# 16

# The Organization of Vineyards and Wineries

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*That the vineyard, when properly planted and brought to perfection, was the most valuable part of the farm, seems to have been an undoubted maxim in the ancient agriculture, as it is in the modern through all the wine countries. … The vine is more affected by the difference of soils than any other fruit tree. … vineyards are in general more carefully cultivated than most others, …. In so valuable a produce the loss occasioned by negligence is so great as to force even the most careless to attention.* [Adam Smith, *Wealth of Nations, Book One, Chapter 11].*

## 16.1 Introduction

It is not surprising that Adam Smith would include a discussion of wine in his great treatise—after all, wine has been in the hearts of poets and at the center of civilization since the beginning of cultivation. Nor is it surprising, indeed almost predictable, that Smith would also focus in on the critical economic aspects of wine. Although most of his discussion relates to the political economy of old vineyard interests, as opposed to the planting of new vines in an effort to protect their rents, there is mention of three critical features. First, wine is a valuable commodity. Second, wine output and quality are heavily

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influenced by Nature in a complicated way. Third, wine production is subject to necessary meticulous care by the grower and vintner. These three fundamental economic features still remain part of the wine story and are important in understanding the organization of vineyards and wineries.

This book contains chapters on the wine industry from all over the world. Each chapter contains a general description of the industry within a given country, concentrating on quantities, varieties, values, and overall industry structure. Our purpose is to consider a selected number of organizational issues of wine production, and in doing so we rely on these chapters as well as the limited studies found in the literature for institutional detail. Although there are many aspects to wine organization, and exceptions everywhere, in this chapter we focus on three stylized facts that are present across all of the chapters. These issues include matters of contracting at the vineyard (the use of labor contracts, the scarcity of tenancy contracts), the inverse relationship between vineyard size and wine quality, and the historical vertical disintegration of the vineyard from the winery in the nineteenth century (and the recent reintegration for boutique wineries).

In general, we rely on the framework of farm organization articulated in Allen and Lueck (2002). Indeed, the organization of wine was not examined in that work and now provides an out-of-sample test of that model. Like other crops, we show below that the organization of vineyards and wineries is best explained by the specific transaction costs that arise in the context of growing grapes and producing wine. This industry produces an interesting case study because of the asymmetric advances in science for producing wine compared to growing grapes and because transaction costs play such a large role in production.

We begin with a brief review of Allen and Lueck (2002), followed by a discussion of grape and wine transaction cost issues. We then explain the various organizational features and close with a discussion of how grapes and wines relate to other crops and their organization.

## 16.2 The Allen and Lueck Framework of Agricultural Organization

Allen and Lueck (2002) created a general framework for examining farm organization that relied on three key features. First, all parties involved choose the organizational structure that maximizes the expected value of the productive relationship. Second, Nature plays an important twofold role: creating

uncertainty in the year-to-year outputs that masks the actual inputs used in production and creating predictable seasonal stages of production through crop cycles, stages, and timeliness. Third, all parties are risk neutral, concerned only with the expected net value of production. These three features allow the development of simple models within the context of a specific crop that depend mostly on the transaction cost constraints of the crop in question. Difficulties that arise over strategic behavior or risk aversion are avoided, and straightforward comparative statics are forthcoming.

In the Allen and Lueck framework, output is: $Q = h(l, e, k) + \theta$, where $Q$ is the observed harvested output which is assumed to have a unit price and $l$ is land attributes, $e$ is labor effort, $k$ is other capital, and $\theta \sim (0, \sigma^2)$ is the randomly distributed composite input of Nature. Any given input can only be measured with error or might even be unobservable. Because the human actions $h(l, e, k)$ and the actions of Nature $\theta$ cannot be separately identified, the conditions for transaction costs are present. The logic then is for the parties to choose the form of organization that maximizes the value of this output subject to the transaction costs that are created with any given type of organization.[1]

Allen and Lueck stressed that in agriculture the critical transaction costs result from conditions "close to the ground" or "at the field level." Thus, the ability of farmers to exploit the difficult-to-measure land attributes, underreport the crop output, over-report crop inputs, or shirk their labor duties to their advantage act as major constraints to contracting and vertical integration. Likewise, land and other capital owners can exploit the labor inputs of farmers or shirk on the application of their capital inputs. The role Nature plays at the field level varies by crop, time of year, and over time. When it comes to the organization of vineyards and wineries, our focus is on the specific features of grapes and fermentation that allow parties to exploit one another.

## 16.3 The Transaction Costs of Grapes to Wine

Wine is the final product of an agricultural-manufacturing process, not unlike bread, cheese, or salami. And yet, the transaction cost conditions of wine production are often so extensive that wine is somewhat of a unique farm

[1] "Organizations" can be thought of as a collection or distribution of property rights. Transaction costs are defined as the costs of establishing and maintaining a distribution of property rights (Allen 1991).

product. Wine comes (mostly) from grapes through a process of natural fermentation. If ripe grapes are placed in a container, they begin to break down, and the natural yeast on the skin interacts with the sugars in the juice to produce an enzyme to initiate the chemical reaction into alcohol. The fermentation process stops when all the sugar is converted or the alcohol content is high enough to kill the yeast. Thus, unlike other so-called processed foods, wine almost produces itself.[2]

Unlike most agricultural commodities where the quality range is quite narrow, with wine there is an enormous quality dimension, and only the highest end is fit and desired for human consumption. Thus, although most wine comes from just one vine species (*Vitis vinifera*), these produce hundreds of thousands of wines.[3] These various wines differ in appearance (color, clarity), aroma (intensity, types such as earthy or floral), and taste (sweetness, body, acidity, tannins, flavors). These in turn are determined by the location of vineyard, terrain, viticulture, vinification, storage, and transport. Each of these general inputs is the result of hundreds of decisions, some of which are observable.

### 16.3.1 Vineyards

Unlike other fruits and vegetables, grapes do not like nutrient-rich soils, and they do well on steeply sloped hillsides due to the enhanced drainage and sunshine.[4] The limited locations for growing grapes fit for wine increase the scarcity and price of wine land.[5] For a given location, the soil fertility, acidity, heat retention, and soil type determine the best variety, vine density, row direction, spacing, vine training, pest control, and winter protection. Many of these decisions are made at the start of the vineyard, but many, like canopy management, pruning, and timing of harvest involve ongoing on-the-spot decisions.

Vines, if properly looked after, can produce for 50–100 years. Much of the processes of layering to fill in gaps and pruning are done by hand and are almost art forms based on skill and knowledge. Pruning too much can reduce

[2] Thornton (2013) has a detailed description of the science of fermentation.

[3] Thornton (p. 55, 2013) notes there are many varieties, perhaps in the thousands using a narrow definition of variety.

[4] Thornton (p. 60, 2013).

[5] As noted in several chapters of this book, across the world wine is one of the most valuable crops per acre. The high value of wine land means that the costs of abusing such land are also high.

yield, while too little pruning can lower the fruit quality. Likewise canopy management is critical: too little sun prevents grape growth and composition, but too much can burn and dehydrate the grapes. Thinning, another hand process, removes some immature grapes during the growing season to improve the quality of remaining grapes. Every vineyard manager must decide on the optimal quantity-quality trade-off. As grapes ripen the acid content starts to fall, but the sugar content increases, creating another trade-off that has to be managed to produce the appropriate sugar-acid balance. Grape tasting, another difficult-to-measure skill, is still the best way to determine the optimal time to harvest.

In each stage of grape production, the conditions for rather large transaction costs exist. Vineyards are location-specific firms that rely on critical natural ingredients that vary from location-to-location, year-to-year, and day-to-day. These measurement problems (Barzel 1982) allow costly actions to hide behind the random inputs of Nature. Vineyards also produce a grape whose value depends on its quality, and although the quality of the grape can be measured at some cost, the human inputs required to produce high quality are difficult to measure.[6] When difficult to measure, suppliers of high-quality inputs have moral hazard incentives. Finally, the grapes themselves are small and costly to divide at the vineyard and are therefore easy to hide or steal.[7]

### 16.3.2 Wineries

Once the grapes are picked, they begin to decay immediately. Because of this perishability, it is important for them to be crushed soon so fermentation starts within a proper window. Wine quality at this stage depends heavily on the ability to manage yeasts, bacteria, sugars, and other chemical elements. In contrast to the vineyard side of production, where grapes are still grown under natural conditions similar over the past few centuries, a technical revolution has taken place in wineries.

Prior to 1850 almost all vineyards were integrated with the winery—the wine being produced in the farmer's cellar. Knowledge of the fermentation process was weak, control of temperature was difficult, and the role of natural elements was enormous. The result: much of production was not palatable.[8] Wine quality

[6] Goodhue et al. (2003) note the difficulty of measuring these qualities.

[7] Simpson (p. 4, 2009), notes "But transaction costs in viticulture were higher than with most other forms of agriculture, because nature influenced considerably both the size and quality of the harvest."

[8] Simpson (pp. 5–7, 2009).

was so variable and difficult to verify that fraud was common as various imposters sold products under the guise of noted or reputable producers.[9]

By 1900, technological changes in the form of thermometers, refrigerators, continuous presses, aero-crushing turbines, sterilizers, and pasteurizers altered wine production and organization.[10] Further innovations came in the form of cultured yeasts, which are more predictable than the natural yeasts present on the grapes. Cultured yeasts produce wine with a smaller variance in output quality. Likewise, the introduction of stainless steel tanks allowed for better control of temperature, oxygen exposure, and speed of fermentation, reducing the variance in the flavor of the wine. These innovations not only created elements of economies of size but drastically reduced the role of Nature in production. Although the fermentation process remained complicated and continued to require extreme monitoring, these processes could be directly or indirectly measured for most qualities of wine.

Because of these technological changes, there has been an interesting organizational difference between vineyards and wineries. Whereas, at one time they were both stages of wine production in which Nature (and therefore transaction costs) played a large role, in the mid-nineteenth and early twentieth century technical innovations occurred that reduced the transaction cost environment at the *winery* stage, but not at the level of the vineyard. In the next section we show how the presence and transformation of transaction costs have shaped the organization of the wine industry.

## 16.4 Explaining Organizational Features

In this section, we examine how organizations involved in producing wine grape and wine have varied over time and location. We use the transaction costs framework just described and merge it with the data from other chapters in this volume and other studies. In particular, we examine the use of contracting, the relationship between quality and vineyard size, and the evolution of the winery.

### 16.4.1 Contracting in the Wine Industry

Vineyards have historically been family farm operations. Even today, vineyards remain relatively small compared to the dramatic increases in farm sizes

[9] Simpson (p. 11, 2009) notes that in the late nineteenth century artificial wines made from raisins mixed with water and sugar accounted for one-sixth of French and one-quarter of Spanish wine consumption.

[10] Simpson (p. 9, 2009).

for grains and other important crops. Also as the quality of grape produced at a given vineyard increases, so does the likelihood of family organization on that vineyard. In modern times there are large vineyards, often organized along corporate lines, but they mostly produce low-quality grapes.

In Allen and Lueck (2002), contracting arises when labor, land, and other capital is owned by different parties and can be combined in low transaction cost settings. In agriculture, land (and the assets attached to the land) is often combined with labor through cash rent or share contracts. In a cash rent contract, the labor owner (the farmer or grower) uses the attributes of the land assets in exchange for some fixed dollar rent per acre. At the margin, the price of any given attribute, such as moisture or canopy size, is zero. This means that when cash rent contracts are used, they provide the farmer with an incentive to exploit the landowner's land attributes to increase output and income to the farmer. Hence, for a grain crop under conventional tillage, the farmer might cultivate the cash-rented land in such a way that excessively uses the moisture and soil nutrients to increase the short-run harvest at the long-run expense to the landowner. If a landowner is able to measure or monitor this exploitation, this moral hazard could be eliminated. In agriculture, this transaction is simply the cost of doing business with the cash rent contract.

The most common alternative to cash renting is a share contract, in which the farmer pays his rent in a fraction of the output rather than in cash. In a share contract, farmer moral hazard is reduced compared to a cash rent. Even though the farmer uses the land attributes at a zero marginal price, the marginal returns of this exploitation are now lowered by the "tax" of the share. This "tax effect" also reduces the labor effort incentive of the farmer and creates an incentive to underreport the crop. The potential for underreporting can be a serious problem for share contracts when the output is easy to hide and valuable.[11]

In cases in which crop production has just one major transaction cost problem: either soil exploitation is important, farmer labor is vital, or crop theft is critical. When there is just one particular problem at hand, then one of these two—contracts cash rent or crop share—is often sufficient to manage the contracting arrangement. For example, alfalfa is a hay crop that is planted (often not annually), cut periodically throughout the year, baled or stacked, and sold. For alfalfa, soil exploitation is limited because the farmer has limited

[11] Umbeck (1977) noted that the problem of underreporting in gold mining made share contracts were highly unlikely on the gold fields during the California rush.

access to the soil nutrients, but crop theft is possible given the size of bales. Under these conditions, a cash rent contract works well, and virtually all alfalfa contracts are cash rents. On the other hand, sugarcane grants the farmer full access to the soil but is impossible to steal given coordination and industrialization required to harvest and process it. For sugarcane, there is also just one major transaction cost problem (soil exploitation) and virtually all sugarcane contracts are crop-share contracts.

In some situations, like the production of grapes, all of the transaction cost effects are present: land attributes can be exploited, farmer labor easily shirks, and outputs can be stolen. In these cases the simple one- or two-dimensional contract used in most agriculture becomes incomplete and incapable of managing the transaction costs at hand. In these cases, contracting is unlikely.

Consider a vineyard available for contracting with a viticulturist-farmer. The viticulturist's incentives are not incentive compatible with the long-term maintenance of the vines and grape stocks, and moral hazard results. To enhance the short-term goals, the farmer will engage in pruning, canopy management, tilling, and pest control that will increase the short-term crop yield but harm the long-term viability of the vine stock and lead to years of recovery. Indeed, it is hard to imagine another crop where the cost of mis-attention and poor incentives are higher—as noted above long ago by Adam Smith. Any use of (short-term) cash rent contracts in the leasing of vineyard land would adversely affect the longevity of the vines.

Crop sharing also has substantial transaction costs. As noted, grapes are highly sensitive to the quality of labor effort applied during the growing season. When crops are shared, the viticulturist has an incentive to lower his quality and quantity of labor input, including the maintenance of the vines. There also is the potential for grape theft. Grapes are small and vary in quality across the entire crop. Given their high value, a farmer working on a share contract would have a strong incentive to collect those grapes of high quality for himself and leave the poorer grapes for the landowner.

With both cash rent or crop-share contracts in there remain are potentially large transaction costs. These costs include the resource costs and deadweight losses arising from measuring the timeliness and quality of farmer effort and the hidden land attributes. These costs also include the resource costs and deadweight losses arising because Nature contributes to variation in the volume and quality of the harvest. Given that vineyards are subject to so many types of transaction cost problems, it is not surpris-

ing that contracting over the vineyard stage of production was rare historically and today.[12] Vineyards are mostly operated by owner-operated family farms.

Interestingly, on these small family run vineyards, the use of wage labor, especially during harvest, is common. Wage workers are paid by time and have an incentive to slow down and work with reduced efforts. Wage labor is used for simple tasks where output is highly correlated with time and effort reasonably easy to monitor. These tasks bear little in common with the viticulture tasks of the owner. During harvest, the use of wage labor for high-quality grapes has two major benefits. First, workers who slow down and "take their time" are not "dirty pickers" who pick just the low-hanging visible fruit. The slow wage picker is more likely to pick all of the grapes on the vine. Second, the wage picker has no incentive to mishandle and bruise the fruit out of haste. Thus, as grape quality increases, more harvest workers on the vineyard are used and paid by the hour.

### 16.4.2 Vineyard Size and Grape Quality

In almost every discussion of wine-growing regions, one relationship stands out: high-quality grapes tend to be grown on small vineyards. The chapters in this volume find this relationship as well, although Chile (Mora this volume) seems to be an exception. In his discussion of the American wine industry, Thornton observes:

> Large wine-grape growers tend to specialize in producing low-quality grapes for bulk commodity wines, while smaller vineyards often concentrate on growing higher-quality grapes for premium and luxury wines. (p. 61, 2013)

Allen and Lueck note that the size and organization of the farm is determined by some fundamental trade-offs. On the one hand, the random role of Nature raises the costs of monitoring and measuring such inputs as labor effort, land use, and capital exploitation—leading to small firms controlled by a single residual claimant. In addition, the predictable seasonal elements of agriculture often prevent any gains from specialization found in large-scale operations—

[12] Carmona and Simpson (2012), mostly relying on our theory laid out in *The Nature of the Farm*, do an excellent job in describing the problem of underreporting grape quantity and quality and use this as a base for explaining why sharecropping was so little used historically. They also go into considerable detail in terms of how contracts were modified away from the standard simple share contracts to accommodate the special circumstances of grapes.

again, leading to small firms. When a farmer has to change tasks every few weeks due to the changing seasons that drive the biological aspects of production, there is little point in specializing in any given task. Large roles of Nature, on both the random and seasonal dimensions, encourage small family farms. On the other hand, whenever Nature can be removed from production, then some type of larger firm often emerges. When random elements are eliminated, then contracting over labor, land, and other inputs becomes routine. When the seasonal elements of production are reduced or eliminated, then larger scales of operation are common with corporate structures.

Consider the facts noted above in the production of high-quality grapes. These grapes tend to be produced on steep hillsides where machinery has a difficult time operating. They are produced in regions that rely on natural weather patterns and not irrigation.[13] They rely on hand pruning, thinning, and picking. Each stage requires care and attention which are difficult to monitor.[14] Under such circumstances, the moral hazard problems are so great, and the gains from specialization of a given task are so small that each farm is limited by the capabilities of a single residual claimant. High-quality vineyards will be small farms operated mostly by one family.

In most wine regions, there are a small number of vineyards that make up large fractions of the total acreage used and tonnage produced. For example, in California these vineyards tend to be located in the central valley where the land is flat, the vines irrigated, and the pruning and picking are mostly done by machine.[15] The flat land allows for the use of machines and for certain types of irrigation, both of which reduce the role of Nature and allow for large numbers of wage employees to be used. Since wage employees cannot be expected to take extreme care of the grapes, these large vineyards tend to produce a lower-quality, lower-variance grape. Taken together, the reduced measurement costs allow corporate structures to exist, with wage labor and larger plantation-style organization.

[13] Indeed, in France the high-quality grapes are not allowed (by law) to be irrigated, (see Ugaglia, Cardebat, and Jiao, this volume). Irrigation reduces variance in both yields and quality. Hence, other things equal, increased irrigation should also be correlated with vertically integrated wineries and vineyards.

[14] In the chapter on Chinese wines (this volume), Jiao and Ouyang note that in the Ningxia region of China the climate is such that the high-quality vines must be covered each winter to prevent damage from the cold.

[15] Lapsley, Alston, and Sambucci (this volume). They also note that in the US just three firms (Gallo, Wine Group, and Constellation) produce or import 50% of wines consumed. The 20 largest firms in the US have a market share of 90%, dominated by the low-priced segment of the market (Thornton, pp. 2–3, 2013). Albisu et al., in this volume, note that in Spain 84% of wineries are small, with less than ten workers, while four large firms do the bulk of exporting, most of which is considered low-quality cheap wine.

### 16.4.3 The Evolution of the Winery

The second phase of wine production involves the winery, the place where the harvested grapes are converted into wine. Historically the winery was also a family run affair (indeed, it was the same family) with no contracting.[16] The Allen and Lueck framework provides an explanation for this historical vertical integration. Prior to the mid-nineteenth century, the role of Nature in the fermentation process was enormous and mostly misunderstood by those in the industry. The grapes were perishable and fermentation starts almost immediately after harvest, and any delays in production could mean a vast reduction in wine quality.[17] During this era, wine making was *by guess and by God*, depending on Nature and ill-defined skills associated with experience and personalized knowledge.

As noted above, a series of innovations throughout the nineteenth century, including increased understanding of the biochemistry of fermentation, allowed for better control and actual measurement over the fermentation process. The result was a great reduction in the role of Nature in the winery. What had at one time been a mysterious process became understood and controllable. At the same time, the efficient size of a modern winery increased, both in terms of physical and human capital. This increased fixed physical and human capital resulted in falling average costs. Large wineries were able to exploit the economies using hired wage labor, which could be more cheaply monitored given the reduced role of Nature. Even in the sensitive areas of blending and timing, low monitoring costs allowed for high-quality wage labor to be engaged.

Beginning in the mid-nineteenth century and carrying on for the next 100 years, wineries vertically *disintegrated* with vineyards.[18] Once produced, high-quality grapes could be measured (unlike the inputs used to produce them), and so it was possible for vineyards to supply wineries with grapes—especially for medium- to low-quality grapes. As a result, large wineries are

[16] Fernandez-Olmos et al. (2008) explain this by focusing on the asset specificity of grapes and vines. Presumably either side of the vineyard/winery transaction could conceivably hold the other side hostage given the importance of asset and timing specificity. However, given the repeated nature of wine production, the importance of reputation, and the ease of the law in regulating such behavior, this seems an unimportant transaction cost source to explain the vertical integration. It also seems unable to explain the vertical disintegration we explain below.

[17] Franken and Bacon (p. 107, 2014).

[18] Knox (1998) argues that in Europe it was the rise of wine cooperatives that separated the vineyard from the winery to increase marketing and transfer rents. This fails to explain why the separation took place in other parts of the world where contracts between vineyards and wineries were used instead of cooperatives. Simpson (pp. 1–2, 2009) has a discussion of the relationship between family vineyards and cooperative wineries in Europe.

able to contract with many small vineyards.[19] In Europe, cooperatives formed at the winery level, while in North America corporate wineries contracted with the vineyards, but the fundamental forces were the same in both cases.[20]

Interestingly, the emergence of high-end "boutique" wines over the past 30 years has seen a move toward vineyard and winery reintegration in this sector.[21] These wineries develop a reputation for a very specific, complex wine, and often this results from the reintroduction of Nature into the process. For example, these wineries often use the natural yeasts found on the grapes, rather than use cultured yeast; they often hand-select grapes for a specific acid/sugar/taste balance.[22] The reintroduction of Nature into the wine-making stage and the requirement for grapes with potentially difficult-to-measure qualities means that the transaction costs of market relations between the vineyard and the winery are higher. Not surprisingly then, these boutique firms reintegrate back to have the vineyard and winery within one firm under the control of a single residual claimant.

## 16.5 Conclusion

The organization of vineyards and wineries can understood using the transaction costs framework of Allen and Lueck (2002).[23] These transaction costs arise when individual farmers and capitalists to alter their inputs in ways that enhance their own wealth at the expense of each other. In agriculture, the variability of Nature introduces random elements into production and prevents the parties from deducing the inputs of others and the seasonal aspects of Nature that limit the ability to exploit gains from specialization.

[19] Thornton (p. 66, 2013) notes that 90% of California grapes are sold by contract to wineries.

[20] Dramatic reductions in transportation costs have allowed the expansion in world trade, but it is not clear how this change has effected wine and vineyard organization. Unsurprisingly, it has increased the size of the industry.

[21] Even in China, where the wine industry is the youngest, the best wines have integrated vineyards and wineries. Jiao and Ouyang state:

> When it comes to the elite Chinese wineries, the wineries in Ningxia are best representatives. All wines are produced by the grapes cultivated in their own vine-yards with certain requirements in quality thus to reflect of its origin. [this volume]

[22] Robinson (p. 779, 2006).

[23] Simpson (2011) examines related issues, stressing path dependence, and political economy forces.

Although most of the chapters in this volume are concerned with the fundamentals of quantity and price of wines around the world, each chapter contains some information on the organization of the wine industry. We have used these studies to examine three common features of wine production around the world: the limited role of contracting, the negative correlation of vineyard size with grape quality, and the general separation of vineyards from wineries over the past 150 years. In each case the observed behavior is well explained by an understanding of the transaction costs involved, and a recognition that the organization of the industry results from an attempt to mitigate these transaction costs.

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