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Biodynamic Wine Certification: Added Value or Just A Scheme?

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Abstract

When consumers buy wine, they do not think about the product distribution process it takes to get the bottle on the shelf. The markets in the United States of America (USA) could have hundreds of thousands of choices, but the number of available bottles are decreased to a selected few because of importers and distributors. The purpose of this research is to investigate the impact that biodynamic certification has on Italian wines imported to the USA market. If biodynamic certified wines can create a competitive value, then importers should consider including them and other similar styles in their portfolios to increase their sales. This study was done through a quantitative lens, using a multiple regression analysis of pricing, or a hedonic price analysis along with ANOVA testing. From the results, it was determined that biodynamic certification as a variable of price premiums for an importer's portfolio was inconclusive. Variables such as brand, type of wine, and grape variety were the three main variables that showed the highest significance, which was consistent with the previous research. With this information, there would need to be more research done to determine if biodynamic certification could have an impact on wine price.

Keywords: biodynamic wine, certification scheme, hedonic price model, importer, wine, USA

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'Il peggior vino contadino è migliore del migloir vino industrale, perché ha un'anima' - Luigi Veronelli

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BD	Biodynamic
Demeter or BFDI	Biodynamic Federation Demeter International
B2B	Business-to-Business
B2C	Business-to-Consumer
CAP	Common Agricultural Policy
COO	Country of Origin
DOCG	Denominazione di origine controllata
DOCG	Denominazione di origine controllata e garantita
EU	European Union
BIO	EU Biological Certification
GED	General Education Diploma
GI	Geographical Indication
IGT	Indicazione geografica tipica
IISD	International Institute of Sustainable Development
FIVI	Italian Federation of Independent Winemakers
KLWM	Kermit Lynch Wine Merchant
OR	Organic
OT	Other
PDO	Protected Designation of Origin
PGI	Protected Geographical Indication
SD	Standard Deviation
SME	Small and Medium Sized Enterprises
SMWC	Small and Micro Wine Companies
SUS	Sustainable
SIVCBD	Syndicat International Des Vignerons En Culture Bio-Dynamique
TD	Traditional
TSG	Traditional Specialties Guaranteed
UN	United Nations
USA	United States of America
USDA	United States Department of Agriculture
WTP	Willingness to Pay

Chapter 1. Introduction

When consumers buy wine, they do not think about the product distribution process it takes to get the bottle on the shelf. Their main concerns are price and flavor, but other factors may impact what bottle they choose, including quality certifications, country of origin (COO), and even the color of the wine (Bazzani et al., 2024; Li, 2024; Lourenço-Gomes et al., 2021). The markets in the United States of America (USA) could have hundreds of thousands of choices, but the number of available bottles are decreased to a selected few because of importers and distributors. They are the controllers who determine which wines will be imported, their country of origin, and where the wine will be sold. Just like consumers, importers and distributors need to think about different variables that may influence which bottles they will be able to sell and at what price they can be sold.

1.1 Background

Previous studies done in wine selection and marketing had traditionally focused on consumers' purchasing behaviors. While the area is important, it has been extensively researched, with study motives being reused to new consumers of different generations and countries (Li, 2024; Pomarici & Vecchio, 2014). The most impactful variables for wine selection remain generally consistent with brands, location, awards, and type of wine being among the highest influencers on consumers' decisions (Ohana-Levi et al., 2023; Pegan et al., 2020; da Rocha Oliveira Teixeira et al., 2023). However, modern-day issues i.e. climate change, have created a new set of priorities that could affect consumers' purchases, especially those from the eco-conscious movement. Buzzwords like 'natural,' 'organic,' and 'biodynamic' impact what is bought in today's market with more consumers having far less apprehension of these products than previously studied (Delmas & Gergaud, 2021).

The eco-conscious trend does not only affect the average consumer in the USA, but also consumers who are considered experts as well. These are professionals in the field, including wine critics, major wine publications, and importers. Importers carry the most influence in the USA since they are the ones who decide what will be sold in the country (Delmas, et al., 2016; Pegan et al., 2020). In order to better understand the dynamics of how the wine market supply chain works, further studies must be done on importers and distributors and how they select wines for sale.

1.2 Problem Statement

There is a notable gap in the literature on what key factors most impact importers and distributors. It is important to understand whether they buy and sell wines according to what their market wants or if they choose based on what they think the new market trends are. The limited number of studies done on this topic means that future studies can utilize any starting factors to help identify potential price premiums. In this research, biodynamic certification was the main variable being looked at while the other variables took more subsidiary positions.

1.3 Objectives and Research Questions

The purpose of this research is to investigate the impact that biodynamic certification has on Italian wines imported to the USA market. Since eco-trends are rising in the US wine market, it is important to understand if there is an additional price premium that can be associated with these types of wines (Andrews, 2024). If biodynamic certified wines can create a competitive value, then importers should consider including them and other similar styles in their portfolios to increase their sales.

To fully comprehend how biodynamic certification impacts wine price, the following subjects were analyzed:

- **Examine Certification Schemes in the Wine Industry.** Since there are numerous types of certification schemes worldwide, it is important to focus on the ones most relevant to the wine sector, including sustainable certification schemes.
- **Explore Principles of Biodynamics.** Although biodynamic farming is a 100-year-old technique, it has increased application in the new generation of farmers due to its connection to the earth and environmental standards. Certification is only available to farmers who satisfy the highest of these standards.
- **Identify Price Determinants in the USA Wine Market.** Importers, distributors, and retailers have to understand what the market in their area wants and needs. If it becomes too saturated with similar products, these firms could risk lost profits and their customer base.
- **Analyze USA Importers' Wine Portfolios and Pricing.** By investigating USA importers' portfolios through statistical analysis, this study seeks to identify a correlation between biodynamic certifications and price. The goal is to see if sustainability is a crucial characteristic in which wines importers are supplying.

After exploring these objectives, the main hypothesis was developed:

> ***H1:*** *Biodynamic certification offers a positive influence on price for imported Italian wines to the United States.*

Along with an additional research question:

> ***RQ1:*** *What variables are the most important for importers and distributors when pricing their Italian wine portfolio?*

1.4 Structure of the Thesis

This thesis has six chapters and may include additional subsections within each to ensure that the study has been properly researched. These subsections offered a way to keep the information more organized to the reader.

Chapter 2 is the Literature Review, which interpreted the previous literature of different aspects of wines. This involved the history, biodynamics and other farming techniques, certifications – including sustainable and governmental – and concluding with different price determinants that influence wine prices. Chapter 3 is Research and Methods. This chapter covered the research and methodology used for this study, explaining how the data was sourced and how it was analyzed using the hedonic price method and ANOVA test. Chapter 4 is the Results of the study. The results presented what was learned from the study, including which variables had the strongest impact on wine price in the USA market and what role biodynamic certification played on price. Chapter 5 is the Discussion, which focused on what the results supplied in a larger context, including how the most significant variables of pricing can impact importers' and distributors' decisions on wine imported and what this means for the future of the wine industry. Lastly, Chapter 6 is the Conclusion. The final chapter deliberated how the study went and what the results meant in the larger picture of wine imports to the USA. An examination of the limitations that occurred, along with what this and future studies would mean to the wine industry supply chain.

Throughout this study, the analysis of what influences a wine importer's choice of Italian wines should be easier to identify and to see if it aligns with current or traditional trends.

Chapter 2. Literature Review

This thesis aims to uncover the impact that biodynamic certification has on overall sales of certified biodynamic wines when compared to non-certified wines in a foreign market. In order to understand how biodynamic certifications have an effect on wine pricing in the market, there needs to be some exploration of the following subject areas: history and farming, general certifications and sustainable certifications, biodynamics and biodynamic certifications, and finally, pricing dynamics for the wine market, including motivations on why importers and distributors would import certified wines.

Sustainable certifications are relatively new within the EU, having first been included in the Common Agricultural Policy (CAP) in 1991 (Weissenberger, 2015, p. 10). Separating sustainable certifications from biodynamic certifications will show the strict protocols required in order to differentiate the two. It will also briefly introduce biodynamic farming and what producers would have to involve in their day-to-day practices to reap the benefits of this farming style. Looking into pricing determinants along with importer and distributor motivations can help explain the reasons behind why wines are priced the ways that they are in the international market. This will be important to see if there is a correlation between wines that have been certified (biodynamic or otherwise) and prices or if there are other factors at play. By exploring the existing research on these subject areas, the advantages and disadvantages of producers obtaining a biodynamic certification should be more apparent. This information should help analyze whether that certification scheme is the appropriate choice for producers to partake in.

2.1 History and Farming

Wine and grapevines have had a long and interesting history, one that has been discussed and dissected for years. The wild grape, scientifically known as *Vitis vinifera sylvestris,* was first recorded by archeologists to have been made into wine in the Zagros Mountains, current day Armenia and Iran, from 9000- 4000 BCE (Standage, 2005, p. 46). From this region and along with other civilizations, the grapevine moved West; to Turkey, Crete, Greece, and finally the Roman Empire in modern day Italy. It was in this Mediterranean state that grape cultivation was distinguished from other crops as it "was honest and down to earth, but the resulting wine was a symbol of civilization" (Standage, 2005, pp. 71-72). In the past, it was sophistication and civilization that kept farmers

motivated to produce better wines, but in today's society, what would make a farmer change their practices with the knowledge that is readily available?

Now a producer must think about what types of farming techniques they will use, whether to harvest early or late season, what type of yeast they will add, and a plethora of other technical wine-making decisions. These choices are all factors which will determine if the producer has created something worthy of the market, or if they will fall behind. With younger generations interested in more sustainable products, producers are becoming more aware of what type of sustainable practices they could be participating in (Pomarici & Vecchio, 2014).

2.2 Certifications

The EU explains that "certification schemes for agricultural products and foodstuffs provide assurance (through a certification mechanism) that certain characteristics or attributes of the product or its production method or system, laid down in specifications, have been observed" (European Commission, 2010, p. 5). These schemes can work in two different ways: business-to-business (B2B), which is when a third-party such as a distributor or supermarket is the final vendor, or business-to-consumer (B2C), which is when the final product is sold to the final consumer, such as selling at the vineyard or direct online sales. The type of certification a product holds can mean different things to the final purchaser, since the values of a business may differ compared to those values of a consumer (European Commission, 2010).

Furthermore, certifications can also add a sense of 'quality' to the product. 'Quality' is a highly subjective term that is relative to the consumer's values. The first thing that should be considered is that there are two types of 'quality': product and system. Product quality is something that would be verified with a product certification, guaranteeing the product meets the standards of the certifying firm. These standards can also be separated into two groups: regulated and unregulated certifications, with regulated being a part of a governmental schematic like Protected Designation of Origin (PDO), Protected Geographical Indication (PGI), Traditional Specialties Guaranteed (TSG) for food or Denominazione di origine controllata (DOC), Denominazione di origine controllata e garantita (DOCG), and Indicazione geografica tipica (IGT) for Italian wines, while unregulated certifications are a part of specialty firms, e.g. Rainforest Alliance, Biodyvin, and Italian Federation of Independent Winemakers (FIVI), (Onofri, 2022, pp. 3-4). It is within these 'unregulated certifications' that begin to unfold endless

possibilities on what can be considered certain types of 'quality' products. But what is the priority for the consumer or for the maker of these products and overall, is it worth the money? In a world where money will always have a major impact, it is critical to understand how and why a producer, a vendor, or a consumer would decide to spend theirs. Acknowledging different types of certifications helps show what is important to these entities, albeit, sometimes not necessarily of their own choice due to social pressures or other external influences (Pomarici & Vecchio, 2019).

Sustainable Certifications

What are the key differences between regular and sustainable certifications and why do they have their own sub-sector? The United Nations (UN) has established regulations to help identify what is considered sustainable and what is not. Utilizing pillars of sustainability, the UN decided on three traits that would best contribute to the overall concept: environment, economic, and social (United Nations, 2012). Environmental sustainability is the easier pillar to decipher; it is to ensure that the company or product is safe for the environment, which includes reducing pollution, and making sure natural resources are being used in a conscious way. Economic and social are more nuanced, as they themselves are broad-termed words. Economic sustainability refers to growth, including an increase in profits which are created fairly without labor abuse, along with development and investment in research and technologies that will help with efficient production and distribution. Social sustainability is connected to the people involved, whether they are the consumers, developers, producers, or workers, and aims to create a higher standard of living. This would involve creating safer working conditions, regulating the age of workers (e.g. no children so they can focus on their education), building a stronger community which includes safe drinking water, sanitary environments, and childcare (United Nations, 2012).

According to the International Institute of Sustainable Development (IISD), there are over 400 different types of voluntary sustainable systems around the world, which includes agriculture, fisheries, mining, and forestry sectors. However, in the agriculture sector, wine and grapes are not included, meaning that there are even more sustainability schemes accessible for grape farmers (ISSD, 2023). There is an obvious interest in sustainability in the world since there are many different schemes to help cultivate sustainability, however, it can become convoluted and confusing to the final consumer with the sheer number, ranging from country to country (Moscovici & Reed, 2018).

Having some key labels, like Figure 1, that are easy to identify and are internationally recognized, is an important attribute that can be utilized across many different fields which in turn, would result in more consumer recognition (Moscovici & Reed, 2018).

Figure 1: *EU Biological (BIO) Label. Symbol for an organic product (Weissenburger, 2015)*

It is with this recognition that consumers may identify that the product does have a 'quality' appeal. However, in the past, Delmas and Grant (2010), discovered that organic wines were not something of fashion, finding that "certifying wine increases the price by 13%, [...but] an eco-label reduces the price by 20%" (p. 35). With mixed justifications in pricing, producers kept their organic certifications to themselves, in fear that consumers would associate them with poorer quality wine that had been "greenwashing" the market (Delmas & Grant, 2010). The question remains: would having an eco-certification help with price impact?

Recent developments in eco-labeling and wine sales have shown much more promising results. Sellers (2016), found that Spanish consumers were willing to pay for a sustainable wine with a higher price than a non-sustainable wine, but only in certain groups surveyed, including those who knew about wine and sustainable products already. Boncinelli et al. (2021), also looked at how consumers viewed and purchased organic wines. They determined that although organic wines may not be the first preference in the majority of consumers, there are niche groups who are significantly more likely to purchase organic wines, even if there is a price increase. Although overall, organic certification was not the main attribute that consumers relied on, mainly focusing on Geographical Indication (GI) certification, including DOCG and DOC (Boncinelli et al.,

2021, p. 13). These studies only looked at the consumers' side of Willingness to Pay (WTP) and more research should be done from the producers' standpoint on their businesses. Further studies are needed on sustainable certification schemes for multiple reasons, including if consumer knowledge of them has an impact on their wine choices. In that controlled environment, the consumer would not feel ostracized for not choosing a 'sustainable' wine, but rather feel supported in identifying what they are interested in and why (Pomarici & Vecchio, 2019).

2.3 Biodynamics

Biodynamic farming has been around for the last 100 years, developed by eccentric philosopher Rudolf Steiner (BFDI, 2023a). Born in 1861 in former Hungary, school was never easy for him, as he was more concerned with "[…] how everything was connected; the other perhaps most significant, was determining the limits of knowledge," (Lachman, 2007, p. 11). His parents recognized the difficulties of traditional school, so his father taught him while working at the local rail station, where he became interested not only in mathematics, but the connection between science and spirituality, along with "spiritual space," (Lachman, 2007, p. 18).

It was with these thoughts that he was able to build his studies, developing not only an educational system: the Waldorf school, and non-traditional medicine practices: Weleda, but also the concept of biodynamic farming. All three of these concepts follow the practices of Anthroposophia, which come from the Greek *anthropos*, meaning human, and *sophia*, meaning wisdom, in short, how humans and spirituality work together to create a better and stronger unity (Lachman, 2007). Although his works about biodynamic farming did not come to fruition until closer to his death, the first recorded lesson was taught in June 1924, in which he claimed that the reason why farmers were having issues started with where the crops were being grown. "The soil itself was sick and so the produce grown on it suffered. They in turn affected the animals and people who ate it," is how Steiner explained it to those participating in his class (Lachman, 2007, p. 217). Soil health is a topic regularly talked about and researched in the agricultural sector, especially with the degree of chemical pesticides that have been used in the last century.

One of the main differences between conventional and even organic farming, compared to biodynamic farming, is that fertilizers are not permitted, but rather a select number of preparations, known as "preps," should be used instead. There are nine different types of preps that are used together to help create the best synergy for the farm,

including prep 500; cow manure that is put into a cow's horn and buried for at least 6 months to later be removed and sprayed on the vines, and prep 505; which is when oak *(Quercus robur)* tree bark is collected and placed into a domesticated animal's skull (sheep, cow, etc.), which will later be used for composting mixes (Bucher & Bucher, 2020). These preparations are recorded by the producers in order to keep detailed information on timelines and statistical information, as a reference for future harvests.

However, it is with these types of preparations and techniques that many people have likened biodynamics to witchcraft, voodoo, and conspiracy theories, (Cole, 2011, p. 72). Since biodynamic farming was founded before the time of modern science and has not had any updates to the original procedures, it has developed many critics over the years. There have also been very few studies done examining the biodynamic farming process, including those that could not extract significant quantitative and qualitative data due to the size of the studies (Masotti et al., 2022) or those where the results were mixed on whether biodynamic preparations were influential (Pettinelli et al., 2023, Rienth et al, 2023) showing overall that more studies need to be completed to see if there is a true science behind the workings of Steiner's design. In 2021, when the Italian legislature was building laws to help with the EU's 'Farm to Fork strategy,' Italian scientists were adamant to have the reference on biodynamic farming modified to read as "[it] cannot be verified through the scientific method," (Nosengo, 2021). As noted by Nosengo (2021), many scientists do not recognize biodynamics as a formal scientific discipline. Although it may not be recognized as hard science by the scientific community, there are different biodynamic certification schemes internationally recognized from around the world.

Biodynamic Certifications in Wine

As seen with sustainable and organic certifications, biodynamic certifications also have many different operators around the world. The two main groups that are found in the EU and have connections to wine are Biodynamic Federation Demeter International (Demeter or BFDI) (Figure 2.2) and Biodyvin (Figure 2.3). These two organizations both require certain levels of expectations met by producers in order to be qualified to participate in their schemes.

***Figure 2**: Demeter Biodynamic Logo. An internationally recognized symbol of biodynamic farming. (Demeter Biodynamic Federation, 2023).*

***Figure 3:** Biodyvin Biodynamic Logo. A European-based company certifying biodynamic wineries. (Biodyvin, 2012a).*

Biodyvin or the full, legal name, Syndicat International Des Vignerons En Culture Bio-Dynamique (SIVCBD), was created in 1995 by a group of fifteen French producers looking to expand their knowledge of biodynamics with one another. Since then, their organization has grown to over 200 producers from across the EU (Biodyvin, 2012a). To become a member of their organization, a producer must complete four main steps: a pre-visit, a tasting, membership, and sharing and advice (Biodyvin, 2012b). Biodyvin's (2012b) procedure incorporates tastings to help understand the "character and energy" of the wine, along with continuous learning in their program in order to help their producers, as education is one of the fundamental reasons they started. Biodyvin is the smaller of the two biodynamic organizations, as Demeter is internationally recognized in over 60 countries, with almost half having their own local branches (BFDI, 2023b).

As for Demeter, it became a registered trademark in 1928 in Germany, four years after Steiner's lectures on the new farming style. Throughout Demeter's almost 100 years, it has gone through many changes and leading bodies, including its most recent merger to create the Biodynamic Federation -Demeter International (BFDI) in 2020 (BFDI, 2023a). With its history and growth, BFDI has been able to not only expand globally, but also has had time to create more detailed standards that producers and farmers need to follow in order to be offered the certification. Demeter's standards, which are readily

available online for prospective members, consists of a guide that's written in four languages – English, German, French, and Spanish – and is over 200 pages long, explaining general principles, production methods, pest control management, and product standards that they certify in, including breads, meats, oils and fats, along with wine and sparkling wine, cosmetics, and textiles (BFDI Standards Committee, 2024). Demeter is also very meticulous when it comes to their standards, regularly checking in with producers and farmers, verifying that their protocols are being followed and recorded with regular log dates (BFDI Standards Committee, 2024). With these strict regulations, consumers can feel confident that they are buying a trustworthy certified product.

2.4 Pricing Determinants in Wines

Looking at a consumers' WTP can help producers justify the prices at which they set their wines. There are some consistent variables that have been documented which indicate what consumer's value most. However, it is important to note that a consumer that is considered an expert (e.g. sommeliers, importers, distributors) will have a different set of variables important to them versus non-expert consumers (Delmas & Gergaurd, 2021). In their study, Delmas and Gergaurd (2021) were able to see a positive opinion in organic and biodynamic wines in regard to expert consumers, especially with how they saw the quality of the wines, which was not the case ten years prior (Delmas & Grant, 2010). 'Eco-conscious' products have been steadily increasing in popularity in the recent millennia, due to more information being available to the public, further promotion of organics, and general interest in food and wine production, which means an increase on demand for these types of products (Bazzini et al. 2024; Delmas et al., 2016; de Rocha et al., 2023; Parga-Dans et al., 2023; Rienth et al., 2023, Simeone et al. 2023). Having more visible recognition of these products is important for non-expert consumers to feel confident in their purchases, which is where the expert wine consumers come into play. As mentioned before, there are an increasing number of sustainability certifications, so experts need be the bridge to help non-expert consumers in breaking down the different type of eco-certifications (e.g. BIO, Demeter) to help them feel more confident in their purchases (Moscovici & Reed, 2018). This is where importers and distributors can play a vital role in the supply chain, by understanding not only what characteristics non-expert consumers are looking for in a wine, but also how to successfully educate them (Lourenço-Gomes et al., 2022).

Price is the most studied characteristic as to why a consumer would purchase a wine, but there are some other major variables as well. In a study by Lourenço-Gomes et al. (2022) they researched distributors' understandings of their consumers, which they discover that grape variety and location play an integral part in what consumers are willing to pay for, finding that red-blend wines had a "positive and significant" (p.331) effect on purchasing power, and French origin wines were significantly more likely to appeal to the consumer than Australian (p.330). Cei & Rossetto (2024) also found that price plays an important factor for lower income consumers who want to enjoy sparkling wines, something that is typically seen as a wine for festive occasions or celebrations, showing that type of wine can also contribute to what sort of pricing schemes may be relevant. Abraben et al. (2017) went a step further, trying to determine if there is a correlation between price and organics in wines. They ended up finding conflicting results, discovering that having a certified organic label on a wine bottle created no effect on the price, whereas organic, not certified wines and certified organic, no label wines had a positive effect on the price.

Expert Consumer Opinions

Price, location, variety, and sustainable recognition for wines are characteristics that have been previously studied in consumers, but the attitude of what producers or expert consumers – importers, and distributors – think about these factors have not been fully studied. One current study by Li, (2024) examined the marketing strategies that small and micro wine companies (SMWC) should consider in China, to determine how to best promote the wines that they are selling. During the research, it was determined that with the rise of younger and more open-minded consumers, it is important to look at what their preferences are which includes brand recognition, producing areas, and variety of grapes; all characteristics that have been deemed important in past studies (Cei & Rossetto, 2024; Delmas & Gergaurd, 2021; Li, 2024; Lourenço-Gomes et al., 2022). With this in mind, the study went on to unearth that these SMWC should be focusing on their unique qualities to find niche consumers, including sharing the producer's origin story of how they started winemaking, or why following the moon is important to them for their biodynamic certification (Li, 2024).

China is a new import wine market, with most of their consumers being in the Generation X to Generation Z age group (born between 1965-2012), whereas the USA is a more mature import wine market with more of their consumers coming from the Baby

Boomer generation (born 1946-1964) (Li, 2024). This is not to say that consumers in the USA are all expert level, but rather the USA's import market is older and has more connections with their producers. Despite the large size and complexity of state-level regulations, small wine producers can rely on the extensive experience of many import companies from the USA when selecting which wines to import and where (Beverage Trade Network, 2013). Even if the USA's importation is hard, these small producers are being sought out by importers since these wineries romanticize the idea of 'Old World' wines, something that expert and non-expert consumers value. These importers know that for the consumer, the Country of Origin (COO), or location, is one of the highest-ranking characteristics in the USA market and Italy is regularly on top (Lourenço-Gomes et al., 2022, Pegan et al. 2020). American consumers have a zealous passion for Italian goods. For some, they represent their ancestral homes, while for others, Italian goods are synonymous with high quality (Pegan et al., 2020). Importers and distributors know this, and sometimes take advantage of this, as one producer mentions:

> "'An Italian wine is bought for the simple fact of being Italian. There is a different image linked to the territory compared to other products from other countries. There is consumer awareness that Italy is an inexhaustible source of flavors, recipes, and fragrances,' (P13)" (Pegan et al., 2020, p. 47).

Sometimes COO can over-influence consumers, as 'Italian sounding' names can easily change non-expert consumers' purchasing power towards a non-Italian product. This is especially true if the price of the 'Italian sounding' product is lower than the real 'Made in Italy' version. This in turn, creates a price competition and can intimidate out the genuine merchandise (Pegan et al., 2020). It is up to the expert consumers to help channel non-expert consumers in purchasing verified products, which can include different types of certification schemes like DOC, DOCG, BIO, and Demeter.

2.5 Final Thoughts

Wine buying today extends beyond deciding between a bottle of red or white. Wine production and labeling on thousands of bottles now include different varieties of grapes, farming techniques used, and certifications standards. Producers need to consider these factors not only when deciding to grow grapes and make wines, but also when deciding how they want their wines sold and to which consumers (Li, 2024; Lourenço-

Gomes et al., 2022). The global market is growing, which means that wines are reaching countries that had not seemed relevant before. With that, producers are finding new consumers that are interested in different styles of wines that had not been previously popular.

Consumers' WTP and what characteristics they want in a wine have been the most researched topics in the industry throughout the years. Price has consistently been a major factor on WTP, along with characteristics like location and variety, whereas sustainability and eco-labels have become more favorable in recent years and with more research (Bazzani et al. 2024, Abraben et al., 2017). With the growing trend of 'eco-conscious' products, it is now more important than ever to have experts in the wine industry who can help verify authentic products (Delmas & Gergaurd, 2021). Producers need to work with these experts (importers and distributors) to make certain that non-expert consumers are understanding what they are purchasing (Pegan et al. 2020).

Future studies should look to importers and distributors to learn more about what characteristics they are looking for in a wine to further understand the importance of biodynamic wine certifications. In addition to studying the decision-making of importers and distributors, producers should be studied to further understand their motivations to follow or not follow popular sale marketing trends. Including these stakeholders in the discussion is important, as there can be further investigations as to why a winery may become organic, biodynamic, or choose to follow some other type of farming scheme. By exploring how biodynamic certified wines influence pricing for producers, this study aims to navigate the future impact that biodynamic wines will have on the wine industry. Since the global market is becoming more interested in sustainable products, having a clear understanding of the impact that certified wines have on profitability will become essential for not only producers, but also importers and distributors. Looking at the bottleneck of the supply chain, where importers and distributors control the market, will help highlight where there are additional gaps and missed opportunities, which in turn will help strengthen the system for the future.

Chapter 3. Research Design and Methods

The purpose of this study was to identify whether or not biodynamic (BD) certification had an effect on wine price on Italian wines sold by a US importer. The next section succinctly explains the research that was performed and how this study came to its final design.

3.1 Research Design

The two main variables of this study were price as the dependent variable and biodynamic certification as the independent variable. However, those were not the only factors that can affect wine price overall, so deciding what else creates a price increase is imperative to research and comprehend. Factors such as location, grape variety, GI certifications, and farming techniques were additional independent variables that affect price and were looked at alongside BD certifications to understand if BD certification was the main influence on price (Boncinelli et al., 2021, Li, 2024; Lourenço-Gomes et al., 2022). This study was done through a quantitative lens, using a multiple regression analysis of pricing, or a hedonic price analysis (Equation 1), on the observed data. This analysis model was used to look at the dependent variable (y) with multiple coefficients (β) that showed the slope of each independent variables (X) with the addition of error (u) outside the stated variables that could impact y (Wooldridge, 2013). A hedonic price model was important to use in this study to offer more flexibility in explaining the reason of price versus biodynamic certification along with taking into consideration the other factors that impacts wine price.

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_k X_k + \ldots + u \quad (1)$$

Since many of the independent variables were qualitative data points, dummy variables, or binary variables, were used in their place to give them a numerical value. This allowed for the analysis to run properly. It consisted of giving the qualitative data point a number of 1 or 0; either the variable was or was not. Looking at biodynamic certification as a binary variable it can be confirmed that a winery either was or was not BD certified, so wines received a variable of 1= yes or 0 = no (Wooldridge, 2013).

3.2 Sample Size and Data Collection

To understand the effects that BD certification had on price, a collection of prices of wines was needed. The best way to source this data was to reach out to importers and distributors who could provide a large collection of wines with a wide array of prices. Some USA importers and distributors were not willing to share their inventories while others did not respond. The responses received were few and from various states within the USA. To keep the data uniform, this study focused on one company that is an importer/distributor, and who offered their full pricing list. To keep anonymity, the company will hereby be known as USImp01. The non-experimental data offered from USImp01 included many different elements including the name of the wine, the wholesale price, bottle size, region, vintage, wine type, and appellation. Since farming and certifications were not included in the data, wine producers were then cross-referenced with their websites to verify and confirm the practices and techniques used. If a producer did not have a website, other importer websites were used to clarify the information.

The four main types of farming techniques that were observed in USImp01 portfolio were: Organic (OR), Biodynamic (BD), Traditional (TD), and Sustainable (SUS). Organic and biodynamic farming were previously explained in Chapter 2, but traditional and sustainable farming were more obtuse in their definitions. For reference, importer Kermit Lynch Wine Merchant (KLWM) (2024) explains the differences between the two, saying that sustainable farming is:

> "a reaction to the use of such chemicals, regarded as a pragmatic approach, where chemical treatments are used only when absolutely necessary, […] Some growers use this as a first step towards full organic farming. Others find it a happy medium between conventional methods and the stricter demands dictated by organic certifying agencies. There is a wide berth of interpretation concerning these methods." (KLWM, 2024)

and traditional farming is:

> "ancestral methods of viticulture and vinification that have been passed down from one generation to another […] *(producers)* might be best identified with a more specific method of farming or winemaking (conventional, sustainable or lutte raisonnée, organic, or biodynamic), they do not necessarily subscribe or adhere to such labels." (KLWM, 2024)

With these terms defined, they were used as identifiers for farming techniques, as long as the term ‘traditional’ or ‘sustainable’ was incorporated on the producer’s website. Even though BD and OR farming are considered ‘sustainable farming,’ in that they limit the use of chemical interference, for the sake of this study, they will not be considered a part of the sustainable farming techniques, unless the producer specifically had the word ‘sustainable’ on their website.

The sales list of bottles from August 2024, provided by USImp01, included 343 different products from Italy, including still red wines, aromatized wines, and sweet wines along with different format sizes (1500ml, 1000ml, 750ml, and 375ml). For the purpose of this study, 750ml bottles that were either still or sparkling were reviewed for a final data group of 273 wine bottles. Wines that had no vintage were also removed from the study to help standardize the data to more accurately represent wine consumption in the USA. Although Cei & Rossetti (2024) find that sparkling wines were typically enjoyed during celebrations and events in the EU, in the USA, consumers enjoy sparkling wines on a regularly. Consumers from the USA are also not as well-versed in understanding that a frizzante wine is not necessarily considered a sparkling wine, so typical frizzante styles, e.g. Lambrusco, were considered sparkling for this study as they are also regularly drunk wines.

Overall, 12 independent variables were considered for this study which can be found in Table 1. Variables such as brand, size, vintage, type, region, GI class, and variety all had fixed information that could not be misrepresented. For farming techniques, six categories were used to differentiate the products including OR Certification, BD certification, Other (OT) certification, BD promotion, TD promotion, and SUS promotion. In the EU, organic labeling is highly regulated and if a producer used the terms ‘organic,’ ‘bio,’ or ‘eco’ on their website, they must be certified organic and follow the proper requirements (Regulation (EU) 2018/848, 2018, Article 30). Since the other farming techniques are not regulated or required, it was necessary to create other distinctions between them. It was important for the BD certified wines to be separated from the BD promotion wines as it would help distinguish whether having a biodynamic certification adds value to wine prices. It should be noted however that the BD promotion category included BD certified wines. TD and SUS promotions were the alternative titles of TD and SUS farming, since it could not be fully determined exactly what type of farming was used on the farms, but these keywords showed up on producers’ webpages.

For the six categories of farming styles, binary variables were given to help analyze the data in the hedonic pricing model, with 1 = yes and 0 = no for each category (Table 2). The other categories had their data filled in accordingly on the excel chart (Table 3). Price (US$/L) was converted from the price/bottle (750ml) by dividing the bottle price by 750 and then multiplying it by 1000 (Equation 2).

Table 1
Determined Variables, Author's data

Variables	
0. Price → US$/L: Dependent Variable	
1. Vintage → year made	7. BD certification
2. Type → red, white, rose, sparkling	8. Other (OT) certification
3. Variety → grape type	9. BD promotion
4. Region → Italian regions	10. TD promotion
5. Brand → name of Winery	11. SUS promotion
6. OR certification	12. GI Class → None, DOC, DOCG, IGT

Table 2
Binary Variable Chart, Author's Data

Name	**OR Cert**	**BD Cert**	**OT Cert**	**BD promo**	**TD promo**	**SUS promo**
JG BENDA ROSSO DI MONTALCINO	1	0	0	1	0	0
KANTE TERRANO	0	0	0	0	0	1
LA VIALLA CHIANTI SUP CONFORTO	1	1	0	1	0	0
FATT MORETTO LAMBRUSCO SECCO	1	0	1	0	0	0

Table 3
Categorical Variables, Author's Data

US$/ 750ml	**US$/ L**	**Vintage**	**Name**	**Variety**	**GI**
$60.40	$80.53	2021	JG BENDA ROSSO DI MONTALCINO	BLEND	DOC
$25.40	$33.87	2018	KANTE TERRANO	TERRANO	IGT
$22.60	$30.13	2020	LA VIALLA CHIANTI SUP CONFORTO	SANGIOVESE	DOCG
$18.40	$24.53	2022	FATT MORETTO LAMBRUSCO SECCO	LAMBRUSCO	DOC

$$\text{USD\$/L} = (\text{USD\$/750ml})/750*1000 \quad (2)$$

3.3. Data Analysis

The first step was to comprehend if the data were considered normal compared to the other variables. To confirm this, a summary of the dependent variable, the standard deviation (SD), and Sharpiro-Wilks (SW) test were performed. When the summary was calculated, it showed the data by finding the points that are the minimum, first quartile, median, mean, third quartile, and maximum. The main points of concern here were minimum, median, mean, and maximum as they help offer base values for the rest of the data analysis. The median is the number that is located in the middle of the dataset when they are arranged in consecutive order. The median is the average of the data points, so when the data point values are added and then divided by the total number of points. Finally, the standard deviation is the number that shows how far away the additional data points are from the mean. This is found through the SD function. If that number was large, it meant that the data points were farther away from the central mean. When analyzing the data, it is better for the median and mean to have integers that are close in values, while the standard deviation should be as close to '0' as possible, ensuring that the data points were distributed close together. The p-value, or probability value, indicates whether or not the data has a level of significance. The closer the p-value is to 0.05 the better, as it means there will be at least a 95% significance that the *null hypothesis* will hold true. Once the p-value goes below 0.05 or less in significance, it can be assumed that the *null hypothesis* can be rejected (Wooldridge, 2013).

If the outcomes from those tests were not suitable or were not in the significance zone for the dependent variable, the log function can be used (*logy*) to create a constant percentage, which made the data easier to analyze (Wooldridge, 2013). Then, this *logy* value was compared against the different independent variables through the hedonic price analysis (Equation 1). From there, it can be determined if there was any significance between *logy* and each of the independent variables. This showed the estimate of each variable, a number that showed the effect it has on *logprice,* positive or negative. Once it runs through the hedonic price model, it can be further analyzed with an ANOVA test. The ANOVA test is an analysis tool that tests the variance, or the means of the independent variables to compute if there were any differences between them. If the p-value is 0.05 or less, it can be determined that the *null hypothesis* can be rejected.

3.4. Limitations and Ethical Considerations

Limitations of this study were largely centered around the lack of diverse data sets. Due to the limited number of importers and distributors that agreed to participate in the study, there was a limited amount of data available. If more importers and distributors had responded, there would have been a larger dataset with potentially more biodynamic certified wineries included, which would have offered more information overall.

Chapter 4. Results

4.1 Statistical Summary

The data were analyzed through a hedonic price model, or regression analysis, using the R-studio program. The first step was to enter in the data and organize each variable. Once completed, the next step was to confirm whether or not the dependent variable (*price)* was normal. This was done using the summary function, the standard deviation (SD), and the Shapiro-Wilk (SW) test of normality. Even though the median and mean are relatively close, the SD is much larger than '0', so the data may be skewed. After completing the SW test, the p-value shows that the *hypothesis of normality* can be rejected. Looking at the results as seen in Table 4, it can be determined that the price distribution was not normal, so the log function was used to create a fitted value which provides more normal data as seen in Table 5. It can also be confirmed that the US$/L data are not functional for this study by looking at its histogram. In Figure 4, it is clearly shown that the data ratio for price is unequal, with most of the prices favoring under 100US$/L with some outliers towards 300US$/L.

Table 4.
Data analysis of price (USD$/L), Author's data.

	Min	Median	Mean	Max	SD	p-value
price (USD$/L)	12.00	56.58	40.40	305.33	46.62	< 2.2e-16

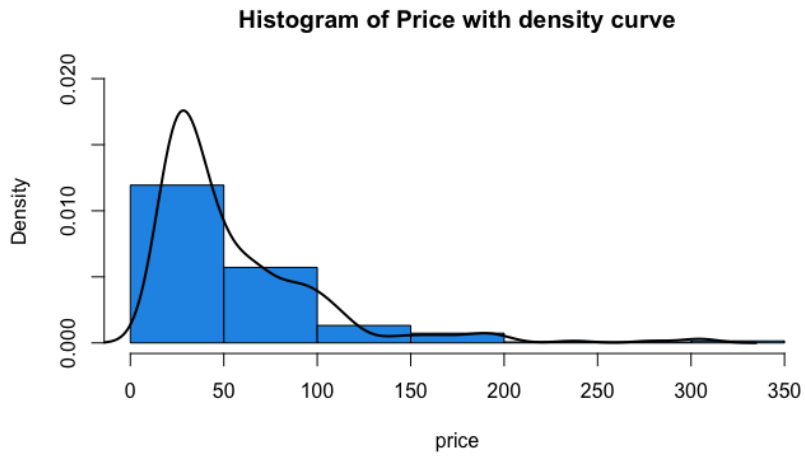

Figure 4: *Histogram of price with curve overlay. Author's rendition*

The next step was to analyze the *logprice,* which was entered into the three functions to see if that data were usable. As seen in Table 5, the median and mean are much closer in value meaning that the data points are more evenly distributed. Also, the minimum and maximum points are in a closer range to one another, creating a better adjusted data set. The p-value for *logprice* is still considerably low, meaning there could be some deviance from a perfectly normal distribution. In Figure 5, the representation of data are also dispersed more evenly, confirming a more balanced bell-curve along the graph using *logprice*. Since *logprice* can be considered to approximately have a normal distribution, it was used as the dependent variable throughout the study.

Table 5.
Data analysis of logprice (US$/L), Author's data.

	Min	Median	Mean	Max	SD	p-value
logprice (USD$/L)	2.49	3.70	3.79	5.72	0.67	1.196e-05

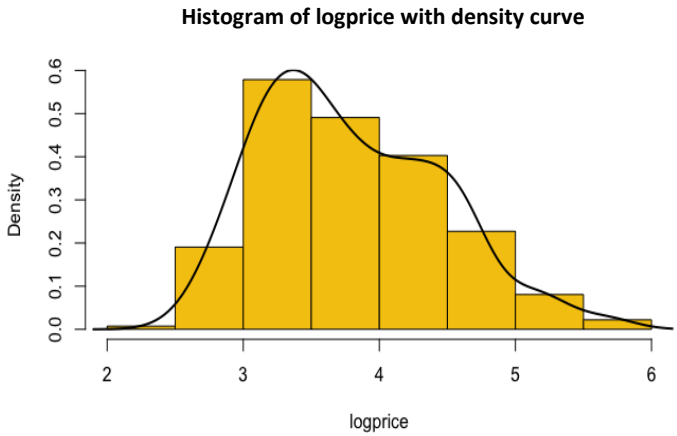

Figure 5: *Histogram of logprice with curve overlay. Author's rendition*

4.2 Independent Variable Analysis

Looking at the data given by USImp01, of the 273 bottles of wines analyzed, it was determined that there were 12 separate independent variables that could influence price. They include vintage, type of wine, region, grape variety, brand, GI classes, BD certification, OR certification, OT certifications, BD promotion, TD promotion, and SUS promotion. By comparing these 12 independent variables in the hedonic price model (Equation 1), it may confirm which variables offer an effect on wine price. As seen in

Figure 6, the range of vintages that were in USImp01 portfolio spans over 14 years. The importance of vintage as a variable was due to the status and quality that they imply. Figure 6 also showed the highest percentage share of bottles in the inventory of USImp01 are from 2022 with 23%, while 2020 (17%) and 2018 (15%) are the next highest vintages available. This would correlate with GI classes and location of bottles since some specific wines, especially from the Piemonte and Toscana regions, have a required aging period before their release for sale. GI classes that are seen in Figure 7 include DOC, DOCG, IGT, and None. 'None' are wines that are considered *vino da tavola* or table wine, as they do not have a certified GI class. DOC and DOCG classes were the majority of the bottles listed, representing 112 and 107 bottles respectively, as seen in Figure 7.

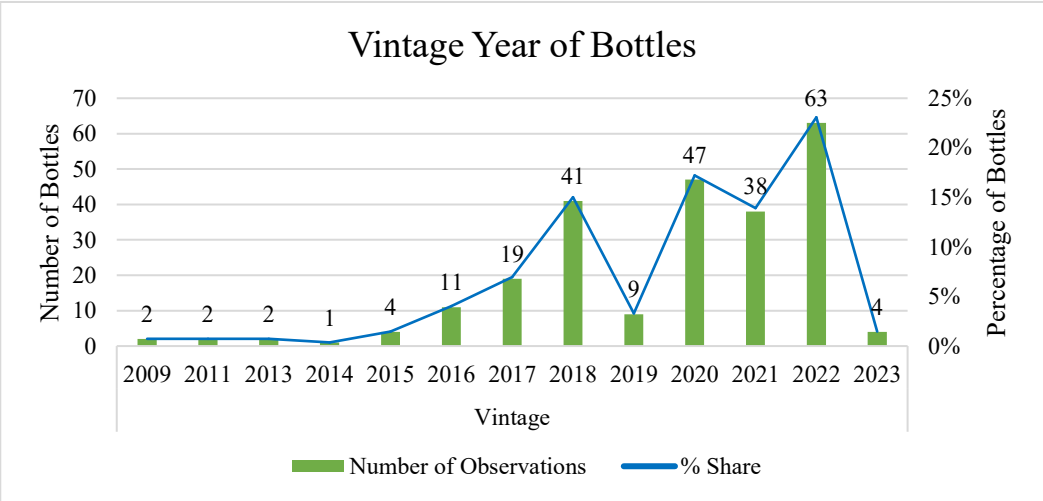

Figure 6: *Vintage Percentage and Totals of Bottles, Author's Rendition*

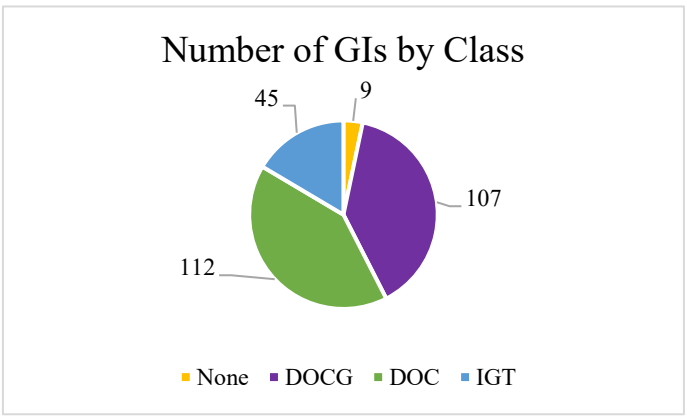

Figure 7*: Number of GI Classes of Bottles. Author's Rendition*

Looking at where the wineries are located as found in Figure 8, it is easily recognizable that the palates and interests of the consumers in the USA have four main focuses: Piemonte (43%), Toscana (19%), Sicilia (9.5%), and Friuli Venezia Giulia (9%). These four regions account for approximately 80% of the total wines distributed by USImp01. Piemonte and Toscana are also two regions with the highest number of DOC and DOCG labels that involve high quality winemaking, integrated history, and influential prestige.

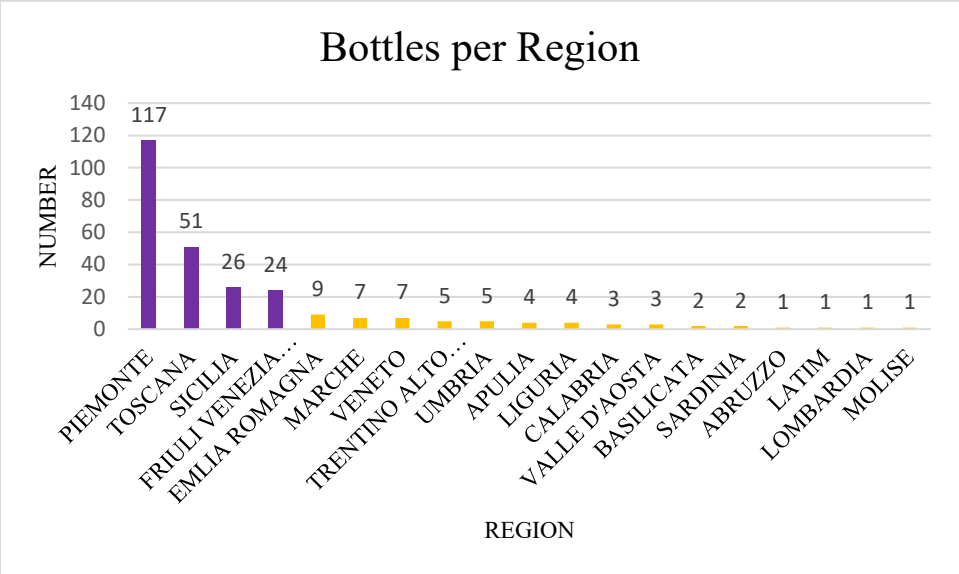

***Figure 8**: Wine Bottles per Region, Author's Rendition*

Although these wine bottles are coming from different regions in Italy, it is important to look at how the overall price distribution is related to each of the 12 independent variables. Since some of the independent variables have a minimal number of bottles, Table 6 highlights the factors with the highest share percentages included in each category. It shows not only the minimum, mean, and maximum of US$/L, but also the results of *logprice*, including the standard deviation (SD).

For the initial testing of the hedonic price model, brand was not included in the starting list of independent variables, as it would have prevented the estimation of the main attributes of interest, mainly the certifications. Thirteen brands had only one bottle available while three brands had over 10 bottles, which can be seen in Table 6. There was also some skewness in blush/rose wine, sparkling wine, 'None' GI class, and BD certified wines. Since BD certified wines was the main focus of this study, this variable was not dropped, however, additional models were run without blush/rose wines and sparkling

wines to see if there was a difference in impact on price. It can also be seen in Table 6 that many of the BD certified bottles range closer in price to one another, whereas wines that are SUS promotion and/or are OT certified have a greater distribution in price, 45UD$ versus 292US$ accordingly. The vintages, regions, and brands were not completely listed in Table 6 due the number of levels each variable had, with only the highest observations listed. They were decided by how many observations were seen compared to their total, while some were easy to recognize like the regions of Piemonte, Toscana, Sicilia, and Friuli Venezia Giulia, the variable of brand was harder to identify since many of the levels had one to two bottles each.

Table 6
Independent variables & their distribution of price through US$/L & logprice, Author's data

Variable	# of wines	Min US$/L	Mean US$L	Max US$/L	Min *logprice*	Mean *logprice*	Max *logprice*	SD *logprice*
Vintage								
2018	41	$16.13	$52.24	$197.33	2.78	3.75	5.28	0.64
2020	47	$18.00	$52.78	$158.00	2.89	3.79	5.06	0.58
2021	38	$14.00	$55.75	$167.33	2.64	3.77	5.12	0.73
2022	63	$15.00	$54.54	$304.00	2.71	3.78	5.72	0.62
Type Wine								
BLUSH/ROSE	5	$16.13	$66.37	$116.00	2.78	3.99	4.75	0.79
RED	195	$12.00	$60.88	$305.33	2.48	3.88	5.72	0.66
SPARKLING	6	$24.53	$54.04	$177.33	3.20	3.67	5.18	0.75
WHITE	67	$14.00	$43.52	$279.33	2.64	3.55	5.63	0.61
Region								
FRIULI VENEZIA GIULIA	24	$15.20	$41.77	$278.33	2.72	3.48	5.63	0.58
PIEMONTE	117	$16.13	$60.39	$237.33	2.78	3.89	5.47	0.64
SICILIA	26	$15.00	$48.75	$153.33	2.71	3.68	5.03	0.65
TOSCANA	51	$12.00	$58.76	$305.33	2.48	3.79	5.72	0.72
GI types								
DOC	112	$15.00	$59.15	$304.00	2.71	3.86	5.72	0.63
DOCG	109	$16.13	$59.42	$305.33	2.78	3.84	5.72	0.68
IGT	45	$12.00	$38.91	$190.66	2.48	3.45	5.25	0.61
None	9	$25.46	$78.88	$197.33	3.24	4.20	5.28	0.61
Variety								
BLEND	51	$15.20	$62.18	$304.00	2.72	3.84	5.72	0.74
NEBBIOLO	84	$16.13	$56.71	$197.33	2.78	3.84	5.28	0.63
SANGIOVESE	33	$16.13	$62.25	$305.33	2.78	3.84	5.72	0.73
Brand								
CA DEL BAIO	13	$33.86	$76.94	$167.33	3.52	4.25	5.12	0.46
PIO CESARE	12	$27.33	$41.70	$64.00	3.31	3.70	4.16	0.26
SCAVINO	29	$16.33	$28.34	$50.66	2.79	3.30	3.93	0.31
Farming								
OR Cert	118	$12.00	$51.28	$279.33	2.48	3.69	5.63	0.67
BD Cert	5	$24.53	$36.98	$70.00	3.20	3.53	4.25	0.43
OT Cert	61	$12.00	$73.81	$304.00	2.48	4.04	5.72	0.73
BD Promo	22	$16.13	$45.67	$153.33	2.78	3.58	5.03	0.67
TD Promo	205	$14.00	$58.91	$305.33	2.64	3.82	5.72	0.69
SUS Promo	96	$12.00	$66.18	$304.00	2.48	3.96	5.73	0.67

As shown in Table 7 there are some fluctuations in the type of farming techniques that are being used. In this sample, there were a low number of BD certified and BD promoted wines; they summed up to about 10% of the total number of bottles in the inventory. Demeter was the only biodynamic certification that was represented in the BD certified wines. Wines that were considered traditional had the highest percentage at 75% and certified organic wines at 43% of the bottle share. The wines that were labeled OR certified were registered under the EU's BIO scheme. For wines that had OT certifications, they included VinNatur, Green Experience, Vegan, 3Equalitas, and the Italian 'Vignaioli Indipendenti.' This was important to take into consideration while looking at the data since the bottles were unevenly distributed between the different farming techniques.

Table 7
Farming techniques distribution, Author's data

Variable	% Share
OR Certification	43%
BD Certification	2%
OT Certification	22%
BD Promotion	8%
TD Promotion	75%
SUS Promotion	35%

4.3 Results Analysis

4.3.1 Eleven Variables

For the first hedonic price model, 11 variables were analyzed to understand their effects on *logprice* as seen in Equation 3.

$$\begin{aligned} log(price) = {} & \beta 0 + \beta 1(\text{vintage}) + \beta 2(\text{typewine}) + \beta 3(\text{GItype}) + \beta 4(\text{region}) + \beta 5(\text{grapes}) \\ & + \beta 6(\text{BDcert}) + \beta 7(\text{ORcert}) + \beta 8(\text{OTcert}) + \beta 9(\text{BDpromo}) \\ & + \beta 10(\text{TDpromo}) + \beta 11(\text{SUSpromo}) + \varepsilon \end{aligned} \quad (3)$$

In Table 8, it can be discerned that the white wine, and OR certification have the highest significance with respect to *logprice*. Delving deeper into the results, it can be seen that both white wine and OR certification have a negative impact on price, which is reflected in the estimate column. In contrast, BD certification and BD promotion both do not show any significance and also have a negative impact on the *logprice*. The DOC GI

class does present a small, but positive significance in price which can be seen in the estimate value.

Table 8
Hedonic price model on logprice with 11 variables and R-Squared, Author's data

Variable	Estimate	Std Error	t-value	Pr(>|t|)	Signif
(Intercept)	2.48	0.79	3.14	0.00	**
vintage2021	0.73	0.43	1.70	0.09	.
typewineWHITE WINE	-0.85	0.23	-3.79	0.00	***
typewineSPARKLING	0.41	0.52	0.78	0.44	
typewineBLUSH/ROSE	-0.17	0.48	-0.35	0.73	
grapesLACRIMA	-2.14	1.14	-1.88	0.06	.
regionTOSCANA	-0.32	0.36	-.90	0.37	
GItypeDOCG	0.33	0.23	1.44	0.15	
GItypeDOC	0.32	0.19	1.75	0.08	.
GItypeNone	0.26	0.37	0.69	0.49	
BDpromo	-0.13	0.22	-0.59	0.56	
TDpromo	-0.11	0.13	-0.84	0.40	
SUSpromo	0.13	0.15	0.88	0.38	
Multiple R-Sq	**0.44**				
Adjusted R-Sq	**0.19**				

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

To make sure that the errors are normally distributed for the dataset after conducting the hedonic price model, plot charts were made to confirm normality. Figure 9 shows the quantile-quantile graph of the hedonic price model, using the theoretical quantiles against the standard residuals of the *logprice*. It shows that the variables are well distributed, meaning that there should be no skewness in the additional results.

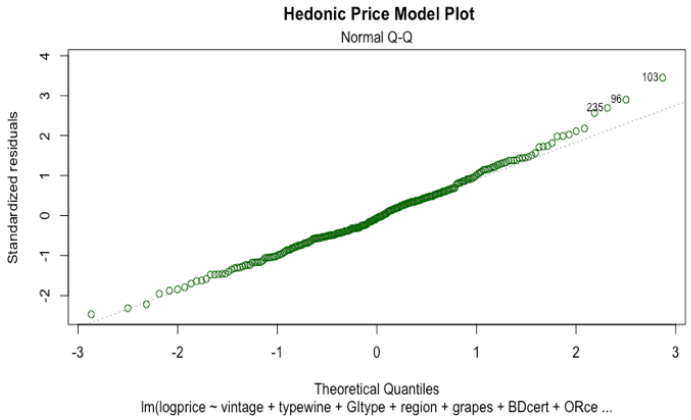

***Figure 9**: Hedonic price quantile-quantile graph, Author's Rendition*

Table 8 also refers to the fit of the hedonic price model. It shows how well the variables fit into the overall model. Looking at the multiple R-squared, the goodness-to-fit was around 44%, meaning that there was a sizable variation that was not captured by the model. The adjusted R-squared, which dropped to 0.19, or 19% accuracy, confirms that these variables were not good predictors and that additional variables may help in new models (Wooldridge, 2013).

Since the adjusted R-squared had such a low value, it was determined that there was some discrepancy in the data being used. It was assumed that the variables did not best explain the variance in price. To produce a better model, the first step was to break the data into two analyses, one for red wines and one for white wines. As seen in Table 8, white wine was a highly significant variable. Red wine was not a variable shown as it was a reference category for the model. Since white wine was negative, it shows that they were priced lower than red wines, which means that BD certifications and promotions could show an increase in price in red wines only. As a number of variables seemed to be unnecessary to keep the R-squared values high, these later models were performed without regions and grape variety in hopes that the lower number of variables would produce more appropriate results.

After the hedonic price model, the next step was to run an ANOVA test. As mentioned previously, an ANOVA test checks for the differences of the variables and will help show relevance. Table 9 presents the results of Equation 3, which shows a few different elements of importance. The sum of squares (Sum Sq) indicates the variation that the variable offered to the dependent variable. When each variable was compared to the Residual Sum Sq, it showed that their values were lower than the Residuals. This meant that there was a large amount of variance that cannot be explained by the model. Variables that had the largest values explained more variable to the dependent variable compared to the other variables (Wooldridge, 2013). Grapes, region, typewine, and vintage had the highest values, although still quite removed from the Residuals Sum Sq. The next element was the mean square (Mean Sq) which is the averaged measure of the sum of squares divided by the degrees of freedom (Df), which specified the variation of each variable (Wooldridge, 2013). This explained the drop-in significance that was originally assumed for grapes in the model. Although the grape variable started with a high Sum Sq, when averaged with the Df, the value decreased, which removed it from what was thought a significant level. From this information, it can be discerned that typewine, OT certification, and GItype were the most significant variables in the model.

This can be observed in their p-values (Pr(>F)) as all three are under 0.05, which means they have over 95% significant variation on the price.

Table 9
ANOVA results of original model, Author's Data

Variable	Df	Sum Sq	Mean Sq	F value	Pr(>F)	Signif
vintage	11	6.39	0.58	1.63	0.09	.
typewine	3	6.80	2.27	6.35	0.00	***
GItype	3	4.64	1.55	4.33	0.01	**
region	18	7.98	0.44	1.24	0.23	
grapes	42	19.77	0.47	1.32	0.11	
BDcert	1	0.49	0.50	1.39	0.24	
ORcert	1	1.27	1.27	3.57	0.06	.
OTcert	1	4.93	4.93	13.79	0.00	***
BDpromo	1	0.16	0.16	0.44	0.51	
TDpromo	1	0.29	0.29	0.81	0.37	
SUSpromo	1	0.28	0.28	0.78	0.38	
Residuals	**188**	**67.14**	**0.36**			

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

4.3.2 White and Red Wines

Splitting the typewine variable into 2 labels, red and white wines, was also determined by what was observed earlier in the chapter; that blush/rose wines and sparkling wines showed some skewness and created an issue for the dataset. Upon first inspection of the white wine data, the first problem noticed was that there were no BD certified wines, only BD promotional wines. Even with this fault, the data were processed through the hedonic price model to see if there was an effect on price with a BD promotion. The model used was similar to the original, however, since the type wine was already determined, it was removed as a variable as was BDcert since there were no wines in that category (Equation 4). As mentioned in the last section, regions and grape variety were also removed.

$$log(price) = \beta 0 + \beta 1(\text{vintage}) + \beta 2(\text{GItype}) + \beta 3(\text{ORcert}) + \beta 4(\text{OTcert}) + \beta 5(\text{SUSpromo}) + \beta 6(\text{BDpromo}) + \beta 7(\text{TDpromo}) + \varepsilon \quad (4)$$

The information seen in Table 10 shows the results of the hedonic price model using the white wine data. The intercept is the most significant variable, showing that the baseline for the model is respectable. SUS promotion and DOCG GI class have a stronger impact on white wine prices than on the total wine types and also have a positive effect versus BD promotion and OT certifications. From a visual perspective (Figure 10), it can be determined that the data, although small, did not have too many outliers to affect the model. Since this data appears normal, it was important to look at the R-square values in order to confirm how accurately the data influences wine price. Table 10 showed that the multiple R-squared and adjusted R-squared values were lower than the original model, at 35% accuracy and 18% accuracy respectively. These percentages revealed that the variables being used may not have had as much influence as initially thought or that other variables were missing.

Table 10

White wine hedonic price model with multiple and adjusted R-Squared, Author's Data

Variable	Estimate	Std. Error	t- value	Pr(>|t|)	Signif
(Intercept)	3.08	0.41	7.57	0.00	***
vintage2022	0.36	0.36	1.00	0.32	
vintage2017	0.61	0.47	1.30	0.20	
GItypeDOCG	0.53	0.25	2.07	0.04	*
GItypeDOC	0.20	0.19	1.05	0.30	
GItypeNone	0.06	0.72	0.09	0.93	
ORcert	-0.06	0.16	-0.38	0.71	
OTcert	-0.39	0.22	-1.75	0.09	.
BDpromo	-0.20	0.45	-0.45	0.66	
TDpromo	-0.01	0.18	-0.04	0.96	
SUSpromo	0.49	0.16	3.03	0.00	**
Multiple R-sq	**0.35**				
Adjusted R-sq	**0.18**				

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

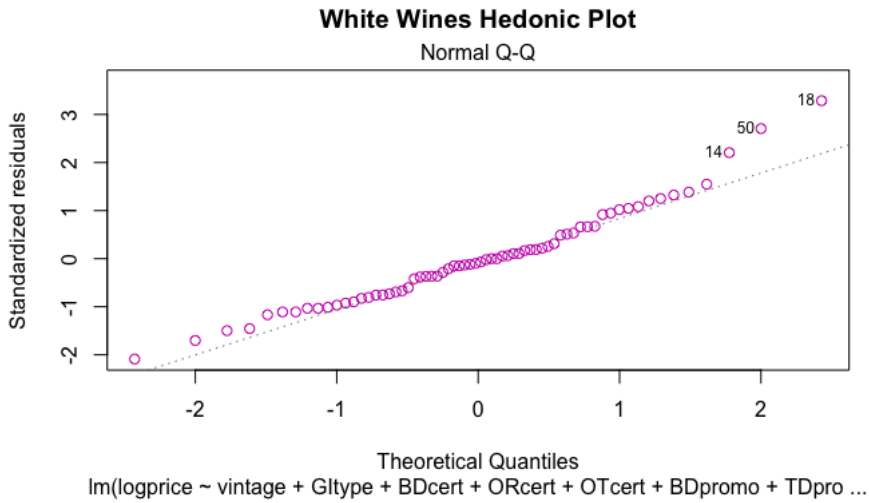

Figure 10: *Hedonic price quantile-quantile graph of white wines, Author's data*

Since the hedonic price model did not show any abnormalities, it was safe to move onto the ANOVA test for additional results. Table 12 confirmed the ANOVA test for this model only showed SUS promotion as the most significant with GI class as the second most significant.

Table 11

ANOVA test of white wine (Equation 4), Author's data

Variable	Df	Sum Sq	Mean Sq	F value	Pr(>F)	Signif
vintage	6	2.68	0.45	1.49	0.20	
GItype	3	2.44	0.81	2.71	0.06	.
ORcert	1	0.05	0.05	0.15	0.70	
OTcert	1	0.10	0.10	0.33	0.57	
BDpromo	1	0.20	0.20	0.65	0.42	
TDpromo	1	0.32	0.32	1.06	0.31	
SUSpromo	1	2.75	2.75	9.16	0.00	**
Residuals	**52**	**15.63**	**0.30**			

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

As the model seemed to be missing some variables as seen in the adjusted R-sq value (Table 10), the next trial was to run white wines against the addition of variables region and variety. When run through the next model (Equation 5), the number of variables that showed positive significance dropped to only the intercept, but the R-squared increased to 76% for the multiple and 31% for the adjusted (Table 12)

$$log(price) = \beta 0 + \beta 1(\text{vintage}) + \beta 2(\text{GItype}) + \beta 3(\text{region}) + \beta 4(\text{grapes}) + \beta 5(\text{grapes}) + \beta 6(\text{ORcert}) + \beta 7(\text{OTcert}) + \beta 8(\text{BDpromo}) + \beta 9(\text{TDpromo}) + \beta 10(\text{SUSpromo}) + \varepsilon \quad (5)$$

As the adjusted R-sq had a higher percentage, an ANOVA test was applied to the second linear model that evaluated white wine (Table 13). Similar to the original model, variety had a Sum Sq that seemed like it would offer a higher significance when compared to the Residuals Sum Sq, but after the Mean Sq was calculated, GI class, and region showed the highest significance.

Table 12

Hedonic price model of white wines on logprice with region & variety, Author's data

Variable	Estimate	Std. error	t value	Pr(>|t|)	Signif
(Intercept)	3.74	1.22	3.06	0.01	**
vintage2020	-0.31	0.50	-0.62	0.54	
vintage2017	-0.09	0.54	-0.17	0.87	
GItypeDOCG	0.79	0.54	1.47	0.16	
GItypeDOC	-0.31	0.34	-0.90	0.38	
GItypeNone	0.66	0.91	0.73	0.47	
regionTOSCANA	0.62	0.94	0.66	0.52	
grapesMOSCATO	-1.06	0.43	-2.43	0.02	*
ORcert	0.08	0.27	0.29	0.77	
OTcert	-0.42	0.42	-1.00	0.33	
BDpromo	-0.75	0.59	-1.27	0.22	
TDpromo	0.11	0.27	0.40	0.69	
SUSpromo	0.16	0.26	0.62	0.54	
Multiple R-Sq	**0.76**				
Adjusted R-Sq	**0.31**				

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Table 13

ANOVA test results for white wines on logprice with region & variety, Author's Data

Variable	Df	Sum Sq	Mean Sq	F vaule	Pr(>F)	Signif
vintage	6	2.68	0.45	1.78	0.15	
GItype	3	2.44	0.81	3.23	0.04	*
region	13	6.50	0.50	1.99	0.07	.
grapes	16	6.25	0.39	1.55	0.16	
ORcert	1	0.00	0.00	0.00	1.00	
OTcert	1	0.00	0.00	0.02	0.90	
BDpromo	1	0.38	0.38	1.52	0.23	
TDpromo	1	0.03	0.03	0.12	0.73	
SUSpromo	1	0.10	0.10	0.39	0.54	
Residuals	**23**	**5.79**	**0.25**			

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Following the pattern for white wines, red wines variables were assessed against price. This model was slightly different from Equation 4, as BD certified wines were in the dataset, which is represented in Equation 6.

$$log(price) = \beta 0 + \beta 1(\text{vintage}) + \beta 2(\text{GItype}) + \beta 3(\text{BDcert}) + \beta 4(\text{OTcert}) + \beta 5(\text{ORcert}) + \beta 6(\text{BDpromo}) + \beta 7(\text{TDpromo}) + \beta 8(\text{SUSpromo}) + \varepsilon \quad (6)$$

The results from the red wine data show more similarities to the original hedonic price model (Table 8) than the white wine data did (Table 10). As seen in Table 14, variables such as DOC GI class, OR certification, and OT certifications showed significance towards *logprice,* but also the 2013 vintage did as well. Like the original model, DOC GI class offered an increase in *logprice* and OR certification had a decreased impact. However, compared to Table 9, BD promotion, albeit not significant, showed a positive effect on price in this model. Other certifications showed the highest significance in this model as well, which may mean that certifications may have a stronger influence overall than initially viewed.

The rates of the R-squared values shown in Table 14 were the lowest accuracy levels compared to the previous models, at 25% for multiple R-squared and 16% for the adjusted. Like with the first white wine model (Equation 4) it was apparent to reintroduce

the variables region and variety, to understand the full scope of each variable along with whether they added any influence in the price model.

Table 14
Hedonic price model on red wines, Author's data

Variable	Estimate	Std. Error	t value	Pr(>|t|)	Signif
(Intercept)	4.64	0.71	6.54	0.00	***
vintage2022	-1.08	0.69	-1.58	0.12	
vintage2013	-1.96	0.80	-2.45	0.02	*
vintage2011	-1.53	0.81	-1.89	0.06	.
vintage2009	-1.47	0.81	-1.81	0.07	.
GItypeDOCG	0.09	0.16	0.58	0.56	
GItypeDOC	0.33	0.17	1.99	0.05	*
GItypeNone	0.45	0.30	1.52	0.13	
BDcert	-0.25	0.36	-0.68	0.50	
ORcert	-0.26	0.12	-2.21	0.03	*
OTcert	0.52	0.16	3.32	0.00	**
BDpromo	0.00	0.21	0.01	0.99	
TDpromo	-0.03	0.13	-0.22	0.83	
SUSpromo	-0.04	0.13	-0.27	0.79	
Multiple R-Sq	**0.25**				
Adjusted R-Sq	**0.16**				

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

The quantile-quantile plot of the hedonic price model of red wines did show similar data configuration to the white wines and original models. Even though this showed normality with the data presented, since the multiple R-sq and the adjusted R-sq showed such a low percentage of accuracy to the formula, it seemed more relevant to test the model using the two additional variables (region and variety) than continuing to the ANOVA test.

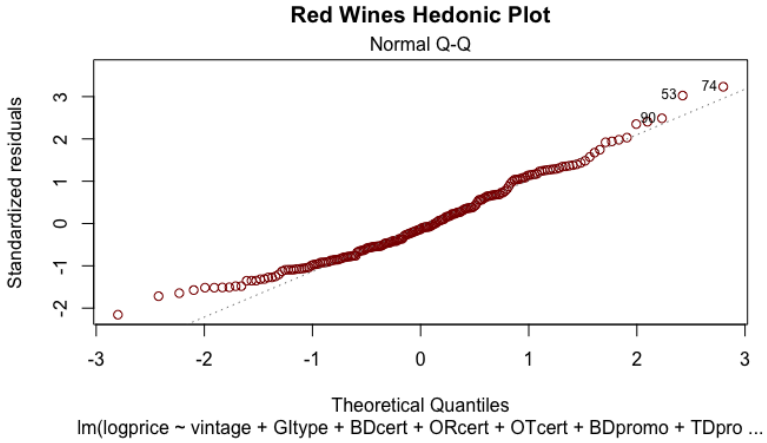

Figure 11: *Quantile-Quantile plot of Red Wines, Author's Rendition*

Table 15 shows the influence that the addition of region and variety had on red wine price. Surprisingly, DOC GI class and OR certification both increased in their significance, while OT certification decreased. The regions of Piemonte and Sicilia had positive significance and the Nebbiolo grape had a negative significance on red wine price. This was interesting since they both had the highest number of bottles in each of their categories that was shown in Table 6. The multiple R-squared showed a better percentage with region and variety involved at 43%, but the adjusted R-squared was reduced to 22% accuracy. This was better than without the region and variety variables, but not very accurate overall. As this had a slight increase of percentage, an ANOVA test was applied to the model to gain more insight on this data.

What was found in the ANOVA test (Table 16) was that OT certification had the highest significance with vintage right behind. This was consistent with the original model's ANOVA results (Table 9) which also had OT certifications as one of the most significant variables in the effect on wine price. The Residual Sum Sq was higher than the white wine model, but less than in the original model, showing that there are less variations that go unexplained. The Residuals were still high and the adjusted R-sq had a lower percent, so another variable should be identified and included in the next model.

Table 15
Hedonic price model results of red wines on logprice with region & variety, Author's data

Variable	Estimate	Std. Error	t value	Pr(>|t|)	Signif
(Intercept)	2.20	1.45	1.52	0.13	
vintage2021	1.26	1.27	0.99	0.32	
GItypeDOCG	0.40	0.27	1.46	0.15	
GItypeDOC	0.63	0.24	2.63	0.01	**
GItypeNone	0.67	0.46	1.43	0.15	
regionPIEMONTE	2.69	1.24	2.18	0.03	*
regionSARDINIA	0.17	0.92	0.18	0.86	
regionSICILIA	3.42	1.29	2.65	0.01	**
grapesNEBBIOLO	-2.13	1.07	-1.99	0.05	*
ORcert	-0.47	0.17	-2.74	0.01	**
BDcert	-0.25	0.67	-0.38	0.71	
OTcert	0.59	0.24	2.43	0.02	*
BDpromo	-0.30	0.26	-1.16	0.25	
TDpromo	-0.25	0.18	-1.37	0.17	
SUSpromo	-0.15	0.22	-0.67	0.50	
Multiple R-Sq	**0.43**				
Adjusted R-Sq	**0.22**				

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '*

Table 16
ANOVA results of red wine with region and variety variables, Author's data

Variable	Df	Sum Sq	Mean Sq	F value	Pr(>F)	Signif
vintage	11	10.21	0.93	2.69	0.00	***
GItype	3	2.15	0.72	2.08	0.11	
region	15	8.95	0.60	1.73	0.05	*
grapes	17	6.87	0.40	1.17	0.29	
ORcert	1	1.85	1.85	5.38	0.02	*
BDcert	1	0.31	0.31	0.90	0.34	
OTcert	1	4.92	4.92	14.27	0.00	***
BDpromo	1	0.30	0.30	0.87	0.35	
TDpromo	1	0.67	0.67	1.95	0.17	
SUSpromo	1	0.16	0.16	0.45	0.50	
Residuals	**141**	**48.61**	**0.35**			

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '*

4.3.3 Brand's Effect on Logprice

After these initial analyses were conducted, it was apparent that additional information was missing from the model. The next logical step was to present brand into the model and analyze if there was added information to the impact of price. Equation 7 introduced brand into the hedonic price model for the next series of calculations.

$$log(price) = \beta 0 + \beta 1(\text{vintage}) + \beta 2(\text{GItype}) + \beta 3(\text{Brand}) + \beta 4(\text{typewine}) + \beta 5(\text{region}) + \beta 6(\text{variety}) + \beta 7(\text{BDcert}) + \beta 8(\text{OTcert}) + \beta 9(\text{ORcert}) + \beta 10(\text{BDpromo}) + \beta 11(\text{TDpromo}) + \beta 12(\text{SUSpromo}) + \varepsilon \quad (7)$$

Unlike the white wine and red wine models, variety and region were included from the start, as the R-squared values showed that they added more accuracy to the hedonic price models. The variable 'type wine' was included back into the equation to make sure that nothing was not missed in the analysis.

The results of the brand hedonic price model showed some interesting information (Table 17). Firstly, type wine: white wine, showed the most significance. Secondly, most of the variables that were considered significant showed a positive impact on *logprice* which can be seen by the estimate of the results. Finally, there were errors with some of the variables. This resulted in 'NA' results in multiple variables which included BD certification, OR certification, OT certification, and BD promotion. A way to show these values would be to pair them with another meaningful variable such as GI class, since every bottle had a GI class associated with them.

The R-squared values for this model increased compared to the previous models. Table 17 shows the R-squared values, which included the multiple R-squared as having a 70% accuracy and the adjusted as a 45% accuracy. Although these percentages were not extremely high, they were substantial compared to the previous models which were included (Table 18). This proved that having the additional variables added to the price variation overall.

Table 17
Brand hedonic price model on logprice, Author's data

Variable	Estimate	Std. Error	t value	Pr(>|t|)	Signif
(Intercept)	1.50	1.24	1.21	0.23	
BrandCUNA	2.17	1.20	1.82	0.07	.
BrandRIOFAVARA	-1.39	0.48	-2.91	0.00	**
vintage2022	0.70	0.45	1.55	0.12	
vintage2021	0.78	0.44	1.78	0.08	.
vintage2020	0.73	0.44	1.64	0.10	
vintage2015	0.93	0.53	1.74	0.08	.
GItypeDOCG	0.56	0.23	2.46	0.02	*
GItypeDOC	0.58	0.20	2.93	0.00	**
GItypeNone	0.67	0.49	1.39	0.17	
grapesBRACHETTO	1.96	1.10	1.79	0.08	.
grapesLAMBRUSCO	1.04	0.62	1.70	0.09	.
TDpromo	0.57	0.64	0.90	0.37	
SUSpromo	0.73	0.51	1.43	0.16	
Multiple R-Sq	**0.69**				
Adjusted R-Sq	**0.43**				

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '*

Table 18
R-squared table with all models, Author's data

Model	Multiple R-Sq	Adjusted R-Sq
Brand	0.69	0.43
Original	0.44	0.19
White wine	0.76	0.31
Red wine	0.43	0.22

The quantile-quantile normality plot (Figure 12), offered a visual representation of how the data were aligned in the new model. Like the previous models, the data followed along the 45° angle which indicated that the data were considered normal with a few outliers at the beginning and end of the plot. The data followed closer to the angles

than previously seen in the white and red wine models, both of which had some slight waves.

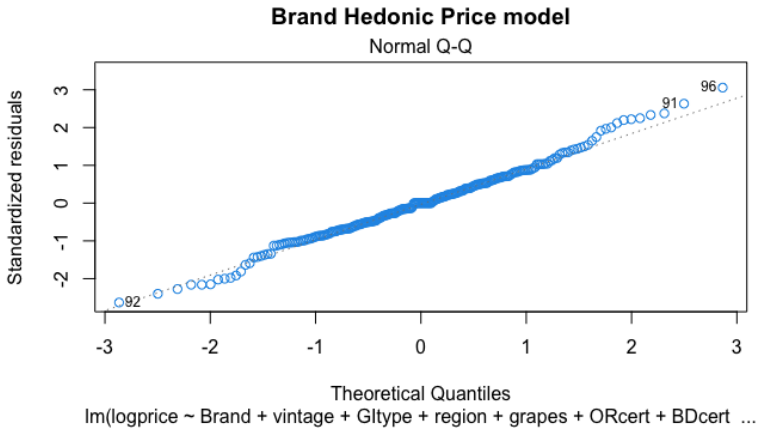

***Figure 12**: Hedonic price model with brand, Author's rendition*

Table 19 listed the results of ANOVA test applied to the hedonic price model that included brand (Equation 6). The biggest impact that was seen was the significance that brand, type wine, and GI class has on *logprice.* Brand had created such an impact overall that it removed both of the unregulated certification (BD and OT), along with OR certification. This was eye-opening as in the previous ANOVA test, OT certification had the highest significance influence.

Table 19
ANOVA results with brand, Author's Data

Variable	Df	Sum Sq	Mean Sq	F value	Pr(>F)	Signif
vintage	11	6.39	0.58	2.38	0.01	**
typewine	3	6.80	2.27	9.28	0.00	***
GItype	3	4.64	1.55	6.33	0.00	***
region	18	7.98	0.44	1.82	0.03	*
grapes	42	19.77	0.47	1.93	0.00	**
Brand	46	38.37	0.83	3.41	0.00	***
TDpromo	1	0.01	0.01	0.04	0.85	
SUSpromo	1	0.51	0.51	2.07	0.15	
Residuals	**146**	**35.68**	**0.24**			

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '*

Since the accuracy level of this model was higher than the previous ones, it can be assumed that brand was a more important variable than otherwise believed. However,

using brand in the hedonic price model and subsequent ANOVA test removed numerous variables. That issue was solved by aggregating selected variables to see if a combination offered more significant results. Equation 8 was the model that was used for the analysis. BD certification was left out as it may have offered some conflicting data with BD promotion, which included BD certified wines. Also, with the low number of bottles that were BD certified, it made sense to remove it as a variable from the model.

$$log(price) = \beta 0 + \beta 1(\text{vintage}) + \beta 2(\text{region}) + \beta 4(\text{BDpromo*GItype}) + \beta 5(\text{Brand}) + \beta 6(\text{typewine}) + \beta 1(\text{variety}) + \beta 7(\text{OTcert}) + \beta 8(\text{ORcert}) + \beta 9(\text{BDpromo}) + \beta 10(\text{TDpromo}) + \beta 11(\text{SUSpromo}) + \varepsilon \quad (8)$$

The results from this model confirmed that by aggregating BD promotion with GI class there was some impact on the *logprice* of wine. Table 19 shows that only DOC GI class has a positive influence on *logprice* and the combination of BD promotion with DOCG does as well. When BD promotion and DOC GI class were combined, however, their impact was negative in regard to *logprice.* BD promotion on its own also had a negative impact with slight significance. Organic and other certifications did not have any resulting data, nor did BD promotion with 'None' GI class because there were no BD wines in the 'None' class. The R-squared showed similar accuracy compared to the first model that used brand, with 63% for multiple R-squared and 45% with the adjusted R-squared as seen in Table 19.

Table 20
Hedonic price model with brand and aggregated variables, Author's data

Variable	Estimate	Std. Error	t value	Pr(>|t|)	Signif
(Intercept)	3.68	0.87	4.24	0.00	***
typewineWHITE WINE	-0.66	0.25	-2.67	0.01	**
BDpromo	-1.03	0.58	-1.78	0.08	.
GItypeDOC	0.37	0.22	1.67	0.10	.
BrandCOS	2.25	0.92	2.44	0.02	*
SUSpromo	0.69	0.50	1.39	0.17	
BDpromo:GItypeDOCG	0.63	0.42	1.51	0.13	
BDpromo:GItypeDOC	3.68	0.87	4.24	0.00	
Multiple R-sq	**0.71**				
Adjusted R-sq	**0.45**				

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '*

In the hedonic price model results, BD promotion presented with significance, but it cannot be assumed that it will keep significance after the ANOVA test (as seen with the previous models with OT certification). Table 21 does show that BD promotion kept significance and that GI class decreased significance to none. Region also dropped value as well from the original brand ANOVA test. Type wine and brand are still the strongest variables, with almost 100% significant variation on price, and variety (grapes) increased p-value as well.

Table 21
*ANOVA results of brand and aggregated variables of BDpromo*GItype, Author's data*

Variable	Df	Sum Sq	Mean Sq	F value	Pr(>F)	Signif
vintage	11	6.39	0.58	2.39	0.01	**
typewine	3	6.80	2.27	9.33	0.00	***
grapes	48	27.15	0.57	2.33	0.00	***
region	12	3.68	0.31	1.26	0.25	
BDpromo	1	1.65	1.65	6.80	0.01	*
GItype	3	1.27	0.42	1.74	0.16	
Brand	45	37.02	0.82	3.39	0.00	***
TDpromo	1	0.01	0.01	0.04	0.85	
SUSpromo	1	0.51	0.51	2.08	0.15	
BDpromo:GItype	2	0.7	0.35	1.43	0.24	
Residuals	**144**	**34.98**	**0.24**			

*Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '*

4.4 Final Analysis

The two final ANOVA tests that were computed showed the best data for the study using the Sum Sq, Mean Sq, and Pr(>F) values discovered. Although BD promotion had some significance in the ANOVA test that had been aggregated with the variable GItype, in the first model with brand (Equation 7), the BD promotion was completely removed from the results (Table 19). It can be assumed from the results found in this study that H1 can be considered inconclusive.

For RQ1, for which variables do have an impact on imported Italian wines in the USA market, it can be justly verified in both Table 19 and Table 21. Brand had a larger Sum sq value than the Residuals Sum Sq. Residuals were the unidentified variables that may be impacting the price and since brand was a higher value, it is safe to assume that

it was a major variable that contributed to price. This was also proven by the significance level in both ANOVA tests, which indicated that brand had the highest statistical significance, with almost 100% in variation. Type wine also had a significant impact on price in both Table 19 and Table 21. Although the Sum Sq was not as large as grapes and brand, the Mean Sq values were both considerably larger than the Residual Mean Sq. The implication was the same as before; if the variable's Mean Sq was larger than the Residuals, then it can be assumed that they explained a significant proportion of price with those variables. Therefore, it can be safely assumed that brand, type of wine, and variety are the three major variables that influence the price of wine for imported Italian wines in the US market.

Chapter 5. Discussion

From the results, it was determined that biodynamic certification as a variable for price premiums for an importer's portfolio was inconclusive. The data did not show enough evidence to confirm the results. On the other hand, brand, type of wine, and grape variety were the three main variables that showed the highest significance which was consistent with the previous research. From this information, there would need to be more research done to discover if biodynamic certification does have an impact on price.

5.1 Interpretation of Results

The data found in this research was able to reject the *hypothesis of normality*. This was immediately verified with the initial hedonic price model and the original 11 variables (Table 8). White wine had the highest significance, although a negative effect, there was still an effect on the price. Looking at the ANOVA test results (Table 9), OT certification and type of wine had the highest significance, showing that these may be influential variables in the rest of the study. This formula did not show any significant information about BD certification, so along with the high Sum Sq value, it was necessary to run additional tests.

5.1.1 White and Red Wine Results

The next formulas that were calculated utilized different segments of the type wine category. As this was originally a significant variable, it seemed probable that there could be some beneficial data. The first round of tests for each segment involved the removal of region and variety. This was completed to see if they helped stabilize the Sum Sq values. As found in the original model, there were some fluctuations with the variables. Region and variety had the highest number of levels within their variables, so it was assumed that they would have the smallest impact overall since the data would be spread across the multiple levels.

When the hedonic price model was first run on white wine without region and variety, there was a low percentage of accuracy (Table 10), so adding back the region and variety variables were needed. The ANOVA test of white wines with the added region and variety variables showed better information, with GI class having the most significance, albeit, not too high. The Residuals' Sum Sq was also quite low which helped identify that the region and variety did remove error from the formula. However, there

were no biodynamic certified wines in this data set, so red wines had to be analyzed as well, first without region and variety, and then after with those two variables.

Red wines showed a similar pattern to the white wines, although OR certification, DOC GI class, and the region of Sicilia all showed higher significance in the hedonic price model. DOC GI class and Sicilia both offered a positive influence to price while OR certification, surprisingly, showed negative influence in price (Table 15). The percentage of accuracy from the Adjusted R-sq was still quite low, showing at 22% (Table 15), so there was still something wrong with the formula. When the ANOVA test was performed, all three variables reduced their significance. Vintage and OT certification proved the most significant overall, which confirmed that the red wines had the greatest variation of vintage, with some of the older bottles having a larger price premium due to their age (Table 6).

Still, something continued to be wrong with the variables to make it so there were not enough explanation about price. It looked like removing variables did not help, so the next logical step was to add in additional variables. Previous research had included variables such as brand, alcohol percentage, packaging, and awards won, with brand and awards won having a significant impact on the price (Lourenço-Gomes et al., 2021). Brand was a variable that was first thought to not have as much relevance for the model, but since the model kept having inconclusive results, it was appropriate to reintroduce it into the study. Data on alcohol percentage and awards were not included in the original data set so was not included. Bottles that were different format sizes (375ml,1000ml, 1500ml) were either dessert wines which were not looked into, or they were duplicates of bottles already included in study. So format size was still kept out of the model to make sure there were no overlapping issues.

5.1.2 Brand Results

The trials were performed for brand did not follow the same structure as white and red wines, since it was apparent that region and variety did provide needed information to the hedonic model. However, the brand variable took over the results in the new models. Table 17 showed that brand as a variable completely eliminated other variables in the results, including OR certification, BD certification, OT certification, and BD promotion. Looking further into this, it could be explained by a few issues like multicollinearity or due to a low number of variables presented in the data. Multicollinearity occurs when highly correlated variables affect one another. This may

have happened to OR, BD, OT certifications and BD promotion, which would have meant that they would be assumed in low numbers as the brand variable had more levels (Hayes, 2024). BD certification, OR certification, OT certification, and BD promotion were identified as binary variables with only one value and one level, therefore, they did not show up as important compared to brand. As seen in Table 18, the hedonic price model using brand offered the highest accuracy level in Adjusted R-sq compared to the other tests run. This showed that brand was a needed variable to run the formula, but it was still under the 50% mark. As seen in Table 19, each variable offered significance to the price of wine, except for all of the certification and promotion variables. Brand also had the strongest Sum Sq value, which was higher than the Residuals' Sum Sq (Table 19). This meant that brand did better even with missing variables in the model, so it showed a very significant impact on the price of wine. As brand created many changes to the results, the next thing that could be done to the hedonic model was to start combining variables.

5.1.3 Aggregated Variables Results

By combining BD promotion and GI class together, the hope was to find some additional influence on price (Equation 8). Since GI classes were associated with all of the wines in four levels (DOCG, DOC, IGT and None), the levels were small enough to hopefully distribute BD promotion across the data. This proved to be correct, as in both the hedonic price analysis and the ANOVA results (Table 21 & 22), BD promotion showed significance. The hedonic price model also showed better accuracy with 45%, which does show that the combination of variables improved the model. Although this helped the results show BD promotion, OR and OT certifications were again removed from the results. This data showed the solutions to H1 and RQ1. For ***H1:*** *Biodynamic certification offers a positive influence on price for imported Italian wines to the United States,* the answer remains inconclusive, as the data did not show any true values that would support or contradict this hypothesis. As for ***RQ1:*** *What variables are the most important for importers and distributors when pricing their Italian wine portfolio,* brand, grapes, and typewine showed the highest significance in the ANOVA results with almost 100% significance, proving again that they had the highest impact on wine price overall.

5.2 Connecting to the Literature

Since brand, type of wine, and variety were all main variables of price while having a low accuracy value, there was motivation to find what other factors could influence price. Factors like alcohol content and medals/awards that were not used, but could be evaluated as well. Alcohol content is an important factor for distributors, as consumers are more aware of overconsumption in today's society, thus wanting to drink wine without the high percentages (Carew et al., 2017; Lourenço-Gomes et al.,2021). In their study, Lourenço-Gomes et al. (2021) also found that price and medals/awards were the best indicators for both the consumer and the distributor. As price was our dependent variable, it can be assumed that medals/awards would be a valuable variable to interpret as well.

Brand continues to be a major factor that influences consumers' purchases in wine. For the consumer, it can signify selected qualities, which would convince the consumer to buy the product over again (Palumbo & Herbig, 2000). Unlike the EU, US consumers are more familiar with brand names as there is an unintentional opposition from producers against GIs within the market (Barham, 2003). Americans have a different way of understanding certifications, which is through trademarks. Barham (2003), shared what makes trademarks different from the EU's GI classes. Trademarks are owned by individuals (including corporations), which allow them to build their reputation and their profits, while GI classes are owned by the region in which the product is being made. Carew et al. (2017) found that wines priced in British Columbia, Canada, also had a significant influence with California wine brands. This included price premiums and price discounts in both the white and red wine categories. Since brands are thought of more highly in the USA than GI classes and other variables, it shows that distributors and importers have more motivation to sell with this variable than others.

Some brands may identify themselves with a region, especially if there is an underlying link and are able to do so (Josling, 2006). As GI classes are regulated by the COO, there are usually very strict rules involved with this value scheme. For example, in order for a wine to obtain the DOCG Barolo label, it must be made in a certain area of the Langhe region of Italy, have a certain percentage of alcohol, specific sensory qualities, and also be made from 100% Nebbiolo grapes (European Commission, n.d.). Since these regulations are so strict, many European wines do not always have the grape variety on the bottle, since it is assumed that the consumer will know because of the GI. However, GI classes did not rank very high for price impact, which may be due to importers only

bringing certain bottles that are recognizable in the US market, like Barolo and Chianti. This would follow the trend for popularity and importer purchasing as bottle shares had the highest percentages in the USImp01 portfolio, making up over 50% of the total bottles.

Sustainable certification schemes are similar to GI classes, as the US market does not fully know about them. There are many different types of sustainable certifications, which can become convoluted in the larger market (Delmas & Gergaud, 2021). The results from this study showed that regulated and unregulated certifications were not substantially significant after different manipulations. This seemed counterintuitive as there have been many studies about consumers WTP for eco-labeled wines in recent years (Delmas & Gergaud, 2021; Moscovici & Reed, 2018; Moscovici et al., 2022). In their study, Moscovici et al. (2022), accomplished learning about global consumer preferences for organic wines, something that had only been done in smaller scaled studies previously. What they found was that consumers were interested in organic labeled wines and would be willing to pay a premium for them, no matter their COO.

5.3 Future Relevance

This study is relevant for future studies as it goes beyond the traditional study of organic labeling and looks into the more niche sector of the wine industry. Biodynamic wines are becoming more popular as the 'natural wine movement' becomes more appealing to the general public (Bazzani et al, 2024). 'Natural wine' is not a nationally regulated term in most countries, with only France having the first and only regulated certification of 'Vin Méthode Nature' (Bazzani et al. 2024). Biodynamic wines, especially those certified under Demeter, follow the same practices that 'natural wines' do, but they focus more attention to the farming side of wine production. Since Demeter Biodynamic is a globally recognized certification scheme, looking at how it affects the overall price of wines could be useful for importers and distributors and also for producers. However many of these Demeter certified farms must pay additional fees, along with standard labor wages for their employees. This means that they would need to have a higher price to sell overall in order to turn a profit (BFDI Standards Committee, 2024; Negro et al, 2022).

There are also limited studies done on importers as consumers, while most studies look at consumers at the end of the supply chain. By looking at qualities that producers

consider while purchasing wines, one could create more insightful research on what producers should look for when importing their wines. Future studies looking at all parts of the supply chain would help show a full view of what can be done to create smoother processes and support for each firm involved. This could be applied not only per country, but also per region within a country. For example, wine on the West coast of the USA may be purchased differently than on the East coast. Or looking at cities with smaller populations, what variables would offer the most impact on price to those consumers? The USA is a large country that cannot be defined by just one state. With the large variability of consumers throughout the country, each firm would need to consider each region differently. If focusing on just Italian wines, there could be studies on what Italian-Americans find the most prominent factor is in their wine purchases. This research could also be applied to other large countries such as Canada, Australia, and China.

5.4 Study Limitations

The limitation of this study primarily involved the lack of available data. Within the dataset, there were very few bottles of wine that had a biodynamic certification attached to them. This meant that the results from the study were inconclusive on biodynamic certification's influence on price. Having a larger amount of data from a large range of importers in the area would have provided more dynamic information on certification and price.

The scope of the area was also limited to one major city on the West coast of the USA. Had this study been expanded to the entirety of the country, there could have been a more complete analysis of each region and the importance of what influences wine prices. This would have created more meaningful results for the length of the wine industry's supply chain.

Chapter 6. Conclusion

The intention of this study was to understand how the US wine market prices their wines that were imported from Italy. The main variable that was intended to be discussed and reviewed was biodynamic certification and the impact it had on price. The reason why this was the main variable for discussion was because of recent literature published. Those studies done in the last decade have found that consumers were more interested in buying wines that had sustainable practices attached to them, including organic and biodynamic produced ones (Delmas & Gergaud, 2021). However, there has been some disconnect about sustainable products in consumers' understandings due to confusing technical information or general lack of knowledge (Pomarici & Vecchio, 2019). With this gap, it should be understood that those who are more educated, like the importers or distributors, should be able to offer clear and concise information if needed (Pegan et al., 2020).

Though there has been an interest in buying sustainable products in the wine industry, in this research, it was not the case as found in the data supplied by USImp01. It was apparent that farming techniques and sustainable practices were not as influential on price compared to the data determinants found. Brand, type of wine, and grape variety were the overall strongest variables because they were more significant on price. This was consistent with research previously done. Lourenço-Gomes, et al. (2021) found that types of wine and branding are the most influential in price increase for the typical consumer. Though questions remain: does the importer's purchase affect the consumers' purchase? Or does the consumers' purchase affect what the importer buys? Or both?

Future studies could focus on those questions to see where the influence of the supply chain comes from and whether importers could change the direction of consumer purchases. If this was found to be the case, importers could work with producers to get different kinds of wines into the market. For the future of wine sales, understanding the relationships between producer-supplier-consumer needs to be more fully understood.

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