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Comparative analysis of organic and conventional farming in Italy

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Sincerely,
Chiara Grotti

Abstract

In the last years, the organic wine production sector has experienced a constant growth but there still several challenges to face. In Italy, in spite of the leading role worldwide for this activity, wine producers still have difficulties when integrating organic production in their operations. This is due to the confusion among consumers about different wine qualities and organic labels that brought them to refuse to pay a higher price for a bottle of organic wine. Consequently, wineries do not recognize a premium price to organic grapes. At the bottom of the supply chain, grapes growers are in front of a decision: adopting organic farming or continuing with conventional practices. Those ones who opt for the first option are entitled to receive governmental subsidies from the European Union.

Based on historical observations, this study aims to understand the profitability of growing organic grapes in the absence of market incentives. The study focuses on Chianti grapes' growers of the province of Arezzo, central Italy. Theoretically, the study is based on the use of a net present value analysis, complemented by a sensitivity analysis of the results. Empirically, the data used relate to grapes' production in the period 2004-2013. These have been elaborated in order to obtain insights about the impact over the profitability of organic farming of the following elements: farm size, quality schemes, subsidies and risk.

The conclusions pointed out that organic farming is generally more lucrative and less risky than conventional farming. The only exception is observed when considering the group of Chianti grapes' growers, who do not own an estate large enough to entitle themselves as professional. My findings also highlighted the complete dependency of the farmers on governmental subsidies. Without a support scheme organic farming would be both riskier and less profitable and then, not a practice to be chosen.

Abbreviations

€ - euro

ARTEA – Tuscan Regional Agency for Agricultural Payments

CAP – Common Agricultural Policy

CF – Cash Flows

CIA - Italian Confederations of Farmers

DOCG - Protected and Guaranteed Designation of Origin

EAFRD - European Agricultural Fund for Rural Development

EBITDA – Earning before interest, tax, depreciation and amortization

EU – European Union

FAO - Food and Agriculture Organization

HA – hectare

INEA – National Institution of Agricultural Economics

ISTAT – Italia Institute of Statistics

MPAAF – Italian Ministry of Agricultural., Food and Forestry Policies

NPV – Net Present Value

PDO - Protected Designation of Origin

PV – Present Value

RDP – Rural Development Plan

SD – Standard Deviation

UAA - Utilized Agricultural Area

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1. Introduction

This introductive chapter will present briefly the problem and motivate the interest in the topic. The aim and the objectives will be stated and some limitations presented.

1.1 Problem background

In recent years, consumers and policy makers have grown interest on organic products and farming due to an increasing concern for environmental and social issues. On the one hand, governments have, worldwide, recognized the environmental benefits of organic practice and promoted the adoption of sustainable methods (Padel and Lampkin 2007). On the other hand, consumers have recognized that organic products are a healthier, safer and fairer alternative to standard products, till the point to be willing to pay a higher price for their purchase (Stolze and Lampkin, 2009). This trend has created market opportunities worldwide. In fact, nowadays 37.2 million of hectares of land are devoted to organic agriculture, with a turnover per year of 63 billion US dollars (INTERNET, FiBL, 1, 2013).

Sheeder and Lynne (2009) sustain that organic farming, as most conservation practice, is not economically advantageous for farmers. However, as mentioned before, the share of organic agriculture has been growing constantly for the last 20 years. Which are the motives that push farmers to convert to sustainable practice? Various studies have been focusing on the analysis of organic farming taking either an economic or a non-economic perspective (see Rigby et al., 2001 for a review of the literature). The results have not been always uniform and have pinpointed important but different drivers that can influence the decision of adopting the mentioned practice.

Even if it is globally felt the urgency of dealing with environmental issues (INTERNET, UNFCCC, 2014, 1), environmental standards set in order to protect social interests raise private costs of production (Porter and Van der Linde, 1995). In addition, international studies have demonstrated that agriculture risky factors, as, for example, bad weather or diseases, affect organic farming to a greater extent than conventional farming. For this reason exists a system of support to farmers that have decided to abound conventional farming. This support to organic farming can take two forms, that are governmental subsidies or premium price. The first are direct payments through which a government compensates farmers for undertaking non-market production activities reducing the environmental impact of their production (Baylis et al., 2011). The second is a higher price justified by a plus value of the product, determined by its quality and features (Porter and Van der Linde, 1995).

According to Serra et al. (2007) it is possible to briefly summarize the major drivers for conversion in two big groups. The first one gathers together the non-economics characteristics. These are connected with farmers' personal history and values as, for example, age and education, personal viewpoints about health and environment, access to information, geographical location or size of his/her farm. The second group includes economic drivers for adoption. These could be represented, for example, by the presence of public subsidies or premium price and of by particular specific managerial skills shown by the farmer.

In the past, ideological drivers were considered crucial for the decision to switch to organic farming (Kerselaers et al., 2007). Recently, it has been proved that profit-making

considerations may matter as well. The reason lays on the economic changes that have occurred in developed countries in the last decades (Rigby et al., 2001). Besides the already mentioned growing demand for organic products, the economic crisis and the market opening to global trade pushed for business diversification also in the agricultural sector. Hence, organic farming is considered by some as a spur for competitive "green" innovations and a chance to open to new market segments (Porter and Van der Linde, 1995).

In view of the above mentioned, is it possible to assume that the economic performance of a farm depends on a combination of economic and non-economics elements (Serra et al., 2007). Even if many farmers may approach organic practice motivated by environmental concerns (Läpple, 2013), businesses oriented towards environmental protection that are not economically sustainable will face a hard time to remain in the market in the long run (Schaltegger and Synnestvedt, 2002). Hence, it is essential to verify if the profit margin provided by organic production is higher than the one earned under conventional farming (Stanhill, 1990 and Hodge, 1982).

1.2 Problem

In the matter of organic farming, Italy represents one of the most important realities within the European Union (INEA, 2013). The Italian organic sector has grown rapidly moving from being just a niche to becoming a recognized production system. In the last few years, in spite of the economic crisis that touched the country, both organic production and national sales market have performed positively. In 2010, the Italian turnover for organic products was of 1.7 billion Euros (*ibid.*). The drivers that positively contribute to the development of sustainable methods are firstly connected with the favorable climate, the agronomic conditions and the closeness to the major export markets (INTERNET, GAIN, 2014, 2).

Another important element of the Italian agriculture economy is the wine sector that is surely one of the most representative drivers of the so-called "Made in Italy". In Italy each year 73,000 wineries produce about 55 million hl of wine falling under 400 different wine varieties (Seccia *et al.,* 2009). Accordingly with the statistics, Italy is not only the largest producers of wine in the world (FAOSTAT, 2014), but it also has the largest territory cultivated as organic vineyards in Europe (INTERNET, EU, 2012, 6).

As in many other food segments, also in the wine sector there has been a certain interest in the switch to organic production (Santini *et al.,* 2013). Organic practice has been seen by some producers as a possible source of diversification (Brugarolas *et al.* 2005). Latest tendencies have shown that a growing segment of population is interested on organic wine, especially in those countries that are not traditionally connected with wine consumption, like northern European countries (Smith and Mitry, 2007). This new segment of consumers could represent a good source of diversification for Italian farmers.

Nevertheless, the economic profitability of organic wine, and consequently of its grapes production, has still not been proved to be positive (Stasi *et al.,* 2010). Organic wine sector shows indeed several weaknesses. Wine has been the last processed food product to be included in the organic regulation of the European Union (EU). A label for organic wine was in fact created only in 2012 (Lisi, 2013). This lack of a clear regulation has slowed marketing incentives to organic production and confused consumers about the actual quality of the product. The literature focusing on the economic and marketing performance of organic wine is rather insufficient and show negative result (see, for instance, Brugarolas *et al.* 2005, Corsi

and Strøm, 2013 and Castellini *et al.,* 2014). Even so, this is a segment in expansion (Lisi, 2013).

This thesis presents a case study based on the data from the Chianti grapes' growers of the province of Arezzo, a city in Tuscany (central Italy). Chianti is the most relevant kind of Tuscan wine and its production is highly regulated by the EU. This regulation allowed the wine producers to sell Chianti and its finest variance, Chianti Superiore, with the Protected Designation of Origin (PDO) logo. In Arezzo Chianti grapes is produced by more than 700 farmers and processed by only five wineries (INTERNET, Consorzio Vino Chianti, 2014, 1). These wine companies are not interested in producing organic wine. This in turn implies that they are not willing to pay a higher price for organic grapes. Hence, the only support recognized to the organic farmers comes from the subsidies of the European Community[1]. However, still the 9% of the farmers has already converted to organic farming and the trend is positive (INTERNET, Regione Toscana, 2010, 1).

The problem that will be analyzed in this thesis is the economic profitability of adopting organic farming for Chianti grapes' producers of Arezzo. This particular case allowed studying in depth the European support scheme for organic farming and its ability to compensate farmers. Moreover, the analysis involves the study of the impact of the European quality scheme, in this case the PDO scheme, to the grapes production.

1.3 Aim

The aim of this thesis project is to study the farmer's decision to adopt organic methods in absence of a premium price for organic production. This research intends to understand the motivation to switch to organic farming for the Chianti grapes producers in the wine sector in the province of Arezzo, Italy. Three factors will be analyzed: i) the net income of farmers, ii) the impact of their risk aversion and iii) the role played by the EU through subsidies and indication of origin, namely PDO quality regulation. The goal of this study is to analyze and compare the net incomes of organic and conventional farms under different levels of risk aversion.

The aim of this research is to answer to the following question:

- Taking an economic and financial perspective, should a Chianti grapes' grower of the province of Arezzo convert from conventional to organic farming?

In order to reduce the complexity and to make the research process more feasible, the main research question is split up into three sub-questions:

- Is the size of the farm a relevant variable in the definition of the profitability of organic farming?
- Which is the impact of EU subsidies and PDO regulation on the decision to switch from conventional to organic production of grapes?

[1] The European Union (EU) identifies organic farming as a key practice to contribute to its environmental goals (INTERNET, EU, 2014, 1). For this reason, since 1992, the EU has introduced agri-environmental payments supporting farmers who voluntary engaged into activities meeting indicated environmental standards (Baylis *et al.,* 2011). In particular, the farmers that are willing to switch from conventional to organic agriculture receive a direct payment to compensate the loss in yield and the higher risk.

- Which is the impact of risk considerations in the decision to switch from conventional to organic production of grapes?

The first and the second question will be addressed by calculating the net farm income on the basis of data characterizing conventional and organic grapes producers active in the province of Arezzo. This calculation will allow understanding the possibilities available to farmers given the current economic and policy's conditions. The last question will be addressed by a sensitivity analysis based on Monte Carlo (MC) simulations.
The results obtained in this thesis will create new knowledge about the organic wine sector that could be used by policy makers in order to develop more suitable policies. In addition, the comparison between scenarios creating different output/input combinations will help farmers to plan their business under the current policy setting (Acs *et al.,* 2005).

1.4 Delimitation

The research in this thesis is subject to a number of delimitations.

First of all, it must be mentioned that, even if they will not be considered in the analysis provided in this thesis, there are some non-economic factors which may affect the switching decision. In this respect, for instance, Burton (1999), on the basis of a study undertaken in Britain, reports that gender, age and education of the farmers were common factors among the ones who adopted organic farming. In particular, a higher propensity to switch was registered among young and educated farmers and in the farm owned and run by women. The study posits that organic farming can be seen as a life-style choice made by farmers having concerns about environmental issues and food security. Mzoughi (2011) presents similar conclusions in a study conducted among French producers. Again, it is shown that social and moral factors matter. Summing up, economic reasons have an important role when adopting environmental friendly practices but they are not the unique factors driving such decision. So, focusing exclusively on them, as in our study, does not fully represent the complexity of the decision. This delimitation has been done because adding qualitative variables to the already collected quantitative data would raise the complexity of the study and interfere with the timeline presented.

Several different approaches are used in order to illustrate the economic advantages attached to organic farming (see for instance Kerselaers *et al.* (2007) for a review of the related literature). For example, one could aim at comparing the same farms before and after the adoption or calculate the economic potential of a farm creating a possible future scenario where the farm undertakes organic farming. The analysis would start by observing conventional activities. Using this last method, the researcher can build a management plan to estimate the convenience of both alternatives. Padel (2002) developed a method by which one can consider both economic and ecological considerations.

Another difference between this study and other studies is the focus applied. As in this case, the majority of the literature considers farms at an aggregate level or an average farm (see for example: Acs *et al.,* 2005, Gardebroek, 2006). An exception is given by Kerselaers *et al.* (2007) where the study focuses on an individual farm. This could help to study in detail all the drivers that move that farmer to switch even though it will make more difficult to find generalizations. The reasons connected with the choice of approach and the focus applied are further developed in the chapter *Method.*

Finally, in the course of the thesis, the policy frame that will be considered is the European policy called Rural Development Plan (RDP), even if, as Zander (2008) points out European farmers have access to several other kind of agri-environmental payments. However, it is difficult to understand the extent of all the possibilities, so I will focus exclusively on the frame that applies to the region under analysis.

1.5 Outline

The research paper is organized as follows. Chapter 1 (*Introduction*) describes briefly the motives to adopt organic farming and introduce the current situation in Arezzo, Italy. Chapter 2 consists of the literature review. This was called as *Organic farming. An overview of the literature review* and intended to describe the theoretical concepts behind organic farming and governmental incentive. Chapter 3 (*Theoretical approach to the analysis)* gives an introduction to the theory of net present value and risk preferences, which form the foundation for the financial analysis used to study the profitability and the risk of the farming system into consideration, namely organic and conventional farming. In the same section the MC simulation used for the sensitivity analysis is presented. Chapter 4 (*Methods)* describes the characteristics of a case study and the data gathered and the reason behind the chosen method, region and sector. In chapter 5 (*Background of empirical study*), the empirical elements of this study are discussed in depth. In particular, the discussion will concern the vine production, the EU policy applied in Arezzo, the production costs and the price of the grapes. Chapter 6 (*The empirical study)* presents in details the data collected for the numerical analysis and the interpretation of the researcher. This section is divided in two major parts, the presentation of the results for NPVs analysis and one for the Monte Carlo simulation. Chapter 7 *analysis and discussions* collects all the findings and the answers to the research questions. Finally, in Chapter 8 the researcher presents conclusions and suggests potential leads for further investigation.

2. Organic Farming. An overview of the literature review

Chapter 2 begins with a brief literature review on of the concept of organic farming and the motivations and barriers to adopt this method. The chapter then introduces the definition of externalities and explains how they can be internalized in an economic analysis in the form of subsidies.

2.1 Definition of Organic Farming

Lampkin (1990:2) in his book "Organic farming" provides the first unified definition of organic farming. He defines organic farming as the system that tries to avoid the direct and continue use of readily soluble chemical substances and biocides, both of natural or synthetic origin. When the use of chemicals cannot be avoided, the farmer should use the ones that have a lower overall environmental impact. This definition allows confuting the false but quite common idea that an organic farmer does not use chemicals, since all the substances, even the ones of natural origins, are chemical compounds. On the other hand, organic practices should not be considered as a mere replacement of agro-chemicals for "organics". Lastly, organic agriculture has to follow technological innovations and must not be considered necessarily as a life choice.

Lampkin's definition has been accepted by governments around the world and has inspired several regulations (López, 2007). In Europe, the Council Regulation (EC) No 834/2007 defines the organic production as an "*overall system of farm management and food production that combines best environmental practices, a high level of biodiversity, the preservation of natural resources, the application of high animal welfare standards and a production method in line with the preference of certain consumers for products produced using natural substances and processes"* (INTERNET, Euro Lex, 2007, 1). More specifically, EU has defined a production framework which takes into account the following needs: i) protecting the consumers' interest on organic products and ii) responding to environmental issues, develop a better animal welfare and improve a sustainable development in rural areas. According to the regulation, the organic production is based on the principle of using only natural or naturally derived substances and, only whenever extremely needed, a possibly minimal use of chemical pesticides[2].

2.2 Motivations and barriers to conversion

Several studies were conducted to understand the motivations and the barriers that push or halt farmers to convert to organic practice (see, for example, Sheeder and Lynne 2009, Gleirscher 2008, de Lauwere *et al.* 2004, Kerselaers *et al.* 2007, Khaledi *et al.* 2010, Flaten *et al.* 2010). Some of the most important factors that influence the decisions are the financial competitiveness of organic farming, the management skills needed, the marketing appeal of the products and the moral concern and social considerations of colleagues and family (Marshall, 1993).

[2] More in detail, the regulation forbids the use of chemical and synthetic products, GMOs and additives that are not listed in specific lists (for examples: oxygen, nitrogen, water, salt, etc.). (INTERNET, Euro Lex, 2007, 1)

2.2.1 Financial competitiveness

The success of organic agriculture relies mainly on the possibility of providing stable and possibly higher income to the farmers switching from conventional to organic farming (see Hodge, 1982 and Stanhill, 1990). Hence, the adoption of organic farming will primarily depend on the comparison between the productivity of the two regimes and on the potential market premium paid for organic products. In any case, the neoclassic theory suggests that any business decision is connected with two goals: "profit maximization" and "risk minimization" (Musshoff and Hirschauer, 2008).

In a competitive market, the *profit maximization* requires that, given input and output prices, the output is set such that the profit is maximized to have the maxim returns (Debertin, 1986). Profit is most specifically defined as the financial benefit realized if the revenues gained undertaking a business activity exceed its total cost. Mathematically is given by the following formula:

$$\text{Profit} = \text{Total Revenues} - \text{Total Costs} \quad (1)$$

The success or failure of a business activity is firstly connected with two factors: cost and revenue.

In organic agriculture, the first concern of the farmers that choose this practice are the higher costs connected with this method in comparison with conventional farming (Läpple, 2013). Organic farming requires, in fact, additional labor units, new machinery and new buildings. It has been estimated that organic farming need between the 10 and the 20% more work than conventional method (Nieberg and Offermann, 2008). Moreover, farmers need to follow new procedures, which involve the payment of the cost of extra training. All these are defined by Musshoff and Hirschauer (2008) as conversion costs. In top of that, organic farming is also connected with loss on revenues caused by lower yields due to the restrictions imposed on the use of chemical fertilizers (Musshoff and Hirschauer, 2008).

Financial studies about the competitiveness of organic farming suggest that organic farming is more profitable than conventional one (Acs *et al.,* 2007, Kerselaers *et al.,* 2007). Nieberg and Offermann (2003) find two reasons for profitability: subsidies and premium price. Firstly, governments, as the EU, offer direct payments for covering both conversion costs and lower revenues (Stolze and Lampkin, 2009). Secondly, the consumers recognize a premium price to organic because they typically consider it safer and healthier. However, consumers' willingness to pay a higher price for organic products may, depending on the country, the market setting or the marketing channel used, be very different (Nieberg and Offermann, 2003).

The theory of profit maximization presented so far, relies on the stability of the price and the output (Debertin, 1986). However, both are seldom certain. Acs *et al.* (2009) point out that the organic farming is more risky than conventional farming. Firstly, the restrictions set on the use of synthetic substances makes the crops more vulnerable to pests, weeds and adverse climate conditions. Second, the organic market is still quite immature and it cannot secure stable profitability in the long term neither can offer good marketing opportunities (Lampkin and Padel, 1994). Finally, since a significant part of actual income for organic farming comes from governmental subsidies, a change in the policy framework could seriously impact on the organic farm financial health (Flaten *et al.,* 2010).

Under an economic prospective, the decision to adopt organic farming depends not only on the profitability of this practice but also on the risk attitude of the farmer. This concept will be discussed in depth in the section 2.4 of this chapter.

2.2.2 Agronomic reasons

Adopting organic farming implies several technical changes for a farmer. Organic farming is often considered as a "more demanding" agricultural system (Marshall, 1993) and it is connected with lower yield and less control on weed, plant diseases and plagues (Drost *et al.,* 2004). For this reason, farmers, once switched to the organic regime, must change production methods and, often, work network. On one hand, a farmer might be concern that organic management practices are not sufficient to face eventual problems (Drost *et al.,* 2004). On the other hand, some farmers could find these changes intriguing (Padel, 2001). A study conducted by Nieberg and Offermann (2008) in 2008 pointed that there is a straight correlation between farm profitability, technical knowledge and marketing skill of the farmer. The success of an organic farm relies on the managerial ability of the owner.

A study by Padel (2001) demonstrates that organic farmers have the characteristics of the innovators. She compared studies from different countries and concluded that organic famers reported several similarity between each other and differ in the same way from the "average" farmer. These differences were related on personal characteristic of the farmer. Even if the study conducted by Padel (2001) is 15 years old, nowadays her findings are still valid and confirmed by other studies such the one by Gardebroek (2006) or Läpple (2013). In line with these findings in 2014, the Italian Association for Biological Agriculture (AIAB) presented the "identikit" of the Italian organic farmer as, on average, younger, better educated and more interested in new technologies and innovation than the "conventional" farmer (INTERNET, AIAB, 2014, 2). In conclusion, it is possible to assume that technical challenge is simultaneously a barrier and a motivation to adopt organic farming.

2.2.3 Institutional motives

Due to tight legislations and policy inconsistency, institutional motives are one of the main barriers to switch to organic farming (Drost *et al.,* 2004) or a good reason to cease it (Flaten *et al.,* 2006). During a study conducted in Norway, Flaten *et al.* (2006) interviewed farmers decided to abandon organic farming. These farmers indicated regulatory issues as the main reason for converting back to conventional. The stronger limitations they perceived were mainly due to: i) the excessive bureaucracy to obtain a certification and the connected controls and ii) the difficulties to follow organic standards and fulfill frequently changing new requirements. A second barrier is represented by the often unpredictable agricultural policies. Organic farmers rely consistently on governmental subsidies and the risk of an unexpected change on the support scheme is perceived by several farmers as excessively high. (Flaten *et al.,* 2006)

2.2.4 Social and cultural considerations

Several studies show that social and moral considerations matter as much as economic concern. In contrast with economic theories based on individual full rationality and profit oriented behavior, people may often take decisions on the basis of commitment to ideas or people (Sheeder and Lynne, 2009). In this case of organic farming, many farmers may

approach organic practice motivated by environmental concern (Läpple, 2013). This is in line with the studies conducted, for instance, by Mzoughi (2011) in France and by Drost *et al.* (2004) in the Netherlands. In both researches, farmers and experts were interviewed and indicated environmental reason as one of the key drivers for the decision to convert to organic farming. Farmers believe that sustainable practice can, for example, help with the fight to climate change or protect their territory to biodiversity or ecological loss. Sheeder and Lynne (2009) also point out that, "*even when facing difficulties, many agricultural producers have maintained an attitude and ethic that treats farming and ranching as "a way of life" and not a venture to maximize profits*". On the other hand, as reported by Drost *et al.* (2004), farmers may dislike the idea of adopting organic farming due to the negative reactions that this may induce within their peer group, i.e., colleagues and families (Padel, 2001).

2.3 Organic Farming in the Italian wine sector

"Organic wine" is a new concept introduced by the Regulation (EU) 203/2012 for those products that comply with settled requirements and organic labels (Castellini *et al.,* 2014). Before 2012, only the certification for "wine made from organic grapes" was available. Together with the use of organic grapes, this regulative frame imposes a different enological process (INTERNET, EU, 2012, 7). Due to the lack of regulation before 2012, there are limited data and studies available concerning the marketing and economic performance of organic wine (Castellini *et al.,* 2014).

The few studies available point out the weakness of this sector. First of all, studies, as the ones by Corsi and Strøm (2013) and Castellini *et al.* (2014), reveal a general skepticism for organic wine from the side of the consumers. Even though consumers perceive organic products as less damaging for the health and the environment, wine represents an exception (Corsi and Strøm, 2013). For this product, quality is considered an essential purchase driver but it is generally believed that organic wine cannot guarantee high quality. Up to the consumers, in fact, "*organic wine is good for the environment but not for those who drink it*" (Castellini *et al.,* 2014:4).

Consequently, the market does not generally recognize a premium price to organic wine and the majority of organic grapes growers usually produce conventional wine (Corsi and Strøm, 2013). This may be due to the fact that the price paid, even in the rare case of premium price, does still not cover the higher production costs. Similar results are provided by the study by Stasi *et al.* (2010), where they demonstrate that, before subsidies, Italian organic wine is not as profitable as conventional wine.

In any case, not all the conclusions are as negative as the one presented so far. Stasi *et al.* (2010) remind that organic wine can, indeed, represent a good possibility of product diversification. Nowadays, organic wine has a thin market (Corsi and Strøm, 2013) even in countries, like Switzerland, where the organic products are highly demanded (Castellini *et al.,* 2014). However, in the past years in Europe and North America, the sales in organic wine sector have increased. The demand for organic wine is mainly concentrated in north European countries. For instance, in Sweden, consumers have shown a vivid interest in organic wine. In 2011, in fact, sales of organic wine grew by 24%, and made of Systembolaget, the Swedish governmental retailer for alcoholic beverage, the largest sellers of organic products in the country (INTERNET, GAIN, 2012, 1).

2.4 Agri-environmental payment schemes in Europe

The European Union defines subsidy as "*a financial contribution made by (or on behalf of) a government or public body which confers a benefit to the recipient*" (INTERNET, Euro Lex, 2009, 3). Since 1962, the year that the Common Agricultural Policy (CAP)[3] was introduced, the EU has started to subsidized agriculture, becoming an essential actor in the European farming system (Baylis *et al.,* 2011). In the course of the years, the European support scheme has changed, adding an environmental dimension to the already existing goals. In 1992 the MacSharry Reforms of the CAP introduced for the first time, an agri-environmental payment scheme for those farmers who voluntary engaged into activities meeting indicated environmental standards.

Since 1999, the EU designed a plan called Rural Development policy (RDP), that aims at reinforcing the European priorities for economic cohesion and environmental goals (INTERNET, EU, 2008, 2). The plan focuses on the reinforcement of directives to be given to national governments in order to improve competitiveness, environment, and quality of life in rural areas on the basis of local private-public partnerships (INTERNET, EU, 2012, 3). In particular, the measure 214a of the RDP proposes the payment of compensations to the farmers who voluntarily commit to undertake organic practices for a period of 5 up to 7 years (INTERNET, EU, 2007, 4).

2.4.1 Subsidies: how to include environmental goals into economic models

Neoclassical economics does not consider environment as a factor to be included in an economic analysis (Hofkes, 2001). In 1960, Coase (1960) started to put under discussion the economic assumptions that do not consider polluter accountable for the social cost that creates. Some years later Buchanan and Stubblebine (1962) clarified the concept of externality as a loss or gain from one agent as a result of the action taken by another agent in the absence of any compensation or remuneration. As explained in their study, an allocation is defined Pareto efficient when all the resources are distributed in a way such that it is not possible to make a person better off without making someone else worse off. An externality needs to be included in a full Pareto equilibrium. The disequilibrium will endure as long as the externality will not be "priced".

Among the different potential actions for environmental protection, organic farming minimizes environmental impact and contributes to food security (Läpple, 2013). Thus, organic farming creates positive externalities for the society such as benefits for human health and ecosystems (Stavins, 2007). Although it is clear that, in a long run, the economic growth cannot be supported by the continuum use of natural resources that are constantly decreasing in quality and quantity (Hofkes, 2001), it is still a central problem defining how to take in account an output, such as the social or environmental benefits, that is not easy to access. In this respect, Buchanan and Stubblebine (1962) assign a central role played to governments and policy makers.

[3] The CAP is a common policy implemented within the European Union that targets the safeguards of food security and the support to agricultural production. Its goals include the stable supply of food to be sold to consumers at accessible prices and the safeguard of fair profit margins to be paid to farmers. It, finally, provides tool for environmental protection and sustainable management. (INTERNET, EU, 2014, 9)

Traditionally, the literature points to governments, as the major actor that should compensate the positive externalities created by organic production. Generally speaking, this benefit is account in an environmental policy as the value calculated by the aggregate willingness to pay of the people to prevent an environmental loss (Stavins, 2007). However, nowadays, the market has started to recognize a higher price for organic products, thanks to the perception of the consumers that organic is safer for the health and of higher quality (Stolze and Lampkin 2009). Organic premium price is a sign of market efficiency and ability to account for the costs and benefits of organic production. When this price is not recognized, it is possible to speak about market failure and governments are the only one accountable to compensate organic farmers.

2.4.2 What impact do the European environmental subsidies have on agriculture?

Several studies have dealt with the impact of the European environmental subsidies on agriculture. Most of the studies focus on the performance of the payments to high the rate of adoption and the stability of number of farmers engaged. Even though the result of the literature review presented ambiguous results, one common denominator was the evidence that the market is still not sufficiently mature to compensate the extra efforts. Consequently the governments have tried to create schemes strong enough to cover the extra costs and losses. Some studies points out that the presence of payments made possible to organic farmers to have higher average profits and returns on investments (Musshoff and Hirschauer, 2008; Lampkin, 1997; Offermann and Nieberg, 2001). However, a study conducted by Zander *et al.* (2008) in 18 European countries confirms the total dependency of the organic farming's profitability on the communitarian payments. For this reason some farmers perceived organic farming as too risky and complex (Flaten *et al.,* 2008). Farmers pointed to the lack of trust on government's stability and the excessive rigor of the certifications linked to the European policies as one of the main reason to not choose organic farming.

Nevertheless, a positive correlation between the introduction of environmental policies and the adoption of organic farming has been demonstrated. In 2008, Gleirscher (2008) ran a study in Austria, one of the leader countries in Europe in terms of percentage of arable land destined to organic farming. He points out that at first, from 1991 (year of introduction of the payments) to 1999, environmental policies had a large impact of the decision to switch. However, between 2000 and 2003, despite a raise of the support of a 43%, the number of organic farmers decreased. This change was registered in that, even though the subsidies were promising a secure income, the organic market did not recognize a premium price. Hence, governmental payments were not fully compensating for the higher costs and the burden due to the limits imposed on allowed agricultural inputs by the certification. Some years later, Daugbjerg *et al.* (2011) made a similar study in Denmark and UK analyzing the connection between 14 different organic farming policies and the adoption rate for the period between 1989 and 2007. They conclude that the policies have had a strong impact on the decision to switch to organic production.

3. Theoretical approach to the analysis

This chapter starts with the presentation of the theoretical elements supporting the analytical method elected, namely the net present value analysis. It continues by proposing a definition of risk and a presentation of the main risk sources in agriculture. The chapter ends with an overview of the concept of sensitivity analysis and Monte Carlo simulation.

3.1 Net present value analysis

EU farmers have then two alternatives options. The first one is to stick with conventional farming, while the other is to adopt organic farming. Hence, there is the need of using a proper framework in order to identify the factors driving their choices. A reasonable choice is using "*a criterion based on present values, that is on the discounting of cash flows at some rate of interest back to the start of the project*" (Russell, 1970:358).

The neoclassical approach assumes that a farmer is interested in the maximization of profits. In organic farming, if the farmer will not be compensated for the additional costs connected with the practice, s/he will not convert. The compensation can be a subsidy by the government or/and a premium price. The decision lays on the expected revenues of the conventional and organic farming over some years. The planning horizon for an organic farmers needs to mirror the constrain of the voluntary contract with the EU, that obliged s/he to a period of time of at least 5 years of contract. Given the contract, the necessary training and the initial investment, it is possible to assume that, in this case, a farmer is interested to maximize long-time profits (Debertin, 1986).

It is common understanding that today's money is worth more than the one received at a future date due the market rate of interest. Therefore, investors, that decide to invest their money on a specific project, expect both to have a return on both the initial investment costs and the *time value of money.* The net present value (NPV) analysis is a standard economic method used in order to analyze the long term convenience of an investment. (Brealey *et al.,* 2011:20)

The present value (PV) of cash flow is defined as the value today of future income discounted by an interest rate (Debertin, 1986). A general PV formula is:

$$PV = \sum R_t / (1 + i)^t \qquad (2)$$

for $t = 1, \dots, n$ years
and where R_t is the cash flow relative to the t-th year

Debertin (1986) states that the PV can be used to define if a farmer can afford an investment in the long-run. Once the future cash flow has been discounted, it is possible to compare it with the initial cost of capital. In other words, the cost of the investment today needs to be subtracted from the PV to obtain the net present value (NPV). If the NPV is non-negative ($NPV \geq 0$), the investment is profitable for the farmer and the project could be undertaken (Perman and Perman, 2003). In case of comparison of different alternative projects over a defined time period, the decision maker will choose the alternative that has the highest NPV, so that will increment the most his/her utility (Hardaker *et al.,* 2004).

In order to calculate the NPV, it necessary to calculate first the free cash flow (FCF) and select the discount rate to be applied in the calculation (Brealey *et al.,* 2011).

3.1.1 Free cash flow

The *"free cash flow is the amount of cash that a firm can pay out to investors after paying for all investments necessary for growth"* (Brealey *et al.,* 2011:90). It is calculated using information shown in standard balance sheet and income statements.

FCF = EBITDA + depreciation and amortization – tax – interests – investment (3)
where:

- *EBITDA* is the earnings (total revenues – total costs) before interest, taxes, and depreciation,
- *Depreciation* is a process that allocates a multi-year cost to each period of useful life of the asset.
- *Tax* is a levy imposed on personal or company's profit by the government,
- *Interest* is a fee due as a compensation for using someone else's money or financial assets.
- *Investment* is defined as a change is working capital (Brealey *et al.,* 2011).

In the empirical chapter of this thesis, I will describe in depth all the elements used for the calculation of the FCF.

3.1.2 Discount rate

For proceeding to the calculation of the NPV, a specific interest rate must be selected. This rate will then be used in order to make temporally homogeneous the values of FCFs accruing over a defined period of time (Peterson and Fabozzi, 2010). This rate is called discount rate or opportunity cost of capital. This is because it can be consider as the return that is foregone by using the investment money for a project instead of investing them in the financial market (Brealey *et al.,* 2011:23). Therefore, a high discount rate may deter the investment. Due to the important impact of the discount rate on the estimation of the PVs, it is essential to define it as precise as possible. However the finance literature does not clearly define how to select the proper discount rate.

Generally, if a project is considered not risky, the discount rate used is equal to the risk-free rate that, conventionally, is equal to the interest rate paid on a governmental bond. To take into account the risk attitudes of the decision maker, one needs to adjust the discount rate applied to the analysis by raising it according to the level of actual risk aversion (Musshoff & Hirschauer, 2008). Hudson *et al.* (2005) underline the problems that occur when trying to quantify risk attitudes in agriculture. Using different risk premium measurement, the aim of their study was to show similar risk attitudes in the same context. The results of their experiments showed eventually limited consistency and suggested that the underlying risk preferences are not consistent. For these reasons, risk premiums are usually arbitrarily assumed by the researcher (Musshoff & Hirschauer, 2008).

Following Musshoff (2012), the researcher considers three scenarios in order to allow for different levels of risk aversion. Each of these scenarios is characterized by a specific discount rate which is calculated as follows (*ibid.*):

$$i = rf + \rho \qquad (4)$$

where i is the risk-adjusted interest rate, rf is the risk-free interest rate and ρ is the risk premium added to the risk-free rate. Usually, for projects undertaken in a risky environment,

the literature suggests a discount rate set equal to approximately 8-12% (see for example: Gebremedhin and Gebrelul, 1992; Zhuang *et al.,* 2005). Another approach is proposed by Brealey *et al.* (2011) where it is suggested that the FCFs should be discounted at a rate equal to the sum of the risk-free rate plus a 7.1%. This percentage is, indeed, the one that, accordingly to their survey, the majority of financial economists suggest as risk premium.

3.2 Risk in agriculture

In many respects, farming is a risky business (Hardaker *et al.* 2004) and "*farmers face a variety of price, yield and resource risks which make their incomes unstable from year to year"*(Hazell *et al.,* 1986:77). The riskiness in agriculture does not only depend on the market's changes and passing fancies, but also on factors that are much harder to control and predict such as weather conditions, weed and pests (Hardaker *et al.* 2004). The literature (see, for example, Debertin, 1986, Hardaker *et al.,* 2004 and Perman and Perman, 2003) differentiates between risk and uncertainty. Following Hardaker *et al.* (2004:5), uncertainty is "*imperfect knowledge*" while risk is a situation with "*uncertain consequences*". Risk is, indeed, not value-free, meaning that the risk is a condition connected with an aversion for the consequences of a situation or decision.

At farm-level, it is important to take into consideration the variation of revenue caused by the different management practices adopted for conventional and organic crops that, usually, lead to different prices and market opportunities (Acs *et al.,* 2009). Different risk attitudes influence the decision to switch. Acs *et al.* (2009) states that a risk-neutral farmer will decide to convert but a risk-averse one would need additional incentives. The individuals can, indeed, be described accordingly with their risk attitude (Perman and Perman, 2003). The risk-neutral individual is the one that will chose the alternative with the maximum output with no consideration of the risk associated with the different alternatives. The risk-seeker (or risk-lover) will choose the risky alternative when this is associated with the preferred outcome. In contrast, the risk-averse is reluctant to accept a risky situation, s/he will rather accept lower income if associated with lower risk.

3.2.1 Source of risk in agriculture

The different sources of risk in agriculture are linked with potential changes in productivity, price and/or institutional aspects, and the bad luck that may characterize individual economic initiatives (Hardaker *et al.,* 2004). More precisely, Hardaker *et al.* (2004) label these four risk categories respectively as: productivity risk, price and market risk, institutional risk and human risk. They, all together, represent the whole business risk of the farmer. The most important category to be taken into consideration in agriculture is the price and production risk (Chavas *et al.,* 2010). However, in organic farming, due to the strong dependence on government subsidies, another important risk category is the one connected to institutional changes (Flaten *et al.,* 2010).

Concerning the production risk, the main source of risk is given by the variability of weather conditions and the occurrence of pests and diseases (Hardaker, 2004). This is particularly true in organic farming where stricter rules on the use of fertilizers and pesticides apply (Lampkin and Padel 1994). This implies that, in case of a disease or a pest, the farmer cannot count on effective pesticides and other chemicals. The organic alternative substances maintain the field in a vulnerable state if compared with conventional farming. In addition, this risk category is perceived in Europe as the one having the larger impact on agriculture due to climate change

(Schaffnit-Chatterjee, 2010). Moreover, Lampkin and Padel (1994) highlight that productivity risk is the first barrier to switch to organic agriculture.

Continuing with Hardaker (2004), price and market risk are due to the unpredictable fluctuations of prices and availability for inputs and outputs. Political instability is the main source of institutional risk. Governments might in fact change policies and regulations that directly affect the farming process. The last category, the human risk, is connected to the people directly involved into farming. In this respect, personal experiences such as divorce, illness or death can severely impact on the health of farm activities.

3.2.2 Sensitivity analysis and Monte Carlo simulation

The NPV analysis is based on the determination of annual cash flow based on periodical payments. Since the calculation may rely on approximations and expected values, it is important to consider the possible outcomes as stochastic variables (Hardaker, 2004). Any time that a farmer is dealing with a cash-flow forecast, s/he needs to identify the key variables connected with a possible success or failure of the project (Brealey *et al.,* 2011:243). When this is done, it is possible to proceed with a risk analysis of the project, an analysis that, based on the available data, can determine i) if and how often a specific event may occur and ii) the importance of its consequences (INTERNET, Palisade, 2014, 1). A risk analysis can be qualitative or quantitative. In the first case, the decision maker can evaluate a risky situation using his/her experience or instinct. In the second case, the analysis assigns a numeric value to risks, either by using empirical observations or quantifying qualitative evaluations.

According to Perman and Perman (2003), in the specific case of a NPVs analysis, a simple modification of the NPV can be used in order to internalize the imperfect knowledge of the future. If the farmer assigns different probabilities to the possible alternatives, it will be possible to define a decision on the basis of the expected NPV. "*The expected value, or expectation, of a decision is the probability weighted sum of the values of the mutually exclusive outcomes*" (Perman and Perman, 2003:367). In other words, instead of considering one "certain" outcome, the farmer could consider two or more possible outcomes calculated considering different scenarios.

Financial literature suggests two main ways to carry out a quantitative risk analysis. The first way is to assign values to distinct scenarios and study the different outcomes (INTERNET, Palisade, 2014, 1). This is the case of deterministic analysis like the sensitivity analysis. It is defined by Saltelli *et al.* (2008:1) as: *"The study of how uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input"*. In other words, the sensitivity analysis studies the variation of a dependent variable, usually the net revenue, when one independent variable has changed and the others are kept constant (Brealey *et al.,* 2011).

This analysis creates different NPV under "optimistic", "most likely" and "pessimistic" circumstances (Paramasivan *et al.,* 2005). When the NPVs of the three situations differ strongly between each other, it implies great risk connected with the variable into consideration. In the case that more than one independent variable is considered interrelated, a possible option to the sensitivity analysis is the scenario analysis (Brealey *et al.,* 2011). The sensitivity analysis allows creating several possible scenarios with different but consistent combination of variables.

The sensitivity analysis is a widely used technic that, however, present several limitations (Abbott *et al.,* 2008), connected, in general, with the excessive, simplification of the model. This implies that sometimes the outcome of the analysis cannot be considered accurate (INTERNET, Palisade, 2014, 1).

A possible alternative to the sensitivity analysis is the Monte Carlo simulation, a computational algorithm that allows repeating random combinations of input variables to obtain the probability distribution of unknown outcome (Brealey *et al.,* 2011). This technique was firstly introduced in nuclear physics but was rapidly adopted by other disciplines (Kochanski, 2005). In finance, this method is used to evaluate potential investments and financial portfolios' composition. The MC simulation, thanks to the complexity of the mathematics, succeeds where other analyses fail to reproduce real life systems (Mun, 2006).

In a MC simulation, a probability distribution is associated to the uncertain variable in a model (INTERNET, Palisade, 2014, 1). Doing so, to each input can be assigned a range of probabilities for different outcomes. As suggested by Brealey *et al.* (2011), the MC simulations can be run following four steps:

1. The first step of the simulation requires i) the introduction in the software of an exact model of the project and ii) the identification of the interrelation within the variables. If the parameters are connected, such a correlation needs to be integrated inside the model (Abbott *et al.,* 2008).
2. The second step is to define the probabilities of forecast errors (Brealey *et al.* 2011). The decision maker estimate the value of the forecast error as zero but it is anyway important to add a range of possible variation of the error to obtain the worst and best possible outcomes.
3. The third step is to calculate potential cash flows for each period and forecast errors. This will allow the software estimating a distribution of the cash flows.
4. Finally, it is possible to calculate the present value.

4. Method

4.1 Research in social science

In social science, there are two mainstream research approaches that are mostly applied to define the strategy to follow for the study. Firstly, positivist philosophy in social science means "*working with an observable social reality and that the end product of such research can be law-like generalizations similar to those produced by the physical and natural scientists*" (Remenyi *et al.,* 1998:32). As in scientific disciplines, the research needs to be based on *facts* generated by the observation of a phenomenon. This in turn leads to the creation of *credible data* (Saunders *et al.,* 2009). Consequently, the researcher concentrates on discovering the connections between the observed events, occurred in society (Robson, 2011). To generate results, the researcher will use existing theory to develop hypotheses that, when tested, can be confirmed or refused (Saunders *et al.,* 2009). This mechanism will bring to a new development of the theory that may, in turn, lead to further research work.

The aim of this approach is to have findings that can be generalized. To do so, the selected sample for the study needs to be sufficiently large. This, in fact, may bring to conclusions that one may consider both valid and reliable. The results of the study need to be, indeed, explanatory of the phenomenon observed (Robson, 2011). More importantly, taking a positivistic approach, the results collected have to be *value-free*, that is, independent from individual preferences and beliefs of the researcher. Positivistic research is conducted mainly in a quantitative manner, using measurable observations. The models used are based on numerical analysis and the researcher has no possibility to manipulate the results (Robson, 2011). All these characteristics are typical of the deductive research approach (Saunders *et al.,* 2009).

This method is in contrast with the hermeneutic philosophy which is based on the interpretation of the researcher and aims to investigate the world by taking the perspective of how people perceive it (Robson, 2011). Due to the nature itself of the research, it is not possible to keep it objective. As under a positivistic approach, a key factor is the uniqueness of the subject under research.

However, the terms are different. If under a positivistic approach, the phenomenon has to be observable and measurable, in the hermeneutic view all the facts collected are unique since all people have unique points of view. All the results presented should produce an understanding of the phenomenon. Under a hermeneutic approach, the research is based on qualitative units, elaborated with flexible analysis, as, for instance, case studies, ethnographic studies and grounded theory studies. When adopting a hermeneutic approach, the researcher uses induction, since s/he will observe the reality before making theories.

Robson (2011) points out that these two methods should not necessarily be seen as conflicting. In this respect, Saunders *et al.* (2009) state that research can benefit from a combination of both quantitative and qualitative methods.

A mixed approach can be also applied to the research proposed in this thesis. On the one hand, this research thesis is mostly focused on quantitative research and measurable methods and data. Cost of investment, production, and methods of cultivation were defined through interviews and data collection. However, on the other hand, in order to answer properly to the research questions, it was not only necessary to apply the economic model to the data

collected, but it was essential to consider indications of the qualitative approach. The decision to convert to organic farming does not completely rely on the economic advantages of one or the other agricultural method. It is, in fact, important to consider the context where the decision may be taken. The context can, indeed, change accordingly with the language of study, personal values of subjects, morals and ethical value and customs of society (Robson, 2011).

4.2 Case study

A case study is a strategy of researching a real life phenomenon that involves empirical investigation using multiple sources of evidence (Robson, 2011). In a case study, the boundaries between the phenomenon of interest and the context where the phenomenon occurs are usually not clearly identifiable (Yin, 2003). Hence, the context is of central important in a case study, when it is not in other research strategies. In the experimental strategy, for instance, the context is completely under the control of the researcher, and in the survey strategy the possibility for the researcher to understand the context is limited by the number of observations that can be collected.

The case study strategy allows gaining an in-depth understanding of the context of the research, generating answers not only for the WHATs and HOWs but also for the WHYs (Saunders *et al.,* 2009). This research strategy is mostly use in case of explanatory and exploratory research and focus on a particular case and an isolated area. The center of a case study could be, for instance, a person, a community, social groups, institutions, country and, of course, a business organization (Robson, 2011). This study is based on the collection of *empirical* data and the use of multiple methods for data collection. A case study can be based on a single case or on several cases (Yin, 2003). The singular case is a unique phenomenon that few have studied before. Multiple cases are chosen to establish if the results found for one case, are also confirmed in others. Yin (2003) continues adding a second dimension concerning the unit of analysis, a case can, in fact, be holistic or embedded. A holistic case concerns a phenomenon as a whole while an embedded case considers the phenomenon as composed by a number of logical sub-units that need to be studied.

This thesis research is focus on a single case study since the chosen analysis is applied in a single province, Arezzo, and for a single product, i.e. Chianti and its variant Chianti Superiore.

4.3 Data sources

In order to analyze the economic impact of adopting organic farming from conventional methods, the analysis started with the collection of historical observations of prices, yields and estimated production costs for several “typical” Chianti farms, some conventional and some organic within the province of Arezzo, central Italy. To follow this aim, quantitative data, both of primary and secondary nature, have been collected by public and private agencies. The gathered data have then been elaborated in order to meet the requirements of the economic analysis.

In this study, the “typical” farm is meant to represent the average approximation of a farm active in the selected area (considering the selected production and a given size of the farm). This was done in order to exhibit the essential characteristics of the reference group of farmers. In particular, to better mirror the reality of the province, the analysis required the

calculation of ten different "typical" farms. In the first part of analysis the average annual cash flows were calculated for four farms, all of 10ha, two producing Chianti and two producing Chianti Superiore. In the second part the Chianti's farms were divided for size groups, with each respective organic and conventional "typical farm". The choice of the size and the approximations used to calculate the average costs and incomes will be explained in details in section 6.2. The aggregation was possible considering the land restriction on one single province and assuming that all the farms have equal access to the same technology (Hazell and Norton, 1986).

The literature presents definition for all data categories (see for example, Saunders *et al.,* 2009 and Robson, 2011). First of all, primary data are new data collected by the researcher to the scope of his/her work only and secondary data are data collected for some other reasons and include published lists or raw data. Most of researches are addressed by using both kinds of data. For research based on a national or international comparison, as this one, secondary data are the main source to answer the research questions (Saunders *et al.,* 2009).

Quantitative data are data of numerical nature that can be quantified and verified and can be used for statistical calculations (Saunders *et al.,* 2009). These kinds of data should have the following characteristics: validity, generalizability, objectivity, and credibility (Robson, 2011). Qualitative data can be of different nature and include basically all the not numerical information (Saunders *et al.,* 2009). However, some observations, even non numerical by nature, can be converted in a number by the researcher through tolls as, for example, scales of values in numerical survey.

Robson (2011) differentiates interviews in *structured*, *semi-structured* and *unstructured* types. For the purpose of this research, the data gathering started with a series of unstructured interviews to sector experts and farmers of Arezzo. Due to the personal contact of the researcher with the people interviewed, the meetings had been in person and performed in an informal way. This first interview section has been essential to gain a first understanding of the wine sector and the advantages and disadvantages of organic versus conventional farming. The following contacts have been mostly by email or phone. This choice was made to cut travel costs and tailor the information exchange to the research schedule (Robson, 2011). Nevertheless, the indirect approach was clearly preferred by the interviewers. To secure the quality of the mentioned data, all information received by the experts though interviews had been triangulated with other experts' opinions, documents, price lists, web-sites and studies. The result of the interviews will be presented in the chapter *Empirical background*.

The secondary data, necessary for this study, have been collected for yields and prices. With the scope of researching, ARTEA has granted access to the data collected about the *yields of organic and conventional grapes* produced in the last 10 years for all the farmers registered in the province of Arezzo (Pers. Com. Martini, 2014). The data was not elaborated and presented in a raw format. Each specific farmer, irrespective of being organic or conventional, was identified by an ID number, the land surface, the quality and quantity of grapes produced. The *prices* for conventional grapes are publicly reported by the Chamber of Commerce of Arezzo in their website[4]. An average of historical prices of the grapes was used as a substitute of the future price.

[4] Available at: http://www.ar.camcom.it/modules/wfdownloads/viewcat.php?cid=70&start=70

4.4 Reasons connected with the case study

In this thesis, the focus will be set on the wine producers who are active in the province of Arezzo. In the following sections, the reasons which have driven the specific choice of country, area, sector and product are presented.

4.4.1 Choice of country or region

Italy is a country located in the southern part of Europe. Italy is the third largest agricultural economy within the European Union (INTERNET, Europarlamento 24, 2014, 1) and the first producer of wine in the world (OIV, 2014) with one fourth of the vineyards in Europe (OIV, 2013). Italy is one of the top ten world producer of organic products and, within the European countries, Italy ranks second after Spain with a total of 1.2 million hectares, the 3% of the total organic land in the world. In 2014 the land farmed organically has increased of 6.4% compared with the previous year. Moreover, Italy counts the largest organic land devoted to wine-grapes production (INTERNET, EU, 2012, 6).

Tuscany is a region located in central Italy that for farm size, production output and climate can be considered very representative of the Italian agricultural sector (Haring, 2004). As pointed out by Haring (2004), the regions in the central part of Italy present, statistically, socio-economic conditions that can represent, on average, the whole Italian context. The wine sector in Tuscany is surely the main agricultural driver and engages almost half of the total farmers (INTERNET, Regione Toscana, 2007, 2). In Tuscany, the organic grapes production covers the 13.4% of the total vineyards[5] (INTERNET, Regione Toscana, 2010, 1). Even though more recent data are not available, in 2012 the Italian Confederations of Farmers (CIA) registered in Tuscany a general increment of +12.4% with respect to 2009 (Castellini *et al.,* 2014).

A problem arising when comparing organic and conventional farming is the scarcity of official statistics on organic farming. In order to narrow the data collection, the research has been delimited to the province of Arezzo. Arezzo can be considered a good representation of the Region, since in terms of economy, geography and agriculture has average values compared with the other provinces. In its territory are located the 14% of the UAA of Tuscany and, even if agriculture generates just the 2.5% of the regional GDP, it has still an important social and economic role (INTERNET, Regione Toscana, 2006, 2). In the wine sector, Chianti is, surely, the most relevant product. In 2013 more than 2000 ha, the 51% of the total vineyards where cultivated with Chianti or Chianti Superiore grapes[6]. Finally, in 2010, in the province of Arezzo the proportion of farms producing organic grapes over the total reaches 9%.

4.4.2 Choice of sector

The International Organization of Vine and Wine (OIV) defines wine as “the beverage resulting exclusively from the partial or complete alcoholic fermentation of fresh grapes, whether crushed or not, or of grape must. Its actual alcohol content shall not be less than 8.5% vol.” (INTERNET, OIV, 2012, 1). In Italy, the wine sector is surely one of the most

[5] The data processed are provided by the agricultural census run in 2010. These data are available at http://www.regione.toscana.it/-/censimento-generale-agricoltura-2010

[6] Own elaboration of the data ARTEA

representative drivers of the so-called "Made in Italy". As mention before, with its 45 mhl of wine produced in 2013, Italy ranked as the largest producer of the world. On the one hand grapes production ranks third in the top ten of commodities produced in Italy in terms of quantities with a production of 5.819.010 tons of fruit in 2012 (FAOSTAT, 2014). On the other hand wine is the most exported agricultural product with a turn over, in 2012, of 3.3 billion US dollars.

Chianti is one of the most common varieties produced and it is exported worldwide (INTERNET, Made in Italy, 2014, 1). Due to the large number of winemakers and to their very specific production practices, it is difficult to identify a standard in terms of organoleptic qualities. However, Chianti is an easy-drinking wine, is intended for early consumption and, in comparison with other quality red wine of the region, Chianti is cheaper. All these characteristics have made Chianti one of the most popular wines around the world.
Finally, a further reason for choosing Chianti and the province of Arezzo is the personal knowledge of the researcher with the area, the sector and the language. The importance of this last factor is relevant if consider that most of the data collected are not publicly reported and the collection required personal meetings and interactions, that would have been difficult otherwise.

4.4.3 Choice of the analysis

This study adopts a net present value analysis, where the farmer is considered as a rational economic agent that will switch to organic farming if the net revenues accruing by undertaking this practice exceeds the one attached to taking other available options (Uematsu and Mishra, 2012). The analysis is carried out aiming to a comparison between the two agricultural regimes, i.e., conventional and organic, considering the conversion period and the policy's constraints. The calculation is based on historic data from 2004 to 2013. Year 2014 was not considered because the data of the harvest were not available to the time of the research. The reason to use a ten-year period is to consider a long run scenario.

Due to the fact that NPV analysis ignores irreversibility, time flexibility of the investment and uncertainty of the investment returns (Wolbert-Haverkamp & Musshoff, 2014), financial literature does not consider this a to understand in depth the complexity of an investment decision but it is, anyway, a useful tool for a first evaluation of a project performance.
The most relevant problem of the NPV is the difficulty of defining a suitable discount rate (Brealey *et al.,* 2011:23). Any change of the discount rate affects the financial result of the analysis. As pointed out by Musshoff & Hirschauer (2008) the use of a risk-free interest rate that, usually, corresponds to the governmental multi-year treasury bonds is only justified if the farmer is considered risk-neutral. In the case of Italy, the rates at 5 years are equal to 1.23% (INTERNET, MEF, 2014, 1) and at 10 years 2.44% (INTERNET, MEF, 2014, 2). Hence, since the analysis reflects 10 years horizon, the first discount rate applied is 2.44%. To take into account the risk attitudes of the decision maker, one needs to adjust the discount rate applied to the analysis by raising it according to the level of actual risk aversion (Musshoff & Hirschauer, 2008). As suggested by Brealey *et al.* (2011), for the purpose of this paper, it is decided that the discount rate is equal to the interest rate of 10 years Italian BTP (2.44%) plus a risk premium equal to 7.1%. Hence, the second discount rate applied is of 9.54%. Finally, in extend our analysis, we include calculations done using a third rate arbitrarily chosen equal to 15%. This is done in order to account for the presence of potential higher business risks. However, it is also in line with the findings presented by Musshoff (2012), who confirms that a risk premium should, in general, fall within the range 8-12%. Considering a risk-free rate of

2.44% and the highest risk premium of 12%, it is then reasonable to choose a discount rate of 15% for the case of strong risk aversion.

Given the uncertainty connected with forecasts, the NPV analysis is followed by a MC simulation. The Monte Carlo simulation has been elected for this study because a model where all the variables are allowed to change at the same time, it appears as a more realistic way to modelling uncertainty. Moreover, Artikis (1999) recognizes the MC simulation as one of the best approaches to account for the risk involved in a project. As Brealey *et al.* (2011) point out, when compared with any determinist approach, the Monte Carlo simulation shows several advantages. As forecast method, it allows to deal at the same time with uncertainty and interdependencies. More precisely, it allows the decision maker to firstly analyze the most relevant sources of uncertainty and secondly to take into considerations different possible scenarios in order to modify the project.

4.5 Ethical considerations

When conducting a study research, one should be aware that the content presented could affect all participants, i.e. the thesis supervisor, the university, the people involved when collecting data, etc. The research should, therefore, be conducted in a way to show integrity and objectivity.

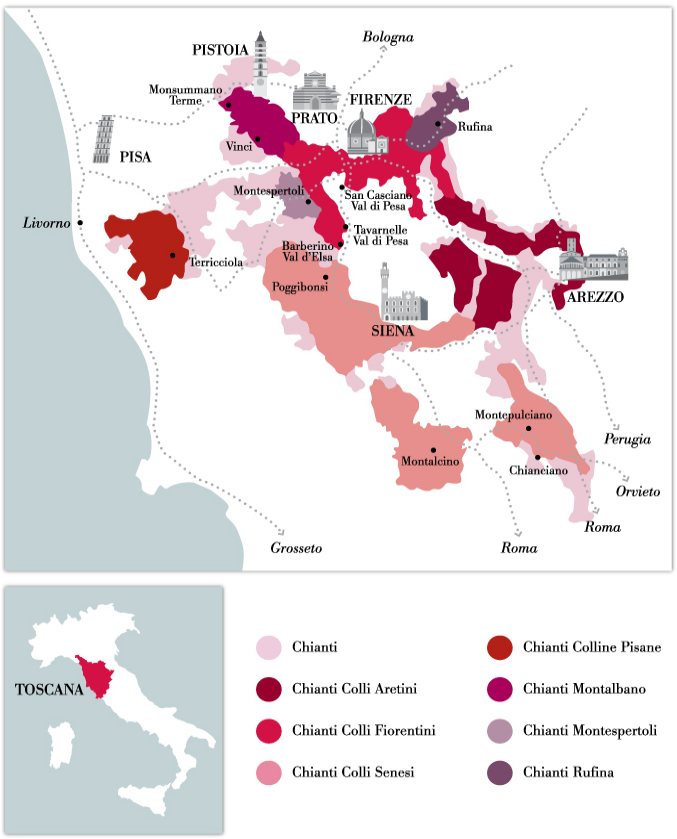
Since this thesis is built using primary and secondary data, it was necessary to contact people to obtain reports and documents, and meet some others for interviews. All the requests were forwarded by email or phone. Then, the contacts were informed of the aim of the study and agreed on the publication of the information shared. They were moreover informed about the eventual publication of the thesis and of the results.

5. Background for empirical study

This chapter will briefly introduce the wine sector in Arezzo, then the specific agri-payments recognized to the farmers in the area and the specific average cost of organic and conventional production of Chianti grapes.

5.1 Vine and wine production in Tuscany

Wine is a strongly regulated sector and the one produced in Tuscany does not make an exception. Generally speaking, EU regulates common standards for the production of wine falling within the following categories: i) protected designation of origin (PDO) and ii) protected geographical indication (PGI). The first denominates the products which have been produced only with grapes growing within a specific geographical area using a defined know-how. The second denomination is provided to wine produced with at least an 85% of specific grapes growing in a defined area. In addition, the labels above compel the methods used for the production and impose restrictions on the yield per ha. This in turn affects the price of the wine. (INTERNET, Euro Lex, 2011, 4)



Chianti is a Protected and Guaranteed Designation of Origin (DOCG, acronym from the Italian, Denominazione di Origine Controllata e Garantita), a branch of the PDO that is recognized for being particularly fine. In the same area, stricter rules applied for the production of the so called Chianti Superiore. The Ministry of Agricultural, Food and Forestry Policies (MPAAF) regulates the minimum requirements in terms of quality and the maximum production performance per ha. (INTERNET, MPAAF, 2014)

Figure 1: Chianti territory division. (INTERNET, Consorzio Vino Chianti, 2014, 2)

The blend of grapes for Chianti and Chianti Superiore requires from 70 to 100% of Sangiovese, a maximum of 10% of Canaiolo and 20% of other red grapes (ex: Cabernet Sauvignon, Merlot or Syrah). The most relevant restrictions on Chianti and Chianti Superiore production are the maximum of 8 tons of yield per hectare for the first one and 7.5 tons for the

second one. The Chianti scheme is meant to assure the physical-chemical and organoleptic quality of the wine, that includes color and alcohol contained[7].

Chianti is produced in six provinces of Tuscany (INTERNET, Consorzio Vino Chianti, 2014, 2). The variety identified as "Chianti" can be produced in the whole territory defined by the law. As shown in figure 1, there are other types of Chianti that are identified on the basis of the area of production.

In the province of Arezzo, the most part of land is dedicated to the cultivation of grapes used for the production of Chianti wine, Chianti Colli Aretini and Chianti Superiore. However, in terms of quantity produced and land devoted, other relevant wine in the area are: 1) a PDO red wine called Cortona DOC, 2) red PGIs and lastly 3) a table red wine. This last category involves 1610 farmers but only a 10 percent of land. It is in general a less valuable wine in terms of quality. Basically, this category includes all the red wines which do not fall into other categories recognized within the scheme. The red wine average production land is of 0.3 ha and this kind can be considered to be the local wine produced for self-consume (INTERNET, Regione Toscana, 2006, 2).

5.2 Production costs

In the course of this study, it was not possible to access to secondary sources for all the needed data. Hence, it has been necessary to set interviews with farmers and experts of the area. Table 1 presents the summary of the data collected through personal meeting and interviews with the agronomist Fatucchi and triangulated with the opinion of some local farmers.

With respect to the farming costs, the results of the data gathering are in line with what suggested in the literature review (see, for instance, Padel, 2001). Organic farming in the province of Arezzo is a labor intensive technology that does not require large investments in terms of additional machineries or buildings.

The annual expenses for agricultural inputs for the two considered practices, i.e., organic and conventional farming, are rather close to each other. Under conventional farming, farmers pay per ha an average of 575€ on fertilizers and other substances, whereas under organic farming this figure is equal to about 560€. The cost has a minimal variation of about 1-2%. Organic cultivation requires a larger quantity of agricultural inputs when compared with conventional. The reason lays on the fact that organic farming inputs are less effective than the conventional alternatives but are generally cheaper because not protected by property rights. In contrast, synthetic treatments are costly, but more efficient in terms of impact on the crop. Considering price and quantities used for both methods, the results obtained point on equal expenses for conventional and organic farmers.

[7] For further information about the requirements for the production of all Italian PDO and PGI, please consult the website of the MPAAF: http://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/4625

Table 1: Average cost of grapes production and summary of treatments applied to organic and conventional land. Source: pers. com. Fatucchi, 2014

	Organic		**Conventional**	
	hours/ha	€/ha	hours/ha	€ /ha
Fertilizing	20	€ 150	20	€ 130
Land preparation	4		4	
Weed cut	16			
Pruning	86		58	
Treatments:				
Sulfur and copper	15	€ 300	4,5	€ 90
Insecticide	1,5	€ 60	1,5	€ 25
Mold treatment	3	€ 50	3	€ 30
Systemic treatment			7,5	€ 300
Weeding			3	€ 50
TOTAL	**141,5**	**€ 560**	**101,5**	**€ 575**

As shown in Table 1, the most common inputs used in organic cultivation are sulfur and cooper. These substances need to be applied at least three times more often than under the conventional regime. Another treatment that cannot enter in the organic procedure is weeding. In grapes' production, this represents the most problematic restriction since the organic alternative expects that farmers cut weeds manually. Hence, conversion to organic farming may impose the purchase of a weed cutter. This is the only investment cost considered in this research.

When in the analysis working hours are considered, the difference between the two methods is very important. To cultivate a hectare devoted to vineyard, one would need 141.5 hours under the organic regime and only 101.5 hours under the conventional one. According to these figures, in percentage an organic farmer needs around an average of 30% hours more each hectare. The difference is due to the use of machineries and synthetic substances. As mention before, organic treatments are less effective, and the farmer needs to repeat them every time this is needed.

5.3 The grape's price

On the basis of the interviews, it seems that the market does not recognize any premium for organic grapes. Hence, both organic and conventionally produced grapes are sold at the same price. Moreover, by comparing Chianti Superiore and Chianti, grapes falling under the first category are usually granted a higher price. The difference is generally equal to about 20%. That is due to the higher quality of the Chianti Superiore, which is obtained by a more severe restriction in terms of yield imposed by the EU.

Finally, Table 2 shows the historical observations of the price of the period 2004-2013. The price does not present any particular trend. It fluctuates from a minimum registered in 2005 of 300€ per ton to a maximum of 800€ paid in the years 2007, 2008 and 2013. The payment of the minimum price or of the maximum one might depend on the quality of the grapes or from the wineries interested to buy the grapes.

Table 2: Price of Chianti 2004-2013 (price expressed in €/ton). Source: Own elaboration based on data published by Arezzo's Chamber of Commerce.

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Min	450	300	350	600	600	350	350	350	500	700
Max	650	500	500	800	800	400	400	400	700	800

5.4 Organic wine in the province of Arezzo

To have a better understanding of the organic market for wine in Arezzo, two different interviews were arranged. The first was with Giuseppe Iseppi, the president of the major winery in the province of Arezzo, a cooperative called Cantina dei Vini Tipici dell'Aretino and the second one with Fabio Sieni, owner of a 13 ha farm and organic Chianti wine producer.

The main goal of these interviews was to understand why wineries is Arezzo do not pay a premium price for organic grapes. On one hand, Fabio Sieni considers his estate's production capacity enough for the niche of market that he serves and does not trust the quality of organic grapes from other grapes' growers. For an organic vinification process, it is essential to have the best quality grapes that it is possible to obtain, even if this implies having a lower yield (pers. com. Sieni, 2014). The standards on the grapes that he demands are perceived as too high by farmers who may potentially produce for him. On the other hand, Giuseppe Iseppi has decided not to include an organic line in the cooperative's wine production. When questioned about the reason behind this decision, he answered that organic market is not stable and strong enough to repay for the investment needed in order to set up a new line of production (Pers. Com. Iseppi, 2014). Producing organic wine, involves, indeed, the purchase of all the new machineries to process the grapes. By law, the process of organic and conventional wine cannot be mixed together and a winery cannot use the same machines (INTERNET, Euro Lex, 2012, 2).

5.5 RDP in Tuscany and the agri-payments of the measure 214a

In Italy the responsibility for the fulfillment of the objectives in the program is on the regional government, which is also, the institution entitled to have access to the funding provided by the EAFRD[8] (www, Regione Toscana, 2013, 3). The agri-environmental payments, regulated by the measure 214a, in the region are mainly targeting the most critical areas which are identified based on the criteria set by the directive 676/91 (INTERNET, Regione Toscana, 2013, 4:48).

The measure 214a recognizes payments for those farmers who voluntary fulfill the requirements of organic and integrated farming. In contrast with the organic, integrated system can still use synthetic inputs but in doses regulated by the EU. Both contracts are valid for five years. The payments have been divided accordingly to the following four sub measures (INTERNET, Regione Toscana, 2013, 4:99):

A1. Actions for the introduction or maintenance of organic farming
A2. Actions for the introduction or maintenance of integrated farming

[8] In order to fund the project, a specific fund was dedicated to the RDP, the so called European Agricultural Fund for Rural Development (EAFRD).

A3. Conservation of landscapes and natural resources
A4. Increase of organic substances in the soil using quality manure

The subsidies are set per hectare and paid each year (INTERNET, EU, 2007, 4). The payments correspond to 720€ per ha for the introduction of organic farming and 650€ per ha for the maintenance of organic farming (Regione Toscana, 2014). The EU does not specifically recognize subsidies for organic wine production (INTERNET, EU, 2012, 6).

Payments to support to organic farming are the only kind of subsidies considered for this thesis. The focus of the analysis is to compare conventional and organic methods and the agri-environmental payments described in this section are the only one to have a major impact on the study. Both types of farms are eligible for all the other kinds of support.

5.6 Eco certifications

In Italy, organic agriculture follows the rules of the EC Regulation 2092/91 and is certified by an authorized third party, i.e., inspection body (INTERNET, AIAB, 2013, 1). The farmer commits to fill in a register of the practice undertaken to simplify the work of the agency (INTERNET, Coldiretti, 2014, 1). Once certified, the product can theoretically be sold in the market at a higher price, after a conversion period of two years. The contract period for certification is five years, stipulated with a governmental agency responsible for the payments, that in Tuscany is called ARTEA (Italian acronym for Tuscan Regional Agency for Agricultural Payments) (INTERNET, ARTEA, 2014, 1).

For the purpose of the thesis, the Italian certification body called Suolo e Salute was consider into the analysis. Suolo e Salute is the major certification body in the province of Arezzo (pers. com. Petrucci, 2014). Hence to the costs of the farmer was add an additional annual cost 390€ plus 13€ per ha (INTERNET, Suolo e Salute, 2014, 1). This fee covers the costs of certification and analysis of the land. No other kind of certifications have been taken under consideration because the aim of this thesis is to study the adoption of organic farming in absence of premium price. Hence, the certification is considered as a mandatory step to access to the payments of the European Union, not as a requirement for marketing purposes.

6. The empirical study

In this chapter the researcher presents the empirical study. In the first part, the researcher lists the factors that influence directly the decision to switch from conventional to organic agriculture. In the second part the agricultural net revenues are presented. Finally, in the third part, the results of the data collection are elaborated under a risk perspective.

6.1 Factors affecting the decision to adopt organic farming

Several factors may influence the decision to switch to organic farming in the province of Arezzo:

- *Subsidies*: Contracts offered by the European Community for organic farming last 5 years. In this thesis, we assume that the farmer commits to organic farming for the entire contract duration and extend it for other 5 years, for a total of 10 years period. The horizon period was chosen following Alexander *et al.* (2009) who suggest that, reasonably, it is not possible to predict analytically cash flows for a longer period. The farmer will be compensated as follows: 720€/ha on the first year and 650€/ha on each of the following years. No other subsidies have been considered because those are paid to both organic and conventional farmers in the same way, with no consideration of the farming method adopted. Consequently, other subsidies are not relevant for a comparative analysis and they were excluded.

- *Net revenues:* In 2013, 60 different types of grapes have been registered by ARTEA. In this study, given the relevance of this variety in the considered area, we will focus on Chianti. Net revenues are calculated on the basis of average values computed by considering all the active farmers in the province of Arezzo. Our focus is restricted to farmers producing Chianti wine grapes during the period 2004-2013. Three types of Chianti are produced: Chianti, Chianti Colli Aretini and Chianti Superiore. However, due to the limited number of observations for Chianti Colli Aretini (in 2013, 49ha were under conventional farming and only 15ha under organic farming), in this thesis the analysis will be restricted to Chianti and Chianti Superiore. In 2013, considering the variety Chianti, 551 farmers and 1328 ha were engaged in conventional production while 103 farmers and 577 ha were under organic farming. Looking at the figures relative to Chianti Superiore, it had 27 farmers and 254 ha under conventional farming and 14 farmers and 231ha under the organic regime. The size of the two samples is considered large enough for supporting reliable and valid conclusions.

- *Conversion costs:* The farmer bears an additional machinery cost of 5000€. Apart from that, no other specific cost is borne when switching to the organic regime. In Arezzo, as part of the RDP, all organic farmers are constantly supported by a team of agronomists recruited by the unions which are active in the sector. This is done in order to provide the technical support needed in order to reduce any production risk. Support is provided by organizing individual and group meetings, classes and courses. All these services are given by the union without additional costs and guaranteed by the EU as actions of technical and learning support connected with the measure 214 (INTERNET, Regione Toscana, 2013, 4). The union membership fee is not considered in our NPV calculations, since it is due in any case irrespective of the actual production regime, i.e., conventional or organic.

- *Discount rate:* Three risk scenarios are considered: a risk free scenario associated with a discount rate of 2.44%, a risky scenario where I use a discount rate equal to 9.54% and finally a high risk scenario where I use a discount rate equal to 15%.

- *Size:* Up to the available empirical evidence, the farm size seems to have an impact on the adoption of organic practices. According to the dimension classes used in the census, it was possible to classify the Chianti's producers as follow:

Table 3: Division for class dimension for Chianti wine in Arezzo. Source: own elaboration

	Total farmers	Total land (ha)	Organic farmers		Organic land	
Less than 1ha	301	169.29	24	8%	14.11	8%
From 1 to 2 ha	150	211.46	23	15%	32.41	15%
From 2 to 5 ha	126	406.87	28	22%	97.04	24%
From 5 to 10 ha	57	384.1	19	33%	135.31	35%
From 10 to 20 ha	34	476.48	12	35%	150.38	32%
More than 20 ha	12	328.7	6	50%	167.22	51%

Table 3 shows an evident relationship between farm size and share of organic farms. Notably, the percentage rises when considering farmers owners of larger estates.

Considering the data provided by agricultural census 2010, the average farm in the province of Arezzo covers 1.3 ha (INTERNET, Regione Toscana, 2010, 1). The regional law identifies as professionals the farmers who are i) dedicating at least the 50% of their working time to agricultural activities and ii) earning from these activities at least the 50% of their earnings (INTERNET, Regione Toscana, 2010, 5). In Tuscany the 28% of the farms produce for self-consumption and the 52% are non-professional family farms (INTERNET, Regione Toscana, 2006, 2). Considering the previous definition, a professional grape grower needs to work at least 5 ha. This is because a full time worker needs to cover in average 1581 hours (INTERNET, MLPS, 2014, 1), and with 5 ha could cover the half of his/her working time. Hence, it makes sense assuming that the farmers with less than 5 ha are non-professionals.

For studying the net incomes of farms with different dimension, the first three groups in Table 3 have been merged to create a non-professional group (from 1 to 5 ha). The other groups are: small producers (from 5 to 10 ha) and large producers (more than 10 ha). NPV calculations are then run accounting only for the category Chianti wine. The reason is that Chianti Superiore does not present a number of observations large enough to allow the study of subgroups' dynamics.

- *Organic certification:* An additional cost for the organic farmer is due to the mere organic certification. Suolo e Salute, an Italian certification body, charges in Arezzo an annual cost of 390€ plus an additional cost of 13€ per ha (INTERNET, Suolo e Salute, 2014, 1).

- *Taxes:* Agricultural levies were calculated with the help of the surveyor Catia Piscitelli. Assuming that all the vineyards are owned by the farmer and that they are producing at full capacity, a famer pays 16.50 € per hectare each year. To this amount it must be added an income tax that can be calculated on the basis of the information

provided by the state. A web platform is provided to citizen for the calculation of taxes. This platform is available at the following web address: http://www.irpef.info/calcolairpef.html

6.2 Net present value analysis

The annual yields and prices for the NPV analysis were obtained from secondary data provided by ARTEA and by the Chamber of Commerce of the province of Arezzo. Production costs were gathered through interviews with sector experts and farmers. All the data were elaborated to create a "typical" farm for conventional and organic farming for the period 2004-2013. In the first section the NPV analysis is carried out for Chianti and Chianti Superiore to compare NPVs when different prices and different production regulations are considered. In the second part the Chianti's producers were divided into classes in order to compare the NPVs of organic and conventional farming according to the farm size. This has been done in order to study the economical profitability of organic farming for non-professional, small and large farms, respectively. Finally, it is essential to remember that no premium price is recognized to organic grapes. This means that the price for organic grapes is, during the conversion period and also later, equal to the price paid for conventional grapes.

In order to evaluate the different scenarios, the analysis was split into the following steps:

1. Calculate the annual cash flows from historic data for each category of interest.
2. Actualize the nominal annual cash flows at the current year (2014) accounting each year for the historical inflation rate. The inflation used is the annual average inflation calculated by ISTAT and published by the Chamber of Commerce (INTERNET, Camera di Commercio, 2014, 1).
3. Estimate the annual cash flows for each project. The estimation is equal to the average value of the historical cash flows.
4. Discount future annual cash flows at the present day with the use of discount rates.
5. Calculate the present values and the net present values for each project.

In the analysis, the EBITDA was calculated by subtracting the total costs from the average farmer's total revenues. Total costs include treatments, pruning, harvest costs (summarized in Appendix 1) and fertilizers. The costs that are common to both practices, as, for instance, cost of fuel, costs of machinery, etc., were not included in the calculation, since the research aims to prove the economic convenience of one over the other practice and not the actual amount of incomes. It was assumed that the land is owned by the farmer and, in the case of organic practice, the initial investment was paid without incurring into debts. Hence, no land leasing costs and interest expenses were considered in the calculations. Finally, both land and income taxes were subtracted from the gross income.

The FCFs were obtained capitalizing the annual cash flows for the year 2014. The average FCF was the proxy used in order to calculate the PV of future period cash flows. All the values are in Euros and inflated up to 2014. Once obtained the PV for organic and conventional farming, the NPV was calculated. The initial investment for switching to the organic practice amounts to 5.000€. This is the cost associated to the purchase of a mechanical weed cutter, which is essential in the organic farming, in particular when the farm size increases (Pers. Com. Fatucchi, 2014).

6.2.1 NPV analysis for Chianti and Chianti Superiore

For Chianti and Chianti Superiore all costs and revenues are calculated for the case of farm covering 10 ha. This is the maximum farm size where a farmer can work by him/herself without employing a second worker. The financial data used for calculating the ten-year cash flows (see Eq. 3) are presented in the appendix 2. The following table shows the PVs calculation for Chianti, discounted at 2.44%, 9.54% and 15%.

Table 4: PVs for Chianti. Source: own elaboration

Organic	0	1	2	3	4	5	6	7	8	9	10
Investment cost	€ 5.000										
Net incomes		€ 15.595	€ 15.595	€ 15.595	€ 15.595	€ 15.595	€ 15.595	€ 15.595	€ 15.595	€ 15.595	€ 15.595
Subsidies		€ 7.200	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500
Certification cost		€ 520	€ 520	€ 520	€ 520	€ 520	€ 520	€ 520	€ 520	€ 520	€ 520
FCF		€ 22.275	€ 21.575	€ 21.575	€ 21.575	€ 21.575	€ 21.575	€ 21.575	€ 21.575	€ 21.575	€ 21.575
PV (2,44%)		€ 21.745	€ 20.560	€ 20.070	€ 19.592	€ 19.125	€ 18.670	€ 18.225	€ 17.791	€ 17.367	€ 16.953
PV (9,51%)		€ 20.341	€ 17.991	€ 16.428	€ 15.002	€ 13.699	€ 12.509	€ 11.423	€ 10.431	€ 9.525	€ 8.698
PV (15%)		€ 19.370	€ 16.314	€ 14.186	€ 12.336	€ 10.727	€ 9.328	€ 8.111	€ 7.053	€ 6.133	€ 5.333
Conventional	0	1	2	3	4	5	6	7	8	9	10
FCF		€ 20.139	€ 20.139	€ 20.139	€ 20.139	€ 20.139	€ 20.139	€ 20.139	€ 20.139	€ 20.139	€ 20.139
PV (2,44%)		€ 21.101	€ 19.931	€ 19.456	€ 18.993	€ 18.540	€ 18.099	€ 17.668	€ 17.247	€ 16.836	€ 16.435
PV (9,51%)		€ 18.390	€ 16.793	€ 15.334	€ 14.003	€ 12.787	€ 11.676	€ 10.662	€ 9.736	€ 8.891	€ 8.119
PV (15%)		€ 17.512	€ 15.228	€ 13.241	€ 11.514	€ 10.012	€ 8.706	€ 7.571	€ 6.583	€ 5.725	€ 4.978

The same calculation can be done for the Chianti Superiore.

Table 5: PVs for Chianti Superiore. Source: own elaboration

Organic	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Investment cost	€ 5.000										
Net incomes		€ 16.660	€ 16.660	€ 16.660	€ 16.660	€ 16.660	€ 16.660	€ 16.660	€ 16.660	€ 16.660	€ 16.660
Subsidies		€ 7.200	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500	€ 6.500
Certification cost		€ 520	€ 520	€ 520	€ 520	€ 520	€ 520	€ 520	€ 520	€ 520	€ 520
FCF		€ 23.340	€ 22.640	€ 22.640	€ 22.640	€ 22.640	€ 22.640	€ 22.640	€ 22.640	€ 22.640	€ 22.640
PV (2,44%)		€ 22.784	€ 21.574	€ 21.061	€ 20.559	€ 20.069	€ 19.591	€ 19.125	€ 18.669	€ 18.224	€ 17.790
PV (9,51%)		€ 21.313	€ 18.879	€ 17.239	€ 15.742	€ 14.375	€ 13.127	€ 11.987	€ 10.946	€ 9.995	€ 9.127
PV (15%)		€ 20.296	€ 17.119	€ 14.886	€ 12.945	€ 11.256	€ 9.788	€ 8.511	€ 7.401	€ 6.436	€ 5.596
Conventional	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
FCF		€ 19.099	€ 19.099	€ 19.099	€ 19.099	€ 19.099	€ 19.099	€ 19.099	€ 19.099	€ 19.099	€ 19.099
PV (2,44%)		€ 18.644	€ 18.200	€ 17.766	€ 17.343	€ 16.930	€ 16.527	€ 16.133	€ 15.749	€ 15.374	€ 15.008
PV (9,51%)		€ 17.440	€ 15.926	€ 14.543	€ 13.280	€ 12.127	€ 11.074	€ 10.112	€ 9.234	€ 8.432	€ 7.700
PV (15%)		€ 16.608	€ 14.442	€ 12.558	€ 10.920	€ 9.496	€ 8.257	€ 7.180	€ 6.243	€ 5.429	€ 4.721

Table 6 summarizes the result of the NPV analysis undertaken for Chianti and Chianti Superiore. The table shows twelve different outcomes, depending on farming practice, wine quality and discount rate.

Table 6: NPV analysis for Chianti and Chianti Superiore. Source: own elaboration

	Chianti			**Chianti Superiore**		
	2.44%	9.54%	15%	2.44%	9.54%	15%
NPV Conventional	€ 176,801	€ 126,391	€ 101,071	€ 167,675	€ 119,866	€ 95,853
NPV Organic	€ 185,097	€ 131,046	€ 103,889	€ 194,447	€ 137,730	€ 109,234

In the province of Arezzo, based on these results, the NPVs for organic farming are always higher than their conventional equivalents, and this is regardless of the discount rate applied. Hence, a rational farmer should always undertake the investment. However, it is possible to draw some additional conclusions. Looking at the impact of higher risk, as expected, higher NPVs are obtained when a lower discount rate is applied. Even though, organic farming is always more economically convenient, the difference between NPVs decreases when the project is considered more risky. This is particularly more evident for the Chianti's grapes growers. When their NPVs are discounted at 15%, the difference between the two projects is not as considerable as in the other cases. Nevertheless, the NPV related to organic farming is still higher than the conventional one, the revenues cover the investment expenses and the adoption can be considered profitable. As shown in Table 7, the difference between the NPVs relative to conventional and organic farming is almost equal to zero when considering higher discount rates. For Chianti this discount rate is about 30%, whereas for Chianti Superiore is 76%. It follows that, given the not so realistic magnitude of these rates, switching to organic farming is a quite robust rationale choice.

Table 7: NPVs analysis applying higher discount rates. Source: own elaboration

	Chianti	Chianti Superiore	
	30%	30%	76%
NPV Conventional	€ 62.259	€ 59.045	€ 24.772
NPV Organic	€ 62.239	€ 65.531	€ 24.701

6.2.2 NPV analysis: impact of the farm size

The empirical evidence emerged in the course of this research leads to the formulation of the following question: is the size of the farm a relevant variable in the definition of the profitability of organic farming?

The data collected by ARTEA suggest, indeed, a relationship between larger size and actual conversion to organic. In this section, the producers of Chianti's grapes have been divided into size classes and the NPV analysis was carried for each group. The first group includes the non-professional farmers, i.e., farms smaller than 5 ha, the second group includes the "typical" small farm, i.e., farm size between 5 and 10 ha, and the third group, the large farmers, i.e., farm size larger than 10 ha. Cost and revenues are calculated for the cases of: a farm of 1.3 ha (first group), for a farm of 7 ha (second group) and, finally, for a farm of 17 ha (third group). These values were chosen in that they represent the average farm in those categories (calculations based on historical observations of the year 2013). The financial data used for calculating the ten-year cash flows (see Eq. 2) are presented in appendix 3. The following tables 8, 9 and 10 show the PVs calculation for the three classes, using as discount rate, 2.44%, 9.54% and 15%.

Table 8: PVs for non-professional farms. Source: own elaboration

Organic	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Investment cost	€ 5.000										
Net incomes		€ 3.970	€ 3.970	€ 3.970	€ 3.970	€ 3.970	€ 3.970	€ 3.970	€ 3.970	€ 3.970	€ 3.970
Gross income		€ 936	€ 845	€ 845	€ 845	€ 845	€ 845	€ 845	€ 845	€ 845	€ 845
Certification cost		€ 407	€ 407	€ 407	€ 407	€ 407	€ 407	€ 407	€ 407	€ 407	€ 407
FCF		€ 4.499	€ 4.408	€ 4.408	€ 4.408	€ 4.408	€ 4.408	€ 4.408	€ 4.408	€ 4.408	€ 4.408
PV (2.44%)		€ 4.392	€ 4.201	€ 4.101	€ 4.003	€ 3.908	€ 3.815	€ 3.724	€ 3.635	€ 3.549	€ 3.464
PV (9.51%)		€ 4.109	€ 3.676	€ 3.357	€ 3.065	€ 2.799	€ 2.556	€ 2.334	€ 2.131	€ 1.946	€ 1.777
PV (15%)		€ 3.913	€ 3.333	€ 2.899	€ 2.521	€ 2.192	€ 1.906	€ 1.657	€ 1.441	€ 1.253	€ 1.090
Conventional	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
FCF		€ 4.402	€ 4.402	€ 4.402	€ 4.402	€ 4.402	€ 4.402	€ 4.402	€ 4.402	€ 4.402	€ 4.402
PV (2.44%)		€ 4.297	€ 4.194	€ 4.094	€ 3.997	€ 3.902	€ 3.809	€ 3.718	€ 3.630	€ 3.543	€ 3.459
PV (9.51%)		€ 4.019	€ 3.670	€ 3.352	€ 3.061	€ 2.795	€ 2.552	€ 2.330	€ 2.128	€ 1.943	€ 1.774
PV (15%)		€ 3.827	€ 3.328	€ 2.894	€ 2.517	€ 2.188	€ 1.903	€ 1.655	€ 1.439	€ 1.251	€ 1.088

Table 9: PVs for small farms. Source: own elaboration

Organic	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Investment cost	€ 5.000										
Net incomes		€ 13.078	€ 13.078	€ 13.078	€ 13.078	€ 13.078	€ 13.078	€ 13.078	€ 13.078	€ 13.078	€ 13.078
Subsidies		€ 5.040	€ 4.550	€ 4.550	€ 4.550	€ 4.550	€ 4.550	€ 4.550	€ 4.550	€ 4.550	€ 4.550
Certification cost		€ 481	€ 481	€ 481	€ 481	€ 481	€ 481	€ 481	€ 481	€ 481	€ 481
FCF		€ 17.637	€ 17.147	€ 17.147	€ 17.147	€ 17.147	€ 17.147	€ 17.147	€ 17.147	€ 17.147	€ 17.147
PV (2.44%)		€ 17.217	€ 16.340	€ 15.951	€ 15.571	€ 15.200	€ 14.838	€ 14.485	€ 14.140	€ 13.803	€ 13.474
PV (9.51%)		€ 16.106	€ 14.298	€ 13.057	€ 11.923	€ 10.887	€ 9.942	€ 9.079	€ 8.290	€ 7.570	€ 6.913
PV (15%)		€ 15.337	€ 12.966	€ 11.275	€ 9.804	€ 8.525	€ 7.413	€ 6.446	€ 5.605	€ 4.874	€ 4.239
Conventional	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
FCF		€ 14.489	€ 14.489	€ 14.489	€ 14.489	€ 14.489	€ 14.489	€ 14.489	€ 14.489	€ 14.489	€ 14.489
PV (2.44%)		€ 14.144	€ 13.807	€ 13.478	€ 13.157	€ 12.844	€ 12.538	€ 12.239	€ 11.948	€ 11.663	€ 11.385
PV (9.51%)		€ 13.231	€ 12.082	€ 11.032	€ 10.074	€ 9.200	€ 8.401	€ 7.671	€ 7.005	€ 6.397	€ 5.841
PV (15%)		€ 12.599	€ 10.956	€ 9.527	€ 8.284	€ 7.204	€ 6.264	€ 5.447	€ 4.736	€ 4.119	€ 3.581

Table 10: PVs for large farms. Source: own elaboration

Organic	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Investment cost	€ 5.000										
Net incomes		€ 22.241	€ 22.241	€ 22.241	€ 22.241	€ 22.241	€ 22.241	€ 22.241	€ 22.241	€ 22.241	€ 22.241
Gross income		€ 12.240	€ 11.050	€ 11.050	€ 11.050	€ 11.050	€ 11.050	€ 11.050	€ 11.050	€ 11.050	€ 11.050
Certification cost		€ 611	€ 611	€ 611	€ 611	€ 611	€ 611	€ 611	€ 611	€ 611	€ 611
FCF		€ 33.870	€ 32.680	€ 32.680	€ 32.680	€ 32.680	€ 32.680	€ 32.680	€ 32.680	€ 32.680	€ 32.680
PV (2.44%)		€ 33.063	€ 31.142	€ 30.400	€ 29.676	€ 28.969	€ 28.279	€ 27.605	€ 26.948	€ 26.306	€ 25.680
PV (9.51%)		€ 30.929	€ 27.251	€ 24.884	€ 22.723	€ 20.750	€ 18.948	€ 17.302	€ 15.800	€ 14.428	€ 13.175
PV (15%)		€ 29.452	€ 24.711	€ 21.488	€ 18.685	€ 16.248	€ 14.128	€ 12.286	€ 10.683	€ 9.290	€ 8.078
Conventional	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
FCF		€ 29.326	€ 29.326	€ 29.326	€ 29.326	€ 29.326	€ 29.326	€ 29.326	€ 29.326	€ 29.326	€ 29.326
PV (2.44%)		€ 28.627	€ 27.946	€ 27.280	€ 26.630	€ 25.996	€ 25.377	€ 24.772	€ 24.182	€ 23.606	€ 23.044
PV (9.51%)		€ 26.779	€ 24.454	€ 22.330	€ 20.391	€ 18.620	€ 17.003	€ 15.527	€ 14.178	€ 12.947	€ 11.823
PV (15%)		€ 25.501	€ 22.175	€ 19.282	€ 16.767	€ 14.580	€ 12.678	€ 11.025	€ 9.587	€ 8.336	€ 7.249

Table 11 shows the result of the NPV analysis for the three different dimensions. The table shows eighteen different outcomes, depending on farming practice, farms' size and discount rate.

Table 11: N*PVs distribution for farm's size. Source: own elaboration*

	Non-professional		Small		Large	
	Organic	Conventional	Organic	Conventional	Organic	Conventional
NPV (2.44%)	€ 33,998	€ 38,643	€ 146,018	€ 127,202	€ 283,068	€ 257,460
NPV (9.54%)	€ 22,898	€ 27,625	€ 103,064	€ 90,933	€ 201,189	€ 184,052
NPV (15%)	€ 17,322	€ 22,091	€ 81,484	€ 72,716	€ 160,048	€ 147,180

According to the data, a non-professional farmer would not find convenient the adoption of organic farming. This would happen for any discount rate. In contrast, for the other two groups, switching to organic farming is always profitable. It will turn not profitable only if the NPVs are discounted at 59% and 78% for small farms and large farms respectively.

Table 12 presents the results of the comparison between the yields of the average production of a non-professional typical farm and the average yield of Chianti grapes' producers.

Table 12: Comparison of yields between non-professional typical farm and the average yield (kg) for 1 ha. Source: own elaboration

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Conventional	7663	6553	6782	7441	6746	7500	6937	7184	6743	6815
Average	7861	6646	6820	7788	7214	7765	7345	7333	6953	7364
Difference	-198	-93	-38	-347	-468	-265	-408	-149	-210	-549
Organic	7294	5797	5895	7090	6313	7181	6485	7486	5377	5768
Average	6940	5130	4898	6873	6252	6613	6550	6649	5937	6150
Difference	354	667	997	217	61	568	-65	837	-560	-382

Based on the results show in the table above, the average yield per hectare produced by a non-professional farm in comparison with the total average is higher for organic and lower for conventional. This means that non-professional farms are not associated to lower yields, but the total revenues are too low to bear the initial investment. Table 13 presents the sum of PVs for non-professional farmers discounted at the considered discount rates. Without the initial investment organic farming still performs better for this category.

Table 13: total PVs for non-professional farmers. Source: own elaboration.

	Non-professional	
	Organic	Conventional
PV (2.44%)	€ 38,998	€ 38,643
PV (9.54%)	€ 27,898	€ 27,625
PV (15%)	€ 22,322	€ 22,091

The initial investment for the purchase a weed cutter is crucial in order to mechanize the very time demanding task of cutting the grass. However, for a non-professional farmer owning a small estate, it is possible to assume that this machine could be replaced with a manual bush cutter. This machine is rather common and could represent a valid alternative. The market price of a bush cutter varies between 500 and 800€. However, even consider the cheapest machine that costs around 500€, the NPVs related to organic farming are still not high enough

to justify, under an economic perspective, the adoption of organic methods. The NPV related to organic farming discounted at 2.44% is indeed lower of 351€ than the one related to the conventional practice, of 374€ when the NPVs are discounted at 9.54% and finally of 386€ considering a discount rate at 15% (386€)[9].

6.3 Monte Carlo simulation

In order to address uncertainty and risks affecting the decision to switch to organic farming, the research continues with a stochastic capital budgeting analysis based on Monte Carlo simulations. The simulation was run for 1000 repetitions which were performed using a Microsoft Excel's add in, i.e., @Risk developed by Palisade. The choice of using such a tool was motivated by its capacity to handle a large amount of inputs. The output of the simulation is the probability distribution of the NPVs of the considered agricultural practices, i.e., organic and conventional farming. The simulation was run assuming a normal distribution that is a symmetric distribution where all the values above and below the expected value are equally likely (Drake and Fabozzi, 2010). The results generated by the simulation were then graphically elaborated with respect to the group of interest.

The purpose of this analysis is to make explicit the impact of potential risks of organic and conventional farming considering a ten-year period (2014-2023). The period and the variables considered in the model reflect the one presented in the previous section. The results allow the decision maker weighting the two alternative farming options against each other with respect to revenues and uncertainty (Artikis, 1999). The three scenarios of risk preference presented correspond to the three discount rates applied. A risk neutral individual will not expect a risk premium when deciding for a project. For this case, the discount rate applied is the risk free discount rate of 2.44%. For a risk averse and a strongly risk averse individual, a risk premium of 7.1% and 12% were respectively added to the risk free rate.

Prior to proceeding with the analysis, I briefly introduce the statistics considered. The *mean* or *expected value*, represent the measure of the central tendency of the distribution. The *standard deviation* (Std Dev or SD) is the measurement of the variation or dispersion of the data from the mean. A low SD suggests that the data are distributed close to the mean whereas a high SD indicates that the observations are spread far from it. In a normal distribution, one standard deviation from the mean accounts for the 68% of the value, two SD from the mean account for the 95% and finally three SD for the 99.9%. The *coefficient of variation* (CV) is the ratio of the standard deviation to the mean and allowed to standardize the measurement of dispersion. (Upton and Cook, 2006)

6.3.1 Source of risk

As already specified in section 2.4.1, sources of risk in agriculture can be divided into four main groups: human risk, production risk, price risk and institutional risk (Hardaker, 2004). For what concerns this specific case study, the main sources of risk considered are as follows:

Output price: according to the historical observations of Chianti prices for the last 10 years (Table 2), it is possible to notice that the price fluctuations do not follow any trend. The mean value of the historical prices equal to 525€, while the standard deviation is of 167€. From the

[9] The values reported are obtained subtracting an initial investment of 500€ to the PVs related to organic agriculture in table 13. Then the PVs for organic and conventional farming where subtracted the one to the other to have the value of the difference.

mean the price can change up to a 32%. This implies a significant variation of the price over time. For this reasons the MC simulation was run considering that the prices could fluctuate between 300€ per ton of grapes to 800€. The fluctuation affects both agricultural practices.

Production capacity: According to the historical observations yield fluctuates for Chianti between 8 tons, the limit for Chianti production according to the EU directive, and 6.5 tons for conventional and 5 for organic. Organic production, however, do not manage to cross the line of the 7 tons. Looking at Chianti Superiore, the limit imposed by the European Union is 7.5 tons. Even though, yields were very bad in 2005 and 2006, the production in the other years fluctuates between 7 and 5.5 tons. These historical boundaries are used in the MC simulation as minimum and maximum values for the potential fluctuations.

As shown in the following table, organic farming is, in terms of yield, more risky than conventional. The CVs of Chianti, its three size categories and Chianti Superiore are higher in regard of organic methods. This means that the quantity of grapes harvested each year varies with a higher intensity for organic farmers and they cannot rely on stable outcomes.

Table 14: Statistics for yield, all the categories. The yields are expressed in tons. Source: own elaboration.

	Chianti	Chianti Superiore	Non-professional	Small	Large
Conventional					
Std Dev	0.416	1.645	0.383	0.420	0.690
Mean	7.309	5.807	7.037	7.307	7.224
CV	5.69%	28.34%	5.44%	5.76%	9.55%
Organic					
Std Dev	0.700	1.753	0.752	0.503	0.930
Mean	6.200	5.387	6.469	6.660	6.105
CV	11.29%	32.53%	11.63%	7.55%	15.23%

Price of the input and labor costs: the NPVs analysis considers production costs as constant. However this is seldom possible. Bad weather and diseases influence not only the yield quantities but also the cost of inputs and the labor. Hence, the production costs are allowed varying between 500€ and 750€ per hectare. Since a study of secondary data in regard with cost of production was not possible due to the absence of such data, these variations have been decided with the help of Mr Fatucchi and other farmers.

6.3.2 Monte Carlo simulation for Chianti and Chianti Superiore

In this section the sources of uncertainty above mentioned had been incorporated into the calculation of the NPVs. Doing so it was possible to observe the range of possible outcomes of project's profitability and elaborate a sensitivity analysis of the distributions.

Presented in Table 15 there is the summary of the major statistics connected with the distributions for Chianti.

Table 15: summary statistics for NPVs of Chianti. Source: own elaboration

	Risk-neutral		Risk-averse		Strongly risk-averse	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Mean	€ 192,322	€ 195,332	€ 137,502	€ 138,355	€ 109,955	€ 109,741
Std Dev	€ 22,591	€ 21,240	€ 16,034	€ 14,712	€ 12,646	€ 11,982
CV	11.75%	10.87%	11.66%	10.63%	11.50%	10.92%

The results suggest that, for risk-neutral and risk-averse farmers, organic farming is slightly the less risky alternative and it is connected with the higher NPV. Considering that the SDs and the CVs for organic farming are lower in value than the one for conventional farming, it is possible to assert that the data points for organic farming are distributed close to the mean. Hence, the real NPV is more probable to be close to the expected value. Moreover, it is also likely that the NPVs for organic farming are going to be higher than the NPVs for conventional practice, since the mean for organic practice is higher.

Finally the third distribution, the one associated to a strong risk-aversion, shows several different results. The values shown for organic and conventional agriculture by the statistics in table 16 (mean, SD and CV) are rather similar when compared each other between the methods. This can suggest that a higher NPV in the case of organic farming is not guaranteed and the results of table 6 cannot be taken for granted. When analyzing the statistics created by the MC simulation more in detail, see Appendix 4, it is possible to state that with a 90% certainty the real value of the NPV related to the conventional production might fall between 88,730€ and 131,096€ and the one connected with organic production might fall within the range of 89,187€ and 129,744€. Hence the two methods perform quite similar and that is not possible to identify which of the two methods will secure a higher NPVs.

The following table 16 is the summary of the statistics for the distribution of Chianti Superiore.

Table 16: summary statistics for NPVs of Chianti Superiore. Source: own elaboration.

	Risk-neutral		Risk-averse		Strongly risk-averse	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Mean	€ 200.100	€ 229.773	€ 143.011	€ 162.972	€ 114.412	€ 129.352
Std Dev	€ 19.865	€ 21.311	€ 14.370	€ 14.804	€ 11.346	€ 12.480
CV	9.93%	9.27%	10.05%	9.08%	9.92%	9.65%

Irrespective of the risk attitude, when considering Chianti Superiore, organic farming represents always the alternative with the higher NPVs and lower risk. On the one side there is a higher probability that the NPV will be higher for organic farmers because mean is relatively higher for them than for conventional ones. On the other hand, even if the higher SDs in case of organic farming suggests a more dispersed distribution of values, the lower CVs demonstrate that organic practice is less risky. This is because, in relative terms, the distributions vary less in the case of organic farming. Hence, it is possible to conclude that the result shown in Table 6 about Chianti Superiore can be considered robust.

6.3.3 Monte Carlo simulation: impact of the size

The Tables presented in this section, namely table 17, 18 and 19, represent the summary of the statistics elaborated for the distributions of the NPVs for the three classes of size, discounted by the three rates.

Table 17 shows the summary of the statistics of the non-professional farms.

Table 17: summary statistics for NPVs of non-professional farmers. Source: own elaboration

	Risk-neutral		**Risk-averse**		**Strongly risk-averse**	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Mean	€ 33,186	€ 27,715	€ 23,727	€ 18,403	€ 18,967	€ 13,723
Std Dev	€ 3,271	€ 2,959	€ 2,279	€ 2,162	€ 1,841	€ 1,698
CV	9.86%	10.68%	9.61%	11.75%	9.71%	12.37%

In line with the results presented in table 11, organic farming is not a profitable practice for this first group of grape's producers and represents the riskier alternative. Even if the SDs of the data points is lower for organic farming, the CV is higher. Hence, irrespective of the risk attitude, the conventional practice is less risky and more profitable.

The following tables show the chosen statistics for the analysis of the small and large size farms.

Table 18: summary statistics for NPVs of small farmers. Source: own elaboration

	Risk-neutral		**Risk-averse**		**Strongly risk-averse**	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Mean	€ 136,034	€ 148,014	€ 97,233	€ 104,492	€ 77,776	€ 82,625
Std Dev	€ 16,953	€ 15,553	€ 12,341	€ 11,440	€ 9,771	€ 9,111
CV	12.46%	10.51%	12.69%	10.95%	12. 56%	11.03%

Table 19: Summary statistics for NPVs of large farmers. Source: own elaboration

	Risk-neutral		**Risk-averse**		**Strongly risk-averse**	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Mean	€ 283,327	€ 300,382	€ 202,501	€ 213,533	€ 161,961	€ 169,966
Std Dev	€ 35,257	€ 31,565	€ 24,520	€ 23,180	€ 19,346	€ 18,117
CV	12.44%	10.51%	12.11%	10.86%	11.94%	10.66%

Table 18 and table 19 show results consistent with table 11. Organic farming is, indeed, the most rewarding practice and the less risky one. Despite the risk attitude considered, the SD and the CV of organic farming is constantly lower than the conventional alternative. Simultaneously, mean is higher confirming that the real NPVs for organic agriculture have better chances to be higher. For small and large farmers organic farming is more profitable and less risky.

6.3.4 Monte Carlo simulation: difference between NPVs for organic and conventional farming

In order to have a better understanding of the risk in a comparative perspective, this final section will consider the difference between NPVs for organic and the NPVs for conventional farming. This difference has been added in the analysis as an additional output of the MC simulation. The chosen statistics have been the mean and the standard deviation of each difference calculated for Chianti, Chianti Superiore and the three classes of size of the first one. Moreover, the simulation was run in respect with the risk attitude.

Table 20: Statistics related to the difference between organic and conventional methods calculated for risk neutral, risk averse and strongly risk adverse farmers. Source: own elaboration

	Chianti	Chianti Superiore	Non-professional	Small	Large
risk neutral farmer					
Mean	€ 2,932	€ 29,548	-€ 5,459	€ 12,005	€ 17,038
Std Dev	€ 30,706	€ 28,445	€ 4,377	€ 23,080	€ 47,836
risk averse farmer					
Mean	€ 824	€ 19,879	-€ 5,333	€ 7,244	€ 10,980
Std Dev	€ 22,013	€ 20,650	€ 3,200	€ 16,389	€ 34,711
strongly risk averse farmer					
Mean	-€ 236	€ 15,069	-€ 5,260	€ 4,880	€ 7,951
Std Dev	€ 17,271	€ 16,218	€ 2,547	€ 13,003	€ 27,414

The results are summarized in table 20. In the case of a positive value of the mean, the NPV of organic farming was higher than the NPVs connected with conventional method. Observing the table above, the conclusions presented in sections 6.3.2 and 6.3.3 seem to find support. The means, or expected values, of the difference between NPVs for Chianti producers are rather small, becoming negative only for the strongly risk averse farmer, and the SDs are definitely larger. This means that NPVs might have negative values. For Chianti Superiore grapes' growers, the results are in line with table 6. The mean of the difference is large enough to secure higher NPVs to organic growers. The SDs do not seems too high since they are smaller or slightly higher than the mean, hence the difference should likely not be negative.

With respect to the size study of the farms, in line with the NPV analysis summarized in table 11 and the analysis in the section 6.3.3, organic farming is not convenient to non-professional farmers. The mean of the difference is constantly negative and the SD small. Therefore the NPV difference is unlikely to reach positive values. Small and large farms show better results if compared to the ones adopting organic farming. Given the values of the means and SDs, it is reasonable to assume that NPVs related to organic farming may be larger than the one for conventional practice. In order to add rigor to this final analysis, table 21 presents the actual percentage related to the possibility that the NPVs for organic farming is higher than the one for conventional farming.

Table 21: Probability to have higher NPVs for organic farming. Source: own elaboration.

	Risk-neutral	Risk-averse	Strongly risk-averse
Chianti	60%	50.7%	46%
Chianti Superiore	80%	85.6%	83%
Non-professional	8%	5.3%	1%
Small	74%	68%	65%
Large	58%	62.5%	63%

The findings presented in the above table are confirmed in line with the previous explanation. However, in relatively terms, thanks to the use of a standardized value, such as the percentage, it is possible to notice that small farms perform better than large ones. This might be due to the elevate costs in taxes or the excessive loss in yields of the large farms. As shown in table 22, in monetary terms, the larger farmers were the one that have lost more sales per hectare.

Table 22: Sale losses for organic grapes per ha. Source: own elaboration

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Non-professional	-€ 203	-€ 302	-€ 377	-€ 245	-€ 303	-€ 120	-€ 170	€ 113	-€ 820	-€ 786
Small	-€ 214	-€ 343	-€ 227	-€ 89	-€ 608	-€ 232	-€ 385	-€ 187	-€ 465	-€ 576
Large	-€ 752	-€ 669	-€ 579	-€ 713	-€ 695	-€ 83	-€ 392	-€ 508	-€ 636	-€ 819

7. Analysis and discussion

Based on the empirical results previously presented, the intention in this chapter is to address the research questions posed in the *Introduction* in relation to the *Literature review* and to the *Theoretical framework*. The main question posed was:

- Taking an economic and financial perspective, should a farmer convert from conventional to organic farming?

To disentangle the effect of the several elements included in the decision process, the research question has been divided into the following three sub questions:

- Is the size of the farm a relevant variable in the definition of the profitability of organic farming?
- Which is the impact of EU subsidies and PDO regulation on the decision to switch from conventional to organic production of grapes?
- Which is the impact of risk considerations in the decision to switch from conventional to organic production of grapes?

The contribution of this research is to study the decision to switch to organic farming based on the profitability of this practice in comparison with conventional agriculture. The analysis is based on a NPV model and it is complemented by a sensitivity analysis of the results. This chapter will consider the three sub questions above in order to give a precise answer to the main research question.

7.1 Is the size of the farm a relevant variable in the definition of the profitability of organic farming?

The empirical results presented in the sections 6.2.2 and 6.3.3 suggest that the size of the farm affects the profitability of organic farming and can represent a barrier of conversion. This is because the extra costs, i.e., initial investment costs, organic certification fee and losses in yield, are not compensated when the farm into consideration does not reach a certain size. The analysis was carried out dividing the Chianti grapes' growers in three size categories: non-professional farms (less than 5 ha), small (farm size between 5 and 10 ha) and large farms (larger than 10 ha). The results are here summarized.

Large and small farmers

The results show that, regardless the risk attitude considered, for small and large farmers the adoption of organic methods is a convenient and profitable investment choice. The data has demonstrated that the choice is so solid that, to become unprofitable, it should be applied a discount rate of 59% for small farms and a 78% for the large ones. These rates, of course, depict rather unrealistic risk scenarios.

A strongly risk averse small farmer switching to organic farming will obtain with a 65% probability, a net present value higher than the one under conventional agriculture. The percentage is decreasing in the degree of risk aversion. Under normal risk aversion, the probability is 68% while it is equal to 74% for risk neutral farmers. In the case of large farmers the results are similar: the chances of having higher NPVs with organic farming are

of 58%, 62.5% and 63% for risk-neutral, risk averse and strongly risk-averse farmers, respectively.

An additional conclusion of the analysis carried out by size classes is that adopting organic farming is less risky for small farmers than for large farmers. The reason for such a difference might lay on the fact that, according to the data collected, large farmers have larger losses in yield when compared with small and non-professional farmers.

The reason of the good performance of these two category is that the subsidies paid are high enough to cover the extra costs. The subsidies are paid per hectare and they amount to 720€ for the first year and to 650€ for the remaining years. When a farm has large dimension, for instance 10 ha, it receives 7200€. Just in the first year the farmer can not only manage to cover the initial investment of 5000€ and the certification fee, but can also count on the residual in order to cover the potential losses in sales. From the second year the subsidies are large enough to cover the losses and pay an extra in terms of income to the farmer.

Non-professional farmers

The choice to opt for the organic practices has proven to be not profitable for non-professional farmers, that is, for those farmers which the estate is not large enough to engage them for, at least, half of their working time. In order to study this category, the data relative to the farms smaller than 5 ha were considered and used to build an analysis for a "typical" farm of 1.3 ha. This is, indeed, the average size farm of Chianti grapes' growers in the province of Arezzo and it is representative of the 52% of the total active farmers. Even though, this category performs as the other two categories, i.e., small and large farms, in terms of yield and sales, the incomes registered for non-professional farmers are not sufficiently high to cover the considered initial investment. This implies that non-professional farmers have not the size needed in order to reach the necessary economy of scales to bear the extra costs. As one can easily see, a farm of 1.3 ha could very unlikely cover all costs and losses with an extra governmental payment of (720*1.3=) 936€ or (650*1.3=) 845€ a year.

7.2 What is the role played by the EU subsidies and PDO regulation in the production of organic grapes?

Since the European Union was formed, it has always had an important influence over the agriculture. This is particularly true in the case of organic farming, a practice so strongly dependent on governmental support. For what may concern the current research, two different policy aspects have been taken into consideration: i) the subsidies for organic farming and ii) the restrictions on wine's production.

7.2.1 The European subsidies

The profitability attached to organic methods is related to the existence of governmental subsidies. Accordingly to the empirical data presented in the tables in Appendix 2 the organic farmers have faced annual loss in terms of total sales in the period 2004-2013. Consequently, the annual cash flows have been lower for organic farming when compared to conventional. However, this figure does not consider the extra cost of organic certification and the governmental subsidies. These two dimensions have been incorporated in the NPV analysis discussed in the *Empirical Study*. The results summarized in tables 6 and 11 show NPVs

higher under organic production than under conventional production, demonstrating the higher profitability of organic methods.

These results are in line with the one presented the literature review. The market for organic wine is not mature enough to compensate the losses in sales (Corsi and Strøm, 2013). This is actually the case in the province of Arezzo where no premium is recognized to organic grapes producers. Moreover, as suggested by Zander *et al.* (2008), currently, organic grapes growers of the province of Arezzo are totally dependent on governmental subsidies. Hence, a change in the governmental payment framework could represent an important source of risk as suggested by Flaten el al. (2006). However, it is possible to consider that for at least the time horizon considered in this study, the Rural Development Program will not stop to recognize the subsidies for organic agriculture. The payment has indeed started on the early nineties and in the year 2014 has been approved a new plan till 2020. Finally, as discussed, among others, by Nieberg and Offermann (2003) and Stolze and Lampkin (2009), the payments recognized to Arezzo's farmers represent a secure source of income and are high enough to compensate the losses in terms of yields.

7.2.2 The European quality scheme: Protected Denomination of Origin

The quality scheme imposed to the grapes production has an important impact in terms of yield losses and it represent a relevant aspect to consider before converting to organic farming. The grapes producer bounded by a stricter regulation that decides to convert to organic farming will lose less yield than the one bounded by a more permissive one. In the case of this study, in order to sell their grapes as Chianti or Chianti Superiore, farmers are obliged to compel with the restrictions imposed by the European Union in term of quality food. Chianti is a PDO and Chianti Superiore is a finer version of the previous one. This distinction has allowed studying two different scenarios with respect to productive features and prices. EU regulation forbids to produce more than 7500 kg of grapes per ha, and dictates several other restrictions in term of, for example, colors and chemical compounds to be applied on the fruit. The quality of these grapes will translate in a better quality wine to which the market recognizes a higher price (20% higher than the price for Chianti).

As shown in Table 6 in section 6.2.1 of the *Empirical Study*, when compared in regard with the conventional practice, NPVs for Chianti Superiore are always lower than the equivalent NPVs for Chianti. Since working hours and cost of labor for the two productions are the same, it is obvious that the negative difference between the two NPVs is connected with the quantity produced. The higher price of Chianti Superiore is not enough to compensate the lower yield. This advantage of Chianti over Chianti Superiore does not exist when considering organic farming.

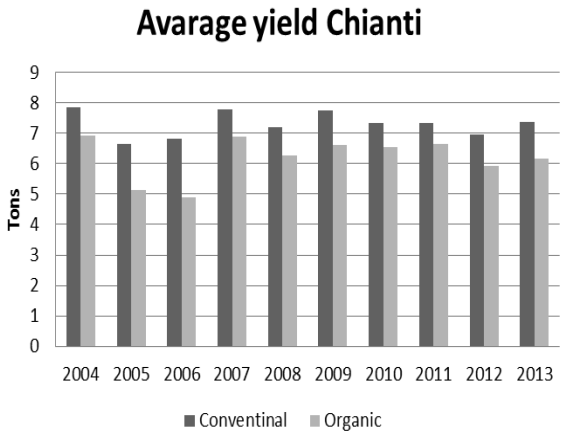


Figure 2: distribution average yield Chianti. Source: own elaboration

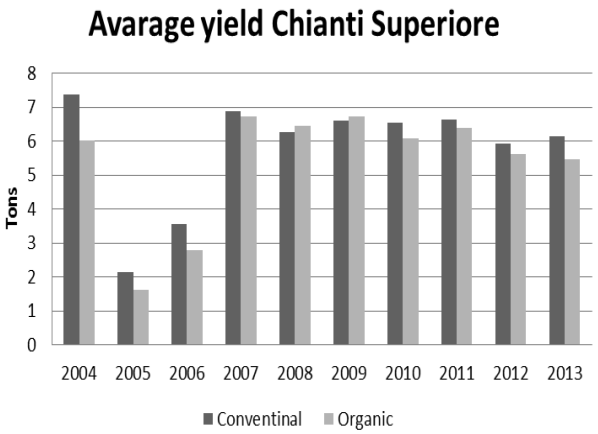


Figure 3: distribution average yield Chianti Superiore. Source: own elaboration

In terms of yield, organic practices have a lower impact when considering the production of Chianti Superiore's grapes rather than Chianti's. Figures 2 and 3 illustrate this consideration. It is possible to notice that the difference between organic and conventional grapes in Chianti production is more evident than the one between Chianti Superiore. For this second PDO, in the years 2008 and 2009 the organic production was even higher than the conventional. According to the data, it is possible to conclude that organic production has a lower impact on Chianti Superiore due to the already existing restrictions of the EU regulation. Hence, the combination of higher prices, good level of yield and governmental support makes Chianti Superiore's organic grapes the most profitable cultivation.

7.3 Which is the impact of risk considerations in the decision to switch from conventional to organic production of grapes?

For the peculiarity of this study the Monte Carlo simulation has generated several different results according with to the type of wine considered and the size group. Apart from the non-professional, for all the other categories organic farming represent the less risky alternative. The analysis has also shown some ambiguous results when considering a strongly risk averse farmer who produce Chianti. If the analysis was stopping at this point the conclusion would suggest that this farmer would probably refuse to opt for organic methods. However, once this category is split into different size sub-groups, it has been shown that, very likely, the only sub-category for which organic farming would not be convenient is the one grouping non-professional farmers. Hence for the other Chianti grapes' producers, namely the small and large farmer, that are strongly risk averse perceive organic farming has the less risky of the two alternatives.

Further considering a risk prospective, Drost *et al.* (2004) sustain that one could expect that a less developed production system, as organic farming, would lead to more sensitive changes in yields and to greater fluctuations in production. These considerations are actually supported by the statistics presented in table 15. The average yield for organic production, represented by the mean value, is lower than the one for conventional cultivations but it has also a higher yield risk since the CVs for organic are larger than the corresponding conventional ones. This confirms that the restriction imposed on fertilizers and pesticides decreases the quantity of grapes produced and increases the risk due to the higher exposition to pest damage and changes in climate. This finding could also support the fear, expressed by Drost *et al.* (2004), that the difficulties in organic management could represent a barrier for conversion. The

technical limit is, surely, an important factor considered by the farmers that want to convert to organic. Consequently, as suggested by the literature review (see: Gardebroek, 2006; Läpple, 2013; Padel, 2001), an organic farmers should be endowed with individual and managerial characteristics that facilitate the conversion.

In this respect, another important consideration could be done by the risk of variation on production costs. On the course of the study, it was not possible to have access to historical observation about the production costs on the period considered. However, the literature, as well as Mr. Fatucchi, suggests being prudent when interpreting the estimated production cost and the variation used for the MC simulation. Production costs per hectare are, indeed, lower in organic farming than in conventional practice but they represent the "average" costs, that could vary strongly in the reality. This is due to the better or worst technical skills and managerial ability of the farmer (Pers. Com., Sieni, 2014).

However, the empirical study suggests that the NPVs are generally higher and less risky for organic vineyards. This last finding is consistent with the idea of organic farming as more profitable but contrary to the one that it is potentially more risky as suggested before or in other studies as the one by Acs *et al.* (2009). Since prices are influencing both the practices in the same way and yield risk is higher for organic practice, the results of NPVs higher and less risky for organic might be due to the subsidies. Consequently, governmental payments are not only increasing farmer income but also, being certain transfers, reducing the business risk.

7.4 Should a farmer convert from conventional to organic farming?

A rational farmer will base his/her decision to convert to organic farming or continue with conventional methods on the basis of the profitability of the alternative considered (Musshoff and Hirschauer, 2008). S/he will choose the farming method maximizing his/her profit. On the one hand, the literature suggests that organic farming is by itself not profitable for farmers (Sheeder and Lynne, 2009) but that governmental subsidies make possible for organic farmers to earn higher average profits (Musshoff and Hirschauer, 2008; Lampkin, 1997; Offermann and Nieberg, 2001). On the other hand, organic farming is perceived as more risky (Acs *et al.,* 2009).

The NPV analysis was carried out for the Chianti grapes' grower of the province of Arezzo and was calculated by using different assumptions to be able to identify the impact of different farm's size, governmental subsidies and different EU quality schemes. In summary, accordingly with the answers presented previously, it is possible to draw the following conclusions:

- The size of the farm affects the profitability of organic farming and can represent a barrier of conversion. The results show that, regardless the risk attitude considered, for small and large-size farmers the adoption of organic methods is a convenient and profitable investment choice. Non-professional farms face more difficulties to bear cost of conversion, hence, it is possible to expect that they will not convert to organic farming.
- When considering the subsidies, organic grapes production is generally more profitable but the farmers are not economically independent by governmental payments. When considering the revenues before the payment of the subsidies, sales in organic farming are constantly lower than the one for conventional. The subsidies

recognized to grapes' growers of the province of Arezzo represent a secure source of income and are big enough to compensate the losses in terms of yields.

- The quality scheme imposed to the grapes production has an important impact in terms of yield losses. For this case, the production of Chianti Superiore's grapes is more severely restricted than the one of Chianti. The study pointed out that a Chianti Superiore farmer faces less production losses when changing to organic farming that the one that produces grapes for Chianti. For Chianti Superiore's grapes growers, organic farming represent the more convenient of the option because i) the yield loss are generously covered by the EU subsidies and ii) this grapes' quality is paid better than the Chianti's one. Hence, when converting to organic farming a Chianti Superiore's grapes producer will receive more total benefit then a Chianti grapes' farmer.
- Finally, apart from the non-professional farmers, for all the other categories organic farming represent the less risky alternative. The findings suggest a lower risk for organic farming which is opposite to the conclusion presented by Acs *et al.* (2009). A higher risk, however, is obtained when considering the yield as an isolated element. This suggests that an organic farmer should have better technical skill and attention in comparison with a conventional one. Organic farming is connected with higher production risks but the presence of a secure income from the subsidies minimize the business risk.

In conclusion, generally, the empirical analysis results suggest lower risk and higher profitability in organic farming for all groups considered except for the non-professional farmers. The following table summarizes the findings of the analysis in section 6:

Table 26: Preferences under risk. Source: own elaboration

	Risk-neutral		**Risk-averse**		**Strongly risk-averse**	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Chianti		√		√	**?**	
Chianti Superiore		√		√		√
Non-professional	√		√		√	
Small		√		√		√
Large		√		√		√

As shown in the table above, a rational grapes producer of the province of Arezzo would choose to convert to organic farming. An exception is represented by the non-professional farmers that would refuse to convert to organic farming. For them this practice is both less profitable and more risky. The incomes and the subsidies are, indeed, too low to cover the extra costs and the loss in revenues. Moreover, this supports the thesis that organic farming is a high technical agricultural management, hence someone who grows grapes for self-consume or as a hobby, do not have the requested capacity to confront the restrictions.

8. Conclusion

The aim of this thesis project has been to study the farmer's decision to adopt organic practices in the absence of a market premium price. This research was conducted in order to understand the main drivers of the decision to switch to organic farming for the grapes producers active in the wine sector in Tuscany, Italy. Three main factors were analyzed: i) the net income of farmers, ii) the impact of their risk aversion and iii) the role played by the EU through subsidies and indication of origin, i.e., PDO quality regulation.

Based on the results presented in this thesis, a rational farmer that grows Chianti grapes in the province of Arezzo should generally prefer organic farming over conventional practice. Organic grapes cultivation appears to be more profitable and less risky than the conventional alternative. This conclusion is supported by a NPV analysis and a sensitivity analysis of the results, run for Chianti and Chianti Superiore grapes growers and checking for the impact of farm size (for Chianti grapes growers). The results pinpoint that non-professional farmers are the only category that may not find organic farming convenient. In contrast, a rational professional farmer should switch to organic practices. These conclusions find their motivation in the fact that the size allowed to create the necessary economy of scale to bear the costs connected with the initial investment.

In regard with the EU role on the decision to opt for organic method, the two elements of interest were the EU subsidies and the EU quality scheme. Firstly, the analysis pointed out that the EU support scheme is adequate to compensate the loss in revenues and the extra costs. However, the organic farmer is totally dependent on such payments. This could represent a risk due to the possibility of political twist. Moreover, the subsidies do not only guarantee higher revenues but they may also reduce the risk connected to organic farming. This is because governmental payments ensure a secure annual income. Secondly, the rules imposed to the production of quality wine seem to facilitate the adoption of organic farming. The losses in terms of yields have eventually a lower impact in the presence of a stricter production regulation.

8.1 Further research

This research aimed to explain the profitability of organic farming for wine grapes' growers of the province of Arezzo (Italy). There are only few studies focusing on the Italian context, thus, this thesis contributes to the literature and may provide leads for further research. Due to the constraints on time and resources, it was not possible to explore a more vast territory or a larger variety of wines. The research would have probably benefited from the comparison between different wines or from the use of data relative to the entire Chianti area. This would have provided a broader view of the situation in Tuscany and added robustness to the findings. However, the data analyzed where complete and specific enough for the purpose of this thesis.

This research bases its findings on the use of average values that allowed defining "typical" farms. It stands to reason that these findings cannot be representative of the actual income of an individual farm. On a financial perspective could be of interest to focus on the study of a single farmer. This could be done using the same framework and analyzing real farm data. This further step could be particular interesting because it could reveal important elements that could represent a barrier and that were hidden in the average data used. In particular, it

could be useful in order to have a better understanding of the variation in the costs of production relative to the two farming regimes.

In addition, since this study does not consider non-economic motives for the adoption of organic farming, it would be interesting to extend the research taking these aspects into account. This could be done by creating a structured interview or a questionnaire focused on the personal drivers characterizing the choice to adopt or not organic farming. Moreover, following Flaten *et al.* (2010), it would be an additional step to personally contact those farmers that, over time, have abandoned organic farming. This would allow understanding in depth any weakness that may characterize the adoption of organic methods and, supposedly, of the European support schemes. Another suggestion could be to reproduce this study in another national context.

Finally, since the NPV analysis is a method that the financial literature do not consider adequate to put a final word over a business choice, another suggestion could be to integrate it with a more sophisticated financial analysis. One suggestion could be the real options analysis, that has the potential of giving the investors the needed flexibility on the process of decision making. This analysis takes, indeed, into account future changes in important variables such as price and discount rate. It allows to model the evolution of the demand curve in a way that makes possible to understand the right time to invest or abandon the project. Moreover, from a model prospective, it could be beneficial to add complexity to the risk analysis. This could show further insights into the riskiness of organic farming and its role in the success of the practice.

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Appendix 1: Harvesting Costs

The table 26 summarizes the harvesting costs. The cost of one seasonal worker is 81€ per working day (6.5 hours), plus 15€ for each worker (pers. comm. Petrucci, 2014). The costs are calculated assuming that the harvest should last 3 weeks (15 working days).

Farm size (ha)	N° seasonal workers	Total harvesting costs
1	1	€ 1.011,92
2	2	€ 2.008,85
3	2	€ 3.005,77
4	3	€ 4.002,69
5	4	€ 4.999,62
6	5	€ 5.996,54
7	6	€ 6.993,46
8	7	€ 7.990,38
9	7	€ 8.987,31
10	8	€ 9.984,23
11	9	€ 10.981,15
12	10	€ 11.978,08
13	11	€ 12.975,00
14	11	€ 13.971,92
15	12	€ 14.968,85

Table 25: harvesting costs. Source: own elaboration.

Appendix 2: Annual cash flows Chianti and Chianti Superiore

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 58.291	€ 12.307	€ 21.705	€ 69.281	€ 63.028	€ 35.715	€ 35.374	€ 35.906	€ 51.301	€ 66.421
Production costs	€ 18.878	€ 18.878	€ 18.878	€ 18.878	€ 18.878	€ 18.878	€ 18.878	€ 18.878	€ 18.878	€ 18.878
EBITDA	**€ 39.413**	**-€ 6.571**	**€ 2.827**	**€ 50.403**	**€ 44.150**	**€ 16.837**	**€ 16.496**	**€ 17.028**	**€ 32.423**	**€ 47.543**
Tax land	€ 198	€ 198	€ 198	€ 198	€ 198	€ 198	€ 198	€ 198	€ 198	€ 198
Tax earnings	€ 7.883	€ -	€ -	€ 11.089	€ 9.713	€ -	€ -	€ -	€ 5.836	€ 10.459
Annual Cash Flows	**€ 31.332**	**-€ 6.769**	**€ 2.629**	**€ 39.117**	**€ 34.239**	**€ 16.639**	**€ 16.298**	**€ 16.830**	**€ 26.389**	**€ 36.885**
Annaual Cash Capitalize in 2014	**€ 37.325**	**-€ 7.929**	**€ 3.019**	**€ 44.170**	**€ 37.463**	**€ 18.079**	**€ 17.430**	**€ 17.803**	**€ 26.679**	**€ 36.885**

Tab 26: Annual Cash Flows Chianti Superiore Conventional. Source: own elaboration

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 47.678	€ 9.274	€ 17.074	€ 67.727	€ 64.888	€ 36.327	€ 32.861	€ 34.531	€ 48.471	€ 59.201
Production costs	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584
EBITDA	**€ 24.148**	**-€ 7.856**	**-€ 1.356**	**€ 40.855**	**€ 38.489**	**€ 14.688**	**€ 11.800**	**€ 13.192**	**€ 24.808**	**€ 33.750**
Tax land	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165
Tax earnings	€ 4.830	€ -	€ -	€ 10.214	€ 7.698	€ 1.028	€ 354	€ 660	€ 3.969	€ 7.087
Net Income	**€ 19.153**	**-€ 8.021**	**-€ 1.521**	**€ 30.476**	**€ 30.626**	**€ 13.495**	**€ 11.281**	**€ 12.367**	**€ 20.674**	**€ 26.497**
Annaual Cash Capitalize in 2014	**€ 22.816**	**-€ 9.396**	**-€ 1.747**	**€ 34.413**	**€ 33.510**	**€ 14.663**	**€ 12.064**	**€ 12.878**	**€ 20.901**	**€ 26.497**

Tab 27: Annual Cash Flows Chianti Superiore Organic. Source: own elaboration

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 43.237	€ 26.586	€ 28.986	€ 54.520	€ 50.499	€ 29.119	€ 27.547	€ 27.501	€ 41.720	€ 55.237
Production costs	€ 15.734	€ 15.734	€ 15.734	€ 15.734	€ 15.734	€ 15.734	€ 15.734	€ 15.734	€ 15.734	€ 15.734
EBITDA	**€ 27.503**	**€ 10.852**	**€ 13.252**	**€ 38.786**	**€ 34.764**	**€ 13.385**	**€ 11.813**	**€ 11.767**	**€ 25.986**	**€ 39.503**
Tax land	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165
Tax earnings	€ 5.501	€ 543	€ 663	€ 9.697	€ 8.691	€ 669	€ 591	€ 588	€ 4.418	€ 9.876
Annual Cash Flows	**€ 21.837**	**€ 10.144**	**€ 12.424**	**€ 28.925**	**€ 25.908**	**€ 12.550**	**€ 11.057**	**€ 11.014**	**€ 21.403**	**€ 29.462**
Annaual Cash Capitalize in 2014	**€ 26.014**	**€ 11.882**	**€ 14.268**	**€ 32.661**	**€ 28.348**	**€ 13.637**	**€ 11.825**	**€ 11.650**	**€ 21.639**	**€ 29.462**

Tab 28: Annual Cash Flows Chianti Conventional. Source: own elaboration

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 38.166	€ 20.522	€ 20.817	€ 48.112	€ 43.770	€ 24.802	€ 24.565	€ 24.935	€ 35.624	€ 46.125
Production costs	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584	€ 15.584
EBITDA	**€ 22.582**	**€ 4.937**	**€ 5.233**	**€ 32.528**	**€ 28.185**	**€ 9.218**	**€ 8.981**	**€ 9.351**	**€ 20.040**	**€ 30.541**
Tax land	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165	€ 165
Tax earnings	€ 3.839	€ -	€ -	€ 8.132	€ 5.637	€ -	€ -	€ -	€ 2.605	€ 6.108
Net Income	**€ 18.578**	**€ 4.772**	**€ 5.068**	**€ 24.231**	**€ 22.383**	**€ 9.053**	**€ 8.816**	**€ 9.186**	**€ 17.270**	**€ 24.268**
Annaual Cash Capitalize in 2014	**€ 22.131**	**€ 5.590**	**€ 5.820**	**€ 27.361**	**€ 24.491**	**€ 9.836**	**€ 9.428**	**€ 9.565**	**€ 17.460**	**€ 24.268**

Tab 29: Annual Cash Flows Chianti Organic. Source: own elaboration

Appendix 3: Annual cash flows for dimension class

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 5.480	€ 3.408	€ 3.747	€ 6.771	€ 6.139	€ 3.656	€ 3.382	€ 3.502	€ 5.260	€ 6.646
Production costs	€ 748	€ 748	€ 748	€ 748	€ 748	€ 748	€ 748	€ 748	€ 748	€ 748
EBITDA	**€ 4.732**	**€ 2.660**	**€ 3.000**	**€ 6.024**	**€ 5.391**	**€ 2.909**	**€ 2.634**	**€ 2.755**	**€ 4.513**	**€ 5.898**
Tax on land	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21
Tax on earnings	€ -	€ -	€ -	€ -	€ -	€ -	€ -	€ -	€ -	€ -
Annual Cash Flows	**€ 4.711**	**€ 2.639**	**€ 2.978**	**€ 6.002**	**€ 5.370**	**€ 2.887**	**€ 2.613**	**€ 2.733**	**€ 4.491**	**€ 5.877**
Annaual Cash Flow Capitalize in 2014	**€ 5.612**	**€ 3.091**	**€ 3.420**	**€ 6.778**	**€ 5.876**	**€ 3.137**	**€ 2.794**	**€ 2.892**	**€ 4.541**	**€ 5.877**

Tab 30: Annual Cash Flows for conventional non-professional farms (less than 5 ha).
Source: own elaboration

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 5.216	€ 3.015	€ 3.258	€ 6.452	€ 5.744	€ 3.500	€ 3.161	€ 3.649	€ 4.194	€ 5.624
Production costs	€ 728	€ 728	€ 728	€ 728	€ 728	€ 728	€ 728	€ 728	€ 728	€ 728
EBITDA	**€ 4.488**	**€ 2.287**	**€ 2.530**	**€ 5.724**	**€ 5.016**	**€ 2.772**	**€ 2.433**	**€ 2.921**	**€ 3.466**	**€ 4.896**
Tax on land	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21	€ 21
Tax on earnings	€ -	€ -	€ -	€ -	€ -	€ -	€ -	€ -	€ -	€ -
Annual Cash Flows	**€ 4.466**	**€ 2.265**	**€ 2.508**	**€ 5.703**	**€ 4.995**	**€ 2.751**	**€ 2.412**	**€ 2.900**	**€ 3.444**	**€ 4.874**
Annaual Cash Flow Capitalize in 2014	**€ 5.321**	**€ 2.653**	**€ 2.880**	**€ 6.440**	**€ 5.465**	**€ 2.989**	**€ 2.579**	**€ 3.020**	**€ 3.482**	**€ 4.874**

Tab 31: Annual Cash Flows for organic non-professional farms (less than 5 ha).
Source: own elaboration

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 28.988	€ 19.151	€ 19.361	€ 37.306	€ 37.151	€ 20.257	€ 20.443	€ 18.926	€ 29.310	€ 38.335
Production costs	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018
EBITDA	**€ 17.970**	**€ 8.133**	**€ 8.342**	**€ 26.288**	**€ 26.132**	**€ 9.239**	**€ 9.424**	**€ 7.908**	**€ 18.292**	**€ 27.316**
Tax on land	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116
Tax on earnings	€ 3.055	€ 285	€ 292	€ 5.520	€ 5.488	€ 554	€ 565	€ 277	€ 3.110	€ 5.736
Annual Cash Flows	**€ 14.799**	**€ 7.733**	**€ 7.935**	**€ 20.652**	**€ 20.529**	**€ 8.569**	**€ 8.743**	**€ 7.515**	**€ 15.067**	**€ 21.465**
Annaual Cash Flow Capitalize in 2014	**€ 17.630**	**€ 9.057**	**€ 9.112**	**€ 23.319**	**€ 22.462**	**€ 9.311**	**€ 9.351**	**€ 7.950**	**€ 15.232**	**€ 21.465**

Tab 32: Annual Cash Flows for conventional, small farms (between 5 and 10 ha).
Source: own elaboration

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 27.487	€ 16.750	€ 17.769	€ 36.680	€ 32.894	€ 18.632	€ 17.750	€ 17.618	€ 26.058	€ 34.304
Production costs	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018	€ 11.018
EBITDA	**€ 16.468**	**€ 5.732**	**€ 6.750**	**€ 25.661**	**€ 21.876**	**€ 7.613**	**€ 6.731**	**€ 6.600**	**€ 15.040**	**€ 23.285**
Tax on land	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116	€ 116
Tax on earnings	€ 2.470	€ -	€ -	€ 731	€ 4.375	€ 266	€ -	€ -	€ 2.256	€ 4.657
Annual Cash Flows	**€ 13.883**	**€ 5.616**	**€ 6.635**	**€ 24.814**	**€ 17.385**	**€ 7.231**	**€ 6.616**	**€ 6.484**	**€ 12.668**	**€ 18.513**
Annaual Cash Flow Capitalize in 2014	**€ 16.538**	**€ 6.579**	**€ 7.619**	**€ 28.020**	**€ 19.022**	**€ 7.857**	**€ 7.075**	**€ 6.752**	**€ 12.808**	**€ 18.513**

Tab 33: Annual Cash Flows for organic, small farms (between 5 and 10 ha).
Source: own elaboration

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 63.443	€ 32.106	€ 32.986	€ 81.714	€ 73.872	€ 48.298	€ 40.440	€ 38.170	€ 58.121	€ 80.371
Production costs	€ 23.594	€ 23.594	€ 23.594	€ 23.594	€ 23.594	€ 23.594	€ 23.594	€ 23.594	€ 23.594	€ 23.594
EBITDA	**€ 39.849**	**€ 8.512**	**€ 9.392**	**€ 58.120**	**€ 50.279**	**€ 24.704**	**€ 16.846**	**€ 14.576**	**€ 34.528**	**€ 56.777**
Tax on land	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281
Tax on earnings	€ 11.158	€ 170	€ 282	€ 18.017	€ 15.084	€ 4.941	€ 2.527	€ 1.749	€ 8.632	€ 18.169
Annual Cash Flows	**€ 28.411**	**€ 8.062**	**€ 8.830**	**€ 39.822**	**€ 34.914**	**€ 19.482**	**€ 14.039**	**€ 12.547**	**€ 25.615**	**€ 38.328**
Annaual Cash Flow Capitalize in 2014	**€ 33.845**	**€ 9.443**	**€ 10.140**	**€ 44.966**	**€ 38.202**	**€ 21.169**	**€ 15.014**	**€ 13.065**	**€ 25.897**	**€ 38.328**

Tab 34: Annual Cash Flows for conventional, large farms (large than 10 ha).
Source: own elaboration

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total sales	€ 76.224	€ 43.472	€ 42.832	€ 93.834	€ 85.694	€ 49.713	€ 47.106	€ 46.813	€ 68.930	€ 94.301
Production costs	€ 23.369	€ 23.369	€ 23.369	€ 23.369	€ 23.369	€ 23.369	€ 23.369	€ 23.369	€ 23.369	€ 23.369
EBITDA	**€ 52.856**	**€ 20.103**	**€ 19.463**	**€ 70.465**	**€ 62.325**	**€ 26.344**	**€ 23.737**	**€ 23.444**	**€ 45.561**	**€ 70.932**
Tax on land	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281	€ 281
Tax on earnings	€ 16.914	€ 4.021	€ 3.893	€ 23.254	€ 19.944	€ 5.269	€ 4.747	€ 4.689	€ 14.124	€ 23.408
Annual Cash Flows	**€ 35.661**	**€ 15.802**	**€ 15.290**	**€ 46.931**	**€ 42.100**	**€ 20.795**	**€ 18.709**	**€ 18.475**	**€ 31.157**	**€ 47.244**
Annaual Cash Flow Capitalize in 2014	**€ 42.482**	**€ 18.509**	**€ 17.559**	**€ 52.994**	**€ 46.065**	**€ 22.595**	**€ 20.008**	**€ 19.543**	**€ 31.499**	**€ 47.244**

Tab 35: Annual Cash Flows for organic, large farms (large than 10 ha).
Source: own elaboration

Appendix 4: Percentile distribution for Chianti for strongly risk averse farmers.

Percentile	Organic	Conventional
5%	€ 89.187	€ 88.730
10%	€ 93.967	€ 93.590
15%	€ 97.954	€ 97.195
20%	€ 100.248	€ 99.355
25%	€ 101.989	€ 101.729
30%	€ 103.577	€ 103.154
35%	€ 105.068	€ 104.906
40%	€ 106.524	€ 106.477
45%	€ 108.140	€ 108.467
50%	€ 109.613	€ 109.663
55%	€ 111.169	€ 111.725
60%	€ 112.312	€ 113.425
65%	€ 113.989	€ 115.134
70%	€ 115.784	€ 116.289
75%	€ 117.644	€ 118.220
80%	€ 119.886	€ 120.075
85%	€ 122.748	€ 123.141
90%	€ 125.771	€ 126.105
95%	€ 129.744	€ 131.096

Tab 36: Percentile distribution of NPVs for strongly averse Chianti farmers
Source: own elaboration from data @Risk