that is related to local sourcing of grapes is relatively straightforward to understand as it can be due to passing on costs of a more expensive input to consumers.[50] Simply, if the locally sourced grapes required to produce VQA wines incur additional expenditures to VQA winemakers, these costs can be passed on to consumers in the form of higher wine prices.

[49]Certain BC winemakers that were consulted during field interviews claimed that the mandatory VQA tasting is highly skewed towards New World wines in the sense that the VQA tasting panel favours wines that possess characteristics of New World wines.

[50]The higher costs of the locally sourced grapes may come because of input scarcity associated with the limited availability of specific grape varieties or lack of land suitable for grapes production, for example.

Linking VQA wines with locally sourced inputs can also have a positive influence on the volume of sales of these wines. The underlying logic is also straightforward. Wine consumers might prefer locally made wines and buy them more often and/or in higher volumes. Their willingness to buy locally sourced and made wines can be an effect of personal preferences that can be additionally enforced by the "buy local" marketing campaigns. This element on its own could positively influence the volume of wine sales, but in the case of BC VQA wines, it is additionally supported by the presence of VQA-particular wine marketing channels (VQA wine stores and more recently also certain supermarkets). Due to a higher number of sales channels, VQA wines can benefit from the higher volumes of sales. Therefore, these two sources of possible increase in the volume of sales either individually or jointly can benefit the winemakers that adopt VQA certification.

Switching to the costs side of VQA certification, the production of BC-made wines is associated with two main costs: the cost of VQA certification and the cost of the primary input in wine production, namely the cost of grapes.[51] While VQA wines are obliged to bear both costs, the production costs of non-VQA wines does not include the cost of VQA certification. In 2016, the cost of VQA certification included: the cost of VQA registration (about CAD 10/tonne of grapes used to produce VQA wines), the cost of SKU registration as a VQA wine (about CAD 110 per SKU), and the annual fee for inspection purposes (about CAD 65 overall). To put it all in a winery perspective, the estimated annual cost of VQA certification of 5000 wine cases (11 SKUs) in 2016 was at the level of about CAD 2000 (as per field interviews with BC wineries pursued in March 2016). As the evidence shows, the cost of VQA certification in BC is not particularly prohibitive, implying that there are no obvious administrative barriers to entry into this certification scheme.

[51]Of course, there are some winery specific costs associated with its business model like marketing costs, labour, etc. This subsection aims to shed some light on costs of main input (grapes) and VQA certification only, leaving other winery specific costs out of this discussion.

The second and likely more significant expenditure associated with VQA certification is linked to the cost of the primary input, the cost of locally sourced grapes. Since VQA certification requires that grapes used for the production of VQA wines must be locally sourced (e.g.: 100% BC-grown grapes, with at least 95% of grapes coming from a stated sub-region and with at least 85% of grapes being of reported variety and vintage year), it immediately suggests that the cost of such input might depend on its demand and supply at any given point of time. Knowing that BC estate wineries do not always source their grapes from their estates, but also purchase them from local grape growers, this might suggest that the cost of grapes might constitute a significant factor in the winemakers' decision to VQA-certify its wines.[52]

The BC VQA and non-VQA wines can be produced from estate-grown grapes, contracted grapes (long-term contracts between grape growers and wineries) or from grapes that are traded in the BC market in any given year, via posts on the website of the BC Grape Growers' Association, for example, but not exclusively (Buy & Sell section: http://www.grapegrowers.bc.ca/grapes accessed on April 1, 2017).[53]

These three different supply sources might bring different costs to both VQA and non-VQA winemakers in any given year. The costs of grapes might also be winery-specific and might depend on a winery's internal business model. For example: in the province of BC some winemakers produce wines only from grapes that are estate-grown; others produce wines from both estate-grown and contracted grapes; and there are those that produce wines only from purchased grapes. The cost of grapes is also varietal and terroir

[52]This suggests that different grape varieties can sell at different prices. The same grape variety, but sourced from different vineyards can sell at different prices. This can be associated with the scarcity of each variety in any given period and location. Additionally, there might be certain sub-regions that produce better grapes than others. This might additionally influence prices of grapes, hence overall costs of the VQA certification.

[53]The non-VQA wines might also include wines "Cellared in Canada" that are made from a mix of BC and foreign grapes (or juice). While the possibility of the production by the estate wineries of wines "Cellared in Canada" is acknowledged, it is more likely that these types of wines are produced mainly by virtual brands. These virtual brands are sometimes owned by the actual estate wineries. For example, Mission Ridge is a virtual brand belonging to Mission Hill (http://johnschreiner.blogspot.ca/2010/08/mission-hill-and-its-alter-ego-and.html). In the process of data preparation, particular attention was given to make sure that wines "Cellared in Canada" were not included in the data set used in this chapter. Therefore, unless estate wineries that produced non-VQA wines sell wines "Cellared in Canada" under their estate winery brand name, the "Cellared in Canada" wines were excluded.

dependent meaning that there might be grape varieties that are more expensive due to their varietal scarcity (low planting acreage, for example) or terroir shortages (lower acreage on terroir that produces higher-quality grapes).[54]

While the significance of interplays between demand and supply of locally sourced grapes and their influence on the production costs of BC winemakers might remain a major factor in VQA adoption, these fundamental economic "push-pull" interactions can be partially mitigated by the long-term input supply contracts between winemakers and grape growers. The field interviews with BC winemakers verified that such contracts exist in the BC wine region.

The average prices for BC grapes on a per variety basis are available from the annual survey report funded by the BC Grape Growers' Association and BCWI. While these reports outline an overall level of grape prices in the province of BC, they do not present the actual costs of grapes that are incurred by individual wineries. Table C.1 in Appendix C: Chapter 4 shows average prices for certain BC-grown grape varieties for the year 2015.

After accounting for all possible benefits and costs, the BC winemakers decide in favour of the VQA certification when the expected benefits of VQA adoption outweigh expected costs. Intuitively, the size of these advantages and costs will depend on many factors that are winemaker-particular, like the long-term business development plan, individual brand building strategy, period that a winemaker has been present in the market, winemaker's production capacity, winemaker's estate location, or access to locally supplied grapes, to name a few.

[54]Some such locations mentioned by winemakers included Golden Mile Bench and Black Sage. Also, during field interviews, the BC winemakers stated that grapes that are being used for blends tend to be maintained with less care. This might make such grapes cheaper than those used for single varietal wines.

In the analysis pursued in this chapter, I aim to verify if and how the VQA certification influences the average volume and average revenue of wine sales and if there exists a price premium on BC VQA wines. Of particular interest in this chapter is to find an answer for the following research question:

What is the average impact of VQA certification on the average volume, average revenue and average price of wines produced by the estate wineries from the Okanagan and Similkameen Valleys of British Columbia?

To my best knowledge to date, there has only been one known scholarly publication that attempted to estimate the influence of VQA recognition on the prices of BC wines: *"Does VQA Certification Matter? A Hedonic Analysis"* written by Danielle Rabkin and Timothy Beatty in 2007. The analysis pursued in this publication used the standard hedonic pricing method on the BCLDB wine pricing data set for years 2002–2004. The results of this research showed that there existed a price premium on BC VQA wines.

There are a couple of reasons that set the research question and analysis of this chapter as an interesting empirical exercise.

First, the BC wine industry is currently undergoing a set of significant policy changes and is aiming for the establishment of new appellations (four) and sub-appellations (16). The analysis regarding the influence of VQA certification on the average volume, average revenue, and average price for BC wines could bring some insights into the possible future effects that the introduction of new appellations and sub-appellations might have on the BC wine industry. The results of this research could also point towards some important factors that influence winemakers' decisions to adopt VQA certification. This, in turn, could suggest what the future impact of the upcoming policy change would be on the BC wine industry if goals for the new appellations and sub-appellations mimicked those set by the VQA example.

Also, the research pursued in this chapter will add to the rich literature on the adoption of third-party certifications in the food and beverage industries. This highly active field of research in industrial organization is still somewhat low in analyses that concern third-party certification of wine[55].

The rest of this chapter is organized in the following way: Section 4.2 discusses relevant literature. Section 4.3 presents stylized facts and a conceptual framework. Section 4.4 shows methodology, discusses the use of explanatory variables, and outlines model specification and estimation method. Section 4.5 shows data sources and explains necessary data transformations. Section 4.6 presents results. Section 4.7 explores research limitations, forms conclusions, and develops recommendations for further studies.

4.2. Literature Overview

There are two main literature streams that build the theoretical basis for the analysis pursued in this chapter.

The first stream is associated with literature that analyzes product certification.

A particularly relevant publication is by Alain de Janvry, Craig McIntosh and Elisabeth Sadoulet (2015): *"Fair Trade and Free Entry: Can a Disequilibrium Market Serve as a Development Tool?"* In this publication, the authors analyze fair trade certification in the coffee market. They show that fair trade certification in a competitive market is unlikely to benefit coffee producers as the current system allows complete arbitrage and rent dissipation due to over-certification of coffee. The situation in the coffee market as described by the authors of this publication resembles the status quo in the BC VQA wine market where a large part of wine producers VQA-certifies their wines. Also, similarly to the fair trade coffee certification, the BC VQA certification, due to relatively inexpensive certification costs also facilitates over-certification. The BC winemakers compete among themselves in the market, possibly enforcing the dissipation of the VQA rent. The obvious analogy between both certification schemes makes this publication an important

[55]A possible exception is organic versus standard wine, and usually with an emphasis on relationships between such certification and price.

source of inspiration for the analysis pursued in this chapter. It also helps set the basis for the development of the conceptual framework that is presented in Section 4.3 below.

The second stream of relevant literature comes from wine-specific scholarly research that investigates wine pricing and concerns the interactions between wine pricing, wine sales, and regional, collective reputation. This stream of literature delivers an important message as to the possible role that the BC VQA certification could have on wine pricing and wine sales for BC-made wines.

Among numerous publications on this topic, one of the most relevant for this analysis is by Luca A. Panzone and Orlando M. Simoes. In 2009, the authors analyzed the importance of regional and local origin in consumers' choice of Portuguese wines. The results of their analysis show that consumers are willing to pay a premium for wines coming from the recognized and reputable regions, but the recognition of appellation per se (e.g., AOC on the label) does not bring a price premium. Only the interaction between the region and the AOC allows for a price premium on these wines. They also established that there are regional differences in the contribution of the AOC recognition to wine prices.

Landon and Smith (1997) analyzed how consumers use quality and reputation indicators for Bordeaux wines in the formation of their willingness to pay for these wines. Their research shows that reputation has a substantial impact on the consumers' willingness to pay for wine, with the long-term reputation being more important than short-term quality adjustments. The authors also established that the collective reputation has as significant an impact on the consumers' willingness to pay for wine as individual reputation.

Noev (2005) analyzed the Bulgarian wine industry, concluding that wine quality, regional and varietal reputation influence wine prices. The author also shows that the regional reputation in the Bulgarian wine industry strongly depends on the regional wine specialization.

Costanigro, McCluskey, and Goemans (2010) analyzed a joint effect of the wine-specific name, individual reputation (wine brand), and collective wine region's reputations. Their results show that a relative importance of reputation differs with the change in wine

prices. Specifically, the premia associated with reputation move from collective to individual reputation as the price of wine increases.

Alessandro Corsi and Steinar Strom (2013) estimated the hedonic pricing function for Piedmont wines from the supply side. The authors used the Heckman correction method for sample selection bias to establish the price premium for organic wines in Piedmont. Their results show that after correcting for the sample selection bias, there exists a price premium on organic wines coming from the Piedmont region of Italy.

Finally, Danielle Rabkin and Timothy Beatty (2007) supplied an analysis that is directly associated with the research pursued in this chapter. Their publication: "Does VQA Certification Matter? A Hedonic Analysis" researched the BC wine industry and the significance of VQA recognition on prices of BC VQA wines. Their results show that VQA certification has a positive impact on wine prices and consumers are willing to pay a price premium for VQA recognition, but VQA certification is less important for expensive wines.

4.3. Stylized Facts and Conceptual Framework

The purpose of this section is twofold: to present a set of stylized facts that show pricing and sales volume of BC-made wines and discuss some supporting anecdotal evidence obtained during field interviews, and to develop a conceptual framework for the empirical analysis that follows. Specifically, in Subsection 4.3.1 I outline some basic pricing and sales statistics for BC VQA and non-VQA wines produced by the estate wineries from the Okanagan and Similkameen Valleys and sold in the BC market from 2011 to 2015. In Subsection 4.3.2 I develop a conceptual framework that I use as a theoretical basis for the empirical analysis pursued in this chapter.

4.3.1. Stylized facts

The available data set of all VQA and non-VQA wines from the Okanagan and Similkameen Valleys estate wineries that were sold in the province of BC in years 2011–2015 paints an interesting picture. While it could be expected that VQA-certified wines would be priced at a premium due to VQA certification and association of these wines with locally sourced and higher-quality products, it does not seem to be the case. As two histograms of average prices for VQA and non-VQA wines show (please refer to Figures 4.1 and 4.2 below), the price distribution for both wine types is almost identical. It suggests that for years 2011–2015 there was not much of a difference in pricing of both VQA and non-VQA wines.

While the pricing histograms seem to send a clear message that VQA certification in BC may not influence wine pricing, the situation looks different regarding the volume of wine sales. Figure 4.3 below shows the volume of sales for BC VQA and non-VQA wines for years 2011–2015. It is visible that the volume of sales of VQA wines is much higher than the volume of wine sales for non-VQA wines. This suggests that VQA certification in BC has a positive influence on the volume of wine sales.
Some additional pricing histograms can be seen in Chapter 4: Appendix C, Figures C1–C4.

Figure 4.1. Distribution of average prices for VQA wines (red and white), 2011-2015.

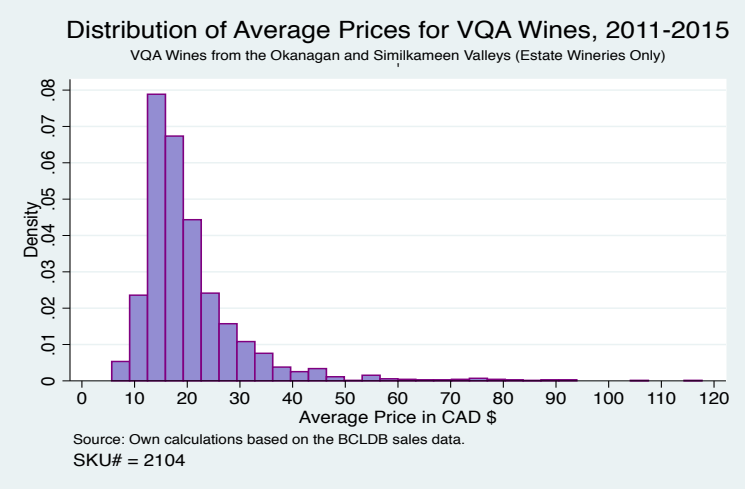


Figure 4.2. Distribution of average prices for non-VQA wines (red and white), 2011-2015.

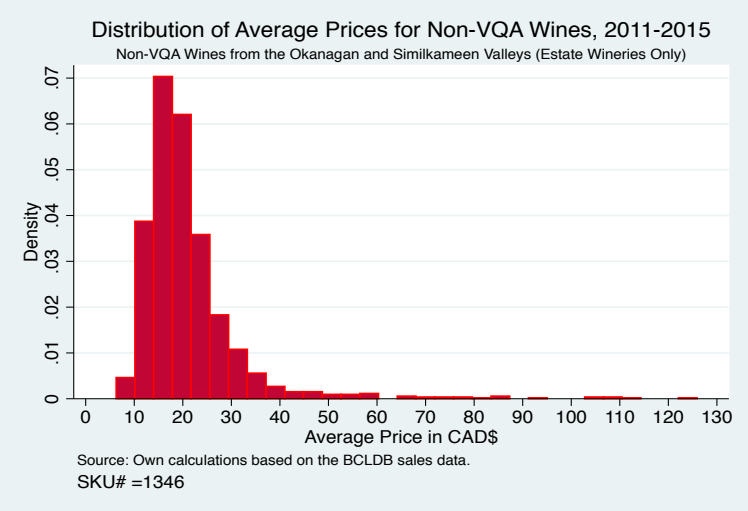
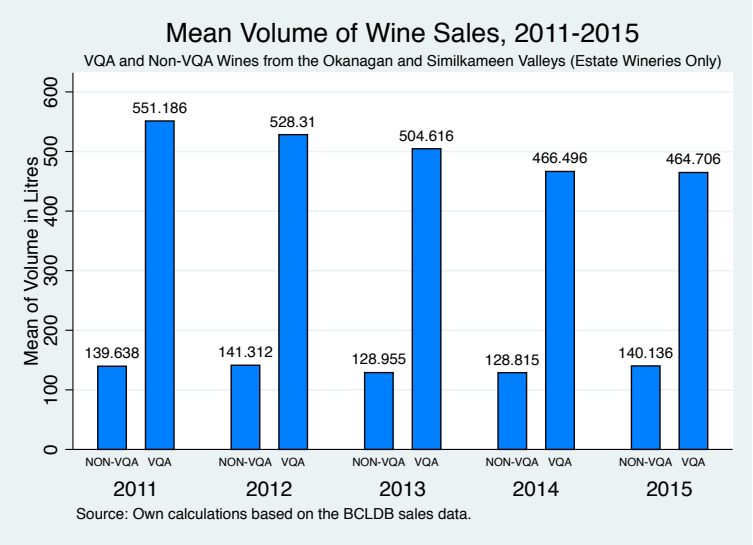


Figure 4.3. Mean volume of wine sales, 2011-2015.



This rather interesting picture of pricing and volume of sales of BC VQA and non-VQA wines produced by the estate wineries from the Okanagan and Similkameen Valleys is additionally supported by information obtained from wineries during field interviews.

None of the consulted wineries claimed that VQA certification allowed them to price their wines higher in comparison to non-VQA wines. At the same time, all these wineries mentioned two main reasons for VQA adoption: the ability to sell a higher volume of wines thanks to additional marketing channels for VQA wines and some brand-building

benefits from the VQA common marketing program. Some other reasons for VQA adoption that were sometimes mentioned were: a belief that VQA certification was bringing some winemaking standards to the BC wine industry and that VQA certification was giving some recognition for BC wines in export markets. When asked about the differences in wine production between VQA and non-VQA wines, the wineries claimed that their production process did not differ and both VQA and non-VQA wines were produced with the same attention to grape sourcing and wine quality.

The most common reason that wineries gave to explain why they did not VQA-certify some (or all) of their wines was a small volume of wine production.

The winemakers explained that if they produced a low volume of a certain wine type, they were able to sell such wine via their winery store and did not need access to VQA marketing channels. This is why they were not VQA-certifying such wines.

While the initial data analysis and anecdotal evidence obtained from wineries during field interviews (as described above) suggest that VQA certification might have a significant influence on the volume of wine sales but a negligible (or non-existent) impact on wine pricing, a more thorough analysis of this issue is necessary. The conceptual framework outlined in Subsection 4.3.2 below is the first step in this process. It develops a theoretical framework for the empirical analysis that follows.

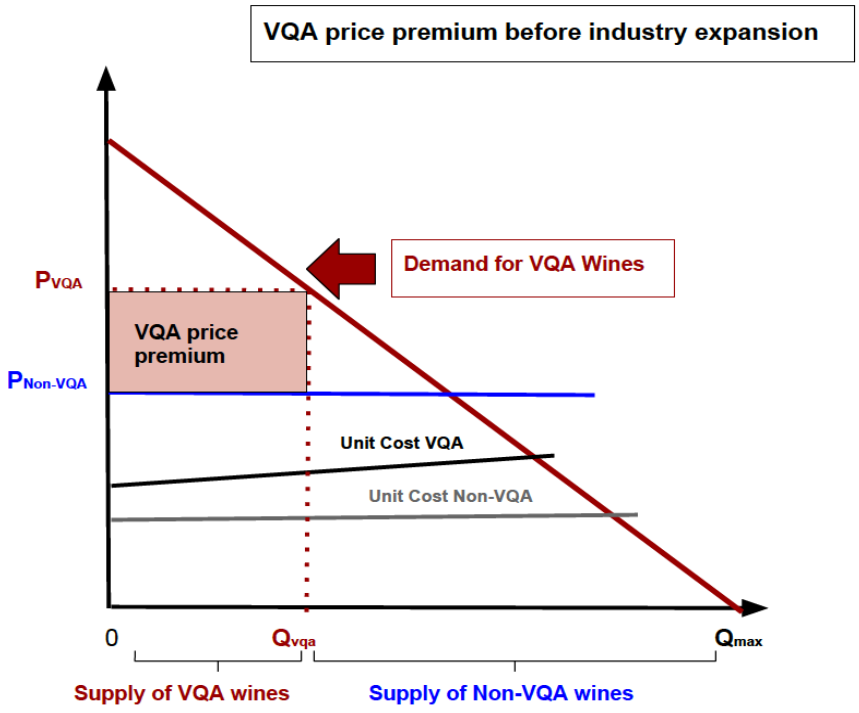
4.3.2. Conceptual framework

As mentioned earlier, the main goal of the analysis in this chapter is to find out if BC VQA certification influences the average volume, average revenue, and average prices of wines produced by the estate wineries located in the Okanagan and Similkameen Valleys of BC. It is suspected that the role of VQA certification in BC has evolved over the years since its introduction in 1990. As it is rather unlikely that the VQA system stayed unchanged, it is expected that its introduction initially brought to the BC wine industry an unprecedented guarantee of wine origin in the form of an official certification for locally produced wines. This, in turn, translated into an increased demand for VQA wines. Knowing that in the short run the supply of grapes could not be increased, as grapes normally require three to five years to produce fruits suitable for winemaking, it is likely

that the initial growth in demand for VQA wines positively influenced the prices of these wines. This brought about a price premium for VQA-certified wines. This situation is visualized in Figure 4.4 below.

Figure 4.4 shows the BC wine market just after the introduction of VQA certification. Initially, due to a comparatively small supply of locally grown grapes required for VQA certification, the volume of VQA wines remained low, resulting in a high price premium for VQA wines.

Figure 4.4. VQA price premium before industry expansion.



Where:

$\mathbf{P_{VQA}}$ = price of VQA wines

$\mathbf{P_{Non\text{-}VQA}}$ = price of Non-VQA wines

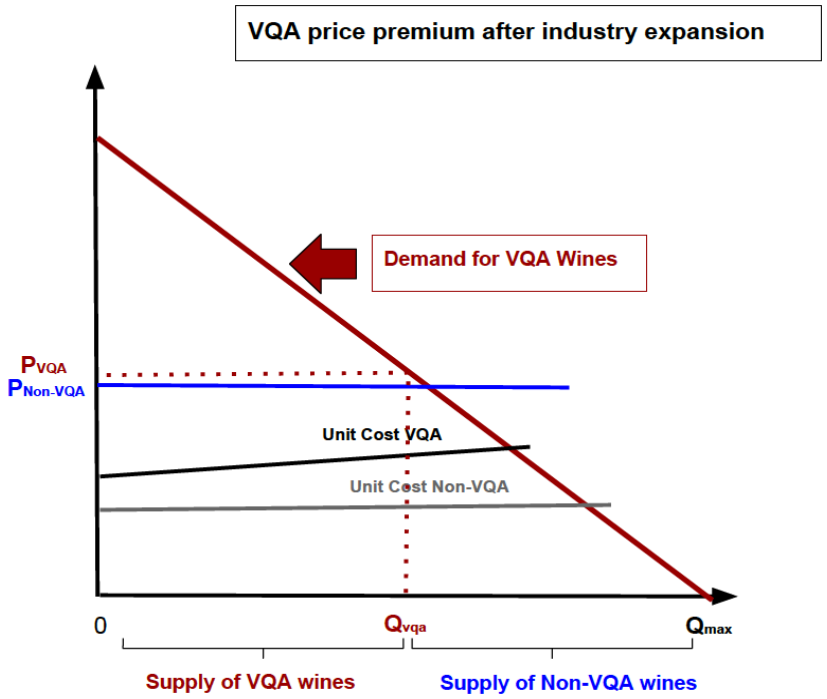
$\mathbf{Q_{VQA}}$ = quantity of VQA wines

$\mathbf{Q_{max}}$ = quantity of all BC made wines

However, since 1990, the BC wine industry grew in both the number of wineries and the supply of locally sourced grapes. Keeping in mind that the costs of VQA certification in BC are relatively small and there are no barriers to entry into VQA certification, with time the VQA certification system produced a high supply of VQA wines.

Figure 4.5 below shows the current situation in the BC wine industry where, with time and a growing supply of local grapes and VQA-certified wines, the additional supply caused a movement down the demand curve, reducing the price premium on VQA wines. Concurrently, the costs of locally grown grapes increased. Consequently, the price premium on VQA wines has been driven down to the unit cost differential between VQA and non-VQA wines.

Figure 4.5. VQA price premium after industry expansion.



Where:

$\mathbf{P_{VQA}}$ = price of VQA wines

$\mathbf{P_{Non\text{-}VQA}}$ = price of Non-VQA wines

$\mathbf{Q_{VQA}}$ = quantity of VQA wines

$\mathbf{Q_{max}}$ = quantity of all BC made wines

Therefore, the current situation in the BC wine market suggests that VQA rents that were initially present in the BC wine market have been fully dissipated.
The perfectly elastic demand for non-VQA wines (flat blue line on Figures 4.4 and 4.5) is constructed because of an assumption that BC non-VQA wines are forced to compete with an inflow of highly competitive wine imports. Therefore, the demand is flat at the world price.

The central hypothesis that motivates the empirical analysis that follows is that VQA certification in BC currently earns a negligible price premium. This is similar to what was presented in the publication about fair trade certification in the coffee market, discussed in Section 4.2. At the same time, because of the expansion of the BC wine industry that is driven by rent dissipation, it is hypothesized that VQA wines observe higher volume and possibly higher revenue share.
It is also expected that wineries will continue to enter the VQA program due to the relatively low costs of entry to this certification. It is also unlikely that wineries will be switching from VQA certification to non-VQA as the costs of certification are relatively small and sunk.

4.4. Methodology, Empirical Model Specification and Estimation Method

This section provides an overview of methodology that I used in the empirical analysis of this chapter, economic theory that rationalizes the choice of this method, choice, and construction of variables and empirical model specification. Specifically, in Subsection 4.4.1 I make general comments on the selection and rationale for the modelling approach; in Subsection 4.4.2 I explain empirical model specification; and in Subsection 4.4.3 I outline details regarding the choice of explanatory variables.

4.4.1. Methodology

The choice of the methodology used in the analysis of this chapter was dictated by the specifics of the research question, available data, and anecdotal evidence obtained from BC wineries during field interviews. Because the research question and data used to answer it suggested a presence of an endogenous dummy variable (VQA certification dummy), correction for this endogeneity issue from the beginning of the modelling process became one of the most important matters that required particular attention. Therefore, to mitigate the problem with the endogenous dummy variable I chose the three-stage procedure described by Woolridge (2010, Subsection 24.4.1, page 937) as a proper modelling approach. The three-stage procedure belongs to instrumental variable (IV) procedures, where fitted values obtained from the estimation of a binary response model for treatment are used in the next stages (first and second stage) of the Two Stage Least Squares (2SLS) estimation as instruments, not as regressors. This procedure itself allows a consistent estimation of the Average Treatment Effect (ATE) with usual 2SLS errors and statistics being asymptotically valid (Woolridge, 2010).
Details on the specific use of the three-stage modelling approach employed in the analysis of this chapter can be seen in Subsection 4.4.2 below.

4.4.2. Empirical model specification

4.4.2.1. Primary equation

To specify the endogenous dummy variable method formally, let us assume that the structural equation (primary equation) of interest for the analysis in this chapter is of this form:

$$y_i = x_i'\beta + VQA_i + \varepsilon_i$$

Equation 4.1

Where:

y_i is either a logarithm of share of the average volume of wine sales (or logarithm of the average wine price; or logarithm of the average revenue share, respectively as 3 different specifications of dependent variable are being tested in this chapter);

x_i' is a matrix of observable, explanatory variables that include:

- Alcohol content (continuous variable),
- Sweetness (indicator variable),
- Variety (indicator variable),
- Color (indicator variable),
- Reserve (indicator variable),
- Winery capacity (indicator variable),
- Sub-appellations (indicator variable),
- Winery age (indicator variable).

VQA_i is an indicator variable that controls for VQA certification, where VQA =1 if wine is VQA-certified and zero otherwise. The estimate on this variable is of highest interest for this research,

β is a vector of regression estimates,

ε_i is an error term of this regression.

The problem in Equation 1 is that the VQA_i variable is an endogenous dummy variable that necessitates the special correction procedure as described in Woolridge, 2010.

Further details concerning the three-stage procedure are described in Subsections 4.4.2.2 and 4.4.2.3 below.

4.4.2.2. Step 1 of the three-stage endogenous dummy variable estimation procedure- the binomial probit

Let us suppose that the Equation 4.2 below represents the binomial probit regression used in stage 1 of the three-stage endogenous dummy variable procedure:

$$z_i^* = w_i' \gamma + u_i$$

Equation 4.2

Where:

$$z_i = \begin{bmatrix} 1 \; if & VQA \; indication = 1 \\ 0 & otherwise \end{bmatrix}$$

z_i is an indicator dependent variable determining winery's choice that is observable (choice to VQA-certify wine (VQA=1), or not to VQA-certify it (VQA=0)),

$\boldsymbol{w_i'}$ constitutes a vector of the following observable variables (The reasons for choice of these variables and their constructions are outlined in the Subsection 4.3.4 below).

- Alcohol content (continuous variable),
- Sweetness (indicator variable),
- Variety (indicator variable),
- Color (indicator variable),
- Reserve (indicator variable),
- Winery capacity (indicator variable),
- Sub-appellations (indicator variable),
- Winery age (indicator variable).

Υ is a vector of regression estimates,

u_i is an error term.

The main goal in the estimation of stage 1 of this three-stage endogenous dummy variable procedure, the binomial probit, is to obtain fitted values for VQA certification that will be used in stages 2 and 3 of the 2SLS procedure as IV for VQA certification.

4.4.2.3. Stage 2 and 3- the Two Stage Least Squares (2SLS) procedure

Stages 2 and 3 of the three-stage endogenous dummy variable procedure involve a classic 2SLS IV estimation of the model presented below, with an inclusion of VQA-fitted values from stage 1 (binomial probit) as instruments for VQA certification.

$$y_i = x_i'\beta + \widehat{VQA}_i + \varepsilon_i$$

Equation 4.3

Where:

y_i is either a logarithm of share of the average volume of wine sales (or logarithm of the average wine price; or logarithm of the average revenue share, respectively as 3 different specifications of dependent variable are being tested in this chapter);

x_i' is a matrix of observable, explanatory variables that include:

- Alcohol content (continuous variable),
- Sweetness (indicator variable),
- Variety (indicator variable),
- Color (indicator variable),
- Reserve (indicator variable),
- Winery capacity (indicator variable),
- Sub-appellations (indicator variable),
- Winery age (indicator variable).

$\widehat{VQA}_i$ is a fitted value for VQA from stage 1 (binomial probit). It is an IV for VQA certification. The estimate on this variable is of highest interest for this research,

β is a vector of regression estimates,

ε_i is an error term of this regression.

4.4.3. Choice and construction of variables

As it was discussed in the introduction to this chapter, it is hypothesized that the individual winemaker's choice to VQA-certify wine depends on an interplay of forces of supply and demand, as well as the expected costs and benefits associated with this certification. Therefore, the most important variables that influence the choice of VQA certification are associated with the winemaker's expected costs and benefits that will arise because of subscribing to the group of VQA-certified wines. Unfortunately, data was not available on the specific costs and benefits observed by each winemaker that decides to VQA-certify its wines. Therefore, the concept of latent variable is invoked in this analysis. In due course of the model specification, it was hypothesized that there exist certain observed variables that could mimic the variables that directly represent costs and benefits coming from the choice of VQA certification and that could be used in lieu of those variables for which the measure was not available.

4.4.3.1 Stage 1 model-the binomial probit

Therefore, in stage 1 of the three-stage endogenous dummy variable estimation procedure, the binomial probit model (as per Equation 4.2 above), I chose the following variables:

- WINERY AGE: This variable aims to control for the unobserved elements associated with the expected benefits and cost that the winemakers obtain from VQA certification. Wineries that have been present longer in the market might have more (or less) willingness to participate in the VQA program, as they know more about its benefits (or lack thereof). It is possible that wineries that have been in the market longer might also have easier access to the locally supplied grapes because of two reasons: 1. They have had more chances to purchase local vineyards; 2. They have had more chances to secure contracts with the local grape growers. Therefore, it is speculated that winery age influences winery choice regarding the production of VQA versus non-

VQA wines in any given year.[56] This variable was constructed in the following way: Year 2015 which is the last year of the available wine data minus the year of winery establishment = winery age. Then, winery age was divided into four groups (four indicator variables):

- indicator variable 1: winery age [1932–1990),
- indicator variable 2: winery age [1990–2000),
- indicator variable 3: winery age [2000–2010),
- indicator variable 4: winery age [2010–2014].[57]

- SUB-APPELLATION: An indicator variable on the sub-appellation associated with the location of the estate winery. This variable aims to control for some of the estate winery location-specific elements that could be related to the costs of production of VQA wines. These elements can be linked to terroir-specific variables like the quality of soil, climate, or the sub-appellation specific know-how that can directly influence wine taste (wine quality), for example. As the wine tasting panel is required prior to the assignment of VQA certification, the natural elements of terroir might constitute an important factor in VQA adoption. In addition, it is stipulated that the location of the estate winery (based on sub-appellation) might influence the access to local grapes; hence, it might have a role in the winery's decision to enter the VQA program. Therefore, these indicator variables account for the possible regional differences that could influence a winery's decision to certify wine as VQA versus its resignation from such certification. The sub-appellations indicator variables used in this model follow the sub-appellations demarcation proposed in 2015 by the BC Wine Appellation Task Group. More details on the topic of proposed sub-appellations can be found in Chapter 2 of this dissertation.
- WINERY CAPACITY: The role of this variable is to put a control on the winery's production capacity. As an actual production capacity on a per

[56]This logic can also hold in the opposite way, meaning that wineries that have been longer in the market might see that the VQA certification does not bring expected benefits and might withhold from the VQA certification of their wines. It is also possible that wineries that have been longer in the market are not more likely to adopt VQA because their business model has been set on the production of non-VQA wines and they did not secure access to locally sourced grapes.
[57]The youngest wineries in this data set were established in 2014.

winery basis wasn't available, a proxy variable was used. I constructed this variable by calculating the total wine sales over 2011–2015 on a per winery basis and assigning each winery to one of three groups according to the total volume of wine sales. Therefore, three indicator variables were constructed: Capacity Large (equal to 1 if winery produced [500,000; ∞) litres of wine and zero otherwise), Capacity Medium (equal to 1 if winery produced: [100,000; 500,000) litres of wine and zero otherwise), and Capacity Small (equal to 1 if winery produced below 100,000 litres of wine and zero otherwise). It is hypothesized that the volume of production that is implied by the volume of wine sales influences a winery's decision to certify its wine as VQA or not. The field interviews with BC wineries confirmed that if a batch of wine is low in volume, wineries frequently decide not to supply such wine for VQA certification. There are two main reasons for doing so: 1. VQA certification incurs additional certification costs for wineries and if the wine batch is small in volume sometimes it is not worth certifying it; 2. If the volume of wine is low a winery is more likely to sell such a wine batch directly via its wine store, and usually there is no need for VQA certification and use of additional marketing channels (VQA stores or supermarkets).

- SWEETNESS—composed of five indicator variables characterizing sweetness of the wine (0, 1, 2, 3, and NA (where NA constitutes unspecified sweetness level));
- ALCOHOL—a continuous variable indicating wine alcohol content (in %);
- RESERVE—an indicator variable that shows if wine was labelled as reserve or not;
- COLOUR— an indicator variable that shows if wine was white or red;
- VARIETY— an indicator variable on wine type (52 varieties);
- VQA indication—an indicator variable that states if an SKU (wine) was VQA-certified or not. This variable constitutes a dependent variable in the binomial probit and shows if a winery chose to VQA-certify its SKU (wine) or not.

4.4.3.2. Stages 2 and 3 model- the 2SLS estimation

In stages 2 and 3 of the endogenous dummy variable procedure (as per Equation 4.3 above), the following variables were used:

- Dependent variable:
    - Step 2 Regression A: LOG_AVG_VOLUME_SHARE,
    - Step 2 Regression B: LOG_AVG_PRICE,
    - Step 2 Regression C: LOG_AVG_REVENUE_SHARE,
    - These variables were constructed in the following way:
        - ✓ LOG_AVG_VOLUME_SHARE: constructed by formulating the ratio of the average individual volume of sales (per SKU basis) to the total industry volume of sales, and taking the logarithm of that number,
        - ✓ LOG_AVG_PRICE: constructed by formulation of the weighted average of prices (per SKU), where weight constituted all monthly sales per SKU over the total aggregated sales for that SKU, and taking the logarithm of that number,
        - ✓ LOG_AVG_REVENUE_SHARE: constructed by formulating the ratio of the average revenue (per SKU) to the total revenue of the industry, and taking the logarithm of that number;
- SWEETNESS—composed of five indicator variables characterizing sweetness of the wine (0, 1, 2, 3, and NA (where NA constitutes unspecified sweetness level));
- ALCOHOL—a continuous variable indicating wine alcohol content (in %);
- RESERVE—an indicator variable that shows if wine was labelled as reserve or not;
- COLOUR— an indicator variable that shows if wine was white or red;
- VARIETY— an indicator variable on wine type (52 varieties);
- VQA INDICATION—a variable that constitutes fitted values for VQA that were obtained in step 1 (binomial probit). It is used as an IV for the VQA certification. The estimate on this variable will show the average effect of VQA certification.

4.4.3.3. Estimation method for the three-stage endogenous dummy variable specification

The estimation of the three-stage endogenous dummy variable model was pursued in two stages using Stata 13 Special Edition (SE) software. The primary goal of the estimation of the binomial probit model in stage 1 was to obtain fitted values for VQA indication. Stages 2 and 3 consisted of the 2SLS regression estimation that included VQA-fitted values obtained in stage 1, and treated them as IVs for VQA certification to correct for the VQA endogenous dummy variable bias.

4.5. Data Sources and Data Transformation

This section presents data sources and descriptive statistics for the data set used in the analysis of this chapter. Specifically, in Subsection 4.5.1 I discuss data sources, and in Subsection 4.5.2 I outline data descriptive statistics.

4.5.1. Data sources

There were two main data sources used for the empirical analysis of this chapter:

1. The BCLDB wholesale pricing data set for all wines sold in the province of BC between April 1, 2011 and March 31, 2015.[58]

   This data set maintains the core data set for all specifications of the empirical modelling process, as described in Section 4.4 above. The full available data set is composed of the scanner data of all wines sold in BC between 2011 and 2015 (domestically produced and imports). From this data set, all BC-made and BC-bottled wines (VQA and non-VQA) were extracted. For each of the extracted wines, the following variables were available:

   - Winery (brand) name,

[58]The measure of the wine age (vintage) was not included as an explanatory variable in this analysis. The reason is that for the majority of SKUs (wines) the vintage year was missing in the data set obtained from the BCLDB, and it was not possible to recover it.

- Grape/wine variety,
- Wine colour,
- Alcohol content (in %),
- Sweetness (scale 1-7 plus, N/A-not stated),
- Monthly volume of sales (in litres and units (0.75l bottles)),
- Wholesale price of wine,
- Year of sales,
- Indication if wine was a VQA or a non-VQA.

2. The self-collected (from online sources) information on the year of the establishment of the estate wineries.

This data on the age of wineries was collected from winery websites, articles on wine, and John Schreiner's blog (http://johnschreiner.blogspot.ca, accessed on February 5, 2017). While searching for the age of a winery, it was assumed that the age of the winery was calculated from the year it stated that its estate winery became operational. In case such information was lacking, the first vintage year was assumed as the year when the estate winery started to exist in the market.[59]

4.5.2. Data descriptive statistics

As I described in the previous sections, in the analysis pursued in this chapter I employ the three-stage endogenous dummy variable modelling approach and test three model specifications that are distinguished because of different dependent variables. All these empirical models use the same primary data source, as described immediately below.

[59]If a winery was out of business as of 2015, but its wine was still in the sales data, it was included in this analysis, and the winery age was established, as described in Subsection 4.3.4.

Main data set

For the empirical modelling of this chapter, I used the data set consisting of all red and white VQA and non-VQA wines sold by the BC wineries that possess real estate locations in the Okanagan and Similkameen Valleys. This means that I excluded all VQA and non-VQA wines made by the virtual brands (brands that did not have a physical estate location at the time of this analysis). I also eliminated from my data set all rosé, organic, ice wines, and all private label wines. The final data set consists of wines (VQA and non-VQA) produced and sold by 139 different estate wineries located in the Okanagan and Similkameen Valleys of BC.

Table 4.1 below shows more details on this topic. The list of all wineries can be seen in Appendix C: Chapter 4, Table C.2.

Table 4.1. Summary statistics -part 1.

Winery type	Number of estate wineries	Number of associated SKU
VQA only	23	423
Non-VQA only	19	326
Both (VQA and Non-VQA)	97	2701
Total	**139**	**3450**

Initially, the data set consisted of 3490 different wines (3490 different SKUs). Out of this total, 40 SKUs were removed as in various sales periods they were inconsistently listed as either VQA or non-VQA wines. The following could cause this situation:

1. A data input mistake,
2. Over time the wine changed its status from a non-VQA to VQA but it remained listed under the same SKU number.

After the removal of the problematic SKUs, the data set diminished from N=87,512 to N=85,986 observations (repeated monthly observations on wine sales). In terms of the number of SKUs, the total number diminished from 3490 to 3450 SKUs. Out of the total

of 3450 different SKUs, 2104 were listed as VQA SKUs and 1346 as non-VQA SKUs. Detailed statistics of this data set can be seen in Tables 4.2 and 4.3 below.[60]

Table 4.2. Summary statistics -part 2.										
	VQA					Non-VQA				
	SKU Count	Mean	St. Dev.	Min.	Max.	SKU Count	Mean	St. Dev.	Min.	Max.
Total SKU #	2104					1346				
Red wine	1118					723				
White wine	986					623				
Price (CAD $)										
Red wine		24.16	12.93	6.91	129.03		24.58	12.59	6.25	125.93
White wine		16.00	4.57	5.67	54.01		16.58	5.01	5.58	54.00
Unit (0.75L bottles)										
Red wine		582.00	1285.08	-10754.00	31575.00		147.96	298.95	-99.00	7159.00
White wine		756.25	1478.04	-72.00	20494.00		217.05	440.77	-173.00	15708.00
Volume (litres)										
Red wine		436.50	963.76	-8065.50	23681.25		110.97	224.21	-74.25	5369.25
White wine		567.19	1108.53	-54.00	15370.50		162.79	330.57	-129.75	11781.00
Alcohol (%)		13.27	0.96	8	15.4		13.3	0.93	9.5	15.6
Winery Age (years)		18.88	13.33	1	83		14.05	9.04	1	47
SKU (total)										**3450**
N (VQA)					**62075**	**N (Non-VQA)**				**23911**
N (total)										**85986**

As Table 4.2 above shows, some unusual patterns arise.

First, it appears that non-VQA wines are priced higher on average than VQA wines. This confirms what was visible on histograms presented in Subsection 4.3.1 where the pricing distribution of VQA and non-VQA wines was almost identical. The initial descriptive statistics results of this chapter differ from the results presented in the previous research

[60]The negative values in Table 4.2 constitute wine returns.

on BC wines (Rabkin and Beatty, 2007) where it was stated that VQA-certified wines observed higher average prices.[61]

Also, when comparing VQA and non–VQA wines, the average number of units (or average volume) of wine sales is higher in the case of VQA wines. In the case of both wine classes, VQA and non-VQA, the average sales of white wines are higher than the average sales of red wines. The count of SKUs (number of different wines) is also higher in the case of VQA than non-VQA wines (in the case of both red and white wines).

Also, in the case of both wine groups, the number of red wine SKUs is higher than the number of white wine SKUs. This suggests that the product differentiation is higher in red than in white wines.

Table 4.3 below presents some additional descriptive statistics that characterize this data set. As the data shows, the most frequently observed sub-appellation associated with both VQA and non-VQA wines in this data set is the area of the proposed sub-appellation that is called "NE side lacustrine bench." This is roughly the region of Naramata, BC. The second most frequently observed sub-appellation in the case of both VQA and non-VQA wines is the area of the proposed sub-appellation that is called "West side mixed sediments." This is essentially the area of West Kelowna. None of these results are surprising, as both these areas are known for a high number of estate wineries. For the map of proposed sub-appellations, please refer to Appendix A: Chapter 2, Figure A.2.

The results outlined in Table 4.3 also show that the "Reserve" indication is seen only in about 9.5% of VQA and 5% of non-VQA wines. It may suggest that such recognition may not be currently important for the marketing of BC wines.

Regarding wine colour, the available data set shows that in the case of both VQA and non-VQA wines, the sales of red wines are more frequently observed than the sales of white wines. This means that even though the volume of sales of white wines is higher when compared to red wines, there is a greater number of red wines (different red wine SKUs) than white wines (different white wine SKUs) observed in this data set.

[61]It is acknowledged that differences in wholesale prices between VQA and non-VQA wines can to an extent be caused by differences in the markup formula used when establishing prices of each wine type.

Table 4.3. Summary statistics -part 3.				
Indicator Variable	**VQA**		**Non-VQA**	
	Frequency	**Percent**	**Frequency**	**Percent**
Sub-appellations				
Alluvial fans and flood plains	5202	8.38	1103	4.61
East side mixed sediments	2513	4.05	135	0.56
Golden Mile	6561	10.57	1062	4.44
Kettled outwash and fans	2070	3.33	1888	7.9
Lakeside alluvial fans	3113	5.01	391	1.63
Mission Creek terraces	5266	8.48	886	3.71
Mixed sediments and fans	5211	8.39	2165	9.05
NE side lacustrine bench	9394	15.13	6279	26.26
Sandy outwash lakeside terraces East side	1623	2.61	468	1.96
Sandy outwash lakeside terraces West side	1021	1.64	210	0.88
Sandy outwash terraces and deposits	6091	9.81	2202	9.21
SE side lacustrine bench	2807	4.52	2232	9.33
Similkameen Valley	2007	3.23	2214	9.26
West side lacustrine bench	1342	2.16	18	0.08
West side mixed sediments	7854	12.65	2658	11.12
Reserve				
Reserve=1	5875	9.46	1227	5.13
Reserve=0	56200	90.54	22684	94.87
Color				
Red	32,527	52.4	12,710	53.16
White	29,548	47.6	11,201	46.84
N(VQA)		**62075**		**23911**
N(total)				**85986**

For the empirical modelling of this chapter the available sales panel data set was transformed into a cross-sectional data set. The monthly observations on the volume of wine sales were averaged over individual SKUs (straight average over 2011–2015 on a per SKU basis). This process yielded a final cross-sectional data set that consisted of N=3450 observations on different SKUs (different wines). This cross-sectional data is a final data set that was used in all three stages of the empirical modelling of this chapter.

4.6. Results and Discussion

This section presents results that I obtained from the empirical analysis and discusses their overall significance. Specifically, in Subsection 4.6.1 I outline the regression results obtained in stage 1. In Subsection 4.6.2 I present results obtained in stages 2 and 3.

4.6.1. Stage 1 results

The model used in stage 1 of the three-stage endogenous dummy variable procedure, the binomial probit (as per Equation 4.2 presented above), assumes that a winery's decision to VQA-certify its wines depends on the following set of explanatory variables:

- Winery age indicator variables (four age groups),
- Sub-appellation, area where the estate winery is located (15 sub-appellations, as per demarcation of sub-appellations proposed by the BC Wine Appellation Task Group), [62]
- Winery capacity proxy (three capacity groups),
- Wine specific variables from the wine sales data that constitute explanatory variables in stages 2 and 3 of this 3-stage estimation procedure: wine variety, wine colour, reserve, alcohol content, and wine sweetness.

The primary role of the binomial probit model is to provide an IV for VQA certification in the form of VQA-fitted values obtained in the post-estimation process of stage 1. The VQA-fitted values are used later in stages 2 and 3 to correct for the endogenous dummy variable problem.

The results obtained from the estimation of the binomial probit (stage 1 of the procedure) that are of highest interest for this research are presented in Table 4.4 below. The full set

[62]There is one more region that is not included in proposed sub-appellations. This is the Similkameen Valley. It was added to this research as an additional sub-appellation, to control for the location of wineries from that area. The official proposal for sub-appellations consists of 16 sub-appellations. Two of these sub-appellations (Valley Bottom Systems and Glaciofluvial Terraces) were not present in the available data set as none of the estate wineries were located in these sub-appellations.

of results of the binomial probit model can be seen in Tables C.3 and C.4 in Appendix C: Chapter 4.

Table 4.4. Binomial probit estimation results.

Binomial Probit	**VQA indication (VQA=1)**
Winery Age [1990, 2000)	0.266+
	(0.149)
Winery Age [2000, 2010)	0.746***
	(0.145)
Winery Age [2010, 2014)	0.879***
	(0.151)
East Side Mixed Sediments	0.769**
	(0.242)
Golden Mile	0.305*
	(0.152)
Kettled Outwash and Fans	-0.680***
	(0.149)
Lakeside Alluvial Fans	0.433*
	(0.182)
Mission Creek Terraces	0.460**
	(0.150)
Mixed Sediments and Fans	-0.165
	(0.125)
NE Side Lacustrine Bench	-0.188
	(0.118)
Sandy Outwash Lakeside Terraces East Side	-0.127
	(0.207)
Sandy Outwash Lakeside Terraces West Side	0.251
	(0.224)
Sandy Outwash Terrace and Deposits	-0.186
	(0.126)
SE Side Lacustrine Bench	-0.605***
	(0.145)
Similkameen Valley	-0.325*
	(0.130)
West Side Lacustrine Bench	0.816+
	(0.449)
West Side Mixed Sediments	0.0811
	(0.136)
Capacity Medium	-1.599***
	(0.153)
Capacity Small	-2.107***
	(0.154)
N	**3419**

Standard errors in parentheses
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001
Comparison groups:
Winery Age [1932, 1990), Capacity: Large
Sub-appellation: Alluvial fans and flood plains
All results after controlling for variety, sweetness, reserve, color, alcohol content.
Full results can be seen in Chapter 4: Appendix C, Table C.4.

Overall the binomial probit model correctly classifies 71.10% of observations. The obtained results show that the influence of winery age on the probability of choosing VQA certification tends to be significant. The estimates on all age groups of the wineries are positive and significant in comparison to the group of the oldest wineries that were combined in the age interval [1932, 1990). These estimates are significant either at a 10% significance level in the case of the wineries from the interval [1990, 2000) or a 0.1% significance level in the case of wineries placed in age intervals [2000, 2010) and [2000, 2014]. The obtained results suggest that younger wineries are more likely to VQA-certify their wines when compared with the base group, the wineries from the age group [1932, 1990). This situation might be caused by the fact that with time the VQA certification program became more prevalent and easy to access as the supply of local grapes increased. These results agree with the theory developed in Subsection 4.3.2 (Conceptual Framework) where it was hypothesized that with time the entry to VQA certification became easier as the supply of locally grown grapes increased.

The probit results also show that winery capacity is a major factor in a winery's choice to VQA-certify its wines. As described in Subsection 4.3.4 above, winery capacity is controlled for via a proxy variable (total volume of wine sales in years 2011–2015 on a per winery basis). The wine sales were used here as a proxy variable for capacity because actual production capacities were not available. The estimates on both capacity indicator variables—winery capacity medium and capacity small—yield negative estimates when compared with the base group, winery capacity large. The results are strongly significant at 0.1%. These results suggest that wineries with large capacity are more likely to adopt VQA certification. This is hardly a surprise. Wineries with higher wine sales (and production) are bigger, and it is likely that they have better access to local grapes, as they might own more local land. When a winery is being established, it usually plans and decides on its production possibilities. This, in turn, is likely to be associated with the size of the winery's vineyards or the number and size of contracts with local grape growers. The large-capacity wineries might be more willing to adopt VQA certification because they have higher production volumes and therefore need access to extra marketing channels for their wines (e.g., VQA wine stores or, recently, the Save-On-

Foods supermarkets). The anecdotal evidence obtained from wineries during field interviews also agrees with the results achieved in this specification.

The results of the binomial probit model also show that the location of the estate winery that in this model is controlled by the sub-appellations indicators is not always significant in the winery's choice to VQA-certify its wines. These results are not surprising, as it was anticipated that a decision to adopt VQA certification might depend on the location of the estate winery and associated terroir.[63] Such decision might come about because of sub-appellation-dependent differences in the availability of land suitable for grape production.

4.6.2. Stage 2 and 3 results

In stages 2 and 3 of the endogenous dummy variable modelling, the 2SLS IV procedure (Stata command: ivregress 2SLS), three different dependent variables were implemented: the share of the average volume of wine sales, the share of the average revenue and the average price of wine (Regressions A, B and C, as seen below). Except for different dependent variables, all three 2SLS IV regression types used the same second stage instrument for VQA certification (the fitted values of the VQA dummy variable obtained in stage 1, the binomial probit) as well as the set of the same explanatory variables: wine variety, wine colour, reserve, alcohol content, wine sweetness, winery age, proxy for winery capacity, and indicator variables on proposed sub-appellations (based on the location of the estate winery). All regressions used the full cross-sectional data with N=3450 observations on individual SKUs (wines).

The estimate of the highest importance and interest for the analysis in this chapter is the estimate on the VQA indication as it estimates the average effect of VQA certification.

The full results associated with each regression (A, B, and C) can be seen in Appendix C: Chapter 4 (Tables C.5, C.6, and C.7).

[63]Terroir in the meaning of grape quality and availability, as both terroir-specific (sub-appellation-specific) quality and quantity of grapes might influence VQA adoption.

Regression A results: Dependent variable -logarithm of the average volume share

The obtained results show that after controlling for the endogeneity of the VQA certification, there exists a positive and significant (at 10%) influence of VQA certification on the average volume of sales for BC wines produced by the estate wineries from the Okanagan and Similkameen Valleys of BC.

The results also show that alcohol level and sweetness N/A have a negative and significant (at 0.01%) influence on the average volume of wine sales.

Similarly, winery capacity medium and small (in comparison to winery capacity large) have negative and highly significant (at 0.01%) impact on the average volume of wine sales.

The results also prove that the age of winery has a significant impact on the average volume of wine sales. Younger wineries (in comparison to wineries from the age interval [1932, 1990)) all show positive and significant (at 0.01%) estimates.

Regarding estimates on sub-appellation dummies, the results are mixed regarding sign and significance. Such results on these regional dummy variables could be expected, as it was anticipated that the volume of wine sales is region-specific and depends on many elements, of which one of the most important would be sub-appellation-specific availability of agricultural land suitable for grape cultivation.

Overall, the results obtained in this specification agree with expectations, the theory developed in the conceptual framework (Subsection 4.3.2), and anecdotal evidence obtained from BC wineries during field interviews.

The results of the highest interest for this chapter that were achieved in stages 2 and 3 of the three-stage endogenous dummy variable procedure with the logarithm of the average

volume share of wine sales as dependent variable are presented in Table 4.5 below. The full results can be seen in Chapter 4: Appendix C, Table C5.

Table 4.5. Regression A, 2SLS first and second stage results. Dependent variable: logarithm of the average volume share.

	First stage	Second Stage
	logarithm average volume share	**logarithm average volume share**
VQA Indication		**0.655+**
		(0.349)
VQA probability	1.015322***	
	(0.00)	
Sweetness N/A	0.0049971	-0.414***
	(0.039)	(0.116)
Alcohol	-0.0034282	-0.155***
	(0.011)	(0.032)
East Side Mixed Sediments	-0.0143846	-0.039
	(0.061)	(0.183)
Golden Mile	-0.0023718	-0.385**
	(0.042)	(0.126)
Kettled Outwash and Fans	-0.0049115	0.311+
	(0.053)	(0.162)
Lakeside Alluvial Fans	-0.0108049	0.564***
	(0.054)	(0.160)
Mission Creek Terraces	-0.0009846	-0.0566
	(0.046)	(0.139)
Mixed Sediments and Fans	-0.0128443	0.236*
	(0.038)	(0.116)
NE Side Lacustrine Bench	-0.0015179	0.470***
	(0.036)	(0.109)
Sandy Outwash Lakeside Terraces East Side	-0.0108636	0.476**
	(0.061)	(0.183)
Sandy Outwash Lakeside Terraces West Side	-0.0066681	0.188
	(0.069)	(0.207)
Sandy Outwash Terrace and Deposits	-0.0044024	0.167
	(0.039)	(0.117)
SE Side Lacustrine Bench	0.0007355	-0.275+
	(0.050)	(0.151)
Similkameen Valley	-0.0081657	0.155
	(0.044)	(0.132)
West Side Lacustrine Bench	-0.0075759	-0.344
	(0.080)	(0.241)
West Side Mixed Sediments	-0.0106201	-0.419***

Table 4.5. Regression A, 2SLS first and second stage results. Dependent variable: logarithm of the average volume share.

	First stage	Second Stage
	logarithm average volume share	logarithm average volume share
	(0.038)	(0.115)
Winery Age [1990, 2000)	0.0037946	0.461***
	(0.034)	(0.104)
Winery Age [2000, 2010)	0.0007705	0.653***
	(0.043)	(0.129)
Winery Age [2010, 2014)	-0.0054993	1.177***
	(0.049)	(0.147)
Capacity Medium	0.0043983	-1.237***
	(0.044)	(0.130)
Capacity Small	0.0125084	-1.875***
	(0.062)	(0.183)
Constant	-0.7498799	-12.24***
	(0.466)	(1.376)
N	3365	3365
R-sq	0.24	0.28
adj. R-sq	0.23	0.26

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Comparison groups:

Winery Age [1932, 1990), Capacity: Large. Sub-appellation: Alluvial fans and flood plains. Sweetness: Sweetness 0,

Above results come after controlling for wine variety, reserve and wine color.

Full results can be seen in Chapter 4: Appendix C, Table C5.

Regression B results: Dependent variable -logarithm of the average price

The obtained results show that unlike in the case of Regression A above, in the case of Regression B the estimate on the VQA indication yields a negative but insignificant estimate. This suggests that VQA certification does not have a significant impact on pricing of BC wines produced by the estate wineries from the Okanagan and Similkameen Valleys of BC.

The results also show that wine colour white (in comparison to red) has a negative and significant (at 0.01%) impact on wine pricing. At the same time, alcohol level and sweetness level 3 both have a positive and significant impact on pricing of BC-made wines (significant at 0.01% and 5%, respectively).

The results obtained on winery capacity indicator variables suggest that the capacity of the winery that implies its production possibilities influence pricing of BC wines, with medium- and small-sized wineries having a positive and significant impact on wine pricing, in comparison to wineries with a large capacity (significant at 0.01% and 5%, respectively).

The results of Regression B also prove that the age of winery has a significant impact on the average price of BC wines with younger wineries having a negative and significant impact (at 0.01%) on wine prices, in comparison to wineries from the age interval [1932, 1990).

Regarding estimates on sub-appellation dummies, as was the case with Regression A above, the results are mixed regarding sign and significance. Such results on these regional dummy variables could be expected as it was anticipated that the volume of wine sales is region-specific and depends on many elements, of which one of the most important would be sub-appellation-specific availability of agricultural land suitable for grape cultivation.

Overall, as was in the case of regression A above, the results obtained in this specification agree with expectations, theory developed in the conceptual framework (Subsection 4.3.2), and anecdotal evidence obtained from BC wineries during field interviews.

The results of the highest interest for this chapter that were obtained in stages 2 and 3 of the three-stage endogenous dummy variable procedure with the logarithm of the average price of wine as dependent variable are presented in Table 4.6 below. The full results can be seen in Chapter 4: Appendix C, Table C6.

Table 4.6. Regression B, 2SLS first and second stage results. Dependent variable: logarithm of the average price.

	First stage	Second Stage
	logarithm average price	**logarithm average price**
VQA Indication		**-0.0657046**
		(0.084)
VQA probability	.9944108 ***	
	(0.00)	
Color White	0.0038534	-0.274***
	(0.029)	(0.021)
Sweetness 3	0.0244488	0.243*
	(0.166)	(0.120)
Alcohol	0.0002667	0.107***
	(0.010)	(0.008)
East Side Mixed Sediments	0.0027112	0.157***
	(0.060)	(0.043)
Golden Mile	0.0104331	0.245***
	(0.042)	(0.030)
Kettled Outwash and Fans	0.0025931	0.0715+
	(0.053)	(0.038)
Lakeside Alluvial Fans	0.0079825	0.0648+
	(0.053)	(0.039)
Mission Creek Terraces	0.0007252	0.194***
	(0.046)	(0.033)
Mixed Sediments and Fans	-0.0018092	0.0698*
	(0.038)	(0.027)
NE Side Lacustrine Bench	0.0058863	0.155***
	(0.036)	(0.026)
Sandy Outwash Lakeside Terraces East Side	-0.0006699	0.0645
	(0.060)	(0.044)
Sandy Outwash Lakeside Terraces West Side	0.0041342	0.542***

Table 4.6. Regression B, 2SLS first and second stage results. Dependent variable: logarithm of the average price.

	First stage	Second Stage
	logarithm average price	**logarithm average price**
	(0.069)	(0.050)
Sandy Outwash Terrace and Deposits	0.0028915	0.207***
	(0.038)	(0.028)
SE Side Lacustrine Bench	0.0068515	0.124***
	(0.050)	(0.036)
Similkameen Valley	-0.0000881	0.149***
	(0.043)	(0.031)
West Side Lacustrine Bench	0.0040074	0.0622
	(0.080)	(0.056)
West Side Mixed Sediments	0.0002643	0.220***
	(0.038)	(0.027)
Winery Age [1990, 2000)	-0.0038217	-0.118***
	(0.034)	(0.025)
Winery Age [2000, 2010)	-0.0030698	-0.127***
	(0.042)	(0.030)
Winery Age [2010, 2014)	-0.0033919	-0.178***
	(0.049)	(0.035)
Capacity Medium	-0.0018829	0.129***
	(0.043)	(0.031)
Capacity Small	-0.0011772	0.107*
	(0.061)	(0.044)
Constant	-0.7788785	1.584***
	(0.465)	(0.328)
N	3413	3413
R-sq	0.24	0.36
adj. R-sq	0.23	0.352

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Comparison groups:

Winery Age [1932, 1990), Capacity: Large. Sub-appellation: Alluvial fans and flood plains. Sweetness: Sweetness 0. Color: Red.

Above results come after controlling for wine variety and reserve.

Full results can be seen in Chapter 4: Appendix C, Table C6.

Regression C results: Dependent variable -logarithm of the average revenue share

The obtained results show that unlike in the case of Regression A above, in the case of Regression C the estimate on the VQA indication yields a positive but insignificant estimate. This suggests that VQA certification does not have a significant impact on the average revenue of BC wines produced by the estate wineries from the Okanagan and Similkameen Valleys of BC.

The results also show that wine colour white (in comparison to red) has a negative and significant (at 5%) impact on the average revenue. At the same time, sweetness level 3 has a positive and significant (at 5%) impact on the average revenue of BC-made wines, but sweetness N/A has a negative and significant (at 0.01%) impact on the average revenue of BC-made wines.

Winery capacity medium and small (in comparison to winery capacity large) have a negative and highly significant (at 0.01%) impact on the average revenue of wine sales. The results of Regression C also prove that the age of winery has a significant impact on the average revenue of wine sales. Younger wineries (in comparison to wineries from the age interval [1932, 1990)) all show positive and significant (at 0.01%) estimates.

The estimates on sub-appellation dummies are mixed regarding sign and significance. As mentioned in the case of Regressions A and B, such results on these regional dummy variables could be expected as it was anticipated that the volume of wine sales is region-specific and depends on many elements, of which one of the most important would be sub-appellation-specific availability of agricultural land suitable for grape cultivation.

Overall, the results obtained in this specification agree with expectations, the theory developed in the conceptual framework (Subsection 4.3.2), and anecdotal evidence obtained from BC wineries during field interviews.

The results of the highest interest for this chapter that were obtained in stages 2 and 3 of the three-stage endogenous dummy variable procedure with the logarithm of the average price of wine as dependent variable are presented in Table 4.7 below. The full results can be seen in Chapter 4: Appendix C, Table C7.

Table 4.7. Regression C, 2SLS first stage results. Dependent variable: logarithm of the average revenue share.

	First stage	Second Stage
	logarithm average revenue share	**logarithm average revenue share**
VQA Indication		**0.635**
		(0.521)
VQA probability	1.015303***	
	(0.117)	
Color White	0.0041057	-0.292*
	(0.030)	(0.134)
Sweetness 3	0.0152561	1.575*
	(0.166)	(0.750)
Sweetness N/A	0.0049815	-0.896***
	(0.039)	(0.174)
East Side Mixed Sediments	-0.0144911	0.207
	(0.061)	(0.273)
Golden Mile	-0.0023701	-0.263
	(0.042)	(0.188)
Kettled Outwash and Fans	-0.0047116	0.241
	(0.053)	(0.242)
Lakeside Alluvial Fans	-0.010542	0.688**
	(0.054)	(0.240)
Mission Creek Terraces	-0.000515	0.113
	(0.046)	(0.207)
Mixed Sediments and Fans	-0.0125779	0.0557
	(0.038)	(0.173)
NE Side Lacustrine Bench	-0.0014762	0.588***
	(0.036)	(0.163)
Sandy Outwash Lakeside Terraces East Side	-0.011025	0.620*
	(0.061)	(0.274)
Sandy Outwash Lakeside Terraces West Side	-0.0064667	0.737*
	(0.069)	(0.310)
Sandy Outwash Terrace and Deposits	-0.0044848	0.131
	(0.039)	(0.174)
SE Side Lacustrine Bench	0.0009897	-0.258
	(0.050)	(0.226)

Table 4.7. Regression C, 2SLS first stage results. Dependent variable: logarithm of the average revenue share.

	First stage	Second Stage
	logarithm average revenue share	**logarithm average revenue share**
Similkameen Valley	-0.0086697	-0.000648
	(0.044)	(0.198)
West Side Lacustrine Bench	-0.0079211	-0.188
	(0.080)	(0.360)
West Side Mixed Sediments	-0.0087799	-0.395*
	(0.038)	(0.172)
Winery Age [1990, 2000)	0.0047147	0.438**
	(0.034)	(0.156)
Winery Age [2000, 2010)	0.002112	0.691***
	(0.043)	(0.193)
Winery Age [2010, 2014)	-0.0049955	0.862***
	(0.049)	(0.220)
Capacity Medium	0.0039414	-1.365***
	(0.044)	(0.195)
Capacity Small	0.0125965	-2.259***
	(0.062)	(0.273)
Constant	-0.7497545	-14.32***
	(0.466)	(2.058)
N	3366	3366
R-sq	0.24	0.25
adj. R-sq	0.23	0.24

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Comparison groups:

Winery Age [1932, 1990), Capacity: Large. Sub-appellation: Alluvial fans and flood plains. Sweetness: Sweetness 0.

Color: Red.

Above results come after controlling for wine variety and reserve.

Full results can be seen in Chapter 4: Appendix C, Table C7.

Some additional tests for instrument relevance (for Regression A, B, and C, as described above) can be seen in Chapter 4: Appendix C, Tables C8–C10.

4.6. Conclusion

In this section I present conclusions, discuss research limitations, and form recommendations for further studies in this area. Specifically, in Subsection 4.6.1 I outline research limitations and form conclusions, and in Subsection 4.6.2 I make recommendations for further research.

4.6.1. Conclusions

The results obtained in the analysis of this chapter point towards some interesting and important findings for the BC wine industry.

First, the obtained results answer research question posed in this chapter and show that VQA certification positively influences the share of the average volume of wine sales of BC-made wines. This is good news as the VQA program has been in place since 1990 and it is reassuring to see that it has some positive impact for BC winemakers. While the results in this chapter show that VQA certification positively influences the share of the average volume of wine sales, the situation looks different in the case of VQA's influence on the average prices of wine and average sales revenue. The obtained estimates on VQA indication in both cases were insignificant and suggest that VQA indication does not influence the average price and average sales revenue of BC-made wines.

The results that show VQA's positive influence on average volume share and simultaneously point to the lack of influence that VQA certification has on the average price and average revenue of BC-made wines prove the correctness of theory developed in Subsection 4.3.2.

One could have expected that VQA certification that is an official BC appellation would have a positive influence on wine prices. The earlier research on this topic (Rabkin and Beatty, 2007) suggested that there existed a price premium on VQA certification of BC-

made wines. The results of this chapter that account for the endogeneity of VQA certification show that such price premium does not exist.
Keeping in mind that more research on the relationships between VQA and pricing for BC-made wines might be necessary (e.g., with an inclusion of BC VQA virtual brands), the results of this chapter seem to give a clear picture of the VQA's role.

The results from the analysis of this chapter might be important for the official introduction of new appellations (four) and sub-appellations (16) that are expected to come to life in BC no later than January 1, 2019. As the analysis of the significance of VQA indication shows, if the proposed appellations and sub-appellations adopt similar strategies to those that are currently used by VQA certification, they will possibly influence the volume of wine sales but not the prices of BC-made wines or the revenue of BC winemakers.

The analysis pursued in this chapter has some limitations.
One limitation of this analysis is associated with using a proxy for winery capacity (in the form of total wine sales over the years 2011–2015), instead of an actual winery production capacity that was not available for this research. A better variable to be used in this model would be a real production capacity on a per winery basis.
Another limitation might come from the lack of other plausible choice-influencing variables that could be used as the explanatory variables in the binomial probit model. Besides the variables that were used and were possible to collect (winery age, sub-appellation and a proxy for winery capacity), the binomial probit model in step 1 could benefit from other explanatory variables that were winery-specific, e.g., some details on the winemaker's education level.

4.6.2. Recommendations

It would be interesting to pursue similar research but on a larger data set with more sales years and with the inclusion of virtual brands of BC wine. Such analysis could outline a full evolution of the importance of VQA certification on BC-made wines. It could also show if differences exist in the role of VQA certification between virtual and non-virtual brands of BC wine.

Chapter 5. Conclusion

In this chapter, I revisit primary research goals set up in this dissertation and outline how the evidence presented in each chapter helped find answers to research questions described in this thesis. This chapter is a concluding chapter that I have divided into four subsections. In Subsection 5.1 I summarize research aims; in Subsection 5.2 I discuss research contributions; in Subsection 5.3 I examine research strengths and limitations. Finally, in Subsection 5.4 I outline research applications.

5.1. Research Aims

The overreaching aim of this dissertation was to pursue research on the British Columbia wine region and its wine industry, with a particular emphasis put on the significance of terroir and collective reputation in pricing and sales of locally sourced and made wines. I achieved this goal via analyses presented in three separate but interconnected chapters that constitute the core of this dissertation. Each of these chapters maintains its independence regarding the central analytical theme and research approach, but all three chapters combined shed light on the BC wine industry in its entirety. The leading reason that influenced my decision to pursue analyses regarding the BC wine region is associated with the most recent wine policy developments that aim for the introduction of new wine appellations (four) and sub-appellations (16). This industry's turning point that per definition intends to strengthen the role of regional recognition for BC-made wines introduced an opportunity to verify the current function of BC's terroir and collective reputation (VQA) in pricing and sales of locally made wines. I envisioned that such analysis could be used as a benchmark for the comparison of terroir and collective reputation influences on wine pricing and sales after new appellations and sub-appellations are established.

The analyses presented in this dissertation are interesting not only from a strictly academic point of view, but they can also assist the BC wine industry and local policymakers in their micro level decisions relating to the wine industry.

The overview of the BC wine region and wine industry as outlined in Chapter 2 of this dissertation was used to set up a stage for the analyses pursued in Chapters 3 and 4. Therefore, in Chapter 2, I presented an analysis of the BC wine industry from the organizational, historical, and policy points of view. In the outline of Chapter 2, I placed particular emphasis on the most current wine policy developments in BC: the change in the liquor markup formula from 2015, as well as the proposal for the establishment of new appellations and sub-appellations and the industry plebiscite that followed. Based on the available scanner sales data obtained from the BCLDB, I presented statistics regarding all wine sales in BC (domestic wines and imports). Also, I outlined the types of domestically sourced wine brands found in the BC wine market during the years 2011–2015. To bring more clarity to an actual number and significance of domestic wine brands in the BC market, I estimated market shares (volume and value) for all main types of brands sold in the BC wine market. I also estimated market shares for the most significant VQA brands in terms of volume and value of wine sales that were selling wines in the BC market during the years 2011–2015.

Overall, my analysis in this chapter shows that the BC wine region is not specialized in the production of any grape or wine type. The BC wine market seems to be heterogeneous at various levels (e.g., heterogeneity of grape and wine types, a large number of wine brands, a relatively large number of estate wineries), but about 59% and 52% of the total volume and value market share, respectively, belong to just five companies. At the same time, a calculated industry concentration index (Herfindahl-Hirschman Index (HHI)) shows that the BC wine industry was characterized by a moderate level of concentration in years 2011–2013 and by a competitive level of concentration in 2014–2015.

After I outlined the status quo in the BC wine industry, I moved to the analysis of Chapter 3. The primary goal of Chapter 3 of this dissertation was to find an answer for its leading research question:

Does terroir influence the pricing of BC VQA wines from the Okanagan and Similkameen Valleys?

To answer this question, I matched scanner sales data on the selected BC VQA wines from the BCLDB wholesale scanner sales data for years 2011–2015 with micro level data collected from 33 BC estate wineries located in the Okanagan and Similkameen Valleys of BC. This allowed me to link each of the selected BC VQA wines with its actual origin, a vineyard that sourced grapes used for its production. In the next step, I collected data on the terroir specifics of each of these vineyards from Google Earth Pro (satellite images) and the Environment Canada weather database, and included in my data set and analysis the following terroir/vineyard-specific variables: soil type, row direction, aspect, average elevation, distance from vineyard to the nearest lake, and a temperature-based climate measure. Since the primary goal of this chapter was to establish what the influence of terroir variables was on the pricing of BC VQA wines, I employed the hedonic pricing method in the modelling stage of this analysis. Specifically, I regressed the price of wine on the terroir variables (as described above) and non-terroir variables available in the BCLDB pricing data set: volume of wine sales, variety, brand, alcohol content, age of wine, and year of sales.

The results of my analysis in this chapter show that terroir elements have some importance in the pricing of BC VQA wines, but they may not constitute the most significant pricing variables. The wine variety and wine brand seem to have more significance in the formation of wine prices for BC VQA wines.

In Chapter 4 of this dissertation I asked a different research question:

What is the average impact of VQA certification on the average volume, average revenue, and average price of wines produced by the estate wineries from the Okanagan and Similkameen Valleys of British Columbia?

To answer this question, I also used the data obtained from the BCLDB scanner sales data set for years 2011–2015. Specifically, I employed the data on wine sales pursued by

the BC wineries located in the Okanagan and Similkameen Valleys that possess a physical estate location. The modelling process in this chapter was based on the three-stage approach, with the correction for the endogenous dummy variable (VQA certification dummy). In stage 1 of this procedure (binomial probit model), I used a control on winery capacity, winery age, and a set of indicator variables for sub-appellations (based on the estate winery location) to calculate VQA-fitted values that were used in stages 2 and 3 of the 2SLS. I estimated three different model specifications that used the same explanatory variables but differed in the dependent variables: logarithm of a share of the average volume of wine sales, logarithm of average price, and logarithm of the share of average revenue.

The results that I obtained show that while VQA certification has a positive and statistically significant impact on the share of the average volume of wine sales, it doesn't have a significant effect on the average price of wine and the share of the average revenue of wine sales.

5.2. Research Contributions

This research constitutes the first analysis of this type and magnitude that concerns the economics of the BC wine region. The uniqueness of the studies presented in this dissertation is a result of various elements that are associated with the particular data sets used in the empirical modelling process, the modelling approach, and the first attempt of such analysis in a young, developing, and sparsely researched wine region.

In terms of strictly scholarly contributions, the studies pursued in this dissertation contribute to three main fields: wine economics, wine business, and wine marketing. With regards to wine economics, this research adds to the stream that investigates the role of terroir and collective reputation in the formation of wine prices and wine sales. In respect of wine business and wine marketing, the empirical analyses pursued in this dissertation show the industry's status quo outlining an overall marketing situation in the province of BC, together with types and number of brands and estimations of individual brand and wine industry market shares. This sort of analysis can be helpful for

winemakers that are already established in the market as well as for new entrants into the BC wine market, to guide them on strategies used for wine pricing and wine sales.

Specifically, in the analysis of Chapter 2, I estimated the number of brands that were present in the BC market, outlined brand division, calculated brand shares for VQA brands, estimated volume and value market shares on a per VQA label basis, and determined industry concentration index (HHI). This analysis brought a previously unseen insight into the organization and functioning of the BC wine industry from the wine business and wine marketing sides.

The empirical modelling approach employed in Chapters 3 and 4 of this dissertation is also mostly unique.

In the case of Chapter 3, I used a standard hedonic pricing methodology, but instead of the usual approach where the price of wine is regressed on various sensory or objective wine characteristics, in this dissertation I regressed the price of wine on the unique, terroir-specific variables. In the empirical modelling of Chapter 3, I used a self-constructed panel data set composed of the following data sets: wine wholesale data that constitutes all wine sales in BC in years 2011–2015 (for the selected BC VQA wines), micro level (winery level) data on the locations of vineyards that sourced grapes used in the production of these wines, the Environment Canada climate (temperature) data, and agronomic data that was self-collected from Google Earth Pro satellite images or from physical visits to the vineyards. The construction of this data set and the hedonic modelling approach allowed me to control for terroir elements that were characteristic for the vineyards that sourced grapes used in the production of each of the selected wines. Therefore, in my hedonic model, I could establish what the influence of terroir variables (and therefore an implied quality of grapes) was on the pricing for BC VQA wines.

In Chapter 4, I used the three-stage endogenous dummy variable modelling specification to estimate the influence of VQA certification on the share of the average volume of wine sales, average price of wine, and average revenue share. To the best of my knowledge,

this approach has not been used previously in estimations related to wine appellations. Therefore, it is likely that the analysis pursued in Chapter 4 also constitutes unique research.

5.3. Strengths and Limitations

The strengths and limitations of this dissertation are chapter-specific, and they have already been discussed in the "Conclusion" subsections of the proper chapters of this dissertation. Regardless, there exist the overall strengths and limitations that apply to all analyses presented in this thesis.

The most apparent strength of the research presented in this dissertation is associated with the fact that this is the first attempt of a rigorously pursued empirical analysis and modelling of this type coming from the BC wine region. This element makes it pioneering research.
Also, the analyses pursued in this dissertation, especially their empirical modelling, are laid out straightforwardly so they can easily be reproduced elsewhere if there exists access to the necessary data.

One of the possible weaknesses of the analyses of this dissertation is associated with the nature of wine as a highly complex product in terms of production (heterogeneous terroir and production costs), consumption (consumer-specific tastes), and marketing process (various levels and options for marketing and brand building). There exists a risk of a hidden endogeneity that could influence empirical modelling and results but could not be accounted for in these analyses due to data unavailability.

Another possible weakness is associated with the lack of a random sample of wineries that provided data for Chapter 3 of this dissertation.

An additional limitation might come from the fact that the empirical results presented in this thesis could be region-specific and apply only to the BC wine region and its winemaking industry. Therefore, the interpretation of results presented in this dissertation might be contextually limited to the BC wine region.

5.4. Research Applications

The results of the research pursued in this dissertation point towards a couple of interesting implications and applications.

First, the results obtained in Chapter 3 of this thesis suggest that in the BC wine region, wine variety and wine brand are currently the two most important variables in the formation of prices for VQA wines. Also, the obtained results suggest that "exotic-sounding" varieties are priced at a price premium (e.g., Sangiovese). These results might be relevant from the perspective of BC winemakers and might suggest that variety specialization might be a "way to go" for the BC wine industry. Therefore, it is possible that the attention of the BC wine industry should be focused more on the sub-regional varietal specialization that would build on the specifics of the sub-regional terroir differences, based on their superior fit for the cultivation of particular grape varieties.

Currently, the BC wine region and its wine production resemble a buffet on a "specials night" or a potluck soirée. A wine customer that visits the BC wine region can get a wide selection of different wine types that are derived from multiple grape varieties. This status quo applies to the whole BC wine region as well as to individual wineries. Unfortunately, the potluck or buffet-like abundance rarely guarantees a quality, consistent sensory experience between the dishes. In other words, buffets usually do not feature any exceptional dishes on which they could build a reputation, but they offer a large choice of dishes instead. This analogy applies to the BC wine region; at the moment nobody associates its winemaking with any particular wine variety.

Also, the results obtained in Chapter 4 of this dissertation show that VQA certification has a positive and significant impact on the average volume share, but it does not have a significant impact on the average price and average revenue share. As I explained in Chapter 4, this situation might be associated with the issue of VQA over-certification that allows rent dissipation.

The results obtained in Chapter 4 might help the BC wine industry in understanding what has happened to VQA certification over time. This, in turn, might provide the BC wine industry and policymakers with guidance on how to properly design future wine policies related to collective reputation.

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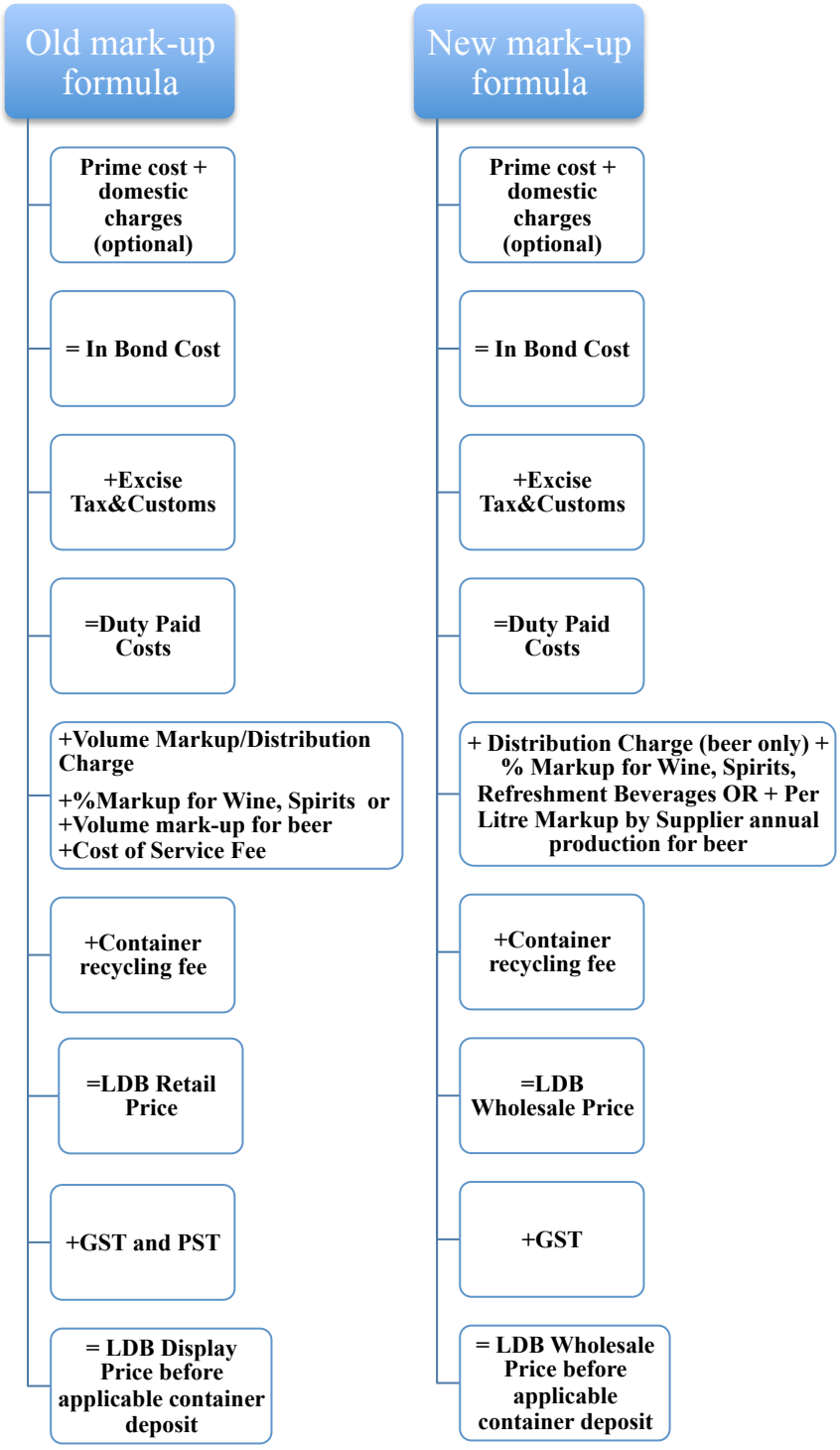
Appendices

Appendix A: Chapter 2.

Figure A.1. The BCLDB old versus new mark-up formula.



Source: Based on the BCLDB website accessed on April 1, 2017: http://www.bcldb.com/files/Wholesale_Pricing_Changes-Overview.pdf

The new wine wholesale pricing markup formula works upwards from supplier's cost of production (winery's prime costs) and brings following markups for wine: 89% markup on the first CAD $ 11.75/litre and graduated markup of 27% on any amount over CAD $ 11.75/litre.
Source: BCLDB website accessed on January 15, 2016: http://www.bcldb.com/files/Wholesale_Pricing_Changes-Wholesale_Customer_Presentation.pdf?v=1).

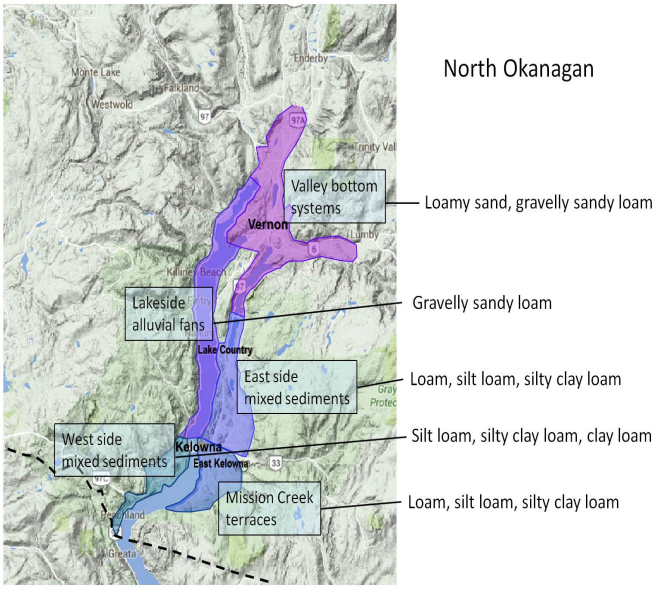
The old (prior to April 1, 2015) provincial wholesale wine markup was at the level of 117% on the first CAD$ 10.25/litre and 51% on the reminder cost to generate the retail prices as seen in the government run liquor stores. From these government run liquor stores prices various discounts were offered to different retailers to come up with a wholesale price for such retailers:

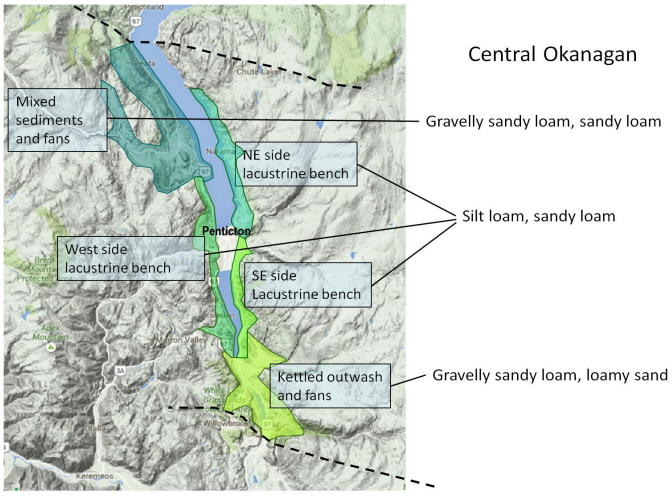
1. Independent wine stores: 30% discount off the LDB display price,
2. Private liquor stores: 16 % discount off the LDB display price,
3. Rural agency stores: 10 % discount off the LDB display price,
4. VQA wine stores: 30% discount off the LDB display price,
5. Restaurants and bars: 0% discount off the LDB display price,

When the new wholesale pricing formula came to life, the provincial markup was lowered to compensate previous retailers for discounts (as seen in point 1-5 above) that were removed and replaced with the common wholesale pricing formula for all retailers.

Source: WineLaw.ca website accessed on January 15, 2015: http://www.winelaw.ca/cms/legal-info-industry/retail-distribution/298-liquor-changes-chart

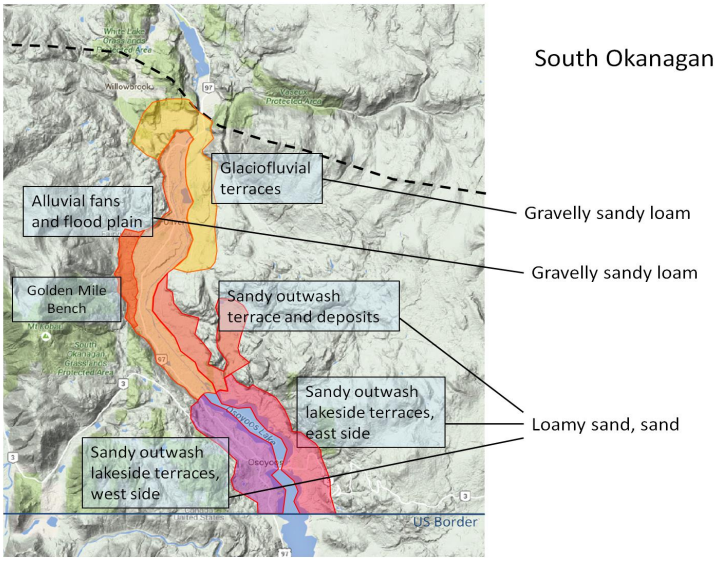
Figure A.2. Proposed demarcation of sub-appellations





Source: dr. Patricia Bowen, AAFC/PARC Summerland.

Figure A.2. Proposed demarcation of sub-appellations



Source: Dr. Patricia Bowen, AAFC/PARC Summerland (used with permission).

Table A.1. The BC Wine Appellation Task Group recommendations and plebiscite results.[64]	
BC Wine Appellation Task Group Recommendations (revised version from April 28, 2016)	**Plebiscite Results**
1. In order to have a winery license producers making wine from 100% BC grown grapes must become members of the BC Wine Authority (BCWA) and be subject of audits conducted and enforced by the Wines of Marked Quality regulations	APPROVED
2 a). Change the "Wines of Distinction" category to British Columbia Wines.	APPROVED
2 b). After the change, both wine types, BC VQA and British Columbia Wines will be allowed to use geographic indication on their labels	REJECTED
3. Taste panels should be put to a review by the Wine Industry Advisory Committee and should use as a reference a survey pursued by the BC Wine Appellation Task Group in the wine industry, in June 2015	NOT INCLUDED IN PLEBISCITE
4. After sub-appellations are established (not later than January 1, 2019), the BCWA should be given the authority to prohibit the use of unregulated geographical indicators on wine labels	APPROVED
5. All wines made 100% from BC grapes must register as, either BC VQA wines or British Columbia Wines	APPROVED
6. Wines of British Columbia that use geographic indication (sub-appellation) will need to show on their label region and sub-region (appellation and sub-appellation)	APPROVED
7. Four new appellations in the emerging regions (Thompson Valley, Shushwap, Lillooet-Lytton and Kootenays) should be established. Boundries of these appellations will require demarcation upon consultations in each of these regions.	APPROVED
8. The set of sub-appellations is proposed for the Okanagan Valley (for details, please refer to the Appendix). The naming of sub-appellations should include the name of town, village or historical place.	APPROVED
9. Three separate audits currently pursued by the Liquor Control and Licensing Branch, BC Liquor Distribution Branch and BC Wine Authority should be harmonized	NOT INCLUDED IN PLEBISCITE
10. BCWA should establish a flat fee for small wineries that covers cost of membership, grape levies, audits and wine certification (with threshold for definition of small winery not exceeding 50 tons)	APPROVED
11. Section 29(3)(c) of the Wines of Marked Quality regulations should be amended to: At least <u>two thirds of the vote measured by registrants of productive wine grape acreage</u> in a proposed	

[64] Note: Some recommendations were omitted from the plebiscite because they either recommended continuation of existing practices/requirements, or they were accepted by the BCWA and didn't require industry voting.

Table A.1. The BC Wine Appellation Task Group recommendations and plebiscite results.[64]	
BC Wine Appellation Task Group Recommendations (revised version from April 28, 2016)	**Plebiscite Results**
geographical area or subdivision, who produce at least two thirds of the total production of wine made from grapes grown in that area or subdivision, must have voted, by ballot, in favour of the proposed geographical area or subdivision;	APPROVED
12 a). Section 29(3)(e) of the Wines of Marked Quality regulations should be deleted. Additional review of section 29 should be pursued by the BCWA and WIAC	APPROVED
12 b). Additional review of section 29 should be pursued by the BCWA and WIAC	NOT INCLUDED IN PLEBISCITE

Source: The BC Wine Appellation Task Group Website & British Columbia Wine Authority Website, accessed on January 1, 2017: http://bcwinetaskgroup.ca/report/

Table A.2. Identified wine brands present in the BC market in 2011-2015.			
	Brand Name	**Town**	**Region/Brand Classification**
1	ALIGOTE	N/A	CANADIAN NON BC BOTTLED
2	ANDREWPELLER	N/A	CANADIAN NON BC BOTTLED
3	BENJAMIN BRIDGE	N/A	CANADIAN NON BC BOTTLED
4	CAVE CELLARS	N/A	CANADIAN NON BC BOTTLED
5	CAVE SPRING	N/A	CANADIAN NON BC BOTTLED
6	CHATEAU DES CHARMES	N/A	CANADIAN NON BC BOTTLED
7	CHILL WINSTON	N/A	CANADIAN NON BC BOTTLED
8	CLOSSON CHASE	N/A	CANADIAN NON BC BOTTLED
9	CSP	N/A	CANADIAN NON BC BOTTLED
10	COYOTE'S RUN	N/A	CANADIAN NON BC BOTTLED
11	DAN AYKROYD	N/A	CANADIAN NON BC BOTTLED
12	EAST DELL	N/A	CANADIAN NON BC BOTTLED
13	EQUIFERA	N/A	CANADIAN NON BC BOTTLED
14	EQUULEUS	N/A	CANADIAN NON BC BOTTLED
15	G. MARQUIS	N/A	CANADIAN NON BC BOTTLED
16	GENERATIONSEVEN	N/A	CANADIAN NON BC BOTTLED
17	GIGGLE JUICE	N/A	CANADIAN NON BC BOTTLED
18	HENRY OF PELHAM	N/A	CANADIAN NON BC BOTTLED
19	INN. NIAGARA	N/A	CANADIAN NON BC BOTTLED
20	KONZELMANN	N/A	CANADIAN NON BC BOTTLED
21	LAILEY WILEY	N/A	CANADIAN NON BC BOTTLED
22	LE CLOS	N/A	CANADIAN NON BC BOTTLED
23	LE CLOS JORDANNE	N/A	CANADIAN NON BC BOTTLED
24	LIAISON WINES	N/A	CANADIAN NON BC BOTTLED
25	MAGNOTTA	N/A	CANADIAN NON BC BOTTLED
26	MIKEWEIR	N/A	CANADIAN NON BC BOTTLED
27	NAKED GRAPE	N/A	CANADIAN NON BC BOTTLED
28	PELEE ISLAND	N/A	CANADIAN NON BC BOTTLED
29	PILLITTERI	N/A	CANADIAN NON BC BOTTLED
30	RED HERRING	N/A	CANADIAN NON BC BOTTLED
31	SCHONMARKE	N/A	CANADIAN NON BC BOTTLED
32	SO KITTLING RIDGE	N/A	CANADIAN NON BC BOTTLED
33	SO MONDE	N/A	CANADIAN NON BC BOTTLED
34	SO PELEE	N/A	CANADIAN NON BC BOTTLED
35	SO STREWN	N/A	CANADIAN NON BC BOTTLED
36	SO VIDAL	N/A	CANADIAN NON BC BOTTLED
37	STRATUS	N/A	CANADIAN NON BC BOTTLED
38	TAWSE	N/A	CANADIAN NON BC BOTTLED
39	THIRTY BENCH	N/A	CANADIAN NON BC BOTTLED
40	WAYNEGRETZKY	N/A	CANADIAN NON BC BOTTLED
41	TRIUS	CANADA	CANADIAN NON BC ESTATE
42	1STROW	SURREY	NON-OKANAGAN ESTATE
43	22OAKS	DUNCAN	NON-OKANAGAN ESTATE
44	40KNOTS	COMOX	NON-OKANAGAN ESTATE
45	ALDERLEA	DUNCAN	NON-OKANAGAN ESTATE
46	AVERILLCREEK	DUNCAN	NON-OKANAGAN ESTATE
47	BACCATA RIDGE	GRINDROD	NON-OKANAGAN ESTATE
48	BACKYARDVINEYARD	LANGLEY	NON-OKANAGAN ESTATE
49	BAILLIEGROHMAN	CRESTON	NON-OKANAGAN ESTATE
50	BEAUFORT	COURTENAY	NON-OKANAGAN ESTATE
51	BLACKWOODLANE	ALDERGROVE	NON-OKANAGAN ESTATE
52	BLOSSOM	RICHMOND	NON-OKANAGAN ESTATE
53	BLUEGROUSE	DUNCAN	NON-OKANAGAN ESTATE
54	CANADABERRIES	RICHMOND	NON-OKANAGAN ESTATE
55	CARBREA	HORNBY ISLAND	NON-OKANAGAN ESTATE
56	CELISTA	CELISTA	NON-OKANAGAN ESTATE

Table A.2. Identified wine brands present in the BC market in 2011-2015.			
	Brand Name	**Town**	**Region/Brand Classification**
57	CHALETESTATE	NORTH SAANICH	NON-OKANAGAN ESTATE
58	CHASEWARREN	PORT ALBERNI	NON-OKANAGAN ESTATE
59	CHATEAUISABELLA	RICHMOND	NON-OKANAGAN ESTATE
60	CHERRYPOINT	COWICHAN VALLEY	NON-OKANAGAN ESTATE
61	COLUMBIAGARDENS	TRAIL	NON-OKANAGAN ESTATE
62	DAMALI	COBBLE HILL	NON-OKANAGAN ESTATE
63	DE VINE	SAANICH	NON-OKANAGAN ESTATE
64	DEOL	DUNCAN	NON-OKANAGAN ESTATE
65	DIVINO	COWICHAN VALLEY	NON-OKANAGAN ESTATE
66	DOMAINEDECHABERTON	LANGLEY	NON-OKANAGAN ESTATE
67	DOMAINE JASMIN	THETIS ISLAND	NON-OKANAGAN ESTATE
68	DOMAINE ROCHETTE	SIDNEY	NON-OKANAGAN ESTATE
69	DRAGONFLY HILL	VICTORIA	NON-OKANAGAN ESTATE
70	EDGE OF THE EARTH	ARMSTRONG	NON-OKANAGAN ESTATE
71	EMERALD COAST	PORT ALBERNI	NON-OKANAGAN ESTATE
72	ENRICO	MILL BAY	NON-OKANAGAN ESTATE
73	FORTBERENS	LILOOET	NON-OKANAGAN ESTATE
74	GARRYOAKS	SALT SPRING ISLAND	NON-OKANAGAN ESTATE
75	GLENTERRA	COBBLE HILL	NON-OKANAGAN ESTATE
76	GODFREY BROWNELL	DUNCAN	NON-OKANAGAN ESTATE
77	GRANITECREEK	TAPPEN	NON-OKANAGAN ESTATE
78	HARPERSTRAIL	KAMLOOPS	NON-OKANAGAN ESTATE
79	HIGHLAND HOUSE FARM	SAANICH	NON-OKANAGAN ESTATE
80	KERMODE	DEWDNEY	NON-OKANAGAN ESTATE
81	LARCHHILLS	SALMON ARM	NON-OKANAGAN ESTATE
82	LITTLE TRIBUNE	HORNBY ISLAND	NON-OKANAGAN ESTATE
83	LOTUSLAND	ABBOTSFORD	NON-OKANAGAN ESTATE
84	LULUISLAND	RICHMOND	NON-OKANAGAN ESTATE
85	MAPLE CREEK	SURREY	NON-OKANAGAN ESTATE
86	MIDDLE MOUNTAIN	HORNBY ISLAND	NON-OKANAGAN ESTATE
87	MILLSTONE	NANAIMO	NON-OKANAGAN ESTATE
88	MISTAKENIDENTITY	SALT SPRING ISLAND	NON-OKANAGAN ESTATE
89	MONTECREEK	MONTE CREEK	NON-OKANAGAN ESTATE
90	MORNING BAY	PENDER ISLAND	NON-OKANAGAN ESTATE
91	MTLEHMAN	ABBOTSFORD	NON-OKANAGAN ESTATE
92	MUSE	NORTH SAANICH	NON-OKANAGAN ESTATE
93	NECKOFTHEWOODS	LANGLEY	NON-OKANAGAN ESTATE
94	NORTHERN EXPRESSIONS	PRINCE GEORGE	NON-OKANAGAN ESTATE
95	OVINO	SALMON ARM	NON-OKANAGAN ESTATE
96	PACIFICBREEZE	NEW WESMINSTER	NON-OKANAGAN ESTATE
97	PRIVATO	KAMLOOPS	NON-OKANAGAN ESTATE
98	RECLINERIDGE	TAPPEN	NON-OKANAGAN ESTATE
99	RIVERSBEND	SURREY	NON-OKANAGAN ESTATE
100	ROCKYCREEK	COWICHAN BAY	NON-OKANAGAN ESTATE
101	SAGEWOOD	KAMLOOPS	NON-OKANAGAN ESTATE
102	SALTSPRING	SALT SPRING ISLAND	NON-OKANAGAN ESTATE
103	SANDUZ	RICHMOND	NON-OKANAGAN ESTATE
104	SATURNA	SATURNA ISLAND	NON-OKANAGAN ESTATE
105	SEA STAR	PENDER ISLAND	NON-OKANAGAN ESTATE
106	SEMPER	GRAND FORKS	NON-OKANAGAN ESTATE
107	SINGLETREE	ABBOTSFORD	NON-OKANAGAN ESTATE
108	SKIMMERHORN	CRESTON	NON-OKANAGAN ESTATE

Table A.2. Identified wine brands present in the BC market in 2011-2015.			
	Brand Name	**Town**	**Region/Brand Classification**
109	SOUTHEND FARM	QUADRA ISLAND	NON-OKANAGAN ESTATE
110	STARLING LANE	VICTORIA	NON-OKANAGAN ESTATE
111	SUNNYBRAE	TAPPEN	NON-OKANAGAN ESTATE
112	SUNSHINE COAST	SECHELT	NON-OKANAGAN ESTATE
113	SYMPHONY	SAANICHTON	NON-OKANAGAN ESTATE
114	THECELLARSATRISE	VERNON	NON-OKANAGAN ESTATE
115	UNSWORTH	MILL BAY	NON-OKANAGAN ESTATE
116	VANCOUVERURBANWINERY	VANCOUVER	NON-OKANAGAN ESTATE
117	VENTURI SCHULZE	COBBLE HILL	NON-OKANAGAN ESTATE
118	VIGNETI ZANATTA	DUNCAN	NON-OKANAGAN ESTATE
119	VISTADORO	LANGLEY	NON-OKANAGAN ESTATE
120	WESTHAM	ENDERBY	NON-OKANAGAN ESTATE
121	WYNWOOD CELLARS	DELTA	NON-OKANAGAN ESTATE
122	WATERSIDE	ENDERBY	NON-OKANAGAN ESTATE
123	50THPARALLEL	CRESTON	OKANAGAN ESTATE
124	8THGENERATION	SUMMERLAND	OKANAGAN ESTATE
125	ADEGA ON 45TH	OSOYOOS	OKANAGAN ESTATE
126	ANCIENTHILL	KELOWNA	OKANAGAN ESTATE
127	ANTELOPERIDGE	OLIVER	OKANAGAN ESTATE
128	ARROOWLEAF	LAKE COUNTRY	OKANAGAN ESTATE
129	BARTIERBROS	OLIVER	OKANAGAN ESTATE
130	BEAUMONT	WEST KELOWNA	OKANAGAN ESTATE
131	BENCH1775	NARAMATA	OKANAGAN ESTATE
132	BLACK DOG CELLARS	OKANAGAN FALLS	OKANAGAN ESTATE
133	BLACKHILLS	OLIVER	OKANAGAN ESTATE
134	BLACKWIDOW	NARAMATA	OKANAGAN ESTATE
135	BLASTEDCHURCH	OKANAGAN FALLS	OKANAGAN ESTATE
136	BLUE MOUNTAIN	OKANAGAN FALLS	OKANAGAN ESTATE
137	BONITAS	SUMMERLAND	OKANAGAN ESTATE
138	BURROWINGOWL	OLIVER	OKANAGAN ESTATE
139	CCJENTSCH	OLIVER	OKANAGAN ESTATE
140	CALLIOPE	OLIVER	OKANAGAN ESTATE
141	CALONA	KELOWNA	OKANAGAN ESTATE
142	CAMELOT	KELOWNA	OKANAGAN ESTATE
143	CANA	OLIVER	OKANAGAN ESTATE
144	CASSINICELLARS	OLIVER	OKANAGAN ESTATE
145	CASTORODEORO	OLIVER	OKANAGAN ESTATE
146	CEDARCREEK	KELOWNA	OKANAGAN ESTATE
147	CHANDRA	OLIVER	OKANAGAN ESTATE
148	CHURCHSTATE	OLIVER	OKANAGAN ESTATE
149	COVERTFARMS	OLIVER	OKANAGAN ESTATE
150	CULMINA	OLIVER	OKANAGAN ESTATE
151	DANGELO	PENTICTON	OKANAGAN ESTATE
152	DAYDREAMER	NARAMATA	OKANAGAN ESTATE
153	DEEP ROOTS	NARAMATA	OKANAGAN ESTATE
154	DESERTHILLS	OLIVER	OKANAGAN ESTATE
155	DIRTYLAUNDRY	SUMMERLAND	OKANAGAN ESTATE
156	DOMAINECOMBRET	OLIVER	OKANAGAN ESTATE
157	ELEPHANT ISLAND	NARAMATA	OKANAGAN ESTATE
158	EXNIHILO	LAKE COUNTRY	OKANAGAN ESTATE
159	FAIRVIEW	OLIVER	OKANAGAN ESTATE
160	FIRSTESTATE	PEACHLAND	OKANAGAN ESTATE
161	FOXTROT	NARAMATA	OKANAGAN ESTATE
162	FREQUENCY WINE AND SOUND	KELOWNA	OKANAGAN ESTATE
163	GEHRINGER	OLIVER	OKANAGAN ESTATE

Table A.2. Identified wine brands present in the BC market in 2011-2015.			
	Brand Name	**Town**	**Region/Brand Classification**
164	GOLDHILL	OLIVER	OKANAGAN ESTATE
165	GRAYMONK	LAKE COUNTRY	OKANAGAN ESTATE
166	GREATA	PEACHLAND	OKANAGAN ESTATE
167	HAINLE	PEACHLAND	OKANAGAN ESTATE
168	HAYWIRE	SUMMERLAND	OKANAGAN ESTATE
169	HEAVEN'S GATE	SUMMERLAND	OKANAGAN ESTATE
170	HESTER	OLIVER	OKANAGAN ESTATE
171	HIDDEN CHAPEL	OLIVER	OKANAGAN ESTATE
172	HILLSIDE	PENTICTON	OKANAGAN ESTATE
173	HOUSEOFROSE	KELOWNA	OKANAGAN ESTATE
174	HOWLINGBLUFF	PENTICTON	OKANAGAN ESTATE
175	INNISKILLIN	OLIVER	OKANAGAN ESTATE
176	INTERSECTION	OLIVER	OKANAGAN ESTATE
177	INTRIGUE	LAKE COUNTRY	OKANAGAN ESTATE
178	JACKSONTRIGGS	OLIVER	OKANAGAN ESTATE
179	JOIE	NARAMATA	OKANAGAN ESTATE
180	KALALA	KELOWNA	OKANAGAN ESTATE
181	KANAZAWA	PENTICTON	OKANAGAN ESTATE
182	KETTLE VALLEY	NARAMATA	OKANAGAN ESTATE
183	KISMET	OLIVER	OKANAGAN ESTATE
184	KRAZELEGZ	KALEDEN	OKANAGAN ESTATE
185	LA FRENZ	PENTICTON	OKANAGAN ESTATE
186	LAKEBREEZE	NARAMATA	OKANAGAN ESTATE
187	LANG	NARAMATA	OKANAGAN ESTATE
188	LARIANACELLARS	OSOYOOS	OKANAGAN ESTATE
189	LASTELLA	OSOYOOS	OKANAGAN ESTATE
190	LAUGHINGSTOCK	PENTICTON	OKANAGAN ESTATE
191	LEVIEUXPIN	OLIVER	OKANAGAN ESTATE
192	LIONELLO	PENTICTON	OKANAGAN ESTATE
193	LIQUIDITY	OKANAGAN FALLS	OKANAGAN ESTATE
194	LITTLESTRAW	KELOWNA	OKANAGAN ESTATE
195	LIXIERE	KALEDEN	OKANAGAN ESTATE
196	LOCK &WORTH	PENTICTON	OKANAGAN ESTATE
197	LUSITANO	OKANAGAN FALLS	OKANAGAN ESTATE
198	MARICHEL	NARAMATA	OKANAGAN ESTATE
199	MAVERICK	OLIVER	OKANAGAN ESTATE
200	MEYER	OKANAGAN FALLS	OKANAGAN ESTATE
201	MISCONDUCT	PENTICTON	OKANAGAN ESTATE
202	MISSION HILL	WEST KELOWNA	OKANAGAN ESTATE
203	MOCOJO	NARAMATA	OKANAGAN ESTATE
204	MONEY PIT	OLIVER	OKANAGAN ESTATE
205	MISTRAL	PENTICTON	OKANAGAN ESTATE
206	MONSTER	PENTICTON	OKANAGAN ESTATE
207	MONTAKARN	OLIVER	OKANAGAN ESTATE
208	MOONCURSER	OSOYOOS	OKANAGAN ESTATE
209	MORAINE	PENTICTON	OKANAGAN ESTATE
210	MTBOUCHERIE	KELOWNA	OKANAGAN ESTATE
211	NICHE	KELOWNA	OKANAGAN ESTATE
212	NICHOL	NARAMATA	OKANAGAN ESTATE
213	NKMIP	OSOYOOS	OKANAGAN ESTATE
214	NOBLERIDGE	OKANAGAN FALLS	OKANAGAN ESTATE
215	OLIVERTWIST	OLIVER	OKANAGAN ESTATE
216	OSOYOOSLAROSE	OSOYOOS	OKANAGAN ESTATE
217	PAINTEDROCK	PENTICTON	OKANAGAN ESTATE
218	PARADISERANCH	PENTICTON	OKANAGAN ESTATE
219	PENTAGE	PENTICTON	OKANAGAN ESTATE

Table A.2. Identified wine brands present in the BC market in 2011-2015.			
	Brand Name	**Town**	**Region/Brand Classification**
220	PERSEUS	PENTICTON	OKANAGAN ESTATE
221	PHASION	OKANAGAN FALLS	OKANAGAN ESTATE
222	PLATINUMBENCH	OLIVER	OKANAGAN ESTATE
223	POPLARGROVE	PENTICTON	OKANAGAN ESTATE
224	QUAILSGATE	KELOWNA	OKANAGAN ESTATE
225	QUIDNI	PENTICTON	OKANAGAN ESTATE
226	QUINTAFERREIRA	OLIVER	OKANAGAN ESTATE
227	REDROOSTER	PENTICTON	OKANAGAN ESTATE
228	RIVERSTONE	OLIVER	OKANAGAN ESTATE
229	ROAD13	OLIVER	OKANAGAN ESTATE
230	ROLLINGDALE	KELOWNA	OKANAGAN ESTATE
231	RUBYBLUES	PENTICTON	OKANAGAN ESTATE
232	RUSTICO	OLIVER	OKANAGAN ESTATE
233	SAGEHILLS	SUMMERLAND	OKANAGAN ESTATE
234	SANDHILL	KELOWNA	OKANAGAN ESTATE
235	SAXON	SUMMERLAND	OKANAGAN ESTATE
236	SCORCHED EARTH	KELOWNA	OKANAGAN ESTATE
237	SEEYALATER	OKANAGAN FALLS	OKANAGAN ESTATE
238	SERENDIPITY	NARAMATA	OKANAGAN ESTATE
239	SILK SCARF	SUMMERLAND	OKANAGAN ESTATE
240	SILVERSAGE	OLIVER	OKANAGAN ESTATE
241	SOARINGEAGLE	PENTICTON	OKANAGAN ESTATE
242	SONORAN ESTATE	SUMMERLAND	OKANAGAN ESTATE
243	SPERLING	KELOWNA	OKANAGAN ESTATE
244	SPIERHEAD	KELOWNA	OKANAGAN ESTATE
245	SQUEEZEDWINES	OLIVER	OKANAGAN ESTATE
246	STHUBERTUS	EAST KELOWNA	OKANAGAN ESTATE
247	STABLE DOOR	PENTICTON	OKANAGAN ESTATE
248	STAGSHOLLOW	OKANAGAN FALLS	OKANAGAN ESTATE
249	STONEBOAT	OLIVER	OKANAGAN ESTATE
250	STONEHILL	PENTICTON	OKANAGAN ESTATE
251	SUMACRIDGE	SUMMERLAND	OKANAGAN ESTATE
252	SUMMERGATE	SUMMERLAND	OKANAGAN ESTATE
253	SUMMERHILL	KELOWNA	OKANAGAN ESTATE
254	SYNCHROMESH	OKANAGAN FALLS	OKANAGAN ESTATE
255	TANGLEDVINES	OKANAGAN FALLS	OKANAGAN ESTATE
256	TANTALUS	KELOWNA	OKANAGAN ESTATE
257	TERRAVISTA	PENTICTON	OKANAGAN ESTATE
258	THWINES	SUMMERLAND	OKANAGAN ESTATE
259	THEHATCH	KELOWNA	OKANAGAN ESTATE
260	THEVIEW	KELOWNA	OKANAGAN ESTATE
261	THERAPY	NARAMATA	OKANAGAN ESTATE
262	THORNHAVEN	SUMMERLAND	OKANAGAN ESTATE
263	TIGHTROPE	PENTICTON	OKANAGAN ESTATE
264	TIME	OLIVER	OKANAGAN ESTATE
265	TINHORN	OLIVER	OKANAGAN ESTATE
266	TOPSHELF	KALEDEN	OKANAGAN ESTATE
267	TOWNSHIP7	PENTICTON	OKANAGAN ESTATE
268	TWISTEDTREE	OSOYOOS	OKANAGAN ESTATE
269	UPPERBENCH	PENTICTON	OKANAGAN ESTATE
270	VANWESTEN	NARAMATA	OKANAGAN ESTATE
271	VIBRANT	KELOWNA	OKANAGAN ESTATE
272	VOLCANICHILLS	KELOWNA	OKANAGAN ESTATE
273	WILDGOOSE	OKANAGAN FALLS	OKANAGAN ESTATE
274	WORKING HORSE WINERY	PEACHLAND	OKANAGAN ESTATE
275	YOUNGWYSE	OSOYOOS	OKANAGAN ESTATE

Table A.2. Identified wine brands present in the BC market in 2011-2015.			
	Brand Name	**Town**	**Region/Brand Classification**
276	ZEROBALANCE	PENTICTON	OKANAGAN ESTATE
277	CERELIA	CAWSTON	SIMILKAMEEN VALLEY EST
278	CLOSDUSOLEIL	KEREMEOS	SIMILKAMEEN VALLEY EST
279	CORCELETTES	KEREMEOS	SIMILKAMEEN VALLEY EST
280	CROWSNEST	CAWSTON	SIMILKAMEEN VALLEY EST
281	EAUVIVRE	CAWSTON	SIMILKAMEEN VALLEY EST
282	FORBIDDEN FRUIT	CAWSTON	SIMILKAMEEN VALLEY EST
283	HERDER	KEREMEOS	SIMILKAMEEN VALLEY EST
284	HUGGING TREE	CAWSTON	SIMILKAMEEN VALLEY EST
285	K MOUNTAIN	CAWSTON	SIMILKAMEEN VALLEY EST
286	LITTLEFARM	CAWSTON	SIMILKAMEEN VALLEY EST
287	OROFINO	CAWSTON	SIMILKAMEEN VALLEY EST
288	ROBINRIDGE	KEREMEOS	SIMILKAMEEN VALLEY EST
289	SAGE BUSH	KEREMEOS	SIMILKAMEEN VALLEY EST.
290	SEVENSTONES	CAWSTON	SIMILKAMEEN VALLEY EST.
291	STLASZLO	KEREMEOS	SIMILKAMEEN VALLEY EST.
292	SIRENSCALL	N/A	VIRTUAL BRAND
293	BOUNTYCELLARS	N/A	VIRTUAL BRAND
294	EARLCO	N/A	VIRTUAL BRAND
295	NAGGINGDOUBT	N/A	VIRTUAL BRAND
296	SONORAN RANCH	N/A	VIRTUAL BRAND
297	_49NORTH	N/A	VIRTUAL BRAND
298	_9ACRES	N/A	VIRTUAL BRAND
299	ACES	N/A	VIRTUAL BRAND
300	ANDRES	N/A	VIRTUAL BRAND
301	BLACK CELLAR	N/A	VIRTUAL BRAND
302	BLACK CLOUD	N/A	VIRTUAL BRAND
303	BLACKSAGE	N/A	VIRTUAL BRAND
304	BLACKSWIFT	N/A	VIRTUAL BRAND
305	BODACIOUS	N/A	VIRTUAL BRAND
306	BONAMICI	N/A	VIRTUAL BRAND
307	BROKENSHADOW	N/A	VIRTUAL BRAND
308	CAIRN&YORK	N/A	VIRTUAL BRAND
309	CAPISTRO	N/A	VIRTUAL BRAND
310	CARSON	N/A	VIRTUAL BRAND
311	CLOUD CHASER	N/A	VIRTUAL BRAND
312	COOLSHANAGH	N/A	VIRTUAL BRAND
313	COPPERMOON	N/A	VIRTUAL BRAND
314	DIBELLO	N/A	VIRTUAL BRAND
315	DIABOLICA	N/A	VIRTUAL BRAND
316	DOMAINE D'OR	N/A	VIRTUAL BRAND
317	EDIBLEMARKET	N/A	VIRTUAL BRAND
318	ENOTECA	N/A	VIRTUAL BRAND
319	ENTRE LACS	N/A	VIRTUAL BRAND
320	ERRO	N/A	VIRTUAL BRAND
321	ESCAPOLOGIE	N/A	VIRTUAL BRAND
322	FORKINTHEROAD	N/A	VIRTUAL BRAND
323	FULL PRESS	N/A	VIRTUAL BRAND
324	HELIOS	N/A	VIRTUAL BRAND
325	HOCHTALER	N/A	VIRTUAL BRAND
326	INCLUDE	N/A	VIRTUAL BRAND
327	KINDLE	N/A	VIRTUAL BRAND
328	L'AMBIANCE	N/A	VIRTUAL BRAND
329	LINDEN BAY	N/A	VIRTUAL BRAND
330	LITTLEDOE	N/A	VIRTUAL BRAND
331	MACFITZ	N/A	VIRTUAL BRAND

Table A.2. Identified wine brands present in the BC market in 2011-2015.			
	Brand Name	**Town**	**Region/Brand Classification**
332	MARVELOUS ADVENTURES	N/A	VIRTUAL BRAND
333	MCWATERS	N/A	VIRTUAL BRAND
334	MISSION RIDGE	N/A	VIRTUAL BRAND
335	MONTAIGNE	N/A	VIRTUAL BRAND
336	NATHALIEDECOSTER	N/A	VIRTUAL BRAND
337	NOBLE BEAST	N/A	VIRTUAL BRAND
338	OKANAGANVINEYARDS	N/A	VIRTUAL BRAND
339	ONEFAITHVINEYARDS	N/A	VIRTUAL BRAND
340	OPEN	N/A	VIRTUAL BRAND
341	PAINTED TURTLE	N/A	VIRTUAL BRAND
342	PEMBERTON	N/A	VIRTUAL BRAND
343	PROSPECT	N/A	VIRTUAL BRAND
344	RAFTER	N/A	VIRTUAL BRAND
345	REDBARN	N/A	VIRTUAL BRAND
346	RIGAMAROLE	N/A	VIRTUAL BRAND
347	ROCHE	N/A	VIRTUAL BRAND
348	SAINT AND SINNER	N/A	VIRTUAL BRAND
349	SAWMILL	N/A	VIRTUAL BRAND
350	SCHLOSS LADERHEIM	N/A	VIRTUAL BRAND
351	SCRAPBOOK	N/A	VIRTUAL BRAND
352	SCREW IT	N/A	VIRTUAL BRAND
353	SEVENDIRECTIONS	N/A	VIRTUAL BRAND
354	SHIFT IT	N/A	VIRTUAL BRAND
355	SKINNYGRAPE	N/A	VIRTUAL BRAND
356	SOAHC	N/A	VIRTUAL BRAND
357	SOLA NERO	N/A	VIRTUAL BRAND
358	SOMMET	N/A	VIRTUAL BRAND
359	STOMPING GROUND	N/A	VIRTUAL BRAND
360	STONEROAD	N/A	VIRTUAL BRAND
361	STRUT	N/A	VIRTUAL BRAND
362	THREEBEARRANCH	N/A	VIRTUAL BRAND
363	TOSCANO	N/A	VIRTUAL BRAND
364	TROVE	N/A	VIRTUAL BRAND
365	VINDICATION	N/A	VIRTUAL BRAND
366	VINTAGEINK	N/A	VIRTUAL BRAND
367	WHISTLER	N/A	VIRTUAL BRAND
368	WHITEBEAR	N/A	VIRTUAL BRAND
369	WILDHORSECANYON	N/A	VIRTUAL BRAND
370	WILLOW HILL	N/A	VIRTUAL BRAND
371	WILDTHYME	N/A	VIRTUAL BRAND
372	WINEOCLOCK	N/A	VIRTUAL BRAND
373	WINE4YOU	N/A	VIRTUAL BRAND
374	XOXO	N/A	VIRTUAL BRAND
375	YOLO	N/A	VIRTUAL BRAND
376	ZIRALDO	N/A	VIRTUAL BRAND
377	MISCELLANEOUS	N/A	MISCELLANEOUS

Source: The BCLDB wholesale scanner sales data for 2011-2015.

Table A.3. Identified BC VQA wine brands present in the BC market in 2011-2015.			
	VQA BRAND	**ESTATE LOCATION**	**CLASSIFICATION**
1	MISCELLANEOUS	N/A	MISCELLANEOUS
CANADIAN BRANDS NON-BC WITH ESTATE LOCATION			
2	MIKE WEIR	CANADA	CANADA NON-BC
3	GENERATION SEVEN	CANADA	CANADA NON-BC
4	TRIUS	CANADA	CANADA NON-BC
NON- OKANAGAN OR SIMILKAMEEN VALLEY ESTATES			
5	1ST ROW	SURREY	NON_OKANAGAN ESTATE
6	40 KNOTS	COMOX	NON_OKANAGAN ESTATE
7	ALDERLEA	DUNCAN	NON_OKANAGAN ESTATE
8	AVERILL CREEK	DUNCAN	NON_OKANAGAN ESTATE
9	BACKYARD VINEYARD	LANGLEY	NON_OKANAGAN ESTATE
10	BAILLIEGROHMAN	CRESTON	NON_OKANAGAN ESTATE
11	BEAUFORT	COURTENAY	NON_OKANAGAN ESTATE
12	BLACKWOOD LANE	ALDERGROVE	NON_OKANAGAN ESTATE
13	BLOSSOM	RICHMOND	NON_OKANAGAN ESTATE
14	BLUE GROUSE	DUNCAN	NON_OKANAGAN ESTATE
15	CANADA BERRIES	RICHMOND	NON_OKANAGAN ESTATE
16	CELISTA	CELISTA	NON_OKANAGAN ESTATE
17	CHALET ESTATE	NORTH SAANICH	NON_OKANAGAN ESTATE
18	CHATEAU ISABELLA	RICHMOND	NON_OKANAGAN ESTATE
19	CHERRY POINT	COWICHAN VALLEY	NON_OKANAGAN ESTATE
20	COLUMBIA GARDENS	TRAIL	NON_OKANAGAN ESTATE
21	DOMAINE DE CHABERTON	LANGLEY	NON_OKANAGAN ESTATE
22	FORT BERENS	LILOOET	NON_OKANAGAN ESTATE
23	GARRY OAKS	SALT SPRING ISLAND	NON_OKANAGAN ESTATE
24	GLENTERRA	COBBLE HILL	NON_OKANAGAN ESTATE
25	GRANITE CREEK	TAPPEN	NON_OKANAGAN ESTATE
26	HARPER'S TRAIL	KAMLOOPS	NON_OKANAGAN ESTATE
27	LARCH HILLS	SALMON ARM	NON_OKANAGAN ESTATE
28	LULU ISLAND	RICHMOND	NON_OKANAGAN ESTATE
29	MISTAKEN IDENTITY	SALT SPRING ISLAND	NON_OKANAGAN ESTATE
30	MONTE CREEK	MONTE CREEK	NON_OKANAGAN ESTATE
31	MORNING BAY	PENDER ISLAND	NON_OKANAGAN ESTATE
32	NECK OF THE WOODS	LANGLEY	NON_OKANAGAN ESTATE
33	PACIFIC BREEZE	NEW WESMINSTER	NON_OKANAGAN ESTATE
34	PRIVATO	KAMLOOPS	NON_OKANAGAN ESTATE
35	RECLINE RIDGE	TAPPEN	NON_OKANAGAN ESTATE
36	RIVER'S BEND	SURREY	NON_OKANAGAN ESTATE
37	ROCKY CREEK	COWICHAN BAY	NON_OKANAGAN ESTATE
38	SALT SPRING	SALT SPRING ISLAND	NON_OKANAGAN ESTATE
NON- OKANAGAN OR SIMILKAMEEN VALLEY ESTATES			
39	SATURNA	SATURNA ISLAND	NON_OKANAGAN ESTATE
40	THE CELLARS AT RISE	VERNON	NON_OKANAGAN ESTATE

Table A.3. Identified BC VQA wine brands present in the BC market in 2011-2015.			
	VQA BRAND	**ESTATE LOCATION**	**CLASSIFICATION**
NON- OKANAGAN OR SIMILKAMEEN VALLEY ESTATES			
41	VANCOUVER URBAN WINERY	VANCOUVER	NON_OKANAGAN ESTATE
42	VISTA D'ORO	LANGLEY	NON_OKANAGAN ESTATE
OKANAGAN VALLEY ESTATES			
43	DOMAINE COMBRET	OLIVER	OKANAGAN ESTATE
44	50 TH PARALLEL	CRESTON	OKANAGAN ESTATE
45	8TH GENERATION	SUMMERLAND	OKANAGAN ESTATE
46	ADEGA	OSOYOOS	OKANAGAN ESTATE
47	ANCIENT HILL	KELOWNA	OKANAGAN ESTATE
48	ANTELOPE RIDGE	OLIVER	OKANAGAN ESTATE
49	ARROOWLEAF	LAKE COUNTRY	OKANAGAN ESTATE
50	BARTIER BROS	OLIVER	OKANAGAN ESTATE
51	BEAUMONT	WEST KELOWNA	OKANAGAN ESTATE
52	BENCH 1775	NARAMATA	OKANAGAN ESTATE
53	BLACK HILLS	OLIVER	OKANAGAN ESTATE
54	BLACK WIDOW	NARAMATA	OKANAGAN ESTATE
55	BLASTED CHURCH	OKANAGAN FALLS	OKANAGAN ESTATE
56	BONITAS	SUMMERLAND	OKANAGAN ESTATE
57	BURROWING OWL	OLIVER	OKANAGAN ESTATE
58	C.C. JENTSCH	OLIVER	OKANAGAN ESTATE
59	CALONA	KELOWNA	OKANAGAN ESTATE
60	CAMELOT	KELOWNA	OKANAGAN ESTATE
61	CASSINI CELLARS	OLIVER	OKANAGAN ESTATE
62	CASTORO DE ORO	OLIVER	OKANAGAN ESTATE
63	CEDAR CREEK	KELOWNA	OKANAGAN ESTATE
64	CHURCH & STATE	OLIVER	OKANAGAN ESTATE
65	COVERT FARMS	OLIVER	OKANAGAN ESTATE
66	CULMINA	OLIVER	OKANAGAN ESTATE
67	D'ANGELO	PENTICTON	OKANAGAN ESTATE
68	DAYDREAMER	NARAMATA	OKANAGAN ESTATE
69	DESERT HILLS	OLIVER	OKANAGAN ESTATE
70	DIRTY LAUNDRY	SUMMERLAND	OKANAGAN ESTATE
71	EX NIHILO	LAKE COUNTRY	OKANAGAN ESTATE
72	FAIRVIEW	OLIVER	OKANAGAN ESTATE
73	FIRST ESTATE	PEACHLAND	OKANAGAN ESTATE
74	GEHRINGER	OLIVER	OKANAGAN ESTATE
75	GOLD HILL	OLIVER	OKANAGAN ESTATE
76	GRAY MONK	LAKE COUNTRY	OKANAGAN ESTATE
77	GREATA	PEACHLAND	OKANAGAN ESTATE
78	HAINLE	PEACHLAND	OKANAGAN ESTATE
79	HAYWIRE	SUMMERLAND	OKANAGAN ESTATE
80	HESTER	OLIVER	OKANAGAN ESTATE
81	HILLSIDE	PENTICTON	OKANAGAN ESTATE

Table A.3. Identified BC VQA wine brands present in the BC market in 2011-2015.			
	VQA BRAND	**ESTATE LOCATION**	**CLASSIFICATION**
OKANAGAN VALLEY ESTATES			
82	HOUSE OF ROSE	KELOWNA	OKANAGAN ESTATE
83	HOWLING BLUFF	PENTICTON	OKANAGAN ESTATE
84	INNISKILLIN	OLIVER	OKANAGAN ESTATE
85	INTERSECTION	OLIVER	OKANAGAN ESTATE
86	INTRIGUE	LAKE COUNTRY	OKANAGAN ESTATE
87	JACKSON TRIGGS	OLIVER	OKANAGAN ESTATE
88	JOIE	NARAMATA	OKANAGAN ESTATE
89	KALALA	KELOWNA	OKANAGAN ESTATE
90	KANAZAWA	PENTICTON	OKANAGAN ESTATE
91	KISMET	OLIVER	OKANAGAN ESTATE
92	KRAZE LEGZ	KALEDEN	OKANAGAN ESTATE
93	LAKE BREEZE	NARAMATA	OKANAGAN ESTATE
94	LANG	NARAMATA	OKANAGAN ESTATE
95	LARIANA CELLARS	OSOYOOS	OKANAGAN ESTATE
96	LASTELLA	OSOYOOS	OKANAGAN ESTATE
97	LAUGHING STOCK	PENTICTON	OKANAGAN ESTATE
98	LE VIEUX PIN	OLIVER	OKANAGAN ESTATE
99	LITTLE STRAW	KELOWNA	OKANAGAN ESTATE
100	LIXIERE	KALEDEN	OKANAGAN ESTATE
101	LUSITANO	OKANAGAN FALLS	OKANAGAN ESTATE
102	MARICHEL	NARAMATA	OKANAGAN ESTATE
103	MAVERICK	OLIVER	OKANAGAN ESTATE
104	MEYER	OKANAGAN FALLS	OKANAGAN ESTATE
105	MISCONDUCT	PENTICTON	OKANAGAN ESTATE
106	MISSION HILL	WEST KELOWNA	OKANAGAN ESTATE
107	MISTRAL	PENTICTON	OKANAGAN ESTATE
108	MONSTER	PENTICTON	OKANAGAN ESTATE
109	MONTAKARN	OLIVER	OKANAGAN ESTATE
110	MOON CURSER	OSOYOOS	OKANAGAN ESTATE
111	MORAINE	PENTICTON	OKANAGAN ESTATE
112	MT. BOUCHERIE	KELOWNA	OKANAGAN ESTATE
113	NICHE	KELOWNA	OKANAGAN ESTATE
114	NK'MIP	OSOYOOS	OKANAGAN ESTATE
115	NOBLE RIDGE	OKANAGAN FALLS	OKANAGAN ESTATE
116	OLIVER TWIST	OLIVER	OKANAGAN ESTATE
117	OSOYOOS LAROSE	OSOYOOS	OKANAGAN ESTATE
118	PAINTED ROCK	PENTICTON	OKANAGAN ESTATE
119	PARADISE RANCH	PENTICTON	OKANAGAN ESTATE
120	PENTAGE	PENTICTON	OKANAGAN ESTATE
121	PERSEUS	PENTICTON	OKANAGAN ESTATE
122	PLATINUM BENCH	OLIVER	OKANAGAN ESTATE
123	POPLAR GROVE	PENTICTON	OKANAGAN ESTATE

Table A.3. Identified BC VQA wine brands present in the BC market in 2011-2015.			
	VQA BRAND	**ESTATE LOCATION**	**CLASSIFICATION**
OKANAGAN VALLEY ESTATES			
124	QUAIL'S GATE	KELOWNA	OKANAGAN ESTATE
125	QUIDNI	PENTICTON	OKANAGAN ESTATE
126	QUINTA FERREIRA	OLIVER	OKANAGAN ESTATE
127	RED ROOSTER	PENTICTON	OKANAGAN ESTATE
128	RIVER STONE	OLIVER	OKANAGAN ESTATE
129	ROAD 13	OLIVER	OKANAGAN ESTATE
130	ROLLINGDALE	KELOWNA	OKANAGAN ESTATE
131	RUBY BLUES	PENTICTON	OKANAGAN ESTATE
132	SAGE HILLS	SUMMERLAND	OKANAGAN ESTATE
133	SANDHILL	KELOWNA	OKANAGAN ESTATE
134	SAXON	SUMMERLAND	OKANAGAN ESTATE
135	SEE YA LATER	OKANAGAN FALLS	OKANAGAN ESTATE
136	SERENDIPITY	NARAMATA	OKANAGAN ESTATE
137	SILVER SAGE	OLIVER	OKANAGAN ESTATE
138	SOARING EAGLE	PENTICTON	OKANAGAN ESTATE
139	SONORAN ESTATE	SUMMERLAND	OKANAGAN ESTATE
140	SPERLING	KELOWNA	OKANAGAN ESTATE
141	SPIERHEAD	KELOWNA	OKANAGAN ESTATE
142	SQUEEZED WINES	OLIVER	OKANAGAN ESTATE
143	ST. HUBERTUS	EAST KELOWNA	OKANAGAN ESTATE
144	STAG'S HOLLOW	OKANAGAN FALLS	OKANAGAN ESTATE
145	STONEBOAT	OLIVER	OKANAGAN ESTATE
146	STONEHILL	PENTICTON	OKANAGAN ESTATE
147	SUMAC RIDGE	SUMMERLAND	OKANAGAN ESTATE
148	SUMMERGATE	SUMMERLAND	OKANAGAN ESTATE
149	SUMMERHILL	KELOWNA	OKANAGAN ESTATE
150	TANGLED VINES	OKANAGAN FALLS	OKANAGAN ESTATE
151	TANTALUS	KELOWNA	OKANAGAN ESTATE
152	TERRAVISTA	PENTICTON	OKANAGAN ESTATE
153	TH WINES	SUMMERLAND	OKANAGAN ESTATE
154	THE HATCH	KELOWNA	OKANAGAN ESTATE
155	THE VIEW	KELOWNA	OKANAGAN ESTATE
156	THERAPY	NARAMATA	OKANAGAN ESTATE
157	THORNHAVEN	SUMMERLAND	OKANAGAN ESTATE
158	TIME	OLIVER	OKANAGAN ESTATE
159	TINHORN	OLIVER	OKANAGAN ESTATE
160	TOP SHELF	KALEDEN	OKANAGAN ESTATE
161	TOWNSHIP 7	PENTICTON	OKANAGAN ESTATE
162	TWISTED TREE	OSOYOOS	OKANAGAN ESTATE
163	UPPER BENCH	PENTICTON	OKANAGAN ESTATE
164	VAN WESTEN	NARAMATA	OKANAGAN ESTATE
165	VIBRANT	KELOWNA	OKANAGAN ESTATE

Table A.3. Identified BC VQA wine brands present in the BC market in 2011-2015.			
	VQA BRAND	**ESTATE LOCATION**	**CLASSIFICATION**
166	VOLCANIC HILLS	KELOWNA	OKANAGAN ESTATE
167	WILD GOOSE	OKANAGAN FALLS	OKANAGAN ESTATE
168	YOUNG & WYSE	OSOYOOS	OKANAGAN ESTATE
169	ZERO BALANCE	PENTICTON	OKANAGAN ESTATE
SIMILKAMEEN VALLEY ESTATES			
170	CLOS DU SOLEIL	KEREMEOS	SIMILKAMEEN VALLEY ESTATE
171	CORCELETTES	KEREMEOS	SIMILKAMEEN VALLEY ESTATE
172	CROWSNEST	CAWSTON	SIMILKAMEEN VALLEY ESTATE
173	EAUVIVRE	CAWSTON	SIMILKAMEEN VALLEY ESTATE
174	HERDER	KEREMEOS	SIMILKAMEEN VALLEY ESTATE
175	LITTLE FARM	CAWSTON	SIMILKAMEEN VALLEY ESTATE
176	OROFINO	CAWSTON	SIMILKAMEEN VALLEY ESTATE
177	ROBIN RIDGE	KEREMEOS	SIMILKAMEEN VALLEY ESTATE
178	SEVEN STONES	CAWSTON	SIMILKAMEEN VALLEY ESTATE
179	ST. LASZLO	KEREMEOS	SIMILKAMEEN VALLEY ESTATE
VIRTUAL BRANDS WITH UNIDENTIFIED ESTATES LOCATION			
180	WILD HORSE CANYON	VIRTUAL BRAND	ARTISAN WINE SHOP
181	49 NORTH	VIRTUAL BRAND	ARTISAN WINE SHOP
182	9 ACRES	VIRTUAL BRAND	
183	ACES	VIRTUAL BRAND	ACES WINE GROUP
184	ANDRES	VIRTUAL BRAND	BELONGS TO ANDREW PELLER
185	BLACK SAGE	VIRTUAL BRAND	BELONGS TO CONSTELLATION BRANDS
186	BONAMICI	VIRTUAL BRAND	BELONGS TO BONAMICI CELLARS CONSULTING GROUP
187	BOUNTY CELLARS	VIRTUAL BRAND	BOUNTY CELLARS (RON PENNINGTON)
188	BROKEN SHADOW	VIRTUAL BRAND	ARTISAN WINE SHOP
189	CALLIOPE	VIRTUAL BRAND	BELONGS TO BURROWING OWL
190	COOLSHANAGH	VIRTUAL BRAND	BELONGS TO SKIP AND JUDY STOTHERT. GRAPES CRUSHED IN THE OKANAGAN CRUSHPAD
191	COPPER MOON	VIRTUAL BRAND	BELONGS TO ANDREW PELLER
192	DIABOLICA	VIRTUAL BRAND	ARTISAN WINE SHOP
193	EDIBLE MARKET	VIRTUAL BRAND	
194	FORK IN THE ROAD	VIRTUAL BRAND	ARTISAN WINE SHOP
195	HELIOS	VIRTUAL BRAND	BELONGS TO TERRABELLA WINERIES LTD.
196	KINDLE	VIRTUAL BRAND	ARTISAN WINE SHOP
197	LITTLE DOE	VIRTUAL BRAND	
198	MAC & FITZ	VIRTUAL BRAND	ARTISAN WINE SHOP
199	MCWATERS	VIRTUAL BRAND	BELONGS TO ENCORE VINEYARDS (HARRY MCWATERS)
200	NAGGING DOUBT	VIRTUAL BRAND	BELONGS TO ROBERT WESBURY
201	NATHALIE DECOSTER	VIRTUAL BRAND	BELONGS TO VMF KELOWNA
202	OKANAGAN VINEYARDS	VIRTUAL BRAND	
203	ONE FAITH VINEYARDS	VIRTUAL BRAND	BELONGS TO BILL LUI

Table A.3. Identified BC VQA wine brands present in the BC market in 2011-2015.			
	VQA BRAND	**ESTATE LOCATION**	**CLASSIFICATION**
VIRTUAL BRANDS WITH UNIDENTIFIED ESTATES LOCATION			
204	OPEN	VIRTUAL BRAND	BELONGS TO CONSTELLATION BRANDS
205	PROSPECT& GANTON	VIRTUAL BRAND	ARTISAN WINE SHOP (BELONGS TO VMF KELOWNA)
206	RAFTER	VIRTUAL BRAND	BELONGS TO BILL AND DARLENE FREDING
207	RED BARN	VIRTUAL BRAND	ARTISAN WINE SHOP
208	RIGAMAROLE	VIRTUAL BRAND	ARTISAN WINE SHOP (BELONGS TO VMF KELOWNA)
209	ROCHE	VIRTUAL BRAND	BELONGS TO DYLAN AND PENELOPE ROCHE
210	SAWMILL	VIRTUAL BRAND	BELONGS TO CONSTELLATION BRANDS
211	SCRAPBOOK	VIRTUAL BRAND	
212	SEVEN DIRECTIONS	VIRTUAL BRAND	BELONGS TO DANIEL BONTORIN (CONSULTING WINEMAKER)
213	SIREN'S CALL	VIRTUAL BRAND	BC WINE STUDIO
214	SONORAN RANCH	VIRTUAL BRAND	ARTISAN WINE SHOP
215	STONE ROAD	VIRTUAL BRAND	
216	STRUT	VIRTUAL BRAND	NIAGARA PENINSULA BRAND
217	THREE BEAR RANCH	VIRTUAL BRAND	ARTISAN WINE SHOP
218	VINTAGE INK	VIRTUAL BRAND	BELONGS TO CONSTELLATION BRANDS
219	WHISTLER	VIRTUAL BRAND	
220	WHITE BEAR	VIRTUAL BRAND	ARTISAN WINE SHOP
221	WILD THYME	VIRTUAL BRAND	
222	WINE O'CLOCK	VIRTUAL BRAND	ARTISAN WINE SHOP

Source: The BCLDB wholesale scanner sales data for 2011-2015.
Note: Virtual brands were defined as those that didn't have physical location for their estate (actual address with tasting room, estate location that could be found while searching for their brand names online). It is acknowledged that certain brands classified as virtual brands could become estate wineries later and open physical tasting room, but at the time when this research was pursued they weren't identified as such. Whenever possible, virtual brand was assigned to its actual owner (physical person(s) or company).

Appendix B: Chapter 3

Letter B.1. Initial letter and email send out to wineries in August 2015.

Dear Sir/Madam,

I am a 3rd year PhD student in the Faculty of Land and Food Systems at the University of British Columbia in Vancouver and would deeply appreciate your assistance acquiring data for my research. An agricultural economist by training, I have undergraduate and graduate degrees from the University of British Columbia. More information about my background and experience can be found here: https://www.linkedin.com/profile/view?id=145572124&trk=nav_responsive_tab_profile

My PhD research is focused on the British Columbia wine industry and specifically the influence of winery location in the Okanagan and Similkameen valleys on wine value.
I hope to have your cooperation in my research. Below are short descriptions of my proposed research; a description of the data I have access to; and the data I am seeking from you.

Research description:
Robert Mondavi once said:" One bad wine in the valley is bad for every winery in the valley. One good wine in the valley is good for everyone." This is one of the statements that led me towards my PhD thesis topic. In researching wine industries around the world and specifically the BC wine industry I noticed a gap in the economic literature and understanding related to spatial relationships and spatial clustering among wineries in wine regions worldwide and specifically in the BC Wine Country.
Therefore, I propose to combine a wine pricing dataset with geographical information system (GIS) data in order to estimate wine price and location relationships for wines and wineries in BC. Specifically, my research aims to test following hypotheses:

Hypothesis 1: Fruit from different locations in the Okanagan and Similkameen Valleys produces wines that differ in quality related variables. The cause is fruit

quality differences resulting from the combined effects of terroir (soil, slope, climate etc.) and management practices. Therefore, the value of terroir is likely location specific and differs regionally.

Research question 1:

What is the value of terroir in different regions in influencing wine price?

Hypothesis 2: The economic theory usually claims that close proximity to a well - established and recognized neighbor brings the recognition to the whole sub-region and as a consequence it is beneficial to all lesser known neighbors in the same area. But there might be instances when a well-known and recognized neighbor (or neighbors) negatively impacts the sale of products of lesser-known neighbors.

Research Question 2: Is there always a positive value gained from a location near a well-recognized winery with a well-known, well -established reputation?

Hypothesis 3: An easy access to the point of sales is one of the most important elements influencing business and sales. It is especially important in cases of EX-factory (or EX-winery) sales. Therefore, it is hypothesized that wineries located near main roads and closer to the wine route are rewarded with higher benefits regardless the quality of wine.

Research Question 3: How does the distance from the main wine route/main road influences wine prices?

Accessible Data

I have access to wine pricing data from the BC Liquor Distribution Branch, for all wine types sold in British Columbia between 2011 and 2015. This includes sales data on a selection of wines produced by your winery.

Data Needed from Your Winery

I would like to obtain the exact location of the vineyard or vineyard block where the grapes used to produce a certain selection of your wines were grown.

Please note: Not all of your wines will be used for the purpose of this research so I won't need GIS data on all grapes growing plots. I aim to use a selection of varietal wines, ***not***

more than 6 wines *depending on how many wine types produced by your winery are in the BCLCB dataset).*

If you are willing to provide the information I am requesting, please send me an email to xxx@gmail.com and I will provide you with a short table for you to identify the vineyard block location to specific wines that I chose to use in my research.

The exact GIS positioning and associated agriculture-related variables I will be able to obtain from Dr. P.B. from PARC/AAFC Summerland after your confirmation on willingness to cooperate on this research.

Having fruit production location data will enable proper estimation of variables associated with the value of terroir. Until now almost all economics research related to wine terroir assumed that grapes are grown in close proximity or at the estate winery. This assumption is often not true and as a consequence such research can yield biased estimates.

I would deeply appreciate your assistance in helping me acquire the data needed for my research. I believe this research will be valuable to the wine industry in recommending locations or clustering that will benefit marketing strategies and economics. In exchange I will offer summary results that will have estimates clearly visible for your winery and coded results for your winery neighbors (to fulfill confidentiality requirements).

Please be assured that all information I receive from you will remain confidential. I would be happy to arrange for a confidentiality agreement if you request one. All results coming from this research will have general character and they won't be showing any specifics related to the exact data information I am asking from you.

If you have any suggestions, questions or comments related to this project, please do not hesitate to contact me. Your insights on this subject would be valuable to me.

Please contact me by email: xxx@gmail.com or phone: XXXX

Thank you very much, and I hope to hear from you soon.

Sincerely,

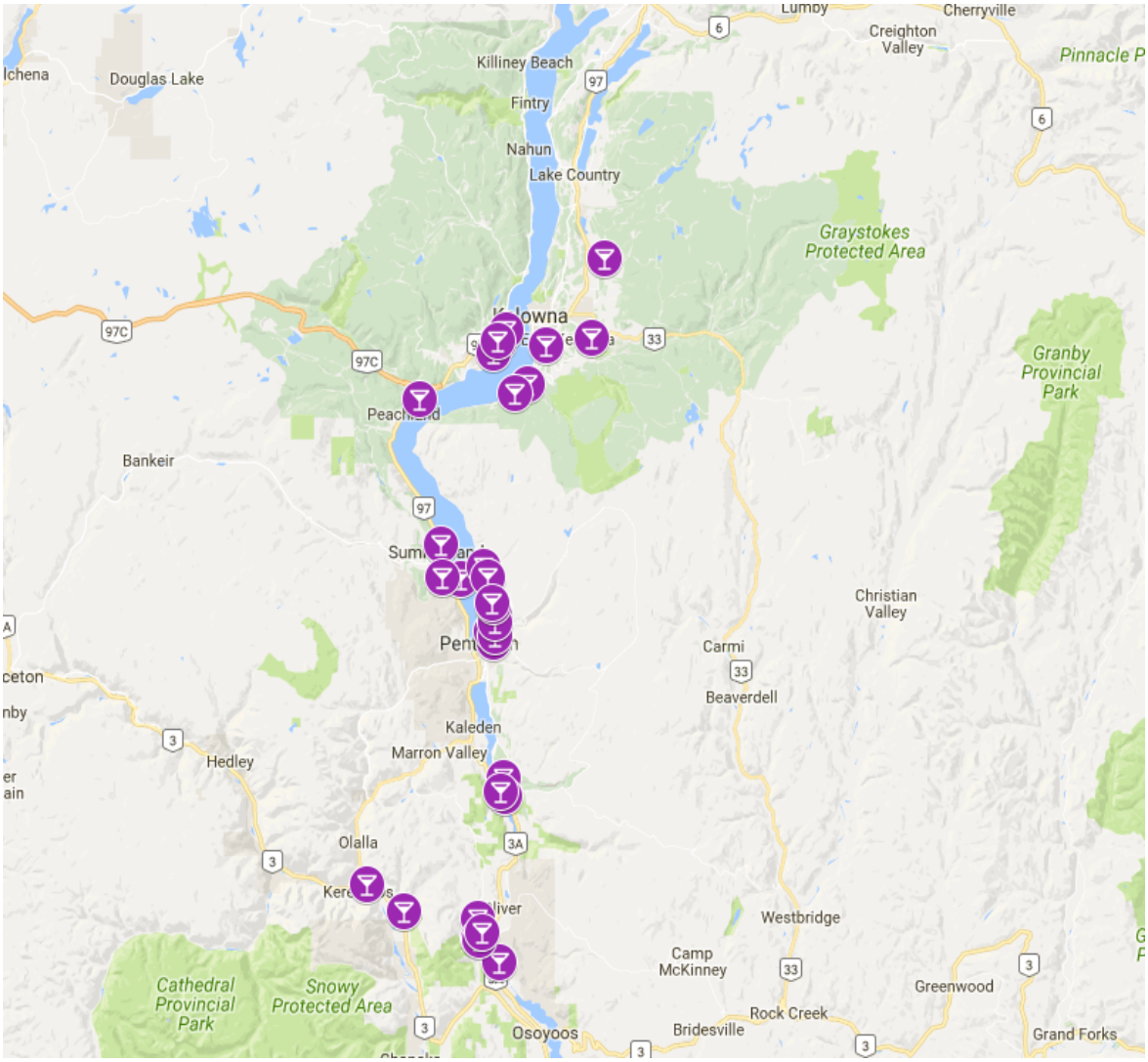
Kate Pankowska

Table B.1. List of wineries that participated in the research presented in chapter 3.

WINERY/ BRAND	ESTATE LOCATION
8TH GENERATION	6807 BC-97, Summerland, BC V0H 1Z9
ANCIENT HILL	4918 Anderson Road, Kelowna, BC V1X 7V7
BENCH 1775	1775 Naramata Rd, Penticton, BC V2A 8T8
BLACK HILLS	4318 Black Sage Rd, Oliver, BC V0H 1T1
BLACK WIDOW	1630 Naramata Rd, Penticton, BC V2A 8T7
CROWSNEST	2035 Surprise Rd, Cawston, BC V0X 1C2
D'ANGELO	979 Lochore Road, Penticton, BC, V2A 8V1
FAIRVIEW	989 Cellar Road, Just off Old Golf Course Road, Oliver, BC
GEHRINGER BROTHERS	876 Road #8, Oliver, BC V0H 1T1
HAINLE	5355 Trepanier Bench Rd, Peachland, BC VOH 1X2
HAYWIRE	16576 Fosbery Rd, Summerland, BC V0H 1Z6
HESTER CREEK	877 Road 8, Oliver, BC V0H 1V5
HILLSIDE	1350 Naramata Rd, Penticton, BC V2A 8T6
HOUSE OF ROSE	2270 Garner Rd, Kelowna, BC
HOWLING BLUFF	1086 Three Mile Rd, Penticton, BC V2A 8T7
LANG	2493 Gammon Rd, Naramata, BC V0H 1N0
LITTLE STRAW	2815 Ourtoland Rd, Kelowna, BC V1Z 2H7
MEYER	4287 McLean Creek Rd, Okanagan Falls, BC V0H 1R1
MISCONDUCT	375 Upper Bench Rd N, Penticton, BC V2A 8T2
NOBLE RIDGE	2320 Oliver Ranch Rd, Okanagan Falls, BC V0H 1R2
POPLAR GROVE	425 Middle Bench Rd N, Penticton, BC V2A 8S5
QUAILS GATE	3303 Boucherie Rd, West Kelowna, BC V1Z 2H3
ROBIN RIDGE	2686 Middle Bench Rd SS 2, Keremeos, BC V0X 1N2
ROLLINGDALE	2306 Hayman Rd, West Kelowna, BC V1Z 1Z5
SERENDIPITY	990 Debeck Road, Naramata, BC V0H 1N0
SPERLING	1405 Pioneer Rd, Kelowna, BC V1W 4M6
ST. HUBERTUS &OAK BAY	5205 Lakeshore Rd, Kelowna, BC V1W 4J1
SUMMERHILL	4870 Chute Lake Rd, Kelowna, BC V1W 4M3
THORNHAVEN	6816 Andrew Ave, Summerland, BC V0H 1Z7
TINHORN	537 Tinhorn Creek Rd, Oliver, BC V0H 1T1
UPPER BENCH	170 Upper Bench Rd S, Penticton, BC V2A 8T1
VOLCANIC HILLS	2845 Boucherie Rd, West Kelowna, BC V1Z 2G6
WILD GOOSE	2145 Sun Valley Way, Okanagan-Similkameen D, BC V0H 1R2

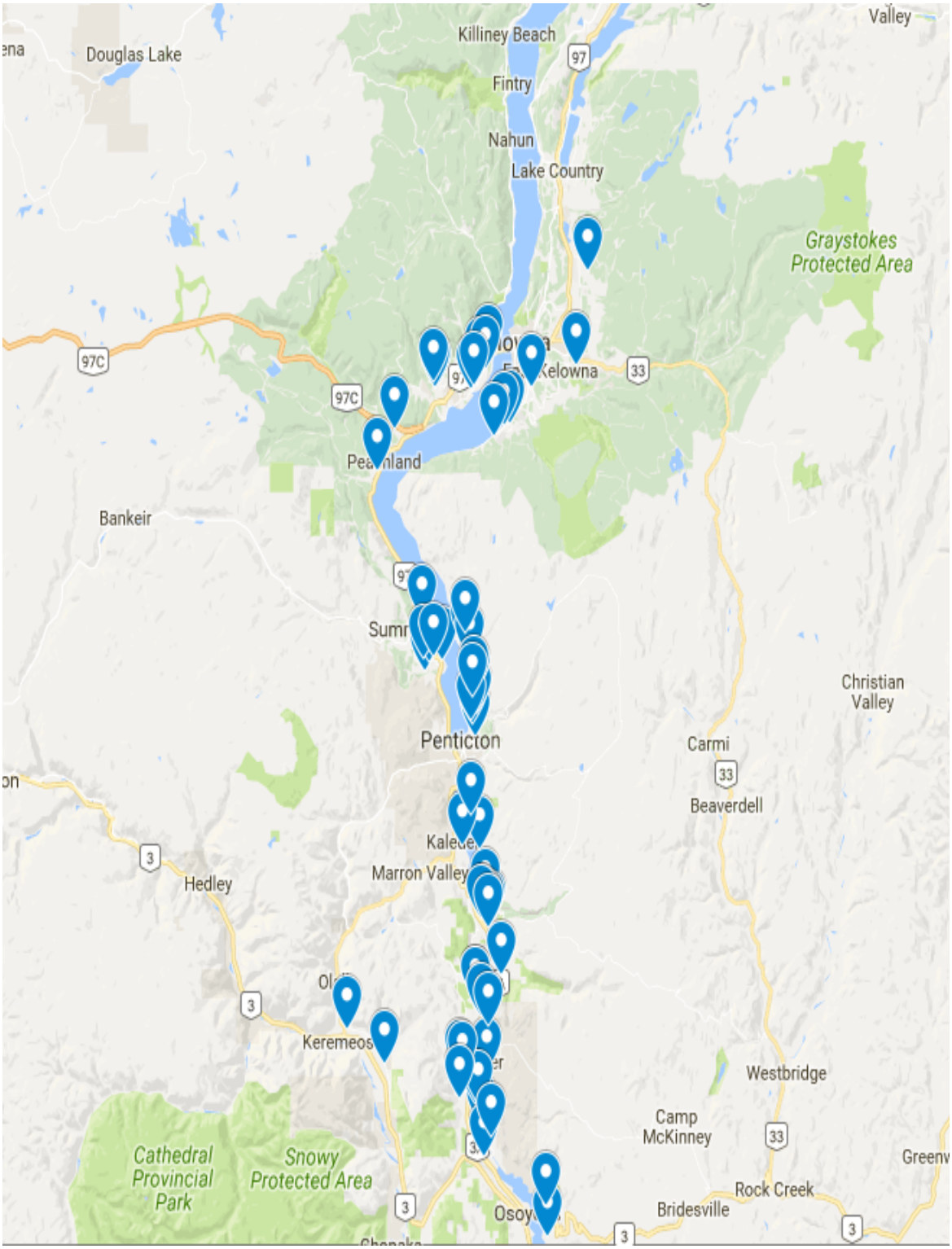
**All winery-specific results from this analysis have been coded to assure privacy.

Figure B.1. The map with locations of the estate wineries that cooperated on the research presented in this chapter.



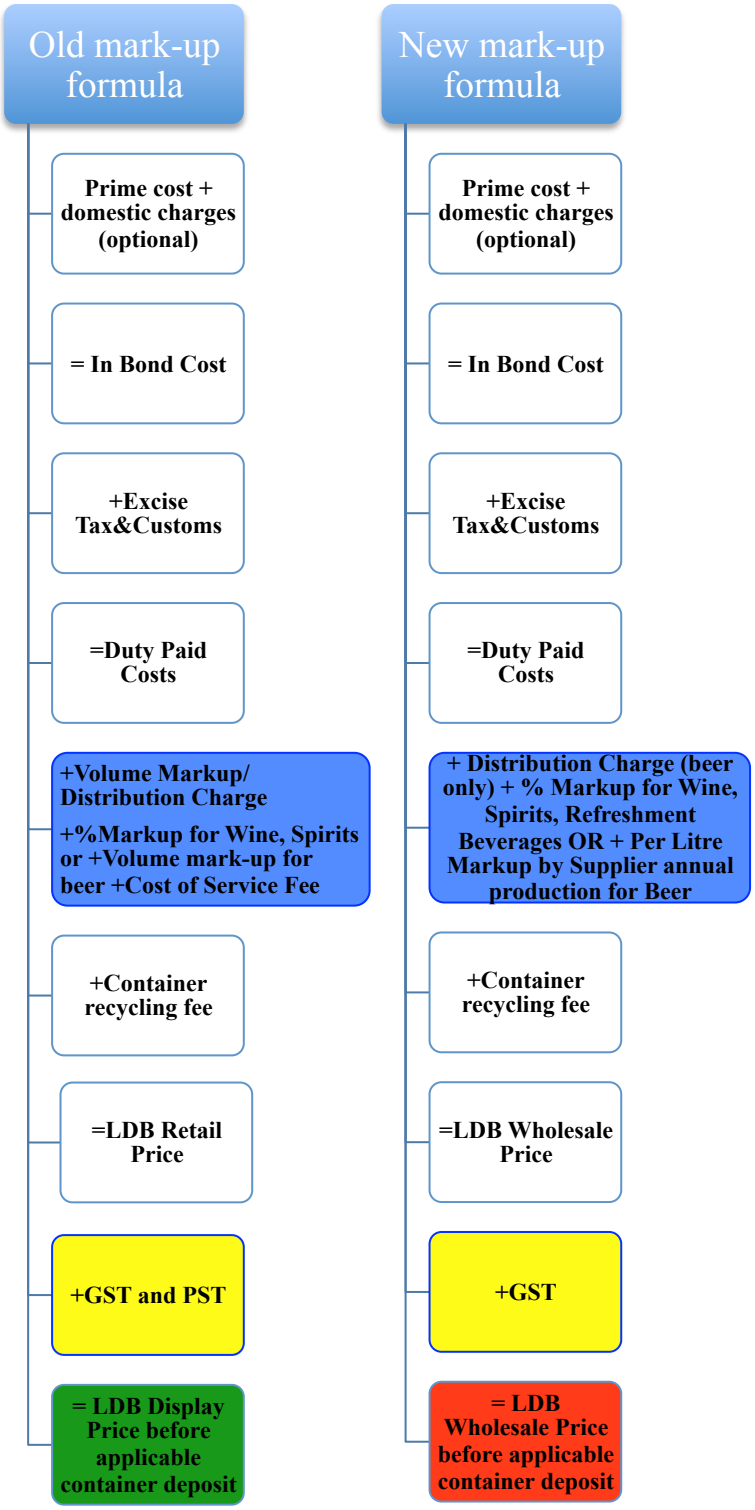
Source: Own mapping using Google maps: https://www.google.com/maps/about/mymaps/

Figure B.2. The map with locations of the vineyards that sorced grapes of the BC VQA wines analyzed in this chapter.



Source: Own mapping using Google maps: https://www.google.com/maps/about/mymaps/

Figure B.3. Old and new BCLDB wine mark-up formulas.



Source: Based on the BCLDB website accessed on April 1, 2017: http://www.bcldb.com/files/Wholesale_Pricing_Changes-Overview.pdf

The BCLDB pricing data set for 2011-2013 includes BC VQA wine prices as per the green box in the Chart 1, above. They include GST and PST taxes.

The BCLDB pricing data set for 2014-2015 includes BC VQA wine prices as per the red box in the Chart 1, above. They include GST tax only.

Therefore, to make them more comparable, the prices for 2011-2013 were corrected to exclude the PST tax. Please compare "yellow" boxes on Chart 1.

Please note: According to the official statements, the BC VQA wines DO NOT go through a standard BCLDB mark-up process. So the "blue" boxes in the Chart 1, above don't apply to the BC VQA wines. There is a chance that there were some other pricing adjustments done by the BCLDB to the BC VQA wines between 2011-2015. Unfortunately the information on such possible pricing adjustments is not available.

Figure B.4. Price vs vineyard's aspect, separated by grape variety.

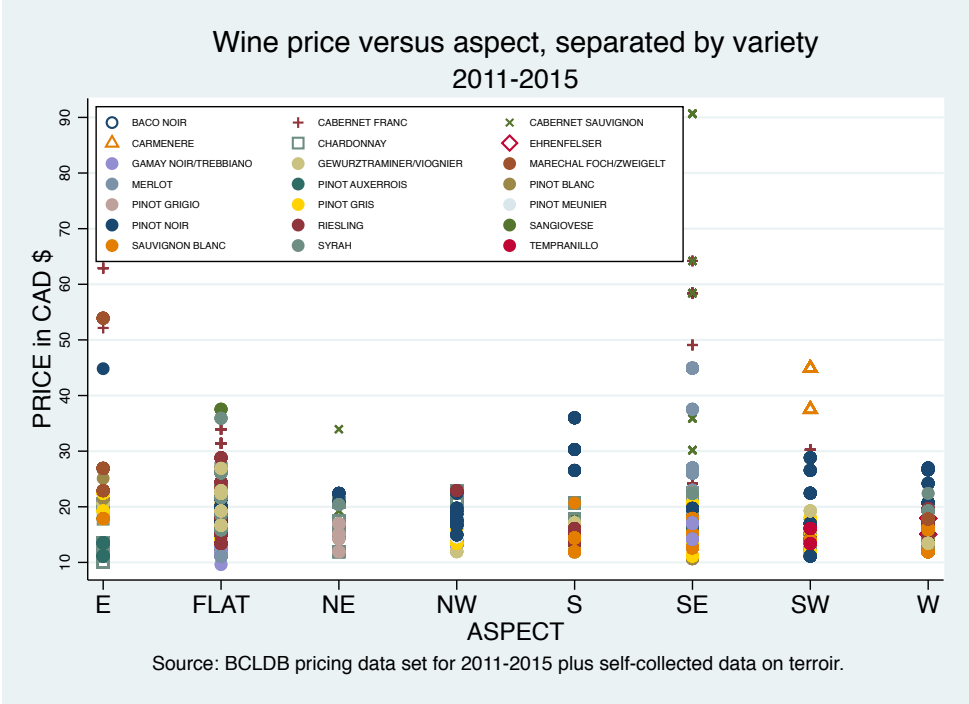


Figure B.5. Price vs row direction in the vineyard, separated by grape variety.

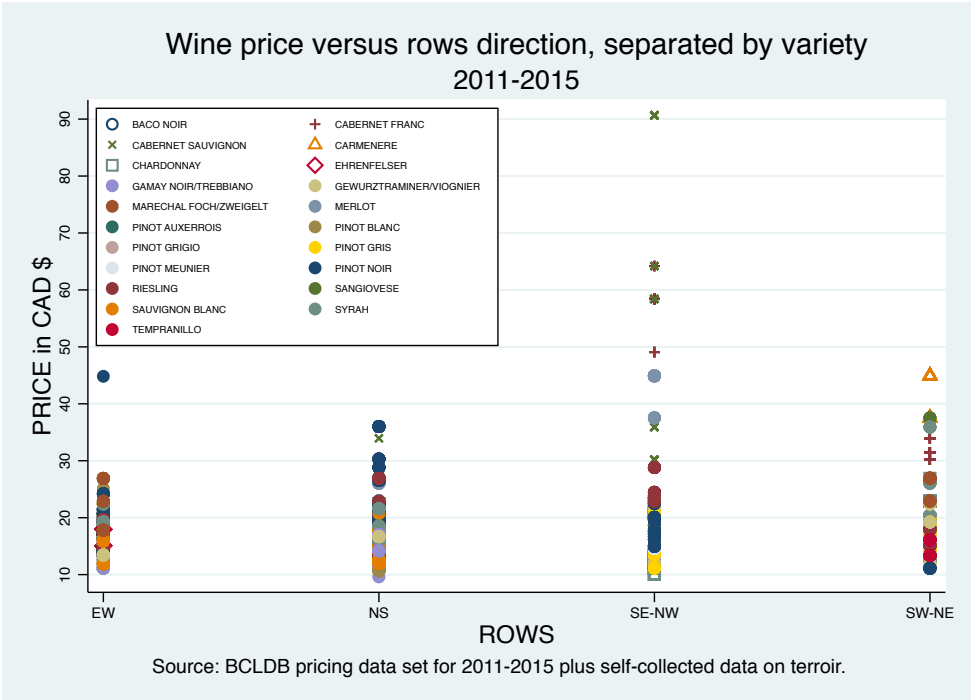
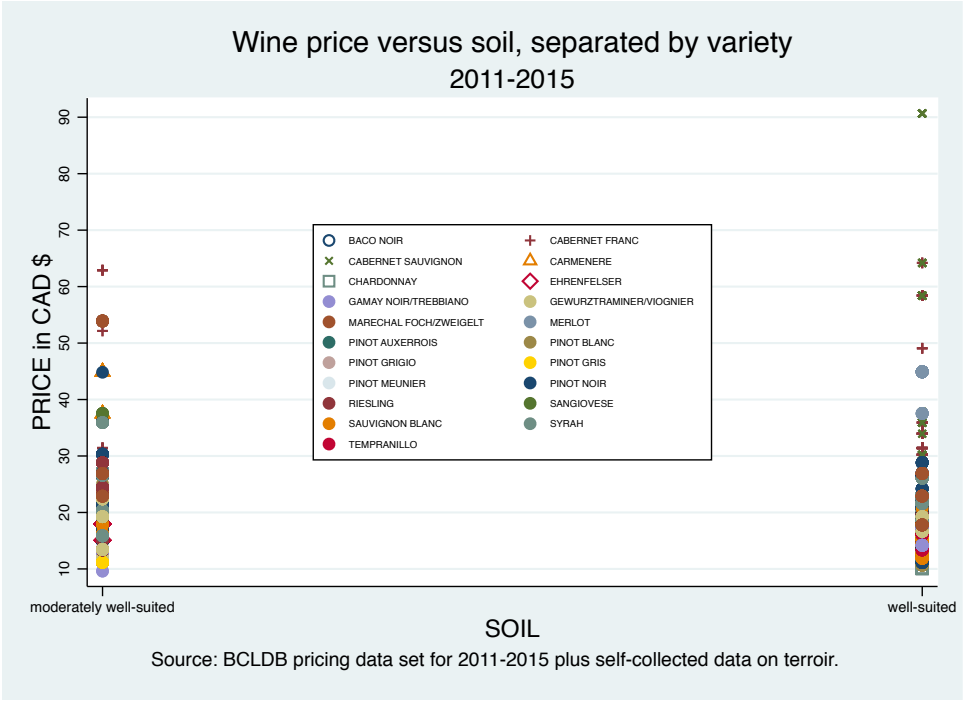
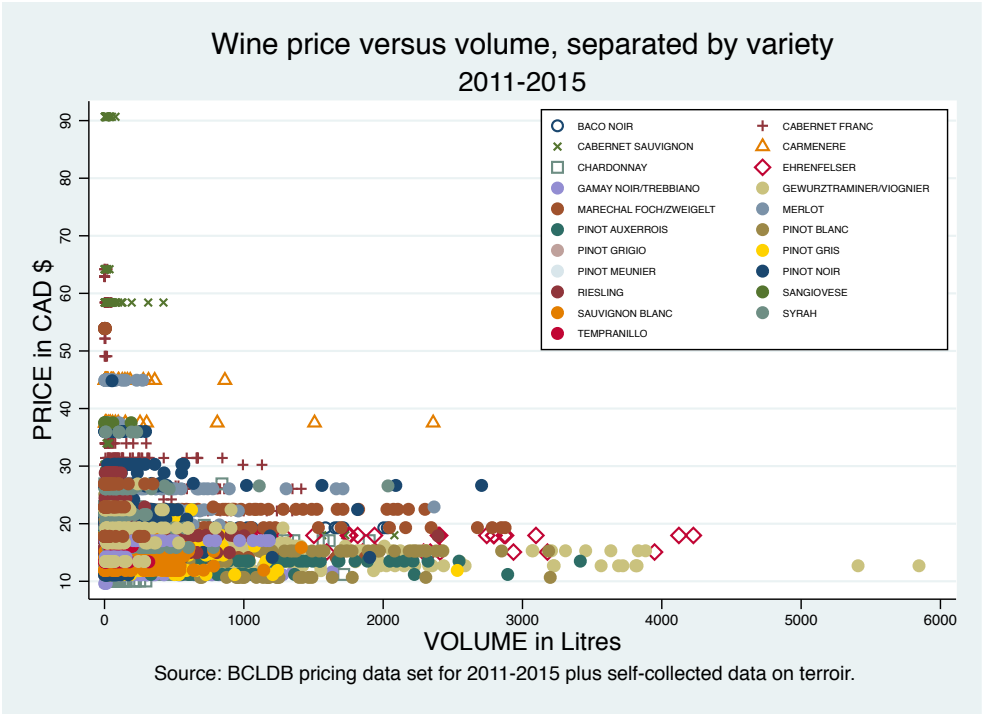


Figure B.6. Price vs row soil on the vineyard, separated by grape variety.



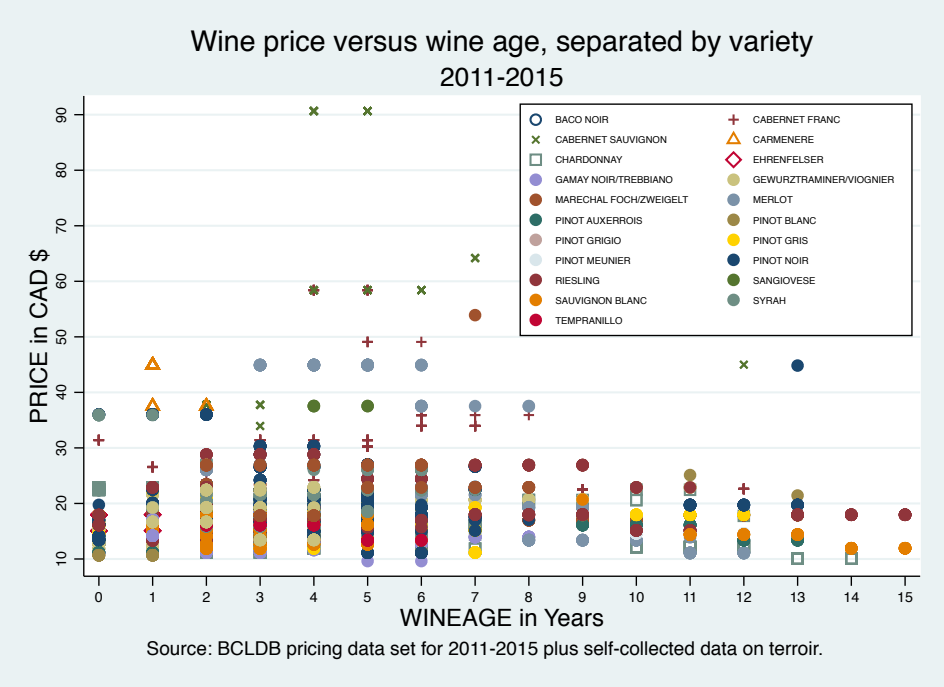
Source: BCLDB pricing data set for 2011-2015 plus self-collected data on terroir.

Figure B.7. Price vs volume of wine sales, separated by grape variety



Source: BCLDB pricing data set for 2011-2015 plus self-collected data on terroir.

Figure B.8. Price vs wine age, separated by grape variety.



Source: BCLDB pricing data set for 2011-2015 plus self-collected data on terroir.

Table B.2. Volume of sales (litres) for selected BC VQA wines per variety, 2011-2015.

	VOLUME IN LITRES					
	Grape Variety	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
1	BACO NOIR	59	503.78	512.09	42.75	2029.5
2	CABERNET FRANC	352	198.22	262.91	0.75	1412.25
3	CABERNET SAUVIGNON	242	157.46	292.11	0.75	2080.5
4	CARMENERE	51	175.74	407.74	4.5	2358.75
5	CHARDONNAY	747	153.73	243.45	0.75	1899.75
6	EHRENFELSER	60	1529.41	1024.39	174	4227
7	GAMAY NOIR	237	197.63	267.47	0.75	1633.5
8	**GEWURZTRAMINER**	**755**	**396.42**	**712.11**	**0.75**	**5846.25**
9	MARECHAL FOCH	317	396.14	562.02	0.75	2875.5
10	MERLOT	482	136.28	220.01	0.75	2365.5
11	PINOT AUXERROIS	120	710.19	709.69	15.75	3415.5
12	PINOT BLANC	145	722.67	831.7	0.75	3199.5
13	PINOT GRIGIO	101	113.92	109.95	0.75	527.25
14	PINOT GRIS	791	166.38	211.21	0.75	2532
15	PINOT MEUNIER	75	66.32	112.4	0.75	563.25
16	PINOT NOIR	985	125.16	192.19	0.75	2706.75
17	RIESLING	506	119.38	193.13	0.75	2393.25
18	SANGIOVESE	5	54.9	79.77	0.75	191.25
19	SAUVIGNIN BLANC	299	225.04	190.63	0.75	1413
20	SYRAH	130	143.01	238.98	0.75	234.75
21	TEMPRANILLO	50	88.05	63.94	0.75	318
22	TREBBIANO	58	276.06	319.8	5.25	1182.75
23	VIOGNIER	112	165.84	215.87	0.75	1281
24	ZWEIGELT	106	46.26	99.62	0.75	780

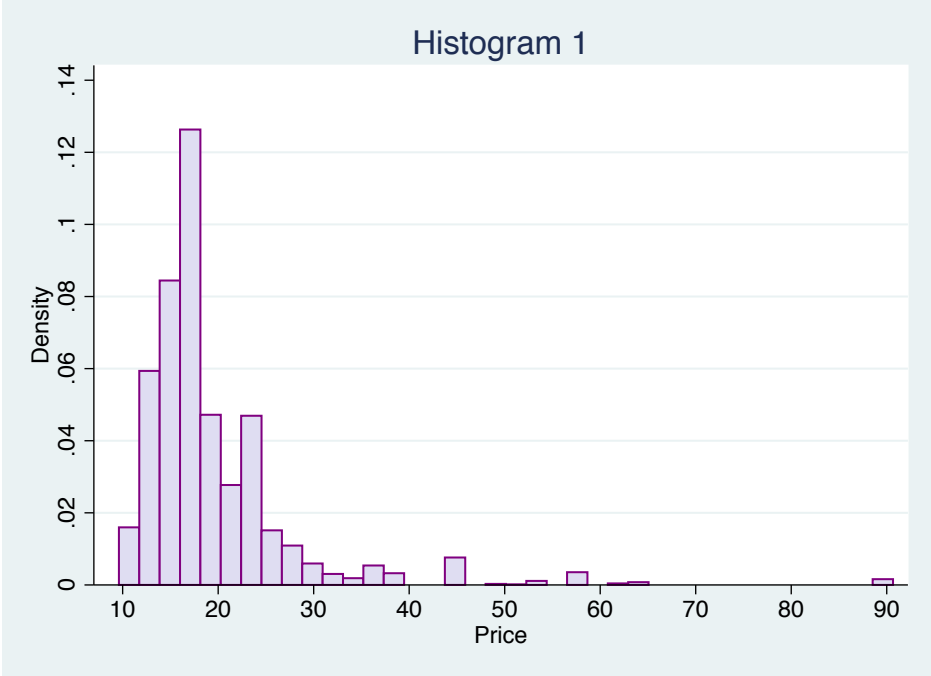
*Note: Gewurztraminer was used as the base/comparison group in regressions because of its highest volume of sales observed in the data set used in this chapter.
Source: The BCLDB wholesale scanner sales data for 2011-2015.

Table B.3. Volume of sales (litres) for selected BC VQA wines, per winery, 2011-2015.

	VOLUME IN LITRES				
WINERY	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
WINERY 1	286	120.01	175.02	0.75	906
WINERY 2	203	117.2	126.81	0.75	663.75
WINERY 3	129	153.55	182.03	0.75	1413
WINERY 4	51	175.74	407.74	4.5	2358.75
WINERY 5	78	292.3	235.78	3	852.75
WINERY 6	260	65.8	79.49	0.75	699
WINERY 7	91	59.51	61.71	0.75	318
WINERY 8	315	47.49	71.11	0.75	480.75
WINERY 9	176	645.82	619.69	2.25	3415.5
WINERY 10	189	10.21	23.36	0.75	183.75
WINERY 11	370	138.26	173.3	0.75	1188
WINERY 12	369	524.94	598.36	1.5	3199.5
WINERY 13	82	175.18	127.94	14.25	534
WINERY 14	93	50.63	41.31	0.75	171.75
WINERY 15	81	100.61	120.77	0.75	553.5
WINERY 16	129	351.76	412.06	0.75	2393.25
WINERY 17	292	179.98	149.13	1.5	783.75
WINERY 18	118	166.18	142.93	1.5	604.5
WINERY 19	6	21	19.63	1.5	48
WINERY 20	236	123.64	131.73	0.75	742.5
WINERY 21	374	204.53	317.9	0.75	2365.5
WINERY 22	**261**	**987.05**	**1022.99**	**0.75**	**5846.25**
WINERY 23	167	47.17	52.96	0.75	287.25
WINERY 24	91	133.15	155.26	0.75	572.25
WINERY 25	62	139.81	134.92	0.75	482.25
WINERY 26	251	79.98	67.11	0.75	345.75
WINERY 27	207	216.14	173.65	0.75	891
WINERY 28	516	312.44	621.82	0.75	4227
WINERY 29	493	224.64	384.24	0.75	2551.5
WINERY 30	34	356.45	610.47	6.75	2706.75
WINERY 31	176	51.2	63.36	0.75	284.25
WINERY 32	253	180.86	270.31	0.75	1633.5
WINERY 33	346	272.49	285.26	4.5	1931.25

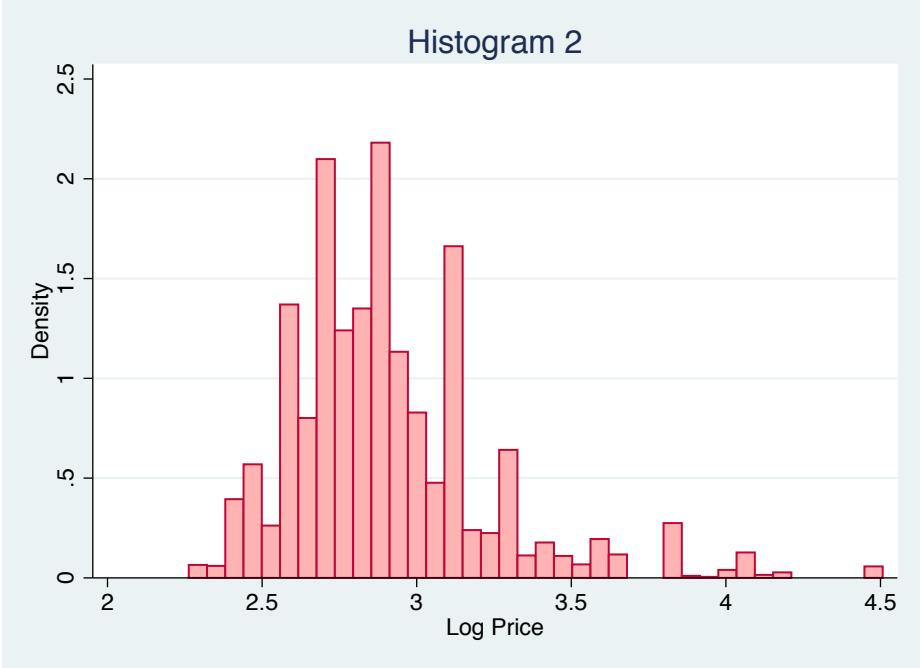
*Note: Winery 22 was used as the base/comparison group in regressions because of its highest volume of sales in the data set used in this chapter.
Source: The BCLDB wholesale scanner sales data for 2011-2015.

Figure B.9. Histogram wine prices .



Source: Based on the BCLDB wholesale scanner sales data for 2011-2015.

Figure B.10. Histogram logarithmic transformation of wine prices.



Source: Based on the BCLDB wholesale scanner sales data for 2011-2015.

Figures B11-B16 concern the full data set.

Figure B.11. Wine price versus sub-appellation, by soil type.

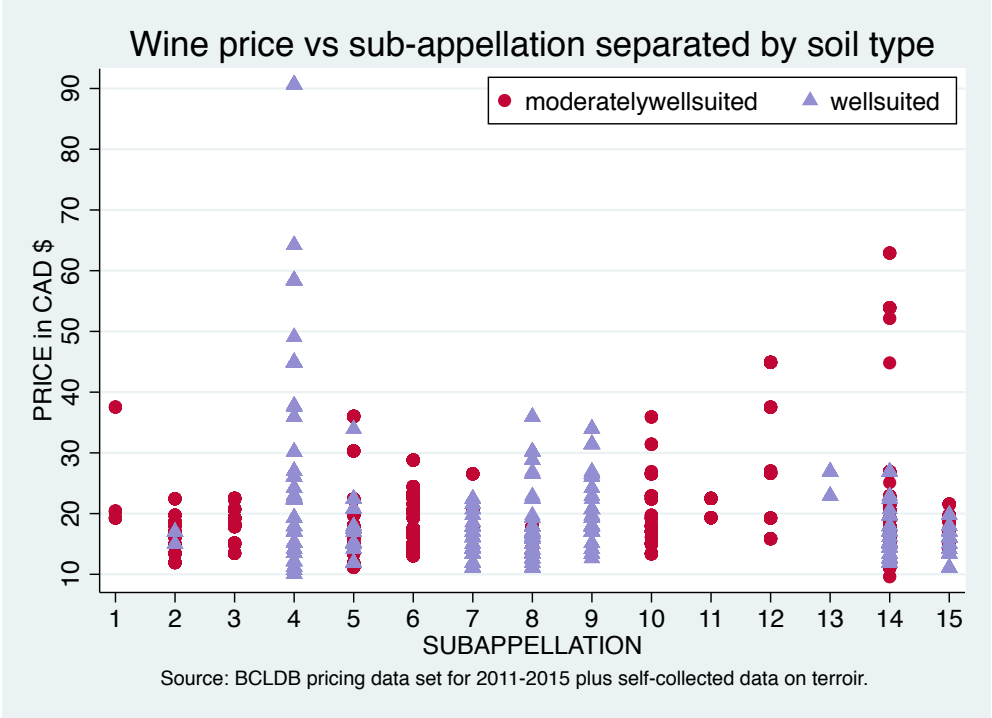


Figure B.12. Wine price versus sub-appellation, by rows direction.

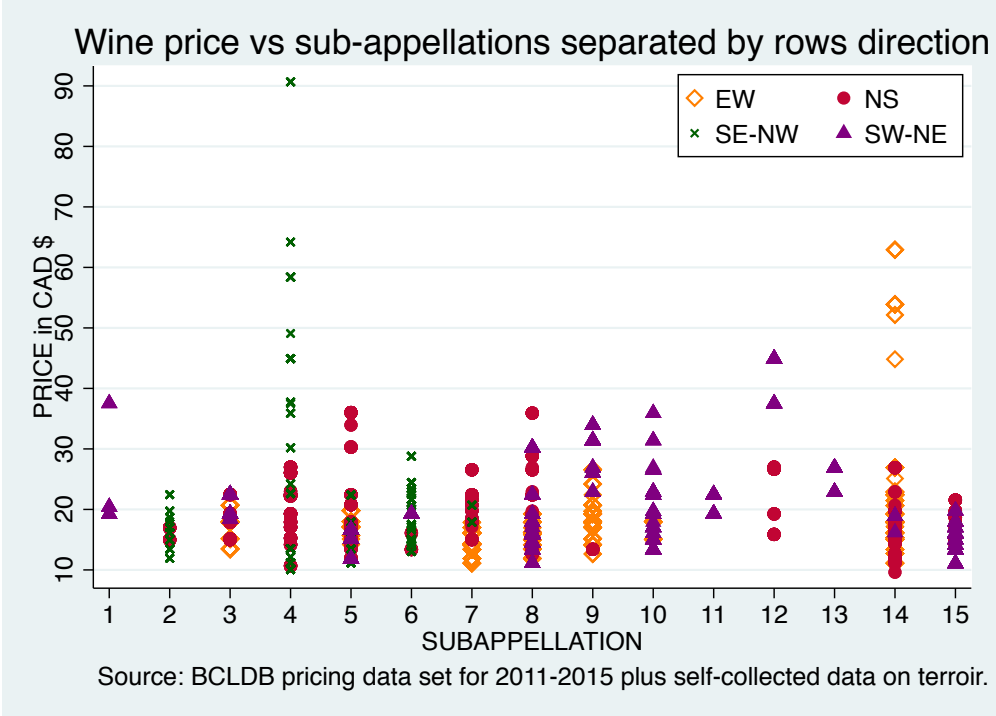


Figure B.13. Wine price versus sub-appellation, by average elevation.

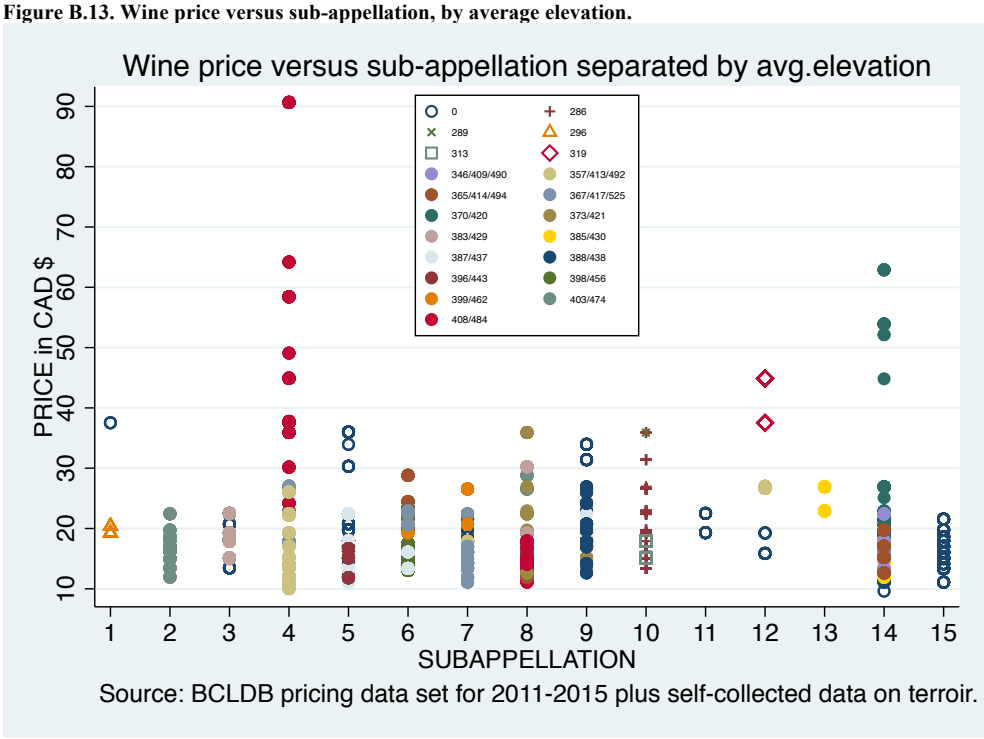


Figure B.14. Wine price versus sub-appellation, by distance to lake.

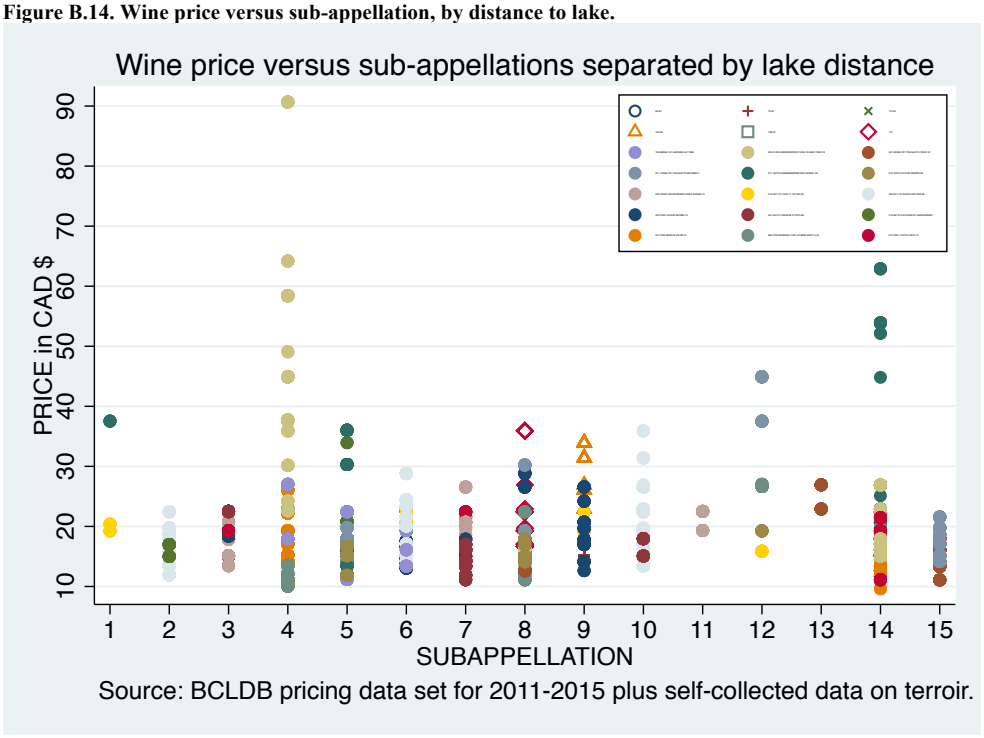


Figure B.15. Wine price versus sub-appellation, by variety.

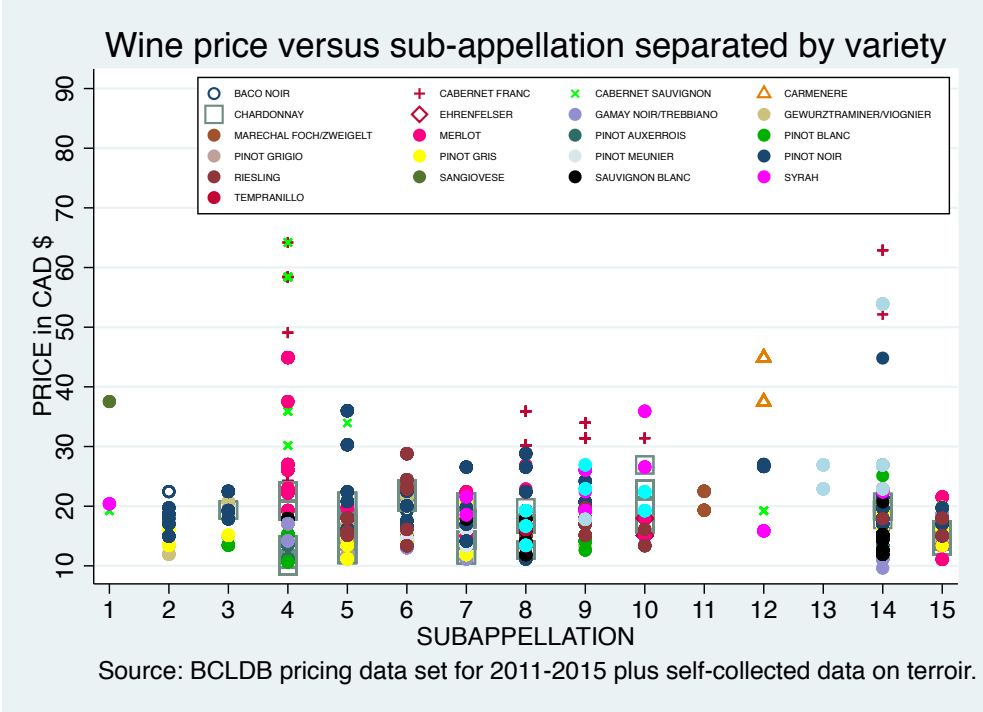
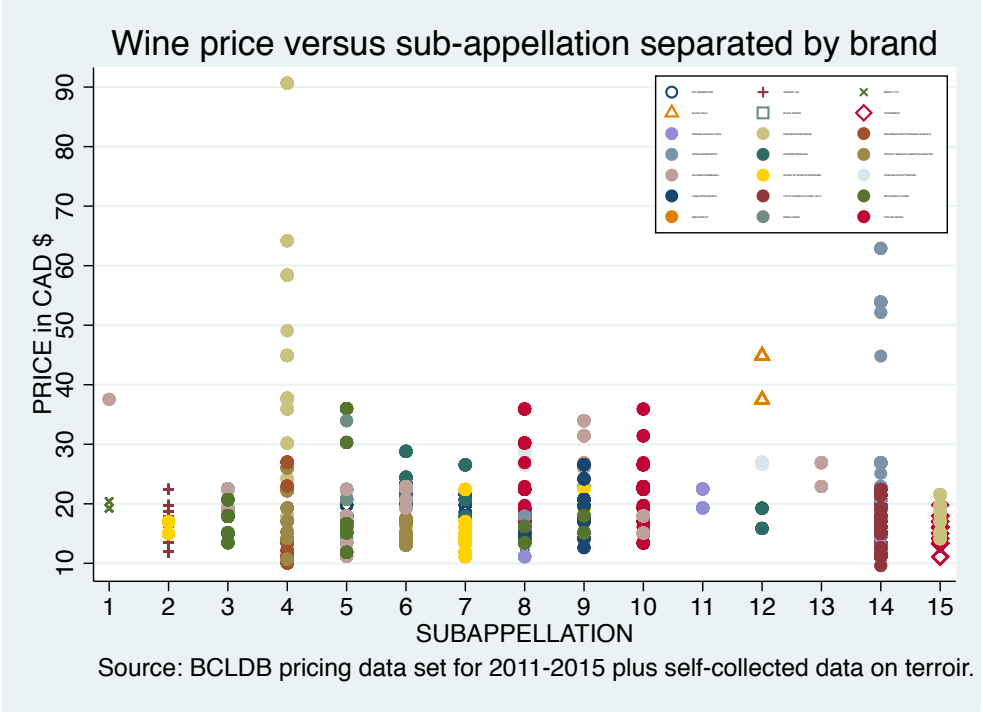


Figure B.16. Wine price versus sub-appellation, by brand.



Figures B17-B26 use grouped data set: group 1: if winery belonged to top 10, group 2: all other wineries.

Figure B.17. Wine price versus sub-appellation, by soil if winery belongs to top 10 biggest producers.

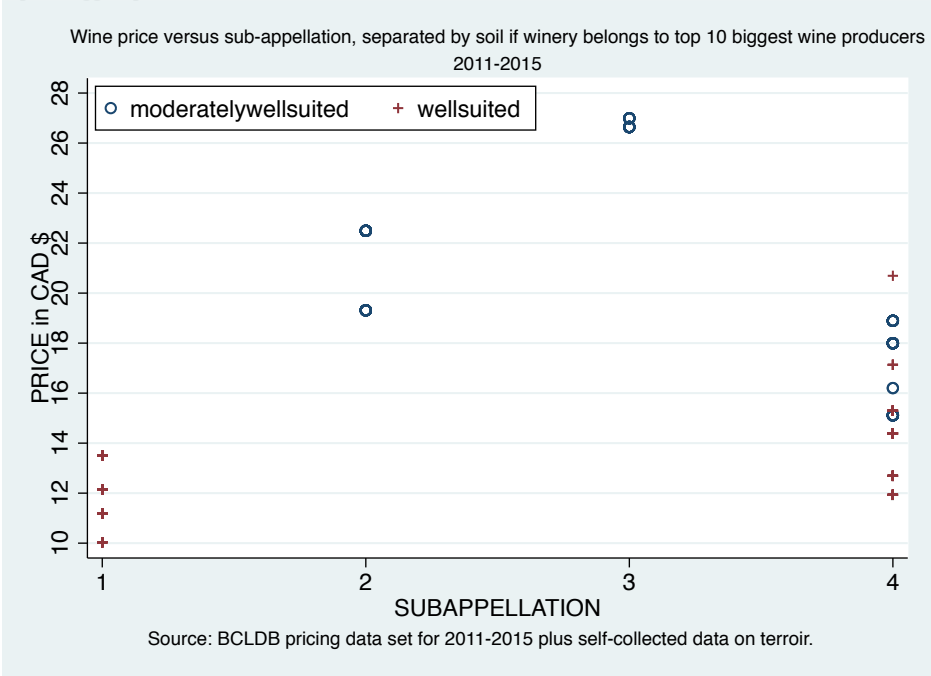


Figure B.18. Wine price versus sub-appellation, by soil if winery doesn't belong to top 10 biggest producers.

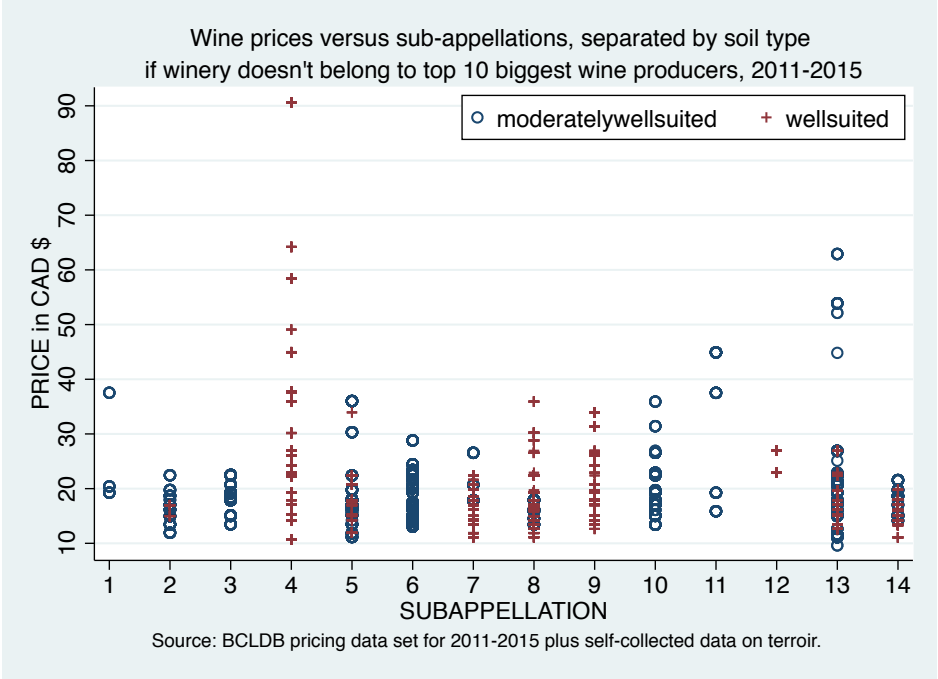
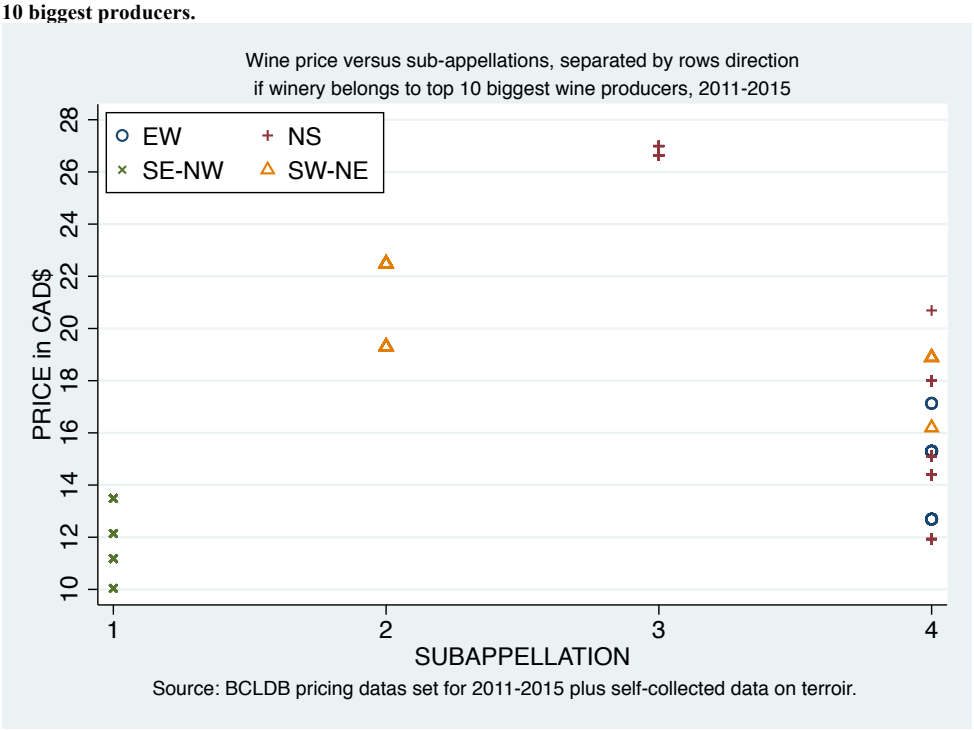
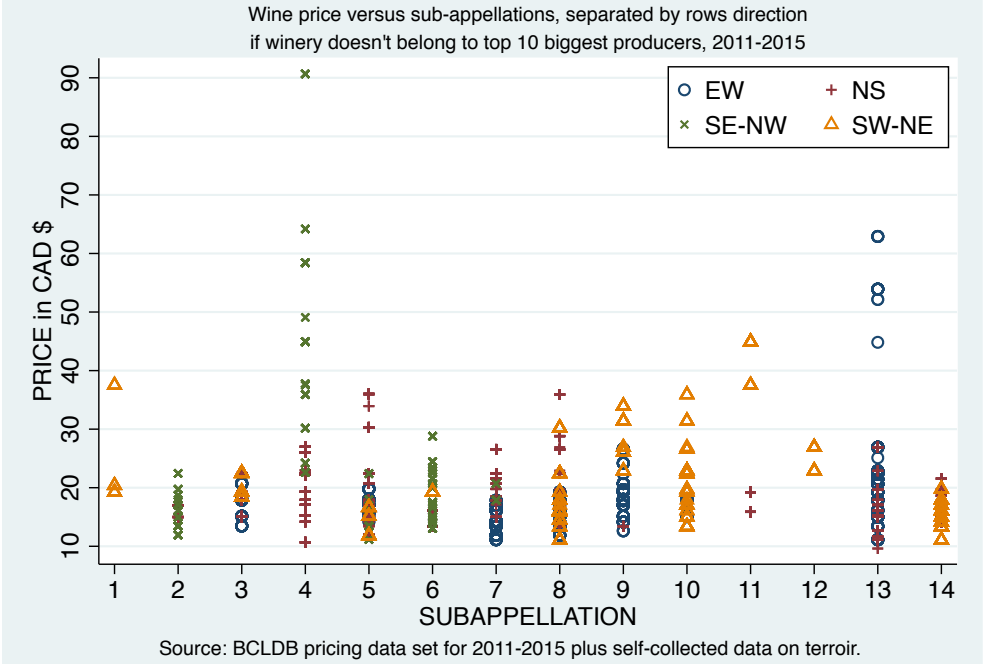


Figure B.19. Wine price versus sub-appellation, by rows direction if winery belongs to top 10 biggest producers.



Source: BCLDB pricing datas set for 2011-2015 plus self-collected data on terroir.

Figure B.20. Wine price versus sub-appellation, by rows direction if winery doesn't belong top 10 biggest producers.



Source: BCLDB pricing data set for 2011-2015 plus self-collected data on terroir.

Figure B.21. Wine price versus sub-appellation, by average elevation if winery belongs to top 10 biggest producers.

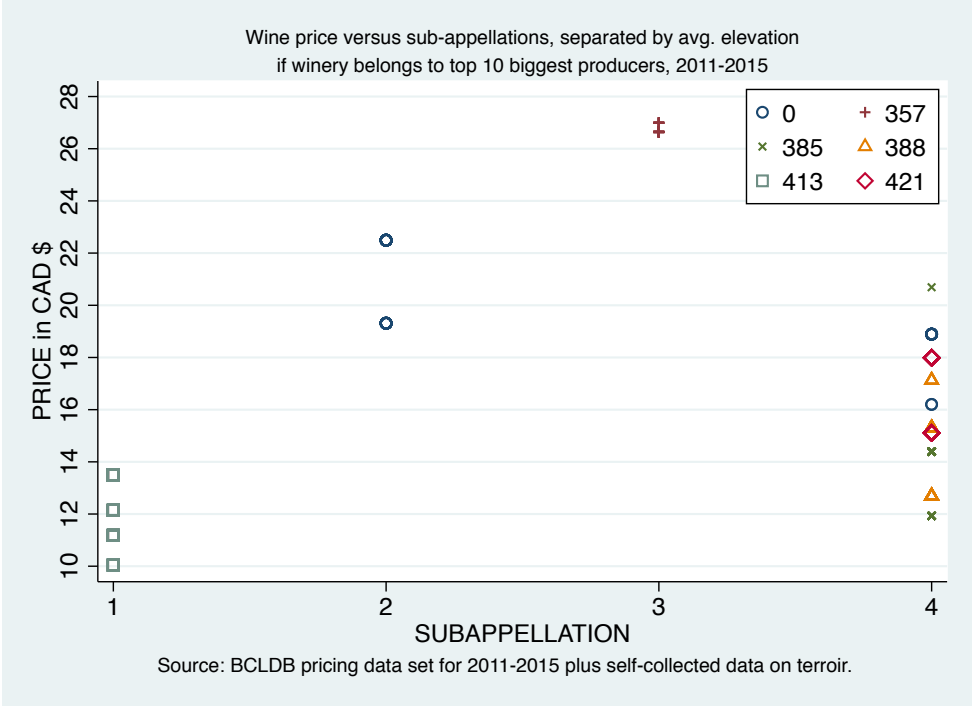


Figure B.22. Wine price versus sub-appellation, by average elevation if winery doesn't belong to top 10 biggest producers.

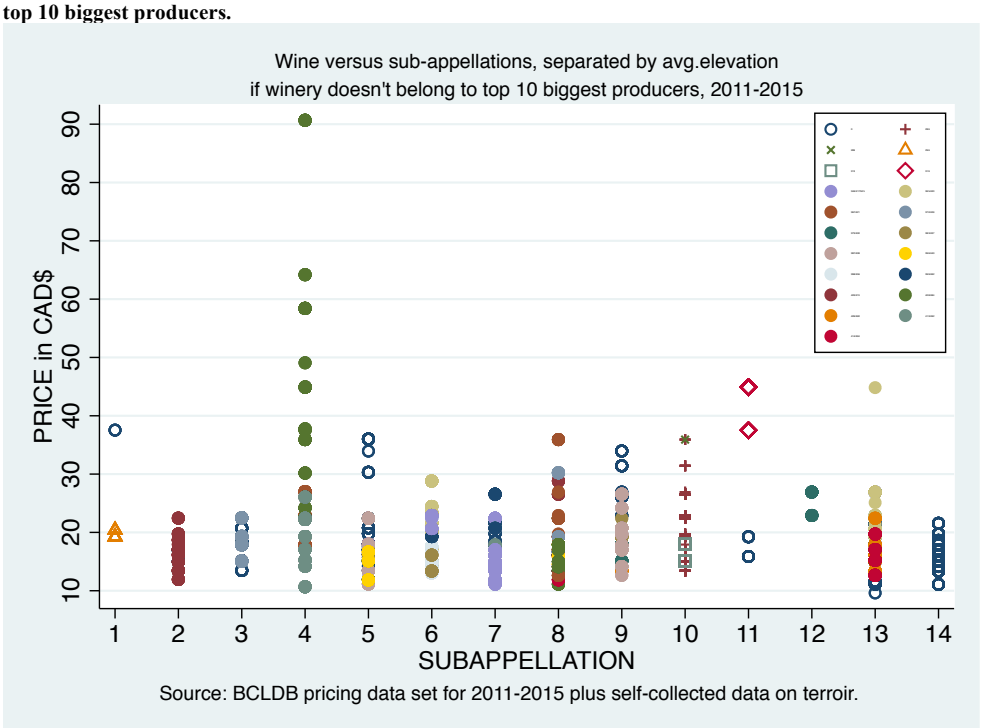


Figure B.23. Wine price versus sub-appellation, by aspect if winery belongs to top 10 biggest producers.

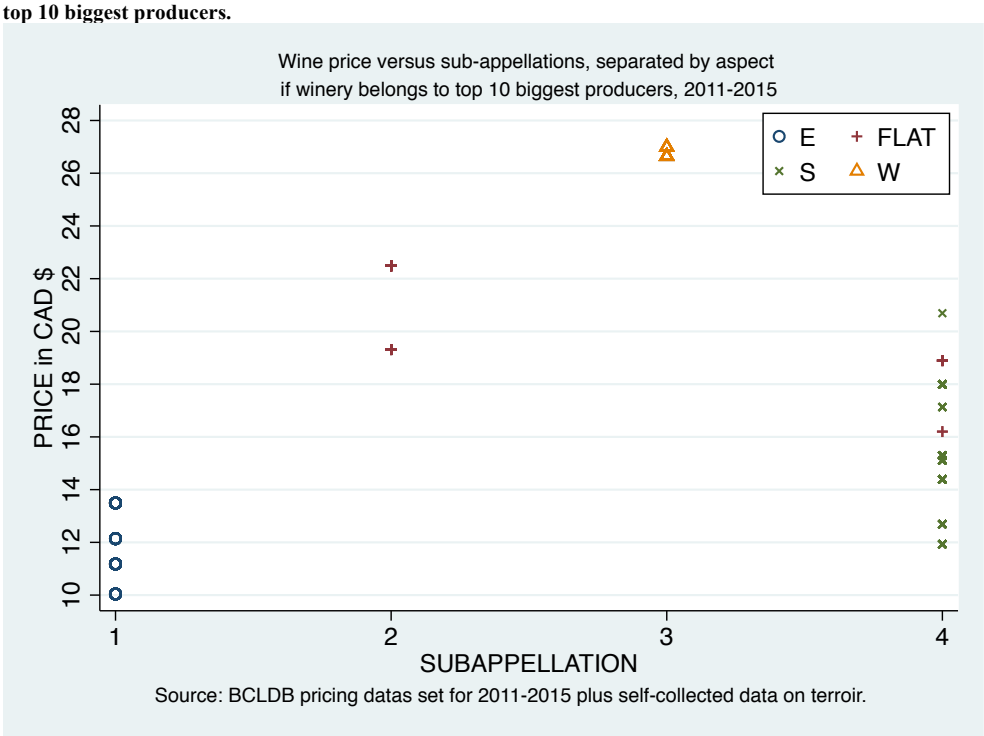


Figure B.24. Wine price versus sub-appellation, by aspect if winery doesn't belong to top 10 biggest producers.

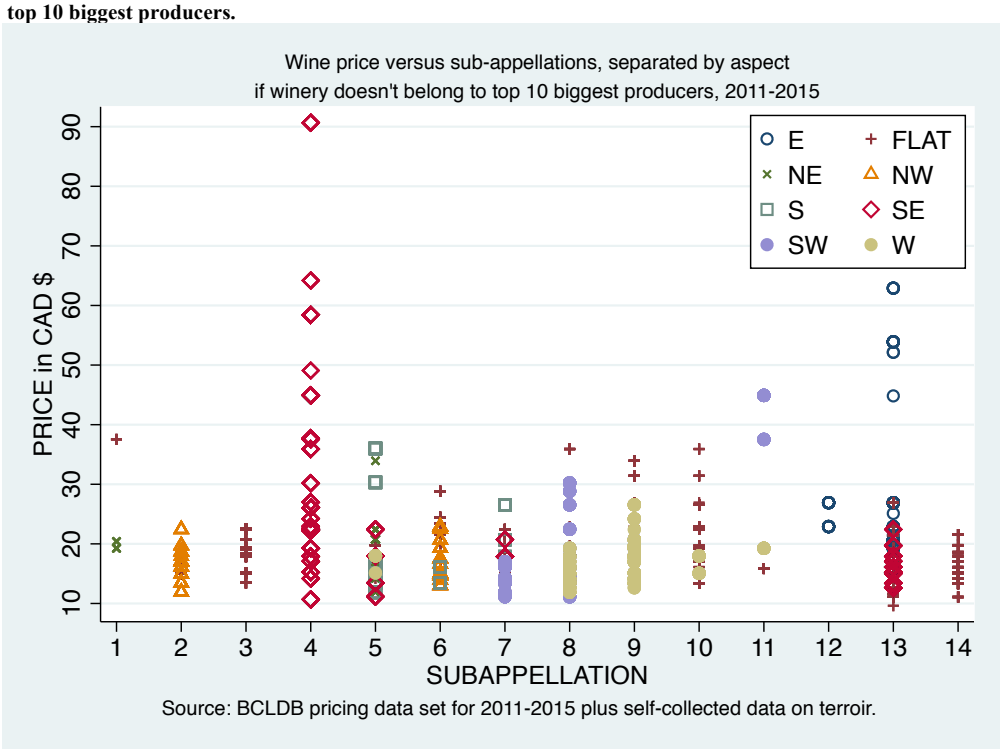
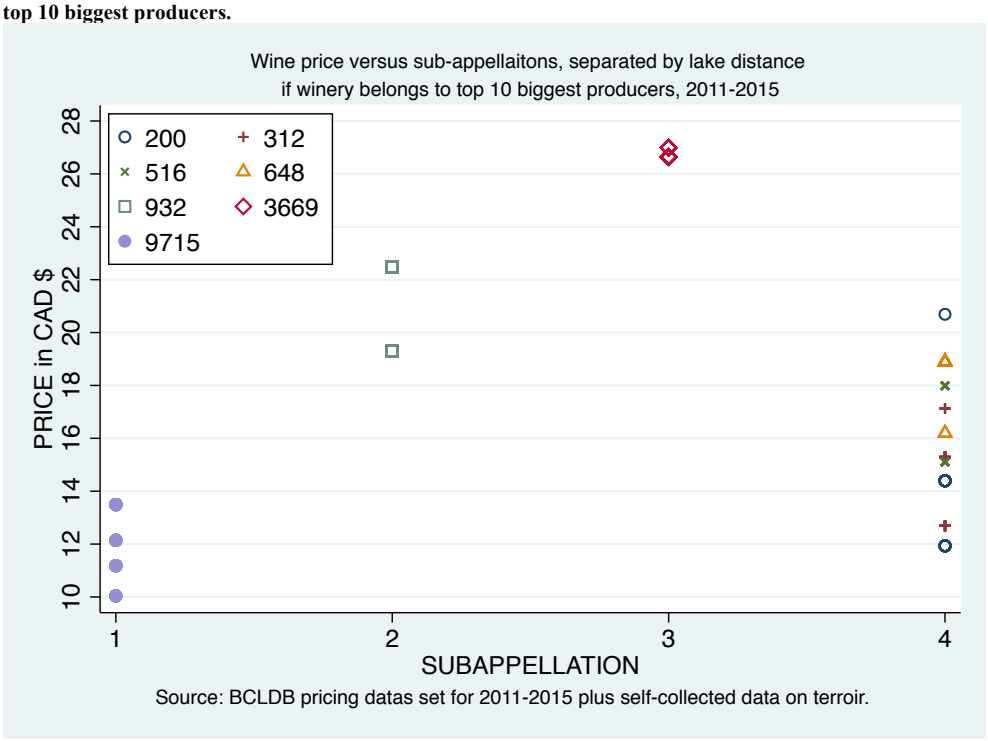
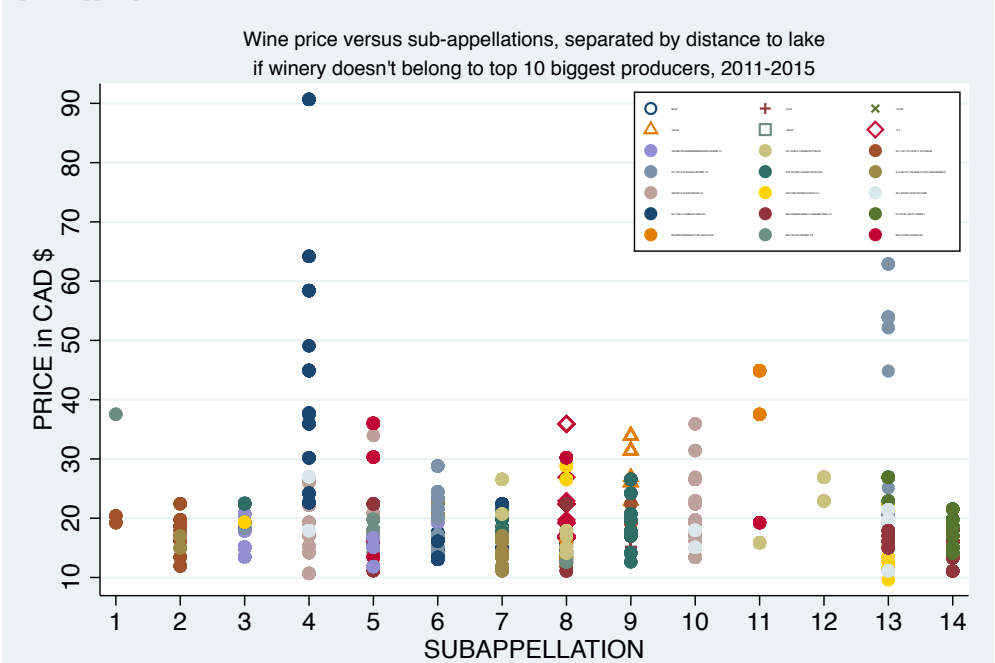


Figure B.25. Wine price versus sub-appellation, by distance to lake if winery belongs to top 10 biggest producers.



Source: BCLDB pricing datas set for 2011-2015 plus self-collected data on terroir.

Figure B.26. Wine price versus sub-appellation, by distance to lake if winery doesn't belong to top 10 biggest producers.



Source: BCLDB pricing data set for 2011-2015 plus self-collected data on terroir.

Figures B27-B36 use grouped data set: group 1: if winery belonged to top 5, group 2: all other wineries.

Figure B.27. Wine price versus sub-appellation, by soil if winery belongs to top 5 biggest producers.

Figure B.28. Wine price versus sub-appellation, by soil if winery doesn't belong to top 5 biggest producers.

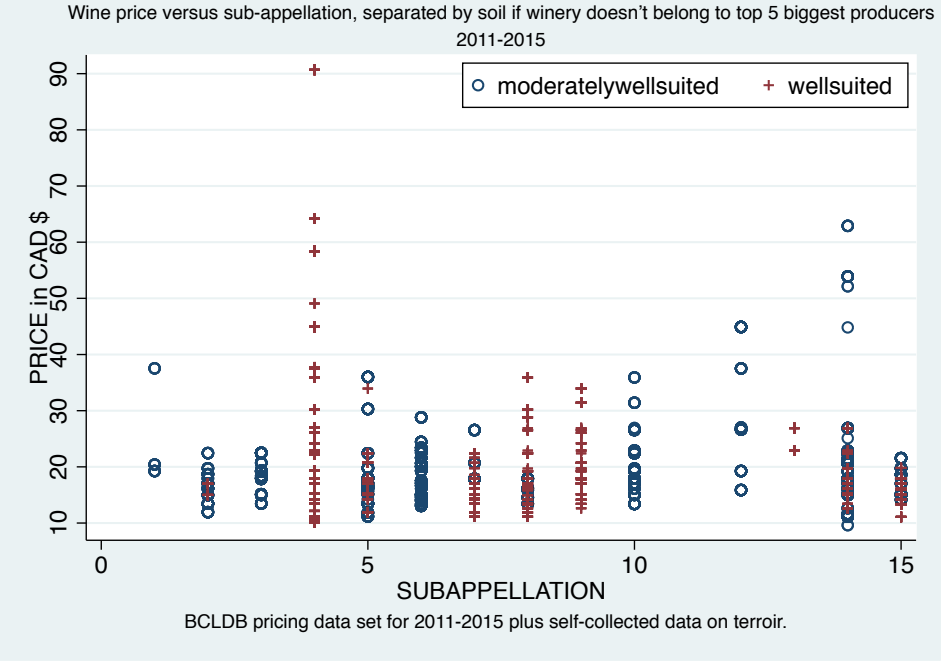


Figure B.29. Wine price versus sub-appellation, by rows direction if winery belongs to top 5 biggest producers.

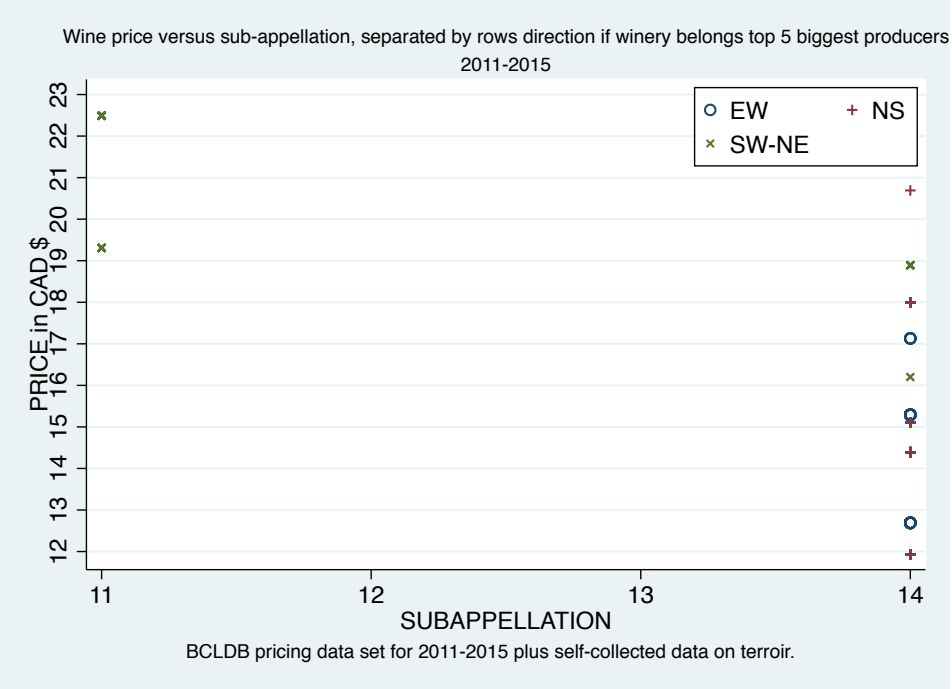


Figure B.30. Wine price versus sub-appellation, by rows direction if winery doesn't belong to top 5 biggest producers.

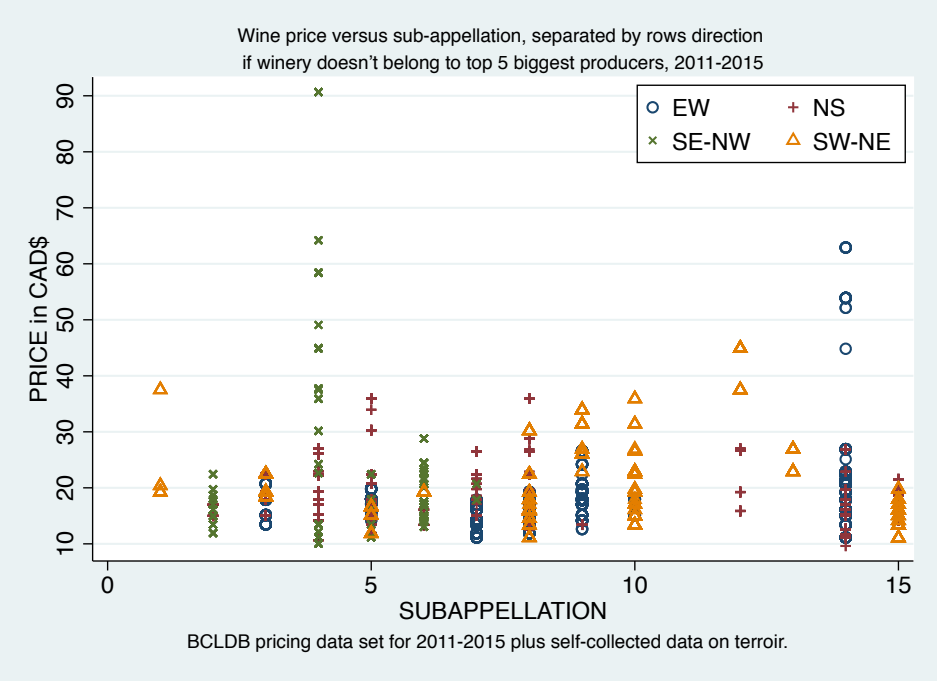


Figure B.31. Wine price versus sub-appellation, by average elevation if winery belongs to top 5 biggest producers.

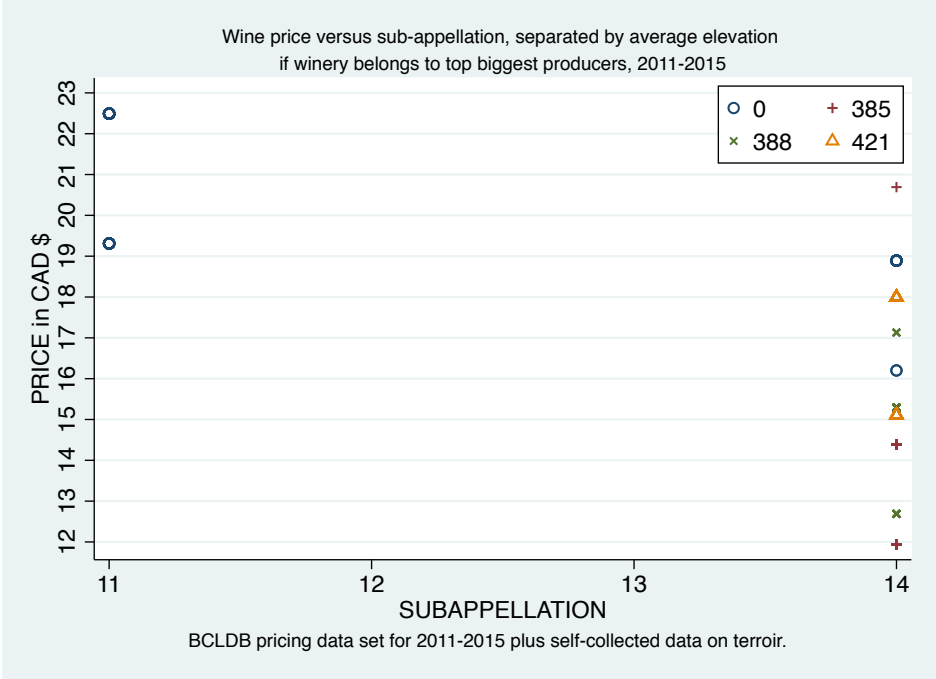


Figure B.32. Wine price versus sub-appellation, by average elevation if winery doesn't belong to top 5 biggest producers.

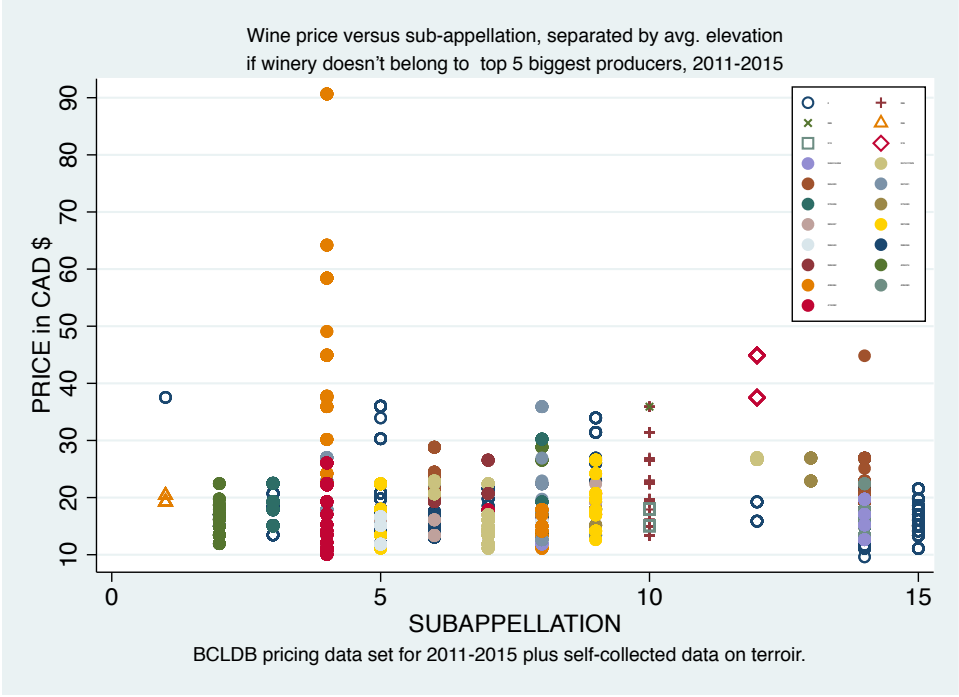


Figure B.33. Wine price versus sub-appellation, by aspect if winery belongs to top 5 biggest producers.

Figure B.34. Wine price versus sub-appellation, by aspect if winery doesn't belong to top 5 biggest producers.

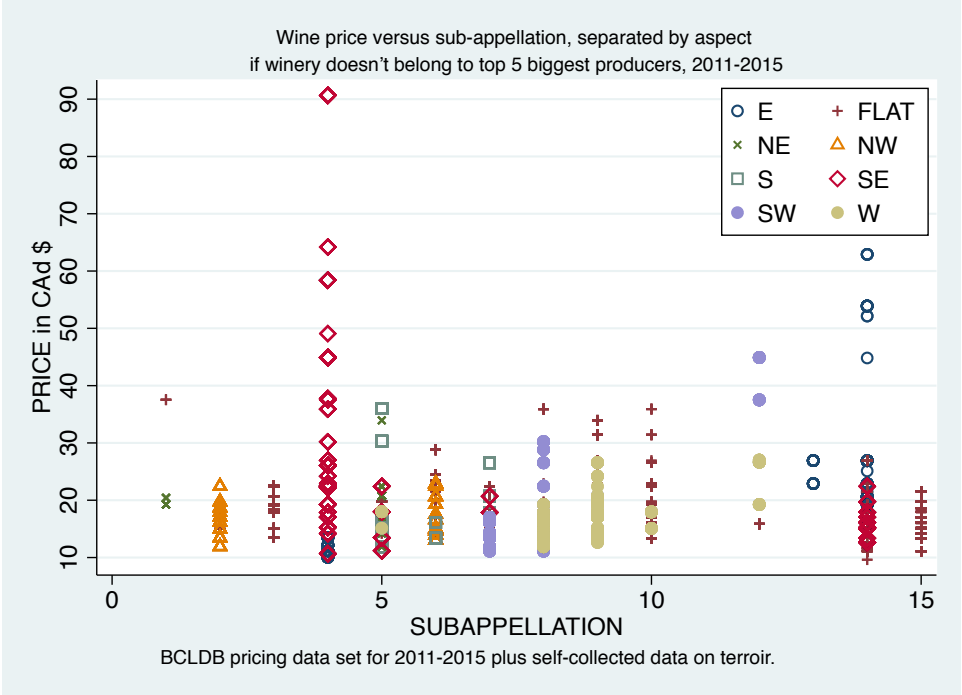


Figure B.35. Wine price versus sub-appellation, by distance to lake if winery belongs to top 5 biggest producers.

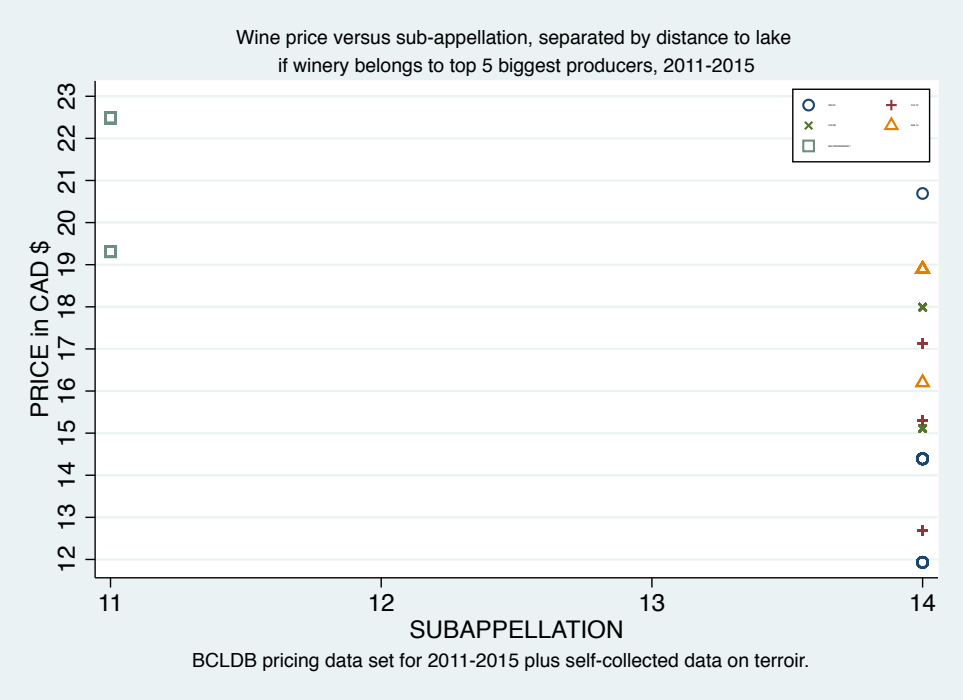


Figure B.36. Wine price versus sub-appellation, by distance to lake if winery doesn't belong to top 5 biggest producers.

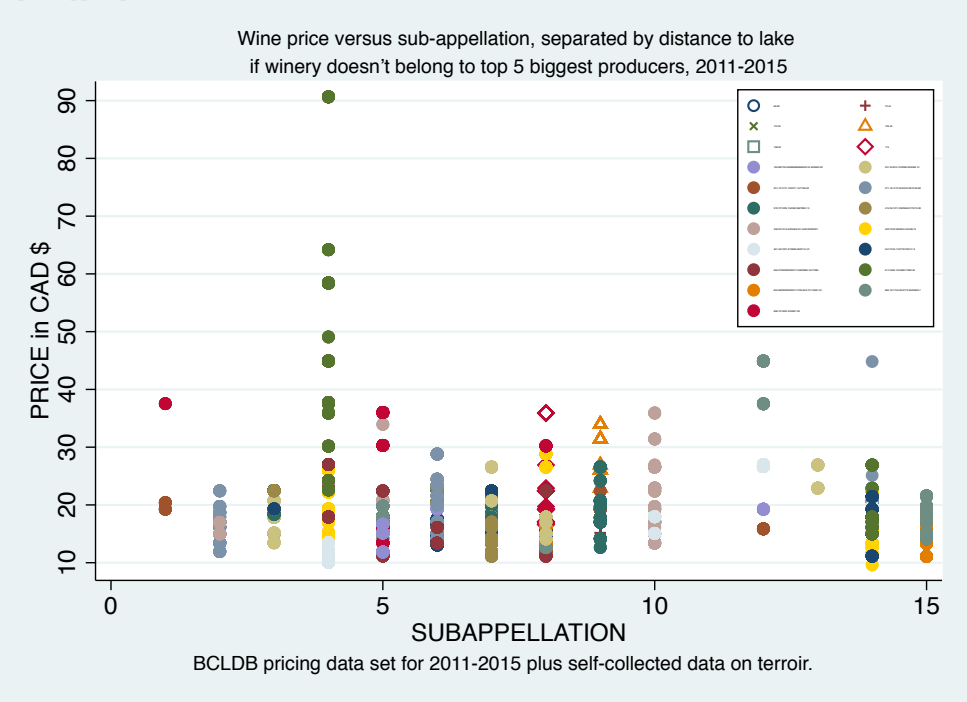


Table B.4. Level-level model. SE clustered on sub-appellations (15).

	(1) price	(2) price	(3) price	(4) price	(5) price	(6) price
wineage	0.395	0.386	0.491	0.47	0.352	0.360
	(0.453)	(0.458)	(0.526)	(0.538)	(0.602)	(0.390)
wineagesq	-0.0285	-0.03	-0.0357	-0.0341	-0.024	-0.0374
	(0.035)	(0.035)	(0.040)	(0.042)	(0.046)	(0.032)
year_2012	-0.271	-0.244	-0.374	-0.391	-0.405	-0.0795
	(0.226)	(0.225)	(0.328)	(0.394)	(0.423)	(0.348)
year_2013	-0.234	-0.242	-0.434	-0.385	-0.468	0.184
	(0.378)	(0.385)	(0.537)	(0.625)	(0.645)	(0.323)
year_2014	-2.961***	-2.971***	-3.163***	-3.132***	-3.231***	-2.523**
	(0.336)	(0.335)	(0.347)	(0.298)	(0.275)	(0.751)
year_2015	-2.818***	-2.806***	-3.037***	-3.014***	-3.075***	-2.327*
	(0.369)	(0.379)	(0.423)	(0.358)	(0.357)	(0.895)
BACO NOIR	3.765+	3.971*	3.902*	4.450***	5.359***	6.216***
	(1.937)	(1.815)	(1.669)	(0.639)	(0.718)	(0.869)
CABERNET FRANC	8.024+	7.707+	7.082+	6.755	6.271	7.573*
	(3.816)	(3.744)	(3.856)	(4.123)	(4.122)	(2.800)
CABERNET SAUVIGNON	11.96*	12.18*	12.38*	13.69**	12.75**	13.51***
	(4.842)	(4.575)	(4.282)	(3.517)	(3.467)	(2.388)
CARMENERE	28.79***	29.51***	28.04***	33.13***	0	0
	(1.364)	(1.821)	(1.320)	(3.373)	(.)	(.)
CHARDONNAY	0.619	0.676	0.613	0.436	0.433	1.117
	(0.939)	(0.964)	(0.948)	(0.874)	(0.815)	(0.793)
EHRENFELSER	-1.632	-1.219	1.511	7.664*	9.503*	11.54*
	(1.795)	(1.759)	(2.990)	(3.373)	(3.483)	(4.916)
GAMAY NOIR	0.105	0.182	0.373	0.508	0.584	3.459+
	(1.989)	(1.953)	(1.903)	(2.054)	(2.000)	(1.676)
MARECHAL FOCH	2.639+	2.740+	2.660+	2.853+	2.405*	3.675***
	(1.498)	(1.528)	(1.324)	(1.359)	(0.994)	(0.857)
MERLOT	3.421+	3.208+	3.291+	2.778+	2.247	3.921**
	(1.663)	(1.597)	(1.672)	(1.518)	(1.303)	(1.036)
PINOT AUXERROIS	-0.0169	-0.014	-0.0803	-0.128	-0.504	-0.837
	(1.133)	(1.105)	(1.150)	(1.428)	(1.379)	(2.217)
PINOT BLANC	-2.698*	-2.652*	-2.412*	-2.648*	-3.174**	-2.906*
	(1.045)	(1.024)	(1.012)	(1.076)	(0.997)	(1.202)
PINOT GRIGIO	-1.301	-1.067	-0.851	-2.227	-2.023	0.0982
	(1.562)	(1.328)	(1.220)	(2.688)	(2.163)	(1.569)
PINOT GRIS	-0.987	-0.893	-1.223	-0.891	-0.828	-0.155
	(0.918)	(0.920)	(1.298)	(1.239)	(1.203)	(1.014)
PINOT MEUNIER	0.48	0.534	0.315	0.436	0.62	0.718
	(0.913)	(0.917)	(1.007)	(0.989)	(0.991)	(1.501)
PINOT NOIR	3.691*	3.722*	3.690*	3.860*	3.902*	5.266**
	(1.302)	(1.300)	(1.321)	(1.381)	(1.433)	(1.284)
RIESLING	1.831	1.823	1.589	2.729+	2.288	3.408*
	(1.148)	(1.279)	(1.347)	(1.462)	(1.318)	(1.497)
SANGIOVESE	20.00***	20.43***	20.34***	20.12***	18.72***	14.29**
	(1.907)	(1.737)	(1.671)	(1.574)	(2.181)	(4.643)
SAUVIGNON BLANC	-2.852	-3.221	-2.273	-1.415	-0.727	1.414
	(2.912)	(3.118)	(2.120)	(1.574)	(1.241)	(1.130)
SYRAH	5.111*	4.734*	4.448*	5.084*	4.811+	6.632**
	(2.093)	(2.125)	(2.070)	(2.296)	(2.307)	(2.173)
TEMPRANILLO	2.56	2.564	2.568	3.161	2.886	3.667
	(1.876)	(1.886)	(1.835)	(1.867)	(2.023)	(2.231)
TREBBIANO	-2.133*	-2.276**	-2.237**	-2.395**	-2.962***	-3.025***
	(0.780)	(0.695)	(0.703)	(0.709)	(0.664)	(0.618)
VIOGNIER	2.344	1.749	1.721	1.843	2.267+	2.876**
	(1.754)	(1.804)	(1.628)	(1.507)	(1.258)	(0.867)
ZWEIGELT	6.645*	6.138*	5.652+	5.504+	5.247+	6.881*
	(2.409)	(2.637)	(2.852)	(2.841)	(2.790)	(2.324)
WINERY 1	1.469	2.008	3.062	2.312	2.434	-1.188

Table B.4. Level-level model. SE clustered on sub-appellations (15).

	(1) price	(2) price	(3) price	(4) price	(5) price	(6) price
	(1.547)	(1.958)	(1.884)	(1.849)	(3.307)	(2.323)
WINERY 2	1.24	1.905	-0.0151	-1.354	-5.061	-10.58*
	(1.390)	(1.664)	(2.523)	(2.085)	(3.628)	(4.209)
WINERY 3	1.701	1.034	1.221	7.538*	4.548	1.503
	(1.425)	(1.461)	(1.234)	(2.947)	(3.085)	(2.886)
WINERY 4	0	0	0	0	33.70***	27.69***
	(.)	(.)	(.)	(.)	(3.566)	(2.894)
WINERY 5	3.873*	4.537*	3.279*	8.118*	7.535*	-0.501
	(1.577)	(1.898)	(1.385)	(2.949)	(2.794)	(2.384)
WINERY 6	-0.0883	-0.929	-3.23	-3.922	-7.214+	-7.707*
	(1.297)	(1.560)	(2.377)	(2.359)	(3.457)	(2.679)
WINERY 7	-1.59	-2.566	-4.925	-1.903	-2.659	-6.121
	(2.212)	(2.765)	(4.021)	(4.020)	(3.848)	(3.666)
WINERY 8	20.37***	19.51***	16.95**	19.30***	14.74**	8.607+
	(2.407)	(2.750)	(4.142)	(3.077)	(4.411)	(4.211)
WINERY 9	-1.839	-2.77	-5.493+	-7.96	-10.82	-9.406+
	(1.447)	(1.577)	(2.804)	(5.233)	(7.189)	(4.751)
WINERY 10	10.93***	11.63***	12.65***	13.13***	13.21**	17.65***
	(1.230)	(1.602)	(1.826)	(3.015)	(3.637)	(3.573)
WINERY 11	4.363+	4.824*	6.138*	7.998*	5.545+	0.427
	(2.144)	(2.236)	(2.143)	(2.740)	(3.037)	(2.766)
WINERY 12	4.629**	3.756*	4.921**	11.57	6.282	0.383
	(1.458)	(1.641)	(1.540)	(7.144)	(7.830)	(6.852)
WINERY 13	-0.395	0.357	-0.0877	0.863	-0.985	-5.933+
	(3.549)	(3.525)	(3.222)	(4.472)	(4.526)	(2.953)
WINERY 14	-0.527	-0.891	0.574	1.05	-1.298	-6.601*
	(2.018)	(2.167)	(2.319)	(2.539)	(2.244)	(3.059)
WINERY 15	6.060***	5.079**	6.161**	10.04**	10.22**	3.911*
	(1.443)	(1.660)	(1.641)	(2.958)	(2.646)	(1.673)
WINERY 16	1.462	0.446	1.24	4.386+	1.675	0.707
	(1.853)	(1.983)	(1.769)	(2.413)	(3.410)	(4.488)
WINERY 17	1.422	0.714	1.046	6.717	1.725	4.265
	(1.820)	(1.654)	(1.505)	(7.109)	(9.333)	(9.129)
WINERY 18	8.256***	8.977***	10.79***	12.78***	11.48**	4.676
	(1.377)	(1.683)	(1.884)	(1.736)	(3.471)	(3.070)
WINERY 19	6.851***	7.500**	6.200**	7.166*	4.321	-0.769
	(1.517)	(1.834)	(1.554)	(2.468)	(2.858)	(2.652)
WINERY 20	2.177	1.103	2.047	12.36**	7.274	1.905
	(1.607)	(2.126)	(1.410)	(3.644)	(4.875)	(3.494)
WINERY 21	4.831**	5.169**	4.371**	5.239*	6.338*	3.202
	(1.501)	(1.642)	(1.317)	(2.203)	(2.609)	(1.999)
WINERY 23	1.548	2.311	3.955*	5.282*	4.176+	-3.842
	(1.856)	(2.023)	(1.752)	(2.050)	(2.013)	(2.831)
WINERY 24	3.602	3.675	4.694	10.45	9.801+	5.383
	(2.839)	(2.696)	(2.808)	(5.977)	(5.521)	(3.622)
WINERY 25	3.533	4.739	5.097+	11.38*	9.654+	2.505
	(2.313)	(2.844)	(2.552)	(4.312)	(4.771)	(3.203)
WINERY 26	5.590**	6.301**	4.335	1.557	3.903	4.005
	(1.579)	(1.940)	(2.782)	(4.726)	(5.082)	(4.829)
WINERY 27	-0.599	0.161	-2.145	-3.09	-1.214	-3.867
	(1.786)	(2.102)	(2.288)	(1.990)	(2.565)	(3.384)
WINERY 28	4.958*	5.296*	3.754*	4.801+	3.587	-0.00427
	(1.956)	(1.997)	(1.458)	(2.462)	(2.567)	(1.927)
WINERY 29	0.415	-0.555	-0.0471	2.34	1.183	-0.928
	(1.452)	(1.743)	(1.424)	(2.394)	(3.200)	(3.858)
WINERY 30	9.533***	10.32***	11.99***	20.48***	19.62***	15.34***
	(1.681)	(1.890)	(2.124)	(4.303)	(4.009)	(3.215)
WINERY 31	2.941+	1.985	2.306	7.129**	3.864	2.899
	(1.659)	(2.109)	(1.629)	(1.949)	(2.955)	(3.977)
WINERY 32	0.624	1.349	2.636	3.091	1.665	0.794
	(1.730)	(2.008)	(2.006)	(2.404)	(2.385)	(3.186)

Table B.4. Level-level model. SE clustered on sub-appellations (15).

	(1) price	(2) price	(3) price	(4) price	(5) price	(6) price
WINERY 33	1.872	2.178	2.216	3.607	3.137	-0.733
	(1.848)	(2.202)	(2.247)	(2.219)	(2.136)	(1.356)
alcohol below12%	-0.402	-0.461	-0.526	-1.545	-0.771	-0.811
	(2.135)	(2.144)	(2.172)	(2.353)	(2.465)	(2.512)
alcohol [12%,14 %]	-0.871	-0.862	-0.894	-1.314	-1.04	-0.391
	(2.094)	(2.058)	(2.019)	(2.096)	(2.165)	(1.954)
soil well-suited		1.731	2.43	3.928*	4.524*	1.972+
		(1.130)	(1.632)	(1.720)	(1.760)	(1.101)
rows NS			-0.796	-2.577+	-2.682*	-2.319*
			(0.738)	(1.315)	(1.166)	(0.974)
rows SE-NW			3.114	5.153	5.039	4.834
			(3.120)	(5.548)	(6.411)	(5.408)
rows SW-NE			2.554	1.445	2.688	1.672
			(2.167)	(2.087)	(2.286)	(1.588)
aspect FLAT				1.053	1.413	2.804
				(1.674)	(3.026)	(3.423)
aspect NE				-8.995**	-4.175	-0.326
				(3.000)	(3.562)	(4.076)
aspect NW				-0.441	1.149	3.774
				(4.186)	(4.414)	(4.456)
aspect S				0.251	1.833	6.145+
				(3.287)	(3.513)	(3.212)
aspect SE				-5.473	-2.38	2.341
				(5.389)	(7.096)	(6.360)
aspect SW				-3.234	-3.971	0.115
				(2.276)	(2.418)	(3.213)
aspect W				-6.114**	-3.863+	-2.734
				(2.037)	(2.045)	(3.081)
avgelev (200m-400m]					-2.32	-3.779*
					(1.834)	(1.570)
avgelev (400m and up)					1.02	0.197
					(1.878)	(2.591)
lake (700m-3000m]					0.954	-1.313
					(1.628)	(1.979)
lake (3000 m and up)					2.174	3.037
					(2.294)	(2.472)
april<11C						0.304*
						(0.110)
april>19C						0.893**
						(0.271)
may<16C						-0.114
						(0.408)
may>25C						0.0029
						(0.182)
june<20C						-0.119
						(0.208)
june>29C						0.294+
						(0.158)
july<25C						-0.624+
						(0.330)
july>33C						-0.542**
						(0.166)
august<24C						-0.458**
						(0.142)
august>33C						0.137
						(0.150)
september<18C						-0.0974
						(0.281)
september >27C						-0.252
						(0.262)
october<10C						-0.404*

Table B.4. Level-level model. SE clustered on sub-appellations (15).

	(1) price	(2) price	(3) price	(4) price	(5) price	(6) price
						(0.168)
october>18C						-0.437
						(0.410)
april<10C						0.0133
						(0.228)
april>16C						-0.194
						(0.144)
may<4C						-0.0139
						(0.191)
may>11C						-0.617*
						(0.210)
june<9C						-0.248
						(0.342)
june>15C						-0.776**
						(0.240)
july<12C						0.133
						(0.167)
july>18C						0.311*
						(0.117)
august<11C						-0.409**
						(0.134)
august>17C						-0.537
						(0.323)
september<6C						-0.338
						(0.331)
september>13C						-0.113
						(0.185)
october<1C						0.203
						(0.260)
october>8C						0.0914
						(0.270)
_cons	15.17***	14.46***	13.43***	13.11***	12.08**	30.40**
	(1.896)	(2.095)	(1.994)	(2.644)	(3.464)	(10.120)
N	6785	6785	6785	6785	6785	6785
R-sq	0.677	0.68	0.686	0.701	0.706	0.751
adj. R-sq	0.674	0.677	0.683	0.698	0.702	0.747
F	.	.	.	.	.	.

Standard errors in parentheses
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001
SE clustered on 15 sub-appellations
These are results obtained after controlling for variety (24), brand (33) and year (5) fixed effects.
Comparison Groups: Soil: moderately well-suited, Rows: EW, Aspect: E,
Elevation: [0-200m], Heat: middle interval for each month.
Alcohol above 14%, Lake distance [67-700m], Elevation [0-200m], Heat: middle interval for each month.

Table B.5. Log-level model. SE clustered on sub-appellations (15).

	(1) lnprice	(2) lnprice	(3) lnprice	(4) lnprice	(5) lnprice	(6) lnprice
wineage	0.0151	0.0148	0.0176	0.015	0.00571	0.00686
	(0.014)	(0.015)	(0.017)	(0.015)	(0.017)	(0.015)
wineagesq	-0.00127	-0.00132	-0.00145	-0.00126	-0.000489	-0.00093
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
year_2012	-0.00605	-0.00514	-0.0092	-0.00867	-0.00832	0.00134
	(0.007)	(0.008)	(0.010)	(0.012)	(0.013)	(0.013)
year_2013	0.000814	0.000527	-0.00575	-0.00221	-0.00585	0.00918
	(0.012)	(0.013)	(0.016)	(0.018)	(0.018)	(0.013)
year_2014	-0.168***	-0.168***	-0.174***	-0.173***	-0.179***	-0.160***
	(0.017)	(0.017)	(0.018)	(0.014)	(0.013)	(0.018)
year_2015	-0.162***	-0.161***	-0.168***	-0.167***	-0.169***	-0.151***
	(0.018)	(0.018)	(0.019)	(0.015)	(0.014)	(0.021)
BACO NOIR	0.234*	0.241*	0.233*	0.211*	0.264***	0.306***
	(0.100)	(0.098)	(0.092)	(0.093)	(0.060)	(0.033)
CABERNET FRANC	0.364*	0.354*	0.330*	0.326*	0.291+	0.352**
	(0.135)	(0.130)	(0.131)	(0.138)	(0.140)	(0.103)
CABERNET SAUVIGNON	0.391*	0.399**	0.404**	0.458***	0.392**	0.434***
	(0.140)	(0.131)	(0.123)	(0.098)	(0.103)	(0.069)
CARMENERE	1.036***	1.059***	1.006***	1.200***	0	0
	(0.057)	(0.073)	(0.066)	(0.160)	(.)	(.)
CHARDONNAY	0.0136	0.0155	0.0159	0.0102	0.00316	0.0237
	(0.047)	(0.048)	(0.048)	(0.041)	(0.039)	(0.033)
EHRENFELSER	-0.0868	-0.073	0.0177	0.278*	0.360**	0.412**
	(0.083)	(0.083)	(0.095)	(0.099)	(0.104)	(0.114)
GAMAY NOIR	-0.0347	-0.0321	-0.0275	-0.0233	-0.016	0.07
	(0.108)	(0.107)	(0.107)	(0.112)	(0.111)	(0.100)
MARECHAL FOCH	0.147*	0.150*	0.147*	0.144*	0.120*	0.148**
	(0.065)	(0.068)	(0.057)	(0.056)	(0.045)	(0.038)
MERLOT	0.171+	0.164+	0.165+	0.137	0.105	0.181**
	(0.088)	(0.085)	(0.087)	(0.083)	(0.075)	(0.047)
PINOT AUXERROIS	0.0158	0.0159	0.0174	0.00999	-0.0124	-0.0223
	(0.051)	(0.050)	(0.050)	(0.060)	(0.059)	(0.076)
PINOT BLANC	-0.213**	-0.212*	-0.204*	-0.220**	-0.253**	-0.231**
	(0.071)	(0.072)	(0.072)	(0.070)	(0.072)	(0.069)
PINOT GRIGIO	-0.0824	-0.0746	-0.0683	-0.111	-0.121	-0.0419
	(0.073)	(0.067)	(0.064)	(0.100)	(0.095)	(0.061)
PINOT GRIS	-0.0555	-0.0524	-0.0583	-0.0527	-0.055	-0.0376
	(0.038)	(0.039)	(0.055)	(0.053)	(0.052)	(0.046)
PINOT MEUNIER	0.0157	0.0175	0.0118	0.02	0.0283	0.0256
	(0.040)	(0.041)	(0.044)	(0.045)	(0.047)	(0.051)
PINOT NOIR	0.181**	0.182**	0.182**	0.192**	0.195*	0.238***
	(0.058)	(0.059)	(0.061)	(0.062)	(0.066)	(0.055)
RIESLING	0.0836	0.0833	0.0771	0.121+	0.0972	0.110+
	(0.054)	(0.058)	(0.061)	(0.062)	(0.058)	(0.053)
SANGIOVESE	0.786***	0.801***	0.785***	0.800***	0.727***	0.656***
	(0.085)	(0.083)	(0.067)	(0.065)	(0.086)	(0.114)
SAUVIGNON BLANC	-0.123	-0.135	-0.111	-0.0851+	-0.0478	0.0283
	(0.088)	(0.093)	(0.063)	(0.048)	(0.038)	(0.038)
SYRAH	0.272**	0.259*	0.245*	0.258*	0.233*	0.299**
	(0.091)	(0.089)	(0.087)	(0.102)	(0.093)	(0.099)
TEMPRANILLO	0.109+	0.109+	0.111+	0.138*	0.122+	0.136*
	(0.054)	(0.056)	(0.056)	(0.053)	(0.060)	(0.057)
TREBBIANO	-0.155**	-0.160**	-0.159**	-0.169***	-0.206***	-0.190***
	(0.042)	(0.039)	(0.041)	(0.038)	(0.035)	(0.026)
VIOGNIER	0.106	0.0859	0.0811	0.0891	0.0974	0.116*
	(0.087)	(0.085)	(0.080)	(0.071)	(0.058)	(0.049)
ZWEIGELT	0.259**	0.242**	0.221*	0.198*	0.183*	0.262**
	(0.080)	(0.079)	(0.082)	(0.087)	(0.083)	(0.077)
WINERY 1	0.057	0.075	0.117	0.0546	0.027	-0.067

Table B.5. Log-level model. SE clustered on sub-appellations (15).

	(1) lnprice	(2) lnprice	(3) lnprice	(4) lnprice	(5) lnprice	(6) lnprice
	(0.073)	(0.087)	(0.078)	(0.079)	(0.096)	(0.093)
WINERY 2	0.0248	0.047	0.00878	-0.124	-0.269+	-0.418**
	(0.068)	(0.077)	(0.112)	(0.083)	(0.139)	(0.117)
WINERY 3	0.0427	0.0205	0.0303	0.229*	0.0638	-0.0419
	(0.060)	(0.067)	(0.053)	(0.101)	(0.107)	(0.097)
WINERY 4	0	0	0	0	1.308***	1.121***
	(.)	(.)	(.)	(.)	(0.161)	(0.118)
WINERY 5	0.154*	0.176*	0.126+	0.317*	0.293**	0.0527
	(0.063)	(0.073)	(0.063)	(0.146)	(0.098)	(0.111)
WINERY 6	-0.0523	-0.0803	-0.163	-0.224+	-0.361*	-0.368**
	(0.063)	(0.073)	(0.096)	(0.108)	(0.151)	(0.122)
WINERY 7	-0.119	-0.152	-0.237	-0.126	-0.138	-0.267+
	(0.088)	(0.104)	(0.140)	(0.180)	(0.147)	(0.127)
WINERY 8	0.651***	0.622***	0.562***	0.588***	0.395*	0.181
	(0.094)	(0.103)	(0.135)	(0.122)	(0.177)	(0.169)
WINERY 9	-0.213**	-0.244**	-0.311*	-0.431+	-0.510+	-0.449*
	(0.065)	(0.075)	(0.113)	(0.203)	(0.251)	(0.156)
WINERY 10	0.438***	0.461***	0.503***	0.448***	0.434**	0.606***
	(0.063)	(0.075)	(0.077)	(0.106)	(0.109)	(0.121)
WINERY 11	0.214*	0.229*	0.272**	0.314**	0.204+	0.0169
	(0.093)	(0.096)	(0.083)	(0.101)	(0.103)	(0.108)
WINERY 12	0.222**	0.193*	0.227**	0.36	0.0927	-0.12
	(0.068)	(0.076)	(0.064)	(0.227)	(0.240)	(0.244)
WINERY 13	-0.0042	0.0209	0.00497	-0.00168	-0.0876	-0.230+
	(0.129)	(0.126)	(0.114)	(0.150)	(0.149)	(0.115)
WINERY 14	-0.0792	-0.0913	-0.047	-0.0469	-0.153	-0.286*
	(0.091)	(0.098)	(0.088)	(0.090)	(0.093)	(0.122)
WINERY 15	0.236**	0.204*	0.235**	0.378*	0.400***	0.194*
	(0.064)	(0.076)	(0.069)	(0.138)	(0.086)	(0.085)
WINERY 16	0.0361	0.00226	0.0317	0.123	-0.0245	-0.0705
	(0.092)	(0.094)	(0.080)	(0.086)	(0.105)	(0.149)
WINERY 17	0.0208	-0.00284	0.0114	0.109	-0.183	-0.122
	(0.072)	(0.073)	(0.064)	(0.236)	(0.286)	(0.298)
WINERY 18	0.311***	0.335***	0.390***	0.476***	0.342*	0.151
	(0.067)	(0.079)	(0.071)	(0.061)	(0.119)	(0.120)
WINERY 19	0.346***	0.367***	0.317***	0.317*	0.183	0.0738
	(0.070)	(0.080)	(0.076)	(0.108)	(0.122)	(0.128)
WINERY 20	0.0959	0.0601	0.0863	0.318*	-0.0285	-0.114
	(0.074)	(0.088)	(0.067)	(0.108)	(0.158)	(0.140)
WINERY 21	0.224**	0.235**	0.205*	0.206+	0.304**	0.187*
	(0.075)	(0.078)	(0.069)	(0.102)	(0.101)	(0.076)
WINERY 23	0.0876	0.113	0.163+	0.177+	0.119	-0.0994
	(0.087)	(0.095)	(0.081)	(0.086)	(0.075)	(0.100)
WINERY 24	0.158	0.161	0.196	0.348	0.333+	0.196
	(0.143)	(0.137)	(0.139)	(0.202)	(0.187)	(0.140)
WINERY 25	0.122	0.162	0.191+	0.412**	0.256+	0.066
	(0.077)	(0.095)	(0.092)	(0.130)	(0.123)	(0.096)
WINERY 26	0.258**	0.282**	0.242+	0.166	0.351*	0.361*
	(0.077)	(0.090)	(0.128)	(0.189)	(0.160)	(0.162)
WINERY 27	-0.0744	-0.049	-0.0976	-0.222*	-0.0842	-0.146
	(0.086)	(0.096)	(0.113)	(0.092)	(0.089)	(0.097)
WINERY 28	0.213*	0.225*	0.182*	0.168	0.118	0.00218
	(0.092)	(0.093)	(0.065)	(0.100)	(0.097)	(0.080)
WINERY 29	-0.0352	-0.0675	-0.0438	0.0361	-0.00436	-0.116
	(0.066)	(0.080)	(0.067)	(0.114)	(0.092)	(0.132)
WINERY 30	0.428***	0.454***	0.506***	0.805***	0.810***	0.692***
	(0.078)	(0.085)	(0.083)	(0.136)	(0.141)	(0.109)
WINERY 31	0.183*	0.151	0.171*	0.331**	0.164	0.102
	(0.075)	(0.087)	(0.073)	(0.085)	(0.118)	(0.152)
WINERY 32	-0.00348	0.0207	0.0672	0.0461	-0.0314	0.0103
	(0.086)	(0.095)	(0.091)	(0.095)	(0.086)	(0.113)

Table B.5. Log-level model. SE clustered on sub-appellations (15).

	(1) lnprice	(2) lnprice	(3) lnprice	(4) lnprice	(5) lnprice	(6) lnprice
WINERY 33	0.0593	0.0695	0.0767	0.113	0.106	-0.027
	(0.097)	(0.107)	(0.109)	(0.093)	(0.085)	(0.058)
alcohol below12%	0.00789	0.00591	0.00263	-0.0326	0.00672	0.0188
	(0.077)	(0.077)	(0.079)	(0.078)	(0.085)	(0.081)
alcohol [12%,14 %]	0.00239	0.00272	-0.000126	-0.0162	-0.00168	0.0296
	(0.065)	(0.064)	(0.062)	(0.062)	(0.063)	(0.054)
soil well-suited		0.0577	0.0813	0.142*	0.152*	0.0852
		(0.045)	(0.057)	(0.054)	(0.056)	(0.050)
rows NS			-0.0126	-0.08	-0.0829*	-0.0817*
			(0.028)	(0.051)	(0.033)	(0.028)
rows SE-NW			0.0861	0.0984	0.0663	0.0563
			(0.114)	(0.198)	(0.192)	(0.158)
rows SW-NE			0.0993	0.0528	0.105	0.0753
			(0.086)	(0.087)	(0.083)	(0.066)
aspect FLAT				-0.0085	-0.00823	0.0858
				(0.043)	(0.092)	(0.105)
aspect NE				-0.276*	0.0283	0.131
				(0.106)	(0.132)	(0.152)
aspect NW				0.0515	0.131	0.254
				(0.169)	(0.143)	(0.156)
aspect S				-0.0894	-0.0045	0.191
				(0.124)	(0.110)	(0.120)
aspect SE				-0.176	0.0199	0.208
				(0.175)	(0.208)	(0.195)
aspect SW				-0.207+	-0.260*	-0.0844
				(0.107)	(0.089)	(0.125)
aspect W				-0.296**	-0.173*	-0.0939
				(0.083)	(0.074)	(0.103)
avgelev (200m-400m]					-0.197**	-0.229**
					(0.066)	(0.057)
avgelev (400m and up)					0.011	0.025
					(0.070)	(0.086)
lake (700m-3000m]					0.0433	-0.012
					(0.057)	(0.068)
lake (3000 m and up)					0.0688	0.0689
					(0.085)	(0.076)
april<11C						0.0104*
						(0.005)
april>19C						0.0321**
						(0.010)
may<16C						-0.00447
						(0.015)
may>25C						-0.0000888
						(0.007)
june<20C						-0.00166
						(0.008)
june>29C						0.0109
						(0.007)
july<25C						-0.015
						(0.012)
july>33C						-0.0187**
						(0.006)
august<24C						-0.0115+
						(0.006)
august>33C						0.00634
						(0.006)
september<18C						-0.00145
						(0.009)
september >27C						-0.00287
						(0.006)
october<10C						-0.0167*

Table B.5. Log-level model. SE clustered on sub-appellations (15).

	(1) lnprice	(2) lnprice	(3) lnprice	(4) lnprice	(5) lnprice	(6) lnprice
						(0.006)
october>18C						-0.0104
						(0.012)
april<10C						0.00398
						(0.009)
april>16C						-0.00661
						(0.006)
may<4C						0.000944
						(0.008)
may>11C						-0.0237**
						(0.007)
june<9C						-0.00943
						(0.012)
june>15C						-0.0270*
						(0.010)
july<12C						0.000689
						(0.007)
july>18C						0.00957+
						(0.005)
august<11C						-0.0147*
						(0.006)
august>17C						-0.0107
						(0.008)
september<6C						-0.00872
						(0.011)
september>13C						-0.0031
						(0.007)
october<1C						0.00673
						(0.009)
october>8C						-0.00529
						(0.009)
_cons	2.747***	2.723***	2.681***	2.758***	2.776***	3.219***
	(0.089)	(0.099)	(0.087)	(0.100)	(0.098)	(0.263)
N	6785	6785	6785	6785	6785	6785
R-sq	0.745	0.747	0.751	0.768	0.78	0.815
adj. R-sq	0.742	0.744	0.749	0.766	0.777	0.812
F	.	.	.	.	.	.

Standard errors in parentheses
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001
SE clustered on 15 sub-appellations
These are results obtained after controlling for variety (24), brand (33) and year (5) fixed effects.
Comparison Groups: Soil: moderately well-suited, Rows: EW, Aspect: E,
Elevation: [0-200m], Heat: middle interval for each month.
Alcohol above 14%, Lake distance [67-700m], Elevation [0-200m], Heat: middle interval for each month.

Table B.6. Regression results (full level-level and log-level models (6), with and without inclusion of capacity dummy. Capacity dummy variable=1 if winery belonged to top 10 market players in BC in 2011-2015.

	Main specification price	Main specification lnprice	Specification with capacity dummy price	Specification with capacity dummy lnprice
year_2014	-2.523**	-0.160***	-2.523**	-0.160***
	(0.751)	(0.018)	(0.751)	(0.018)
year_2015	-2.327*	-0.151***	-2.327*	-0.151***
	(0.895)	(0.021)	(0.895)	(0.021)
capacity			**4.265**	**-0.0738**
			(9.129)	**(0.128)**
soil well-suited	1.972+	0.0852	1.972+	0.0852
	(1.101)	(0.050)	(1.101)	(0.050)
rows NS	-2.319*	-0.0817*	-2.319*	-0.0817*
	(0.974)	(0.028)	(0.974)	(0.028)
aspect S	6.145+	0.191	6.145+	0.191
	(3.212)	(0.120)	(3.212)	(0.120)
avgelev (200m-400m]	-3.779*	-0.229**	-3.779*	-0.229**
	(1.570)	(0.057)	(1.570)	(0.057)
april<11C	0.304*	0.0104*	0.304*	0.0104*
	(0.110)	(0.005)	(0.110)	(0.005)
april>19C	0.893**	0.0321**	0.893**	0.0321**
	(0.271)	(0.010)	(0.271)	(0.010)
june>29C	0.294+	0.0109	0.294+	0.0109
	(0.158)	(0.007)	(0.158)	(0.007)
july<25C	-0.624+	-0.015	-0.624+	-0.015
	(0.330)	(0.012)	(0.330)	(0.012)
july>33C	-0.542**	-0.0187**	-0.542**	-0.0187**
	(0.166)	(0.006)	(0.166)	(0.006)
august<24C	-0.458**	-0.0115+	-0.458**	-0.0115+
	(0.142)	(0.006)	(0.142)	(0.006)
october<10C	-0.404*	-0.0167*	-0.404*	-0.0167*
	(0.168)	(0.006)	(0.168)	(0.006)
may>11C	-0.617*	-0.0237**	-0.617*	-0.0237**
	(0.210)	(0.007)	(0.210)	(0.007)
june>15C	-0.776**	-0.0270*	-0.776**	-0.0270*
	(0.240)	(0.010)	(0.240)	(0.010)
july>18C	0.311*	0.00957+	0.311*	0.00957+
	(0.117)	(0.005)	(0.117)	(0.005)
august<11C	-0.409**	-0.0147*	-0.409**	-0.0147*
	(0.134)	(0.006)	(0.134)	(0.006)
Constant	30.40**	3.219***	30.40**	3.219***
	(10.120)	(0.263)	(10.120)	(0.263)
N	6785	6785	6785	6785
R-sq	0.751	0.815	0.751	0.815
adj. R-sq	0.747	0.812	0.747	0.812

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table B.6. Regression results (full level-level and log-level models (6), with and without inclusion of capacity dummy. Capacity dummy variable=1 if winery belonged to top 10 market players in BC in 2011-2015.

	Main specification price	Main specification lnprice	Specification with capacity dummy price	Specification with capacity dummy lnprice
SE clustered on 15 sub-appellations				
These are results obtained after controlling for variety (24), brand (33) and year (5) fixed effects.				
Alcohol(3), Lake distance(3).				
Comparison Groups: Soil: moderately well-suited, Rows: EW, Aspect: E,				
Elevation: [0-200m], Heat: middle interval for each month.				
Capacity: in top 10 market players.				
Only results that yielded significant estimates in Model 6 are presented here.				

Table B.7. Regression results (full level-level and log-level models (6), with and without inclusion of capacity dummy. Capacity dummy variable=1 if winery belonged to top 5 market players in BC in 2011-2015.

	Main specification	Main specification	Specification with capacity dummy	Specification with capacity dummy
	price	lnprice	price	lnprice
year_2014	-2.523**	-0.160***	-2.523**	-0.160***
	(0.751)	(0.018)	(0.751)	(0.018)
year_2015	-2.327*	-0.151***	-2.327*	-0.151***
	(0.895)	(0.021)	(0.895)	(0.021)
capacity			**0.769**	**-0.0738**
			(2.652)	**(0.128)**
soil well-suited	1.972+	0.0852	1.972+	0.0852
	(1.101)	(0.050)	(1.101)	(0.050)
rows NS	-2.319*	-0.0817*	-2.319*	-0.0817*
	(0.974)	(0.028)	(0.974)	(0.028)
aspect S	6.145+	0.191	6.145+	0.191
	(3.212)	(0.120)	(3.212)	(0.120)
avgelev (200m-400m]	-3.779*	-0.229**	-3.779*	-0.229**
	(1.570)	(0.057)	(1.570)	(0.057)
april<11C	0.304*	0.0104*	0.304*	0.0104*
	(0.110)	(0.005)	(0.110)	(0.005)
april>19C	0.893**	0.0321**	0.893**	0.0321**
	(0.271)	(0.010)	(0.271)	(0.010)
june>29C	0.294+	0.0109	0.294+	0.0109
	(0.158)	(0.007)	(0.158)	(0.007)
july<25C	-0.624+	-0.015	-0.624+	-0.015
	(0.330)	(0.012)	(0.330)	(0.012)
july>33C	-0.542**	-0.0187**	-0.542**	-0.0187**
	(0.166)	(0.006)	(0.166)	(0.006)
august<24C	-0.458**	-0.0115+	-0.458**	-0.0115+
	(0.142)	(0.006)	(0.142)	(0.006)
october<10C	-0.404*	-0.0167*	-0.404*	-0.0167*
	(0.168)	(0.006)	(0.168)	(0.006)
may>11C	-0.617*	-0.0237**	-0.617*	-0.0237**
	(0.210)	(0.007)	(0.210)	(0.007)
june>15C	-0.776**	-0.0270*	-0.776**	-0.0270*
	(0.240)	(0.010)	(0.240)	(0.010)
july>18C	0.311*	0.00957+	0.311*	0.00957+
	(0.117)	(0.005)	(0.117)	(0.005)
august<11C	-0.409**	-0.0147*	-0.409**	-0.0147*
	(0.134)	(0.006)	(0.134)	(0.006)
Constant	30.40**	3.219***	29.63**	3.293***
	(10.120)	(0.263)	(9.063)	(0.294)
N	6785	6785	6785	6785
R-sq	0.751	0.815	0.751	0.815
adj. R-sq	0.747	0.812	0.747	0.812

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

SE clustered on 15 sub-appellations

Table B.7. Regression results (full level-level and log-level models (6), with and without inclusion of capacity dummy. Capacity dummy variable=1 if winery belonged to top 5 market players in BC in 2011-2015.

	Main specification price	Main specification lnprice	Specification with capacity dummy price	Specification with capacity dummy lnprice
These are results obtained after controlling for variety (24), brand (33) and year (5) fixed effects.				
Alcohol(3), Lake distance(3).				
Comparison Groups: Soil: moderately well-suited, Rows: EW, Aspect: E,				
Elevation:[0-200m], Heat: middle interval for each month.				
Capacity: not in top 5 market players.				
Only results that yielded significant estimates in Model 6 are presented here.				

Appendix C: Chapter 4.

Table C.1. Average prices of BC grown grape varieties, year 2015.	
Varietals	**Average Price/Tonne**
White	
Pinot Gris	$2,076
Chardonnay	$2,033
Gewürztraminer	$1,866
Sauvignon Blanc	$1,799
Riesling	$1,790
Pinot Blanc	$1,822
Viognier	$2,267
Bacchus	$1,951
Muscat	$2,121
Auxerrois	$1,906
Ehrenfelser	$1,816
Semillon	$2,348
Icewine Riesling	$2,305
Siegerrebe	$1,939
Kerner	$1,994
Müller Thurgau	$1,559
Vidal	$1,046
Misc. White Vinifera	$2,175
Roussanne	$2,415
Misc. White Hybrid	$1,378
Schönburger	$1,733
Madeleine Angevine	$1,420
Optima	$2,012
Ortega	$1,825
Rotberger	$2,000
Siegfriedrebe	$1,665
Red	
Merlot	$2,466
Cabernet Sauvignon	$2,563
Red	

Table C.1. Average prices of BC grown grape varieties, year 2015.	
Varietals	**Average Price/Tonne**
Pinot Noir	$2,270
Cabernet Franc	$2,563
Syrah/Shiraz	$2,683
Malbec	$2,713
Gamay Noir	$2,063
Petit Verdot	$2,681
Maréchal Foch	$1,786
Zweigelt	$2,400
Misc. Red Hybrids	$2,156
Tempranillo	$2,393
Zinfandel	$2,002
Misc. Red Vinifera	$2,187
Lemberger/Blaufränkisch	$2,128
Sangiovese	$2,664
Pinot Meunier	$1,768
Carmenere	$2,741
Chancellor	$1,305
Dunkelfelder	$2,204
Mourvedre	$3,225

Source: 2015 British Columbia Wine Grape Report, accessed on April 1, 2017: http://www.grapegrowers.bc.ca/sites/default/files/resource/2015%20-%20Crop%20Report%20-%20Public/files/2015%20BC%20Wine%20Grape%20Crop%20Report%20-%20Public.pdf

Table C.2. List of estate wineries.

	Winery		
1	CASSINI CELLARS	72	GREATA
2	QUINTA FERREIRA	73	HILLSIDE
3	COVERT FARMS	74	LE VIEUX PIN
4	DESERT HILLS	75	JOIE
5	SAXON	76	KETTLE VALLEY
6	MISCONDUCT	77	HAYWIRE
7	CHURCH&STATE	78	ST. HUBERTUS
8	OROFINO	79	RED ROOSTER
9	HAINLE	80	THE VIEW
10	WILD GOOSE	81	SUMMERHILL
11	RIVER STONE	82	LANG
12	NICHOL	83	QUAILSGATE
13	PENTAGE	84	TANTALUS
14	POPLAR GROVE	85	SPERLING
15	ROBIN RIDGE	86	HERDER
16	PERSEUS	87	CROWSNEST
17	SONORAN ESTATE	88	TINHORN
18	LASTELLA	89	KISMET
19	ADEGA	90	SYNCHROMESH
20	INTERSECTION	91	MORAINE
21	LAKE BREEZE	92	MT. BOUCHERIE
22	ARROWLEAF	93	NK'MIP
23	D'ANGELO	94	BENCH 1775
24	INTRIGUE	95	CORCELETTES
25	8TH GENERATION	96	FOXTROT
26	SILK SCARF	97	LAUGHING STOCK
27	FAIRVIEW	98	BARTIER BROS
28	ROLLINGDALE	99	DEEP ROOTS
29	HESTER	100	LITTLE STRAW
30	BURROWING OWL	101	CULMINA
31	HOUSE OF ROSE	102	SEE YA LATER
32	RUBY BLUES	103	MISTRAL
33	VOLCANIC HILLS	104	GOLD HILL
34	CAMELOT	105	ANTELOPE RIDGE
35	YOUNG & WYSE	106	SILVER SAGE
36	ZERO BALANCE	107	TWISTED TREE
37	ROAD 13	108	BEAUMONT
38	MISSION HILL	109	MOCOJO
39	JACKSON TRIGGS	110	50TH PARALLEL
40	CLOS DU SOLEIL	111	TH
41	MOON CURSER	112	CALONA
42	HEAVEN'S GATE	113	RUSTICO
43	NOBLE RIDGE	114	BONITAS
44	EXNIHILO	115	EAUVIVRE
45	VIBRANT	116	SUMAC RIDGE
46	SPIERHEAD	117	BLACK HILLS OSOYOOS
47	SEVEN STONES	118	LAROSE
48	SERENDIPITY	119	PAINTED ROCK
49	PLATINUM BENCH	120	CERELIA
50	HIDDEN CHAPEL	121	BLUE MOUNTAIN
51	OLIVER TWIST	122	KRAZE LEGZ
52	VAN WESTEN	123	MEYER
53	MAVERICK	124	ANCIENT HILL
54	HOWLING BLUFF	125	BLACK WIDOW
55	INNISKILLIN	126	GEHRINGER
56	UPPER BENCH	127	MARICHEL
57	LIQUIDITY	128	STONEBOAT
58	STAG'S HOLLOW	129	FIRST ESTATE
59	TIGHTROPE	130	ST. LASZLO
60	GRAY MONK	131	DIRTY LAUNDRY

Table C.2. List of estate wineries.

	Winery		
61	SANDHILL	132	HUGGING TREE
62	CEDARCREEK	133	BLACK DOG
63	CASTORO DE ORO	134	CANA
64	TOWNSHIP 7	135	TOPSHELF
65	KALALA	136	DAYDREAMER
66	C.C. JENTSCH	137	THE HATCH
67	THORNHAVEN	138	LARIANA
68	LA FRENZ	139	MONTAKARN
69	BLASTED CHURCH		
70	THERAPY		
71	NICHE		

Figure C.1. Distribution of prices for red VQA wines, 2011-2015.

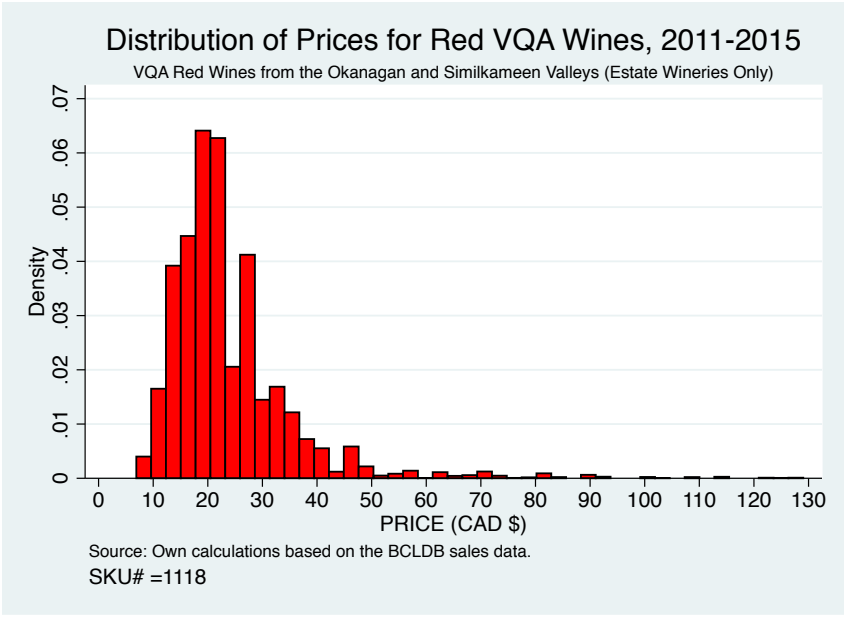


Figure C.2. Distribution of prices for red non-VQA wines, 2011-2015.

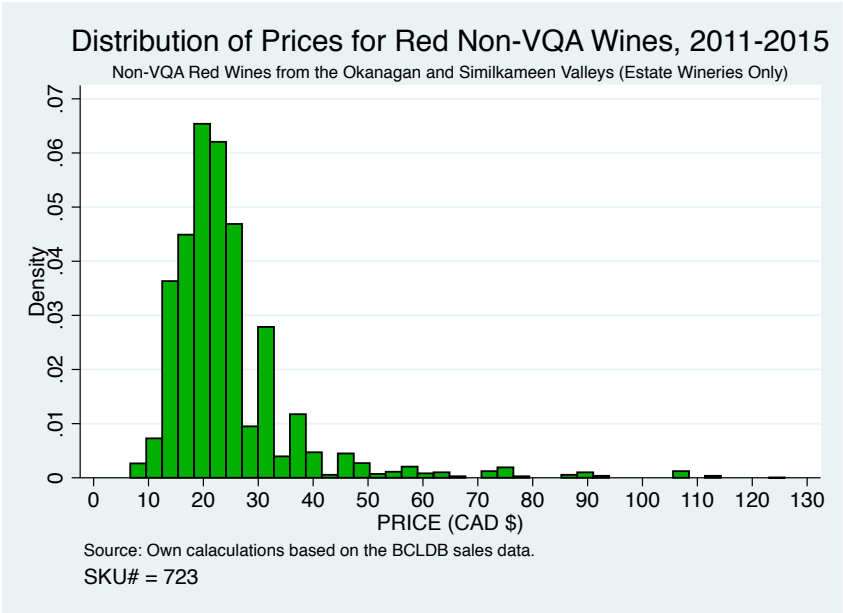


Figure C.3. Distribution of prices for white VQA wines, 2011-2015.

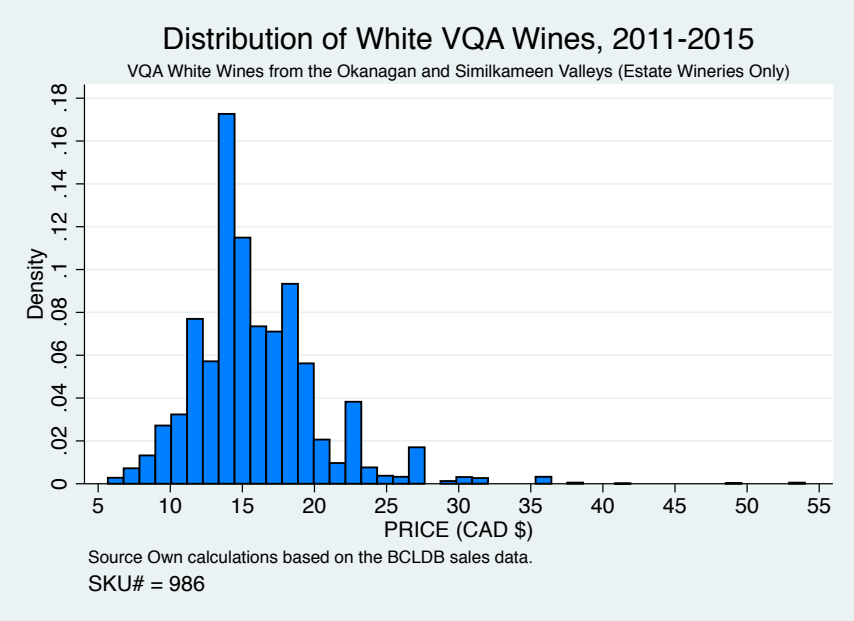


Figure C.4. Distribution of prices for white non-VQA wines, 2011-2015.

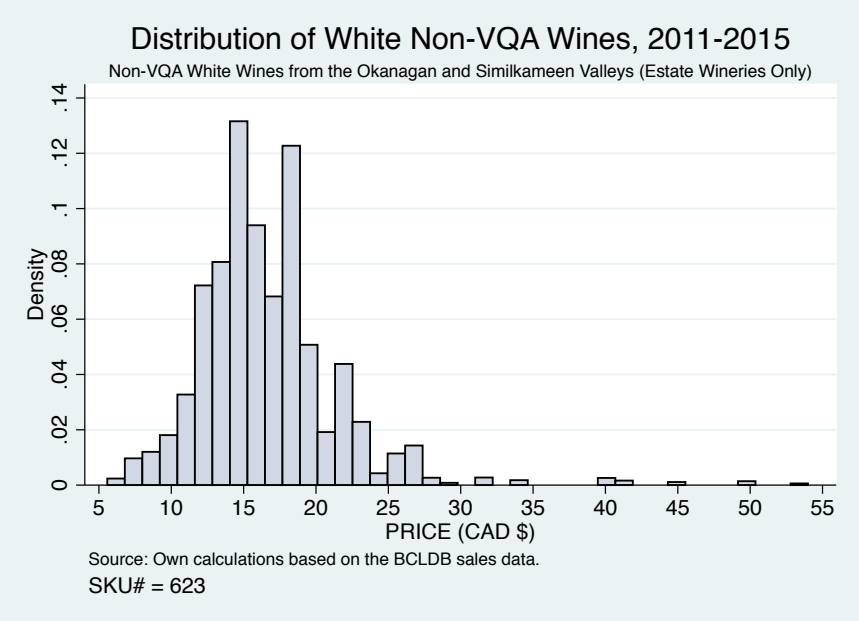


Table C.3. Explanatory power of the binomial probit model.

	-------- True --------		
Classified	D	~D	Total
+	1588	491	2079
-	497	843	1340
Total	2085	1334	3419

Classified +if predicted Pr(D) >= .5	
True D defined as vqaindic != 0	
Sensitivity Pr(+|D)	76.16%
Specificity Pr(-|~D)	63.19%
Positive predictive value Pr(D|+)	76.38%
Negative predictive value Pr(~D|-)	62.91%
False + rate for true ~D Pr(+|~D)	36.81%
False - rate for true D Pr(-|D)	23.84%
False + rate for classified +Pr(~D|+)	23.62%
False - rate for classified - Pr(D|-)	37.09%
Correctly classified	**71.10%**

Table C.4. Binomial probit -full estimation results.

Binomial Probit	VQA indication (VQA=1)
Winery Age [1990, 2000)	0.266+
	(0.149)
Winery Age [2000, 2010)	0.746***
	(0.145)
Winery Age [2010, 2014)	0.879***
	(0.151)
East Side Mixed Sediments	0.769**
	(0.242)
Golden Mile	0.305*
	(0.152)
Kettled Outwash and Fans	-0.680***
	(0.149)
Lakeside Alluvial Fans	0.433*
	(0.182)
Mission Creek Terraces	0.460**
	(0.150)
Mixed Sediments and Fans	-0.165
	(0.125)
NE Side Lacustrine Bench	-0.188
	(0.118)
Sandy Outwash Lakeside Terraces East Side	-0.127
	(0.207)
Sandy Outwash Lakeside Terraces West Side	0.251
	(0.224)
Sandy Outwash Terrace and Deposits	-0.186
	(0.126)
SE Side Lacustrine Bench	-0.605***
	(0.145)
Similkameen Valley	-0.325*
	(0.130)
West Side Lacustrine Bench	0.816+
	(0.449)
West Side Mixed Sediments	0.0811
	(0.136)
Capacity Medium	-1.599***
	(0.153)
Capacity Small	-2.107***
	(0.154)
Reserve	-0.163
	(0.112)
Color White	0.0338
	(0.096)
Sweetness 1	0.202
	(0.225)
Sweetness 2	-0.133
	(0.425)
Sweetness 3	0.249
	(0.587)
Sweetness 4	0
	(.)
Sweetness 5	0
	(.)
Sweetness 6	0
	(.)
Sweetness N/A	-1.104***

Table C.4. Binomial probit -full estimation results.

Binomial Probit	VQA indication (VQA=1)
	(0.095)
Baco Noir	-0.0387
	(0.906)
Barbera	0
	(.)
Blaufrankisch	0
	(.)
Blend	-0.41
	(0.337)
Cabernet Franc	-0.344
	(0.362)
Cabernet Sauvignon	-0.714*
	(0.360)
Carmenere	0.0524
	(0.846)
Chardonnay	-0.372
	(0.356)
Chasselas	0
	(.)
Chenin Blanc	-0.563
	(1.031)
Ehrenfelser	-0.806
	(0.573)
Gamay Noir	-0.745+
	(0.387)
Gewurztraminer	-0.396
	(0.360)
Grenache	0
	(.)
Gruner Vetliner	0
	(.)
Kerner	-0.442
	(0.651)
Lemberger	0
	(.)
Malbec	-0.271
	(0.407)
Marechal Foch	-0.523
	(0.449)
Merlot	-0.528
	(0.344)
Mourvedre	0
	(.)
Muscat Ottonel	-0.215
	(0.674)
Optima	0
	(.)
Oraniensteiner	-0.63
	(0.640)
Petit Verdot	-1.078+
	(0.601)
Pinot Auxerrois	-1.011
	(0.743)
Pinot Blanc	-0.242
	(0.386)
Pinot Grigio	-0.228

Table C.4. Binomial probit -full estimation results.

Binomial Probit	**VQA indication (VQA=1)**
	(0.435)
Pinot Gris	-0.573
	(0.358)
Pinot Meunier	0
	(.)
Pinot Noir	-0.494
	(0.341)
Pinotage	-0.156
	(0.546)
Riesling	-0.276
	(0.365)
Sangiovese	0
	(.)
Sauvignon Blanc	-0.09
	(0.374)
Schonburger	-0.775
	(0.841)
Semillon	-0.798+
	(0.484)
Siegerrebe	0
	(.)
Sovereign	-1.887
	(1.688)
St.Laurent	0
	(.)
Syrah	-0.457
	(0.352)
Tannat	-0.236
	(0.973)
Tempranillo	0.541
	(0.587)
Tokay	0
	(.)
Touriga	0
	(.)
Trebbiano	0
	(.)
Vidal	-0.412
	(0.680)
Viognier	-0.468
	(0.371)
Voros	0
	(.)
Zinfandel	-0.469
	(0.550)
Zweigelt	0
	(.)
Alcohol	0.103**
	(0.034)
Constant	1.420*
	(0.585)
N	**3419**

Standard errors in parentheses
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001
Comparison groups:
Winery Age [1932, 1990), Capacity: Large,

Table C.4. Binomial probit -full estimation results.

Binomial Probit	**VQA indication (VQA=1)**
Sub-appellation: Alluvial fans and flood plains	
Variety: Arneis, Sweetness=0, Reserve=0	

Table C.5. 2SLS estimation results. Dependent variable: logarithm of the average volume share.

	First stage	Second Stage
	logarithm average volume share	logarithm average volume share
VQA Indication		0.655+
		(0.349)
VQA probability	1.015322***	
	(0.00)	
Reserve=1	-0.0039349	0.0851
	(0.031)	(0.093)
Color White	0.0042477	-0.0302
	(0.030)	(0.089)
Sweetness 1	0.0060714	0.0939
	(0.044)	(0.132)
Sweetness 2	-0.0094689	-0.293
	(0.112)	(0.339)
Sweetness 3	0.0151871	0.684
	(0.166)	(0.501)
Sweetness 4	0	0
	(.)	(.)
Sweetness 5	0	0
	(.)	(.)
Sweetness 6	0	0
	(.)	(.)
Sweetness N/A	0.0049971	-0.414***
	(0.039)	(0.116)
Baco Noir	0.7668957	-0.173
	(0.484)	(1.478)
Barbera	0	0
	(.)	(.)
Blaufrankisch	0	0
	(.)	(.)
Blend	0.7819821+	0.11
	(0.433)	(1.321)
Cabernet Franc	0.7773784+	-0.196
	(0.436)	(1.329)
Cabernet Sauvignon	0.7766538+	-0.316
	(0.436)	(1.323)
Carmenere	0.7775433	0.388
	(0.496)	(1.521)
Chardonnay	0.7851669+	-0.29
	(0.433)	(1.323)
Chasselas	0	0

Table C.5. 2SLS estimation results. Dependent variable: logarithm of the average volume share.

	First stage	Second Stage
	logarithm average volume share	logarithm average volume share
	(.)	(.)
Chenin Blanc	0.7660962	-0.417
	(0.467)	(1.422)
Ehrenfelser	0.7745429+	0.0533
	(0.449)	(1.360)
Gamay Noir	0.782682+	0.289
	(0.439)	(1.329)
Gewurztraminer	0.776901+	-0.0608
	(0.434)	(1.323)
Grenache	0	0
	(.)	(.)
Gruner Vetliner	0	0
	(.)	(.)
Kerner	0.7725572+	-0.487
	(0.464)	(1.411)
Lemberger	0	0
	(.)	(.)
Malbec	0.7810404+	-0.5
	(0.439)	(1.340)
Marechal Foch	0.7779297+	-0.219
	(0.444)	(1.352)
Merlot	0.7882533+	-0.12
	(0.434)	(1.323)
Mourvedre	0	0
	(.)	(.)
Muscat Ottonel	0.7610193	-0.585
	(0.474)	(1.445)
Optima	0	0
	(.)	(.)
Oraniensteiner	0.7827361+	-0.325
	(0.468)	(1.419)
Petit Verdot	0.7879901+	-0.834
	(0.455)	(1.375)
Pinot Auxerrois	0.8784982+	0.561
	(0.475)	(1.444)
Pinot Blanc	0.7884337+	0.144
	(0.435)	(1.333)
Pinot Grigio	0.7751416+	0.645
	(0.439)	(1.344)

Table C.5. 2SLS estimation results. Dependent variable: logarithm of the average volume share.

	First stage	Second Stage
	logarithm average volume share	**logarithm average volume share**
Pinot Gris	0.7778133+	0.267
	(0.434)	(1.319)
Pinot Meunier	0	0
	(.)	(.)
Pinot Noir	0.7838458+	-0.174
	(0.434)	(1.323)
Pinotage	0.771444+	-0.000491
	(0.452)	(1.385)
Riesling	0.7693093+	-0.332
	(0.434)	(1.326)
Sangiovese	0	0
	(.)	(.)
Sauvignon Blanc	0.772091+	-0.131
	(0.434)	(1.330)
Schonburger	0.9338849+	0.374
	(0.530)	(1.605)
Semillon	0.7676919+	-0.317
	(0.445)	(1.348)
Siegerrebe	0	0
	(.)	(.)
Sovereign	0.7815046	-0.987
	(0.532)	(1.603)
St.Laurent	0	0
	(.)	(.)
Syrah	0.782937+	-0.092
	(0.435)	(1.325)
Tannat	0.7864829	0.532
	(0.526)	(1.605)
Tempranillo	0.7870768+	-0.273
	(0.455)	(1.407)
Tokay	0	0
	(.)	(.)
Touriga	0	0
	(.)	(.)
Trebbiano	0	0
	(.)	(.)
Vidal	0.8508183+	-0.393
	(0.474)	(1.448)
Viognier	0.7837274+	-0.12

Table C.5. 2SLS estimation results. Dependent variable: logarithm of the average volume share.

	First stage	Second Stage
	logarithm average volume share	logarithm average volume share
	(0.435)	(1.324)
Voros	0	0
	(.)	(.)
Zinfandel	0.7755698+	-1.054
	(0.451)	(1.373)
Zweigelt	0.7732222+	-0.571
	(0.443)	(1.358)
Alcohol	-0.0034282	-0.155***
	(0.011)	(0.032)
East Side Mixed Sediments	-0.0143846	-0.039
	(0.061)	(0.183)
Golden Mile	-0.0023718	-0.385**
	(0.042)	(0.126)
Kettled Outwash and Fans	-0.0049115	0.311+
	(0.053)	(0.162)
Lakeside Alluvial Fans	-0.0108049	0.564***
	(0.054)	(0.160)
Mission Creek Terraces	-0.0009846	-0.0566
	(0.046)	(0.139)
Mixed Sediments and Fans	-0.0128443	0.236*
	(0.038)	(0.116)
NE Side Lacustrine Bench	-0.0015179	0.470***
	(0.036)	(0.109)
Sandy Outwash Lakeside Terraces East Side	-0.0108636	0.476**
	(0.061)	(0.183)
Sandy Outwash Lakeside Terraces West Side	-0.0066681	0.188
	(0.069)	(0.207)
Sandy Outwash Terrace and Deposits	-0.0044024	0.167
	(0.039)	(0.117)
SE Side Lacustrine Bench	0.0007355	-0.275+
	(0.050)	(0.151)
Similkameen Valley	-0.0081657	0.155
	(0.044)	(0.132)
West Side Lacustrine Bench	-0.0075759	-0.344
	(0.080)	(0.241)
West Side Mixed Sediments	-0.0106201	-0.419***
	(0.038)	(0.115)
Winery Age [1990, 2000)	0.0037946	0.461***
	(0.034)	(0.104)

Table C.5. 2SLS estimation results. Dependent variable: logarithm of the average volume share.

	First stage	Second Stage
	logarithm average volume share	**logarithm average volume share**
Winery Age [2000, 2010)	0.0007705	0.653***
	(0.043)	(0.129)
Winery Age [2010, 2014)	-0.0054993	1.177***
	(0.049)	(0.147)
Capacity Medium	0.0043983	-1.237***
	(0.044)	(0.130)
Capacity Small	0.0125084	-1.875***
	(0.062)	(0.183)
Constant	-0.7498799	-12.24***
	(0.466)	(1.376)
N	3365	3365
R-sq	0.24	0.28
adj. R-sq	0.23	0.26

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Comparison groups:

Winery Age [1932, 1990)

Capacity: Large

Sub-appellation: Alluvial fans and flood plains

Sweetness: Sweetness=0

Color: Red

Reserve: Reserve=0

Variety: Arneis

Instrumented: VQA Indication

Table C.6. 2SLS estimation results. Dependent variable: logarithm of the average price.

	First stage	Second Stage
	logarithm average price	**logarithm average price**
VQA Indication		-0.0657046
		(0.084)
VQA probability	.9944108 ***	
	(0.00)	
Reserve=1	-0.0017288	0.00224
	(0.030)	(0.022)
Color White	0.0038534	-0.274***
	(0.029)	(0.021)
Sweetness 1	-0.0019688	-0.0567+
	(0.043)	(0.031)
Sweetness 2	-0.0045814	-0.000643
	(0.112)	(0.081)
Sweetness 3	0.0244488	0.243*
	(0.166)	(0.120)
Sweetness 4	0	0
	(.)	(.)
Sweetness 5	0	0
	(.)	(.)
Sweetness 6	0	0
	(.)	(.)
Sweetness N/A	0.000036	-0.00914
	(0.039)	(0.028)
Baco Noir	0.7697206	-0.127
	(0.484)	(0.353)
Barbera	0	0
	(.)	(.)
Blaufrankisch	0	0
	(.)	(.)
Blend	0.7803659+	-0.0554
	(0.433)	(0.316)
Cabernet Franc	0.7763052+	0.0543
	(0.436)	(0.318)
Cabernet Sauvignon	0.7784848+	0.119
	(0.436)	(0.316)
Carmenere	0.7788005	0.256
	(0.496)	(0.363)
Chardonnay	0.775539+	0.0454
	(0.433)	(0.316)
Chasselas	0	0

Table C.6. 2SLS estimation results. Dependent variable: logarithm of the average price.

	First stage	Second Stage
	logarithm average price	logarithm average price
	(.)	(.)
Chenin Blanc	0.766925+	0.111
	(0.462)	(0.336)
Ehrenfelser	0.7741154+	-0.067
	(0.449)	(0.325)
Gamay Noir	0.7779764+	-0.318
	(0.439)	(0.318)
Gewurztraminer	0.7763291+	-0.0894
	(0.434)	(0.316)
Grenache	0	0
	(.)	(.)
Gruner Vetliner	0	0
	(.)	(.)
Kerner	0.771672+	0.0144
	(0.464)	(0.337)
Lemberger	0	0
	(.)	(.)
Malbec	0.7803657+	0.0898
	(0.439)	(0.320)
Marechal Foch	0.7801818+	-0.168
	(0.444)	(0.323)
Merlot	0.7819632+	-0.122
	(0.434)	(0.316)
Mourvedre	0	0
	(.)	(.)
Muscat Ottonel	0.7731595	0.22
	(0.474)	(0.346)
Optima	0	0
	(.)	(.)
Oraniensteiner	0.7812458+	-0.0684
	(0.468)	(0.339)
Petit Verdot	0.7809098+	0.218
	(0.455)	(0.329)
Pinot Auxerrois	0.7733528+	-0.266
	(0.468)	(0.339)
Pinot Blanc	0.7847109+	-0.0902
	(0.435)	(0.318)
Pinot Grigio	0.7775192+	-0.171
	(0.439)	(0.321)

Table C.6. 2SLS estimation results. Dependent variable: logarithm of the average price.

	First stage	Second Stage
	logarithm average price	**logarithm average price**
Pinot Gris	0.7749337+	-0.0578
	(0.434)	(0.315)
Pinot Meunier	0	0
	(.)	(.)
Pinot Noir	0.7761917+	-0.0273
	(0.434)	(0.316)
Pinotage	0.7801885+	-0.0787
	(0.452)	(0.331)
Riesling	0.7778449+	0.0784
	(0.434)	(0.317)
Sangiovese	0	0
	(.)	(.)
Sauvignon Blanc	0.7739112+	-0.0269
	(0.434)	(0.318)
Schonburger	0.7784991	-0.0118
	(0.500)	(0.361)
Semillon	0.7697902+	-0.0622
	(0.444)	(0.322)
Siegerrebe	0	0
	(.)	(.)
Sovereign	0.7769405	-0.404
	(0.532)	(0.383)
St.Laurent	0	0
	(.)	(.)
Syrah	0.7774509+	0.0501
	(0.435)	(0.317)
Tannat	0.783551	0.193
	(0.526)	(0.384)
Tempranillo	0.7921102+	-0.0792
	(0.455)	(0.336)
Tokay	0	0
	(.)	(.)
Touriga	0	0
	(.)	(.)
Trebbiano	0	0
	(.)	(.)
Vidal	0.7629139	-0.0371
	(0.467)	(0.340)
Viognier	0.7790443+	0.0293

Table C.6. 2SLS estimation results. Dependent variable: logarithm of the average price.

	First stage	Second Stage
	logarithm average price	logarithm average price
	(0.435)	(0.317)
Voros	0	0
	(.)	(.)
Zinfandel	0.7758777+	0.088
	(0.451)	(0.328)
Zweigelt	0.7717516+	0.185
	(0.443)	(0.325)
Alcohol	0.0002667	0.107***
	(0.010)	(0.008)
East Side Mixed Sediments	0.0027112	0.157***
	(0.060)	(0.043)
Golden Mile	0.0104331	0.245***
	(0.042)	(0.030)
Kettled Outwash and Fans	0.0025931	0.0715+
	(0.053)	(0.038)
Lakeside Alluvial Fans	0.0079825	0.0648+
	(0.053)	(0.039)
Mission Creek Terraces	0.0007252	0.194***
	(0.046)	(0.033)
Mixed Sediments and Fans	-0.0018092	0.0698*
	(0.038)	(0.027)
NE Side Lacustrine Bench	0.0058863	0.155***
	(0.036)	(0.026)
Sandy Outwash Lakeside Terraces East Side	-0.0006699	0.0645
	(0.060)	(0.044)
Sandy Outwash Lakeside Terraces West Side	0.0041342	0.542***
	(0.069)	(0.050)
Sandy Outwash Terrace and Deposits	0.0028915	0.207***
	(0.038)	(0.028)
SE Side Lacustrine Bench	0.0068515	0.124***
	(0.050)	(0.036)
Similkameen Valley	-0.0000881	0.149***
	(0.043)	(0.031)
West Side Lacustrine Bench	0.0040074	0.0622
	(0.080)	(0.056)
West Side Mixed Sediments	0.0002643	0.220***
	(0.038)	(0.027)
Winery Age [1990, 2000)	-0.0038217	-0.118***
	(0.034)	(0.025)

Table C.6. 2SLS estimation results. Dependent variable: logarithm of the average price.

	First stage	Second Stage
	logarithm average price	**logarithm average price**
Winery Age [2000, 2010)	-0.0030698	-0.127***
	(0.042)	(0.030)
Winery Age [2010, 2014)	-0.0033919	-0.178***
	(0.049)	(0.035)
Capacity Medium	-0.0018829	0.129***
	(0.043)	(0.031)
Capacity Small	-0.0011772	0.107*
	(0.061)	(0.044)
Constant	-0.7788785	1.584***
	(0.465)	(0.328)
N	3413	3413
R-sq	0.24	0.36
adj. R-sq	0.23	0.352

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Comparison groups:

Winery Age [1932, 1990)

Capacity: Large

Sub-appellation: Alluvial fans and flood plains

Sweetness: Sweetness=0

Color: Red

Reserve: Reserve=0

Variety: Arneis

Instrumented: VQA Indication

Table C.7. 2SLS estimation results. Dependent variable: logarithm of the average revenue share.

	First stage	Second Stage
	logarithm average revenue share	logarithm average revenue share
VQA Indication		0.635
		(0.521)
VQA probability	1.015303***	
	(.1173954)	
Reserve=1	-0.0041384	-0.00851
	(0.031)	(0.139)
Color White	0.0041057	-0.292*
	(0.030)	(0.134)
Sweetness 1	0.006316	-0.0844
	(0.044)	(0.198)
Sweetness 2	-0.0091668	-0.376
	(0.112)	(0.507)
Sweetness 3	0.0152561	1.575*
	(0.166)	(0.750)
Sweetness 4	0	0
	(.)	(.)
Sweetness 5	0	0
	(.)	(.)
Sweetness 6	0	0
	(.)	(.)
Sweetness N/A	0.0049815	-0.896***
	(0.039)	(0.174)
Baco Noir	0.7662217	0.321
	(0.484)	(2.210)
Barbera	0	0
	(.)	(.)
Blaufrankisch	0	0
	(.)	(.)
Blend	0.7815424+	0.737
	(0.433)	(1.975)
Cabernet Franc	0.78215758+	0.481
	(0.436)	(1.988)
Cabernet Sauvignon	0.7762864+	0.54
	(0.436)	(1.978)
Carmenere	0.7773415	1.348
	(0.496)	(2.274)
Chardonnay	0.7848753+	0.466
	(0.433)	(1.977)
Chasselas	0	0

Table C.7. 2SLS estimation results. Dependent variable: logarithm of the average revenue share.

	First stage	Second Stage
	logarithm average revenue share	logarithm average revenue share
	(.)	(.)
Chenin Blanc	0.76592	0.454
	(0.467)	(2.126)
Ehrenfelser	0.7740857+	1.175
	(0.449)	(2.033)
Gamay Noir	0.7820952+	0.598
	(0.439)	(1.987)
Gewurztraminer	0.7763698+	0.669
	(0.434)	(1.978)
Grenache	0	0
	(.)	(.)
Gruner Vetliner	0	0
	(.)	(.)
Kerner	0.7722179+	0.231
	(0.464)	(2.110)
Lemberger	0	0
	(.)	(.)
Malbec	0.7808552+	0.202
	(0.439)	(2.003)
Marechal Foch	0.7768535+	0.321
	(0.444)	(2.021)
Merlot	0.78787+	0.505
	(0.434)	(1.978)
Mourvedre	0	0
	(.)	(.)
Muscat Ottonel	0.7606186	0.884
	(0.474)	(2.161)
Optima	0	0
	(.)	(.)
Oraniensteiner	0.7817366+	0.528
	(0.468)	(2.122)
Petit Verdot	0.787856+	-0.208
	(0.455)	(2.056)
Pinot Auxerrois	0.8784145+	1.666
	(0.475)	(2.158)
Pinot Blanc	0.7880064+	0.823
	(0.435)	(1.992)
Pinot Grigio	0.7747998+	1.262
	(0.439)	(2.010)

Table C.7. 2SLS estimation results. Dependent variable: logarithm of the average revenue share.

	First stage	Second Stage
	logarithm average revenue share	logarithm average revenue share
Pinot Gris	0.7774812+	1.006
	(0.434)	(1.973)
Pinot Meunier	0	0
	(.)	(.)
Pinot Noir	0.7832359+	0.55
	(0.434)	(1.978)
Pinotage	0.7707695+	1.139
	(0.452)	(2.070)
Riesling	0.7688285+	0.482
	(0.434)	(1.982)
Sangiovese	0	0
	(.)	(.)
Sauvignon Blanc	0.7717954+	0.511
	(0.434)	(1.988)
Schonburger	0.9338304+	1.609
	(0.530)	(2.400)
Semillon	0.7672159+	-0.0613
	(0.445)	(2.016)
Siegerrebe	0	0
	(.)	(.)
Sovereign	0.7821661	-1.787
	(0.532)	(2.397)
St.Laurent	0	0
	(.)	(.)
Syrah	0.7825821+	0.642
	(0.435)	(1.981)
Tannat	0.7859317	0.725
	(0.526)	(2.400)
Tempranillo	0.78677+	0.215
	(0.455)	(2.103)
Tokay	0	0
	(.)	(.)
Touriga	0	0
	(.)	(.)
Trebbiano	0	0
	(.)	(.)
Vidal	0.8502812+	0.496
	(0.474)	(2.165)
Viognier	0.7835296+	0.573

Table C.7. 2SLS estimation results. Dependent variable: logarithm of the average revenue share.

	First stage	Second Stage
	logarithm average revenue share	logarithm average revenue share
	(0.435)	(1.980)
Voros	0	0
	(.)	(.)
Zinfandel	0.7751668+	-0.467
	(0.451)	(2.053)
Zweigelt	0.7719931+	0.3
	(0.443)	(2.031)
Alcohol	-0.0034776	-0.072
	(0.011)	(0.047)
East Side Mixed Sediments	-0.0144911	0.207
	(0.061)	(0.273)
Golden Mile	-0.0023701	-0.263
	(0.042)	(0.188)
Kettled Outwash and Fans	-0.0047116	0.241
	(0.053)	(0.242)
Lakeside Alluvial Fans	-0.010542	0.688**
	(0.054)	(0.240)
Mission Creek Terraces	-0.000515	0.113
	(0.046)	(0.207)
Mixed Sediments and Fans	-0.0125779	0.0557
	(0.038)	(0.173)
NE Side Lacustrine Bench	-0.0014762	0.588***
	(0.036)	(0.163)
Sandy Outwash Lakeside Terraces East Side	-0.011025	0.620*
	(0.061)	(0.274)
Sandy Outwash Lakeside Terraces West Side	-0.0064667	0.737*
	(0.069)	(0.310)
Sandy Outwash Terrace and Deposits	-0.0044848	0.131
	(0.039)	(0.174)
SE Side Lacustrine Bench	0.0009897	-0.258
	(0.050)	(0.226)
Similkameen Valley	-0.0086697	-0.000648
	(0.044)	(0.198)
West Side Lacustrine Bench	-0.0079211	-0.188
	(0.080)	(0.360)
West Side Mixed Sediments	-0.0087799	-0.395*
	(0.038)	(0.172)
Winery Age [1990, 2000)	0.0047147	0.438**
	(0.034)	(0.156)

Table C.7. 2SLS estimation results. Dependent variable: logarithm of the average revenue share.

	First stage	Second Stage
	logarithm average revenue share	**logarithm average revenue share**
Winery Age [2000, 2010)	0.002112	0.691***
	(0.043)	(0.193)
Winery Age [2010, 2014)	-0.0049955	0.862***
	(0.049)	(0.220)
Capacity Medium	0.0039414	-1.365***
	(0.044)	(0.195)
Capacity Small	0.0125965	-2.259***
	(0.062)	(0.273)
Constant	-0.7497545	-14.32***
	(0.466)	(2.058)
N	3366	3366
R-sq	0.24	0.25
adj. R-sq	0.23	0.24

Standard errors in parentheses

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Comparison groups:

Winery Age [1932, 1990)

Capacity: Large

Sub-appellation: Alluvial fans and flood plains

Sweetness: Sweetness=0

Color: Red

Reserve: Reserve=0

Variety: Arneis

Instrumented: VQA Indication

Table C.8. First-stage regression summary statistics. Dependent variable: logarithm of the average volume share.

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(1,3302)	Prob > F
vqaindic	0.2418	0.2275	0.0222	74.8055	0.0000

Minimum eigenvalue statistic = 74.8055

Critical Values	#of endogenous regressors			1
Ho: Instruments are weak	#of excluded instruments			1
	5%	10%	20%	30%
2SLS relative bias	(not available)			
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	16.38	8.96	6.66	5.53
LIML Size of nominal 5% Wald test	16.38	8.96	6.66	5.53

Table C.9. First-stage regression summary statistics. Dependent variable: logarithm of the average price.

		Adjusted	Partial		
Variable	R-sq.	R-sq.	R-sq.	F(1,3302)	Prob > F
vqaindic	0.2427	0.2287	0.0214	73.1809	0.0000

Minimum eigenvalue statistic = 73.1809

Critical Values	#of endogenous regressors			1
Ho: Instruments are weak	#of excluded instruments			1
	5%	10%	20%	30%
2SLS relative bias	(not available)			
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	16.38	8.96	6.66	5.53
LIML Size of nominal 5% Wald test	16.38	8.96	6.66	5.53

Table C.10 First-stage regression summary statistics. Dependent variable: logarithm of the average revenue share.

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(1,3302)	Prob > F
vqaindic	0.2416	0.2274	0.0221	74.7979	0.0000

Minimum eigenvalue statistic = 74.7979

Critical Values	#of endogenous regressors			1
Ho: Instruments are weak	#of excluded instruments			1
	5%	10%	20%	30%
2SLS relative bias	(not available)			
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	16.38	8.96	6.66	5.53
LIML Size of nominal 5% Wald test	16.38	8.96	6.66	5.53