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Abstract

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JEL Classification: L23, N63, N64, O13, Q12, R14

Keywords: Italy

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RISK MANAGEMENT IN TRADITIONAL AGRICULTURE:

INTERCROPPING IN ITALIAN WINE PRODUCTION[1]

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Abstract

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Keywords: intercropping, diversification, risk management, traditional agriculture, Italy.

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1) Introduction

All economic activities are risky, but arguably agriculture is the riskiest of all, bar niche jobs such as firefighting. It is subject, as all other activities, to unpredicted price changes, but on top of this also to unpredictable changes in output because of weather. Modern technology has reduced output risks and most farmers have enough financial resources to stand all but the most catastrophic events. Furthermore, the development of financial markets has offered many opportunities to manage output risks with insurance and price risks with hedging (Moschini and Hennessy 2002, Tack and Yu, 2021). If worse comes to worst, farmers can get help from states and international organizations.

Traditional peasants had not these options, and even normally adverse weather conditions could cause serious troubles to a population barely above subsistence (Federico, 2005). They adopted a number of risk management strategies (Besley, 1995a and 1995b), including risk-sharing contracts such as sharecropping and diversification of the output mix, which could protect jointly against time-specific weather shocks and against price fluctuations. On top of this, for any given output mix, they could diversify across fields. The most famous (and debated) historical case of such a practice is the Open Fields - i.e., the allocation of common land to households in fields scattered all around the village (Fenoaltea, 1976, McCloskey, 1976, Bekar and Reed, 2003, Richardson, 2005).

This paper deals with another risk-management strategy, intercropping, which so far has been almost entirely neglected in the historical literature for lack of data (Bardhan and Udry, 1999: 95). Farmers can cultivate two or more field crops on the same plot, exploiting the differences in their growing seasons or cultivate jointly a field and a tree crop at the same time[2]. The latter practice was common in history. The desert oasis features three layers of cultivation: wheat or barley on the field, short fruit trees in the middle and high palm trees on top (Battesti, 2005). Fruit trees were scattered in the fields in many areas of Northern Europe – the so-called *Streuobst* system (Herzog, 1998) – and in many other European countries (Ferrario, 2019). Now

[2] The current view of intercropping refers mostly to the cultivation of field crops. For instance, Wikipedia defines intercropping as 'a multiple cropping practice involving growing two or more crops in proximity. The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources or ecological processes that would otherwise not be utilized by a single crop' (accessed Nov 3 2019).

this type of intercropping seems to have disappeared, at least in Europe, and it is reminded with nostalgia mostly in landscape studies (Pleininger et al., 2006, Zimmerman, 2006).

This paper explores its economic rationale for the first time. Why did peasants scatter trees, losing the economies of scale derived from planting neighboring fields with the same crop (Holmes and Lee, 2012)? We model farmers' decision making as a two stages process. First, farmers decide how much trees or vines to plant, taking into account the environment, their factor endowment and the potential markets, at home and abroad, and then decide whether to scatter them across fields or to concentrate in a patch of the farm. We focus on this latter choice, which we hypothesize depended on the trade-off between the reduction in risks of catastrophic weather events, such as hailstorms, by scattering the plants, and the additional costs of tending plants far apart (and maybe monitoring against theft). These latter were lower where farmers lived close to their fields. Thus, ceteris paribus intercropping was less likely to be adopted in places where peasants lived concentrated in villages rather than dispersed across the countryside.

We test this hypothesis with the exceptionally detailed data on intercropping for vines in Italian agriculture in the 1930s. Statistics had somehow distinguished specialized and intercropped fields (respectively, *coltura specializzata* and *coltura promiscua*) since the early 19th century, but only in the 1920s the Central Statistical Institute defined consistently the threshold between the two and started to estimate output. Intercropping was very diffused: it accounted for about three quarters of all acreage and half of the total output of wine, one third of the output of olives, for all the production of mulberry leaves, the feed for silkworms, and for most fruit production.

Italy offers a unique opportunity of testing alternative models for the causes of intercropping for two other reasons. First, the practice was not uniformly adopted in the country. Vines were by far the most important tree-crop in Italy, and the only one diffused all over the country, but they were mostly intercropped in the Centre-North-East and were grown in specialized vineyards in the Southern latifundia regions. Second, the century-old practice disappeared during the 'economic miracle' of the 1950s and 1960s and we can trace the process with the (less detailed) post-war statistics. We argue that our model can explain change both in space and in time

In the next Section, we describe the main features of intercropping, we discuss the hypotheses on its adoption in the technical literature and we present our intuition (with a formal model in the Appendix A5).

We then discuss the available data (Section Three) and our estimation strategy (Section Four). We report the results in Section Five, and we discuss the causes of the demise of intercropping since the late 1950s in Section Six. We conclude in Section Seven.

2) What is intercropping and why was it adopted?

Intercropping of vines was first described by Roman authors, but it was much more ancient (Sereni, 1972). It had been abandoned in the early Middle Ages, when vines had to be cultivated in enclosed vineyards to protect grapes from animals, but diffused again since the late Middle Ages (Desplanques, 1956, Sereni, 1972) as part of an overall growth of cultivation of tree-crops in all the Mediterranean basin (Tabak, 2008: 161-168). In Veneto, intercropping was widely adopted during the wave of investment in landed properties by the Venetian *patriziato* in the XVI century (Cosgrove, 1993). In the words of an Austrian official surveying the countryside of Lombardy-Venetia in the 1840s: 'There is nothing more striking to the eye of a Northern traveller as those parallel rows of different trees that rise amid the wheat fields, and from the foot of which the vines rise, climb up to the beginning of the branches and are then stuck from tree to tree in the manner of garlands hanging in the air and full of fruit … Getting from the same field a crop of grain and wine, is something that can be had only in a climate as warm as is that of Italy. This method is ancient, as Cato and Varro already talked about it nineteen centuries ago, as a common practice in the country. If the climate were less hot, the shade of trees would damage far more the harvests of grains, and the grapes would be located so far from the ground to be not able to ripen … Most of the wine of the Regno Lombardo-Veneto is produced on flatland … On flatland, vines are never cultivated otherwise than in the midst of cultivated fields … Vines are stuck to many kinds of trees, such as maple, poplar, willow, ash, cherry and even walnut …' (Burger, 1843, pp. 61–63).

The literature on intercropping is rather unbalanced. The textbooks on wine growing offer many details and practical advice, but few hypotheses on the causes of the adoption of intercropping (Desplanques 1956, Ferrario 2019). Agronomists discussed the different implications of the prevailing form of planting in each area, taking them as a matter of fact (Niccoli and Fanti, 1943, p. 235-237, Tassinari, 1945, p.397-399). If anything, they tended to condemn intercropping as a 'backward' and irrational technique (Ottavi, 1885, p.

736ss.) to be abandoned in favor of 'modern' viticultural practices (i.e., specialized vineyards). The economic historian Sereni (1972) argued that the key factor was the origin of vines – wild local ones being suited to intercropped cultivation and imported (Asian) ones to specialized cultivation. We deem this hypothesis highly implausible to explain the diffusion in the 20th century, since the choice of varieties is likely to be endogenous and different varieties have been available since long time in the whole peninsula. Tirone (1975 and 1996) argues that intercropping was adopted because it supplied the household with all its basic food, and at the same time offers the landowner an easily marketable product as wine. This explanation may or may not be true, but it refers to the decision about the crop mix, rather than about the technique of cultivation of vines. Other explanations focus on the technical advantages of hanging vines to trees (*piantata*) relative to the alternative method of sustaining them with poles of wood, as in the production of *vinho verde* in Portugal (Ferrario, 2019: 21). Trees provided wood and leaves as fodder, and their roots helped against soil erosion in hilly terrains. Their shade protected vines from the excessive heat of the Mediterranean sun, without affecting too much the productivity of cereals, as it would have in colder climates[3].

Arturo Marescalchi (1926 p. 93), a leading oenologist of the first half of the 20th century, put forward a more sophisticated version of the same hypothesis which can explain regional differences. He points out that vines, as olive trees, are suited to semi-arid Mediterranean climates because they need less rain/humidity in the soil than any other major crop. During a drought, however, they could be deprived of water if cultivated jointly with other, thirstier crops in the same plot of land. Lack of water could endanger their survival, causing a major capital loss. This risk is clearly lower in the rainy areas of the Centre-North of Italy than in the South. The spread of phylloxera, an American insect which ravaged French vineyards since the 1860s (Banerjee et al 2010), highlighted other advantages of intercropping, Intercropped vines were more resistant because they were larger and with deeper roots than specialized ones and it was more difficult for the insect to jump from one vine to another if they were hung to distant trees than if they were packed in a vineyard. Of course, resistance to phylloxera was an unintended benefit, as the *piantate* had been established much earlier than the arrival of phylloxera in Europe.

[3] Although Arthur Young scorned Italian vine intercropping precisely because vine and tree leaves reduced the sun exposure of wheat (Ottavi, 1885, p. 736). On the other hand, the Inchiesta Jacini, a major official survey of the Italian agriculture in the 1880s, criticized intercropping with trees because the shade of their leaves prevented full ripening of the grapes (Mocarelli and Vazquez Piñeiro 2019).

As far as we know, only Marescalchi has suggested a possible economic cause for intercropping – and risk was a relevant factor in the decision: 'intensive specialized vineyards certainly allow a more careful tending, a reduction of unitary costs, a higher output in less space and a greater ease of technical improvements; but at the same time they require higher levels of investment and increase the exposure to climatic and disease risks, whereby on occurrence of hailstorms or pest infestations everything is lost, while in intercropped viticulture one just loses a part of production – and not necessarily a large one' (Marescalchi, 1926, p. 71)[4].

We develop this economic insight by modelling the decision of intercropping as a second step in the decision-making process of farmers[5]. They first decide the income-maximizing crop mix, given factor endowments, production technology and prices, and then, if the optimal mix includes both field crops and tree crops, decide whether to scatter the latter across the different fields of the farm or concentrate them in specialized vineyards (or olive trees groves, or orchards). Thus, our problem differs from the classic model of open field, which refers to a single product, with the same productive technology and level of crop-specific risk. To frame the decision, it is necessary to remind the differences between cultivation of vines and field crops.

First and foremost, planting vines was a long-term decision. It entailed a massive investment (1 hectare costed 5 to 20 times the annual wage income of an adult male in the late 1920s[6]) and vines achieved full production after about five years, continuing for fifty years. Thus, most of the vines planted in Southern Italy during the 1880s to take advantage of the phylloxera-induced skyrocketing French demand for Italian wine exports (Federico and Martinelli 2018) were still producing when we observe planting techniques in 1930. Second, cultivation of vines differed from cultivation of field crops for four reasons: i) vines need much more work than field crops - on average 4 times more days per specialized hectare than wheat and double the number of days than corn (Federico et al., 2019 Appendix); ii) vines need frequent tending all over the year, while work on field crops is concentrated in few short periods of time (tilling, sowing, harvesting); iii) vines are

[4] Less analytically explicit remarks, but vaguely inspired by similar principles of risk assessment, can be found in the much earlier Nicolaj (1832, p. 406).

[5] See the Appendix A5 for our formal treatment of the choice of intercropping. Here we rely on the intuitive features and implications of the model.

[6] According to the planting accounts from all over Italy in Dalmasso (1934, p. 8), and assuming that a rural labourer worked 150 days per year. The range, of course, depends on different levels of vine density. Irrespective of density, the fixed cost of planting was about 4 times the total annual cultivation costs (inclusive of both labour and other inputs).

subject to weather risks throughout the year, while field crops mostly, if not only, during the growing season; iv) adverse weather, most notably hailstorms, may damage the capital (the vines), affecting not only the current year harvest but also future ones. In a nutshell, winegrowing needs more trips to a given field, ceteris paribus, and is decidedly riskier than field crops[7].

Scattering vines would reduce weather-related risks, but impose additional costs to move from one field to another to tend them. In our model, the decision whether to intercrop or not depends on this trade-off. If peasants were risk-neutral, they would never intercrop, planting vines in a vineyard and growing each crop in a single field, in order to minimize travel costs. The more risk-averse peasants were, the more would they be attracted by intercropping, ceteris paribus. For any level of risk-aversion, there is a distance threshold *d* to the fields such that the peasant is indifferent between the two strategies, and further increases in *d* will make specialization the dominant strategy. Given similar conditions, peasants tend to make the same choice and thus we expect either intercropping or specialization in homogenous agricultural areas. We cannot measure directly the degree of risk aversion, while we can use the share of people living in dwellings scattered in the countryside as a proxy for the average distance to the fields. Everything being equal, the more peasants lived close to the fields, the shorter the distance the average peasant had to travel and thus the more frequent the expected incidence of intercropping as a cultivation technique.

3) The diffusion of intercropping in the world

Measuring the intercropped acreage and/or its output is very difficult. In principle, one would need to know the number of plants per unit of land and the average yield per plant. The density of plants could vary a lot. In Veneto, in the early 19th century, the rows of trees with hanging vines were in some areas 50-60 meters away and in others so close that branches could touch (Ferrario, 2019, p. 115). Furthermore, multiple intercropping with different tree species (e.g. vines and olive trees) was fairly common in many areas and thus the data should be collected for all of them. It may not be surprising that most statistical offices renounced to measure intercropping, even if this caused an undervaluation of the agricultural output.

[7] These features hold also for other tree crops. Olive trees needed less work than vines – but still more than cereals.

The American Census of Agriculture of 1935 admits that 'For many farms, on which there were a small number of trees reported or on which the trees were scattered around the farmstead, acreage in orchards, vineyards, and planted nut trees was not reported." (Bureau of the Census, 1936, p. IX). The otherwise very detailed German Fruit Trees Census of 1934 (Statistisches Reichsamt, 1935, p. 255) estimates the number of fruit trees in household gardens (80 million) and alongside the country roads or railways (16 million), but lumps together intercropped trees in fields and in specialized orchards (72 million). Other countries at least made an effort to count. Austro-Hungarian sources (an Inquiry on wine from 1873 for Cisleithania and 1857 statistics on the still unfinished cadastre for the whole of the dual monarchy) quote intercropped vines, which were widespread in areas soon to be annexed to Italy (Lombardy-Venetia) and close to the post-unification Italian border (Dalmatia, Tirol and the Littoral) (K.K. Finanzministerum, 1858 and K. K. Ackerbau Ministerium, 1873). The 1930 Spanish agricultural statistical survey (Anuario de Estadísticas Agrarias, 1930, pp. 104-105) reports a high share of intercropped acreage (18.9% of total) but includes the mixed cultivation of olive trees and vines with no field crops, which would not necessarily be classified as intercropping in the Italian cadaster. According to the source (p.106-107), tree and field crops were cultivated in the same plots (our definition of intercropping) only in a handful of provinces, mostly in Catalonia, Galicia and the Basque countries. In France, intercropping accounted for 8.7% of total acreage and for 5.4% of output in 1882, but ten years later these shares had sharply decreased respectively to 7.3% (in 65 departments out of the 77 wine-growing ones) and 3.6%[8] The next *Enquête* in 1929 does not record intercropping at all, although there is evidence it was still present in the Isère valley (Perrin, 1935).

It is likely that this fast demise of intercropping was, at least in part, related to the fight against the phylloxera. There was no cure but to eradicate the vines and substitute them with new ones, grafting local traditional varieties on phylloxera-resistant American ones. This substitution started, after many attempts to find less invasive solutions, in the 1880s (Chevet et al., 2018). The total wine-bearing acreage in France declined from an all-time peak of 2.5 million hectares in 1874 to 1.6 million in 1904, and then to 1.5 million on the eve of World War Two, while yields per hectare increased from about 20 hectolitres per ha. (down from

[8] Thus, intercropped fields produced about half grapes (and thus wine) per hectare of vineyards – about double the Italian yield. The difference might be caused either by a higher productivity of each single plant or by a greater density of plants, which in turn might reflect a more restrictive definition of 'intercropped vines' in the French case, excluding fields below a threshold. In this latter case, the statistics would underestimate the share of wine from intercropping and also the total output. Unfortunately, the source does not report any detail on the definition of intercropping.

25 before the disease) to 35 in the 1910s and to 40 in the late 1930s (Anderson and Pinilla, 2017, T1 and T6)[9]. The fall in acreage and the rise in yields is consistent with an increase in the average density of plants, as modern intensive winegrowing was expanding in the Midi.

In this dearth of data, Italy shines. Most pre-unitary cadastres reported separately acreage in intercropped (*arativo vitato* or *coltura promiscua*) and specialized vineyards (*vigneto spesso* or *coltura specializzata*) since the mid-18th or early 19th century (Federico and Martinelli, 2018, tab 5.3). The distinction was omitted in the first official Italian statistics of the 1870s and 1880s, but it reappeared in a survey on wine production of the 1890s (MAIC, 1896) and then in the series published by the newly re-organized *Ufficio di Statistica Agraria* since 1910. Unfortunately, the definition of intercropped acreage is seldom explicit and differs across sources and across areas within each source.

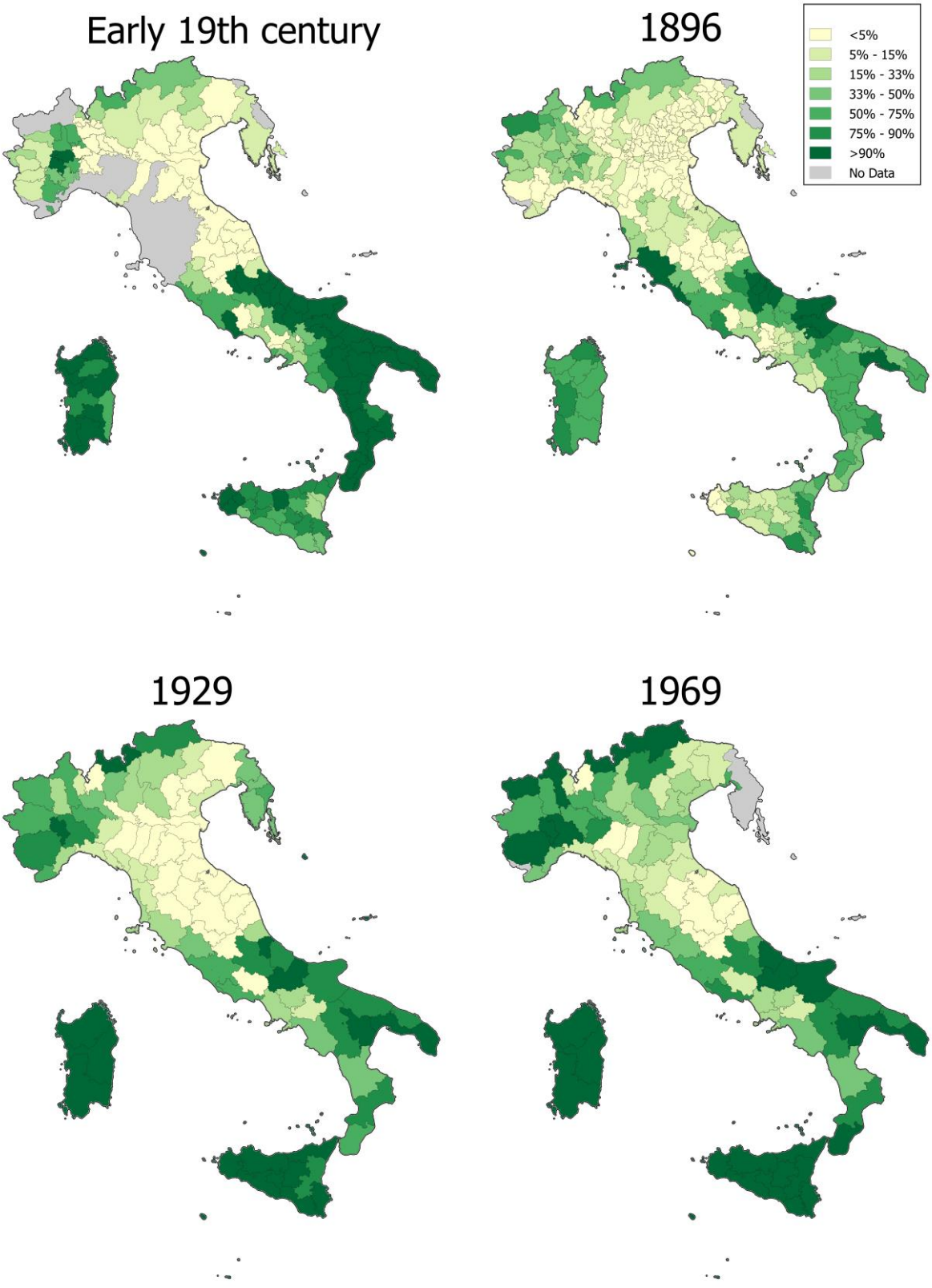
The figures became really reliable and consistent, with a new and more accurate nationwide definition, only after the completion of the very detailed 1929 *Catasto Agrario* (ISTAT, 1932-1937) which refers to the conditions in the late 1920s. It included in the specialized acreage not only pure vineyards (plots exclusively growing vines) but also all vineyards growing some other tree crops (often used for hanging vines on them), provided that grapes were the most important product. The intercropped acreage included the areas where vines were grown with other field crops (the bulk of the intercropping category) or scattered among other tree crops, as well as vines in field borders and the like. Overall, it accounted for 76% of total wine-growing acreage (about 3 million hectares vs 0.93 specialized ones) and for 48% of total production. – i.e. a hectare of intercropped vines yielded about a quarter of a hectare of vineyards. This definition of intercropped acreage was maintained also in post-war statistics, to be substituted in 1970 by a more restrictive one, based on the value of output rather than on acreage (Tirone, 1996).

We plot the shares of specialized vineyards on total vine acreage from the available sources in Map 1. 'Early 19th century' collects all existing pre-unitary sources with some distinction between specialized and intercropping vine cultivation, referring to periods from the 1750s to the 1860s.

[9] In Spain the process started later, in the 1890s (Fernández and Pinilla, 2018). The acreage declined from 1.5 million hectares in 1898 to 1.2 million in 1914, but yields remained stable (Anderson and Pinilla, 2017, T1 and T6).

MAP 1

The share of specialized vineyards on total acreage with vines



The maps highlight three points:

i) Intercropping accounted for a sizeable share of total acreage in the early 19th century. We do not have complete data for Liguria, Emilia and Tuscany, but it seems highly unlikely that specialized cultivation was relevant there. Indeed, the 1791 Cadaster of Modena (Rinaldi, 1995) and the 1835 Tuscan Cadaster (Zuccagni-Orlandini, 1856) do not even quote vineyards as a category of land-use, although they explicitly distinguish between simple arable land and arable land with intercropped vines. Filling these gaps with some plausible assumptions yields a nation-wide share of 82% of intercropped acreage (see the Appendix A4, for a further discussion of this estimate and the sources of Map 1). This figure is somewhat higher than the corresponding share for the late 1920s from the *Catasto*. In that century, the total intercropped acreage remained broadly stable (3.1 and 2.9 million hectares), while the specialized area increased from 678,000 to 934,000 hectares, mostly in the South and Sicily – in all likelihood as a result of the extensive planting of new vineyards during the export boom of the 1880s (Federico and Martinelli, 2018).

ii) The traditional pattern of cultivation was quite different across regions. In relative terms, the geographical distribution displays a remarkable stability over the nearly two centuries considered in Map 1. By and large, intercropping prevailed in the Centre-North, and specialized vineyards in the South. There were however exceptions –Southern Piedmont and the coastal areas of Southern Tuscany and Latium (but not, tellingly, the core wine-growing areas of Chianti) in Centre-North, and some hilly areas of Campania and Calabria in the South. The very limited quantitative information suggest that this geographical pattern dated back to the late Middle Ages and Early Modern period [10].

iii) Intercropping started to decline in the early 1950s, to disappear in the early 1990s. In 1952, it still accounted for 73% of acreage (2.9 million hectares) and for 38% of grape output. It shrank to 1.6 million hectares in 1969 (61% of area, with 23% of output), the last year it was recorded in a comparable way (ISTAT,

[10] Intercropping accounted for 96% of the vine-bearing area in the area around Siena, in Tuscany, in the early 14th century (Proprietà fondiaria, 1974) and for 98% in the 1920s (ISTAT, 1932-1937). The *piantate* (intercropped fields) represented 83% of vine-bearing land sold in the area around Mantua, in Southern Lombardy in the 13th century (Torelli, 1930, p. 279), only slightly less than the share (98%) for the whole province in the late 1920s. They ranged from 67% to 85% of all fields in the areas around Treviso, close to Venice, in 1542 (Ferrario 2019: 87) and for 60-70% in the 1920s. Vice-versa, vineyards were the only type of vine cultivation registered by the 1531 cadastre in Valtellina, in the Lombard mountains (Boscacci, 2000), and accounted for 93% of vine-bearing hectares according to the 1929 *Catasto*.

1971). It halved again from 0.7 million in 1970, according to the new, more restrictive definition, to 0.38 in 1982. In the same period, the specialized acreage rose from 1 to 1.2 million hectares – i.e., only a small part of the intercropped vines was transformed in specialized vineyards, while most of them were abandoned or converted to field crops.

4) The causes of intercropping: a quantitative analysis.

Italy in the 1930s was still a mostly agricultural country, with over a half of the workforce, 10.5 million out of 19.5, employed in agriculture (Vitali, 1970, Tav.3). Wine was one of its most important agricultural products (Table 1).

Table 1

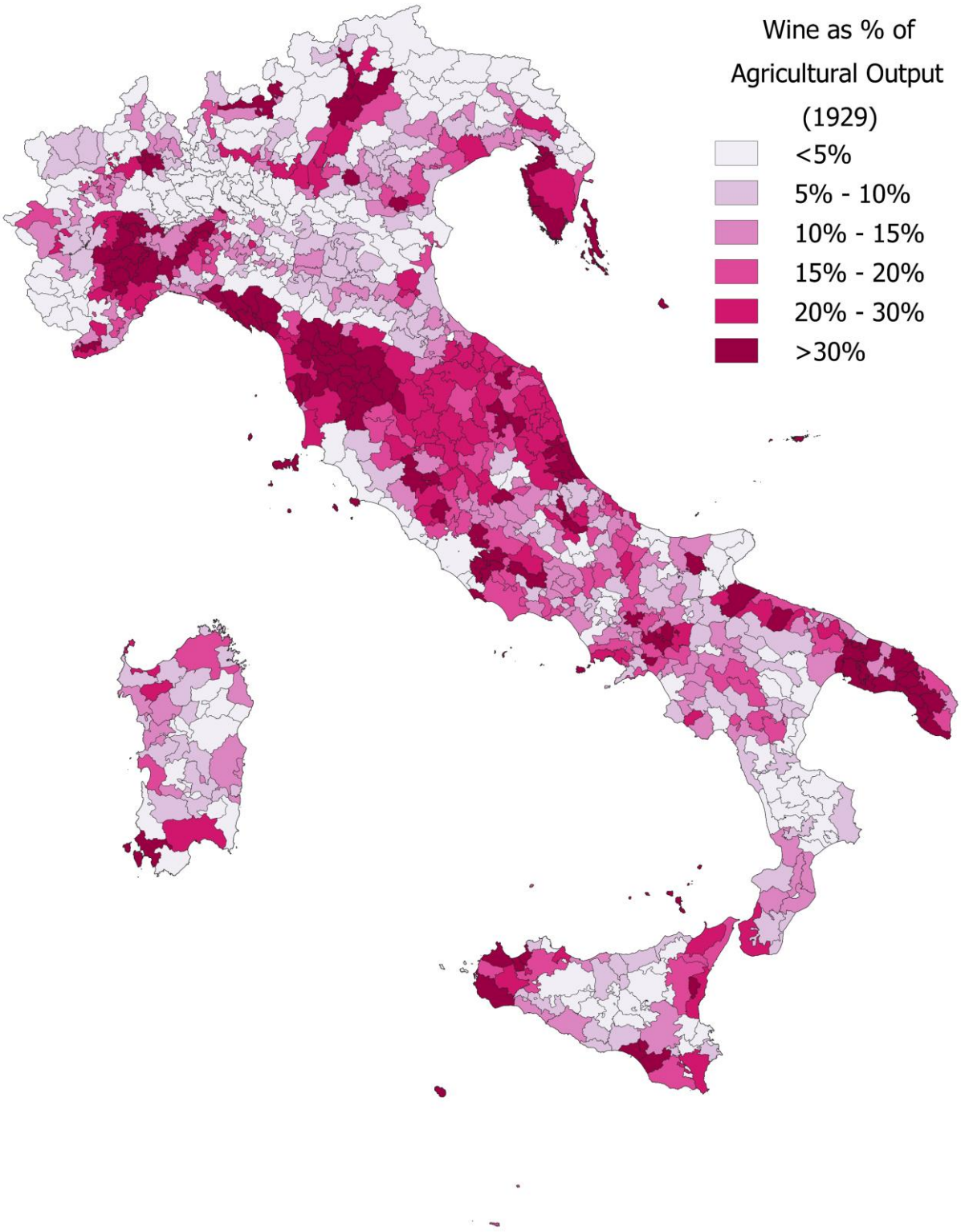
Wine in the Italian economy

	1891	**1911**	**1938**	**1951**
% of gross value of agric. output:				
Wine and by-products	***21.2***	***22.2***	***11.2***	***9.3***
Wheat	19.7	15.3	24.3	14.9
Other cereals and pulses	9.7	6.3	6.3	6.9
Other crops	9.6	11.8	12.1	12.6
Oil and by-products	5.2	4.4	2.8	6.1
Other tree crops	8.2	8.7	12.4	10.2
Livestock	14.3	20.0	21.3	28.5
Other animal products	9.1	8.9	9.1	11.3
Cocoons	3.1	2.4	0.5	0.2
Wine's share of total GDP (%)	8.6	7.7	2.9	2.0
Wine's share of total private consumption (%)	11.6	11.1	5.1	3.6

Source: Federico and Martinelli (2018), tab 5.1.

The low figures for 1938 and 1951 are to some extent deceptive, as they reflect the collapse in the relative price of wine. In fact, the shares of wine and related products on gross agricultural output expressed in constant (1911) prices declined only by few percentage points, from 24.2% in 1891 and 23.1% in 1911 to 19.3% in 1938, with a modest rebound to 21.6% in 1951. Map 2 shows the share of wine in total agricultural production at the agrarian zone level in 1929 (at 1938 prices). Viticulture was of first order economic importance for the local economy across much of Italy.

MAP 2



Italy was also a densely populated country (134 inhabitants per square kilometer in 1931). Until the economic miracle of the 1950s and 1960s, about a quarter of Italians lived in *case sparse* (scattered dwellings in the

countryside). The settlement patterns differed widely not only across regions (Table 2) but also within each region (Map 3).

Table 2
The share of scattered population

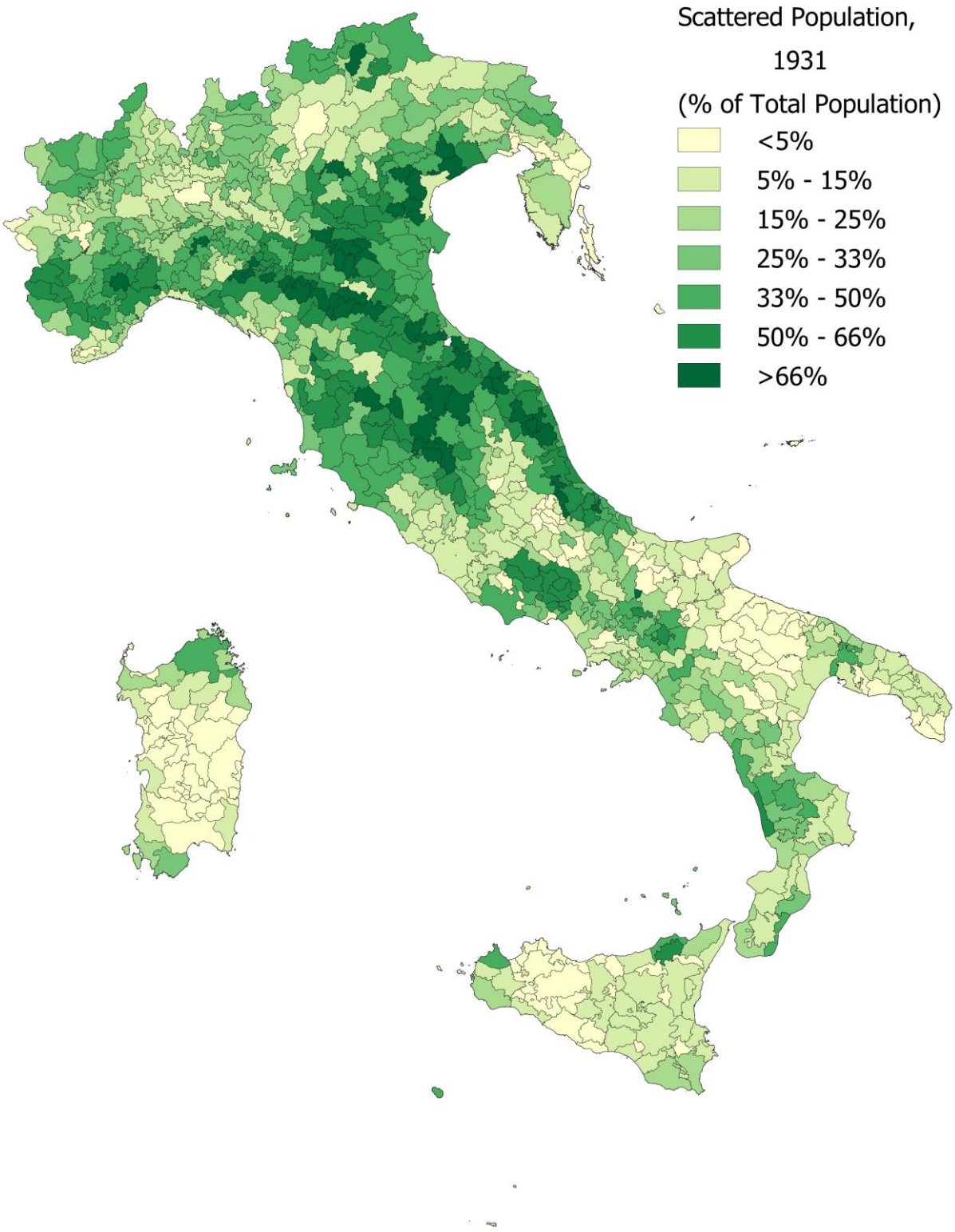
	1871	***1881***	***1901***	***1911***	***1931***	***1951***	***1961***	***1971***
Piedmont	26	29	29	28	27	24	10	8
Liguria	25	27	23	21	16	15	6	5
Lombardy	21	23	23	23	20	17	5	4
Venetia	35	37	39	40	37	37	21	16
Emilia	58	60	59	59	53	46	25	17
Tuscany	43	45	45	46	39	36	19	13
Marche	53	54	56	55	55	51	35	25
Umbria	54	55	57	56	54	51	34	25
Lazio	17	18	21	21	21	19	11	8
Abruzzi	23	24	28	29	32	32	20	16
Campania	9	11	15	14	17	17	9	7
Apulia	6	7	7	8	8	7	5	3
Basilicata	5	7	9	11	13	16	12	12
Calabria	11	14	17	17	22	22	13	10
Sicily	7	8	11	11	10	8	4	3
Sardinia	5	7	8	9	8	8	4	3
Italy	**26**	**28**	**29**	**29**	**26**	**24**	**12**	**9**

Sources 1861, 1871, 1881, 1901, 1911, 1931 and 1951 ISTAT 1965 Table 2.1; 1961 ISTAT 1966; 1971 ISTAT 1974 tab.1

In some mountain areas of the North peasant households clustered in villages, but in most of the region they dwelled on their farms. In the western Po Valley, where large- and medium-sized integrated estates were frequent, fixed-contract laborers lived on farms' central facilities (*cascine*) and casual workers in nearby villages and hamlets. All over the Centre-North, owners, tenants and sharecroppers lived on their farm – all tenancy agreements included the right to a house in the farm (*poderi*). Peasant households living in scattered farmhouses were also common in the Abruzzi and in some mountain areas of Campania and Calabria, but these areas accounted for a small fraction of Southern agricultural population. Unlike in the Centre-North, most of these 'islands' of dispersed settlement were a historically recent phenomenon (Biasutti, 1932, p. 22). Most Southern agricultural workers lived in big villages or small cities, numbering thousands or even tens of thousands of inhabitants ("agro-towns")[11]. They commuted to the estates, sometimes at considerable distance, which had hired them in the village market for casual labor, often on a daily basis (Martinelli, 2014b).

[11] In 1861, centres over 10,000 inhabitants accounted for 13.5% of the population in Centre-North and for 25.6% in the South, and agricultural workers for respectively 27% and 42% of urban employment (Chilosi and Ciccarelli

MAP 3



forthcoming tab A3). In 1931 the share of urban population was still higher in the South, although the gap had reduced to 38.6% vs. 31.2% (ISTAT 1931-35 vol VII prosp.2).

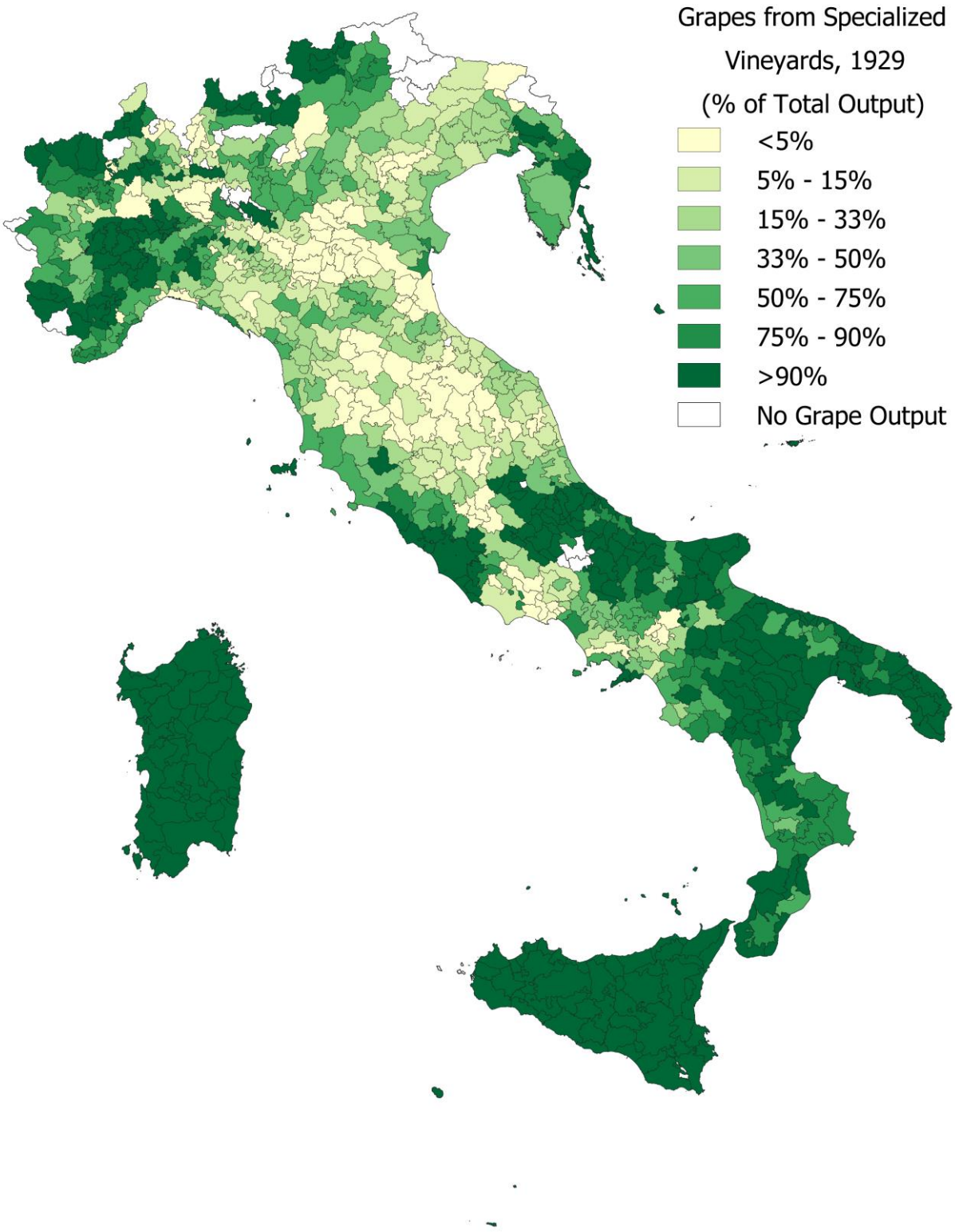
Map 3 plots the distribution of population by type of settlement, from the census, according to the boundaries of the so-called agrarian zones, geographical units introduced in the Italian agricultural statistics in the early 20th century. They were meant to be homogenous from the point of view of environment, landownership and crop mix and thus are very suitable for our test. There were 795 such zones and all but 28, in the mountains, produced some wine (Martinelli, 2014). For each of them, the *Catasto Agrario* provides accurate information on the local incidence of specialized as against intercropped grape production. We plot the share of the former in Map 4, and a visual inspection shows huge differences between areas. Intercropping seems to be inversely related to the shares of scattered population from Map 2. We test this hypothesis by running the regression

$$INTERCROPPING_{i,t} = \alpha + \beta\, SCATTERED_{i,t} + \gamma' \boldsymbol{X_{i,t}} + \varepsilon_{i,t} \quad (1)$$

Where INTERCROPPING is a measure of the diffusion of intercropping (the variable of interest) in the i-th agrarian zone from the *Catasto Agrario* in a single period (t=1929), SCATTERED, is the share of population living in dispersed dwellings from the 1931 population census (ISTAT, 1935), and **X** a vector of variables proxying for other determinants of the choice and testing the alternative, environment-based, explanation for intercropping (see for details and sources Appendix A1)[12]. For each wine-producing zone we can compute four different measures for INTERCROPPING - the share of intercropped acreage on total vine-bearing acreage, the share of intercropped vines on total vines, the share of output from intercropped vines on total output and the number of vines per vine-bearing hectare (a synthetic measure of vine dispersion). We use as our baseline measure of intercropping the share of output, as ultimately what mattered was production, but we run regressions with the other variables as a robustness check.

[12] Only five out of 165 correlation coefficients between explanatory variables exceed 0.5 (correlation matrix available upon request).

MAP 4



The census figures refer to the whole Italian population, and thus they are likely to bias downward the share of scattered agricultural population, as almost all workers in industry and services lived in urban centers. The bias was likely to be greater in the North, where the share of non-agricultural population was higher. We

control for this potential bias by adding the share of agricultural households ('Agricultural Employment'), defined as those having a family-head employed in agriculture, from the 1931 census (ISTAT 1931-1935). Likewise, we control for the density of agricultural population, as measured by the number of agricultural families per hectare: the denser the population, the shorter the distances from houses to fields for any level of dispersion of agricultural population.

The vector **X** includes first and foremost the share of wine in total agricultural output (Wine specialization) from Martinelli (2014), which in our model is the outcome of the first step of the decision-making process. It is expected to be negative: the higher the desired share of wine in the crop mix, the denser must be vines on the farm and thus the higher the proportion of acreage exceeding the threshold for being classified as specialized. Other variables in **X** can be grouped in four main categories, measuring respectively risk and (indirectly) risk-aversion, transportation costs, the size of scale economies in cultivation and/or in wine-making and the role of environment, plus geographical dummies.

a) Our main measure of local climatic risk (Hail risk) is a hail hazard indicator (obtained from daily data on severe thunderstorms in 2004-2014), in the area corresponding to each agrarian zone[13]. We cannot measure risk-aversion directly, but we do add three measures of the capacity of agricultural households to withstand risk: their income, ('Agrarian family income') and the shares of fixed-rent tenants ('Tenants') and sharecroppers ('Sharecroppers') on decision-making agricultural population – i.e., these categories plus owners. We expect income (defined as the value of agricultural output per agricultural household) to be negative, and the two contract variables to be positive. Fixed-rent tenants and sharecroppers could withstand less risk than owners, who could pledge their land as collateral.

b) In the 1930s, modern (and expensive) means of transportation had not yet diffused in the Italian countryside. In 1929, there were only 300,000 cars and 70,000 motorcycles in the whole country (ISTAT on line) and 21,000 tractors – i.e., one every thousand hectares of cropland (UMA, 1968). Peasants simply walked

[13] The hail hazard indicator is obtained normalizing by agrarian zone area the number of hail-relevant severe thunderstorms occurred between 2004 and 2014. Satellite detections of severe thunderstorms (potentially conductive to hailstorms) are based on overshooting cloud tops (Bedka, 2011). Since not all such thunderstorms led to actual hailstorms, Punge et al. (2017) filtered them to obtain an 11-year dataset of storms whose updraft velocity in the core was large enough to support hailstone growth. At the present moment, this is the most refined measure of the probability of experiencing a hail event with huge spatial accuracy. As a robustness check, we also used in the analysis the non-filtered dataset. Results (available upon requests) were qualitatively very similar.

around or at best rode donkeys and mules. In both cases, they needed more time to cover the same distance in hilly or mountainous terrain than in the plains: we control for this possible effect by adding variations in altimetry within the agrarian zone (Ruggedness).

c) We explore the scale effects separately for cultivation and wine-making. We measure scale effects in production with data on the average acreage by productive unit ('Farm size'), from the 1930 Census of Agriculture (ISTAT,1935). The physical extension affected the diffusion of intercropping at the opposite sides of the size distribution of farms. On one hand, scattering the desired number of vines was, by definition, physically impossible below a certain size (tiny plot effect). On the other, over a certain size, the costs associated with dispersion increased, making it more profitable to concentrate all the vines in a specific part of the estate and the grain crops in another one (large estate effect). Overall, we consider the net effect of large scale to be an empirical question – i.e., we don't have a strong prior for the sign of farm size.

Wine-making was subject to scale economies as any other processing of agricultural products: even the most rudimentary equipment was profitable only if there was a minimum quantity of grapes to process and the scale and sophistication (i.e., the cost) of equipment increased substantially if one wanted to produce high quality wine (Simpson, 2011). Of course, ceteris paribus, there was more potential output to process the more productive was the farm: given a desired % of wine on total farm production, greater output made it more likely to produce the quantity of grapes above the threshold for purchasing advanced machinery without need to resort to greater levels of specialization. On the other hand, great estates had more financial resources to weather a difficult year and had an easier access to credit if needed, reducing the demand for the insurance provided by intercropping. Thus, the net effect of both forces is undefined. We proxy the value of output of estates of the same owner in each zone with the average rental income ('Landownership value') and we add the corresponding Gini coefficient to control for differences in its distribution ('Landownership value inequality')[14]. Contrary to the conventional wisdom, there was not a clear-cut land inequality North-South

[14] The data were produced in the late 1930s and collected and published after the war (INEA 1946-1948). The Landownership value aims at measuring the pure rent, net of costs, and it is poorly correlated (0.18 only) with Farm size, which measures the extension of productive units in hectares, for two main reasons (Martinelli 2016). First, the farm value (and hence its rental value) is not necessarily correlated with extension: a specialized vineyard produced much more than a pasture per hectare. Second, the sources classify estates belonging to the same owner but rented out to independent agricultural households as a single ownership unit in assessing rents but as many productive units in measuring the average extension.

gradient (Martinelli, 2016). The higher land productivity in Centre-North compensated the greater physical extension of Southern latifundia and the highest concentration of landownership is registered in Central Italy (Tuscany and Umbria).

A sufficient amount of grapes to be processed, however, could be collected by pooling the production from many different farms. In 1930s Italy, there were two distinct mechanisms for pooling. Large estates (*fattorie*), especially in Central Italy, centralized processing of grapes from all tenant family farms, while in other areas, especially in the North, small producers joined in co-operatives to purchase the wine-making equipment. We capture the effect of these pooling strategies by adding controls for the maximum share of output that could be processed by cooperative wineries, given their equipment capacity (Cooperative Wineries) and for the number of *fattorie* for every 100 farms (Fattorie). Both arrangements made it possible to process the typically small production of intercropping cultivation with more modern equipment and thus we expect them to be positive. Last but not least, we control also for the production of high-quality wine. There are no data on the share of high-quality wine on output before the 1980s and thus we proxy it with a dummy (Quality) if at least one producer of the zone participated to the first Italian Exhibition for high quality wine in Siena in August 1933 (Comitato Esecutivo, 1933)[15].

d) We test the environmental explanations for the diffusion of intercropping by including two variables capturing climatic conditions: the yearly averages of rainfall (Rain) and temperature ('Temperature'). Since environment can affect intercropping by reducing the viability of vines competing with other crops for scarce water resources, we also control for the ability of soil to retain moisture at similar levels of rainfall. We capture such ability by including a measure of the soil texture that has the highest water-retention capacity: the share of clay soils over all soils. Clay soils are composed by the smallest class of soil particles, are more compact, and thus are less permeable, retain more moisture and are less subject to droughts than sandy soils composed by larger particles.

e) We add geographic dummies to capture factors which we have not been able to measure, such as the supply of credit and institutional differences, including social control and the enforcement of property

[15] Results are almost identical with the number of participants by zone. We prefer to use the dummy because the number might be affected by the distance from Siena.

rights, from the century-old political division of the peninsula. We start with the standard North-South division, with Centre as reference category[16]. Although this macro-area division reflects broad patterns with a well-established developmental gradient in the present day, they fail to capture historical institutional differences within them, which were arguably as large as if not larger than difference among them. Hence, in different specifications, we also control for two sets of dummies for pre-unification states in 1796 (the 18th century borders, when the settlement pattern was already defined) or in 1859 (the 19th century borders, set in the Congress of Vienna).

Our baseline OLS estimation assumes the pattern of settlement to have been exogenous Indeed, the difference in settlement patterns between Centre-North and South date back to the 15th century (Rao 2015) and many agro-towns were established in Sicily in the 16th and 17th century (Aymard 1985, Vesco 2013, Militello 2017). Changing the pattern of settlement in the 1930s would have implied huge investments, many orders of magnitude larger than potential gains from intercropping. The cost of relocating nearly half a million peasant families living in agro-towns to the countryside and replanting vines in specialized vineyards would have been astronomical: more than 8 times the annual value of agrarian production of the relevant agrarian zones, 75% the value of national agrarian output and almost a quarter of Italian GDP in 1929[17].

It is nevertheless possible, although not likely, that the prospects for wine-growing affected the settlement decisions in the early modern period and thus as a robustness check we also run an IV specification. In order to establish causality and to minimize the omitted variable bias we need an instrument that captures the determinants of the (historical) settlement pattern while not directly impacting the vine-planting strategies. The historical literature does not dwell much on the economic rationale of patterns of settlement. The arid

[16] Following the standard Italian convention on this partition, the 'Centre' is defined as the regions of Tuscany, Umbria, the Marches and Latium (all at 1946 borders).

[17] This is a conservative back of the envelope calculation. Assuming that only peasant families living in Southern agrarian zones with less than 5% scattered population were to be relocated (and a glimpse at map 2 suggests that this was just a fraction of the peasant families in agro-towns), we get a figure of nearly 470 thousand families. In these agrarian zones there were more than 150 thousand hectares of specialised vines (again, just a fraction of the total), which would need to have been replanted in intercropped fields. We assume a (conservative) conversion rate of 1 to 3 between both types of plantations. Relying on a bunch of early 20th century sources (see the Online Appendix in Martinelli, 2014), we assume 50 thousand Lire per family farmhouse and 10 thousand Lire per hectare of intercropped vines. We obtain a figure of 28 thousand million lire at 1929 prices. We neglect other necessary infrastructure costs (e.g.roads) which would have increased the final bill. Peasants were re-settled in some limited areas of the South as part of the land reform of the 1950s, at a very high cost (Bianchi-Vimercati et al., 2022 and Caprettini et al. 2022).

Southern environment, the high land/labor ratios and the European demand for grain fostered the specialization in extensive wheat-growing and livestock-rearing rather than in tree crops and thus reduced the need to live close to the fields and increased the advantages of central location for the labor market (Davies 1983). Historians prefer to stress the autonomous decision-making by kings and feudal lords and their interest in social control of peasants and the protection which agglomerated dwelling offered against the incursion of Muslim pirates, who plagued the Mediterranean from the early 16th century to the early 19th (Lorenzoni, 1910 p. 43, Tabak 2008, Davis, 2003, tab. I). Conflicts fostered concentration of people in cities all over pre-industrial Europe (Dincecco and Onorato, 2016), but pirate raids were exceedingly dangerous as they aimed at plundering and enslaving rather than at conquering new territories [18]. After experiencing such agglomeration push, other institutional and economic aspects of agro-towns (such as wealth concentration, the ease of social control by local elites and fixed costs in the provision of other public goods) tended to reinforce each other and resulted in a self-sustaining equilibrium providing strong frictions to change (see the levels and trends in Table 2). In a recent paper, Accetturo et al. (2019) find that the probability of Muslim pirate attacks shaped the geography of municipalities in 1871 and that its effect lasted well into the 20th century, only to vanish in the few decades following WWII. They measure the probability of attack with the geographical distance from Tunis, the center of Muslim piracy.

We adopt a similar approach and instrument the share of scattered population with the exposition to Barbary piracy, as proxied by the shortest travel time (by sea and/or land) from Tunis, in the late Middle Ages and Early Modern period, to any point of Italy using the fastest preindustrial transportation mean. We rely for this on Roman transport technology, as estimated with ORBIS – the Stanford Geospatial Network Model of the Roman World (http://orbis.stanford.edu/), which takes into account the speed of different transportation means, the strength and direction of sea streams, the existence of Roman roads and topography. The exclusion restriction easily holds. Even assuming that pirates were looking for wine, a rather implausible case given the religious restrictions and the cost of transporting wine back in Tunis, they would have surely been not interested in how wine had been produced.

[18] Other military frontiers with religious cleavages, such as the area of Spain affected by the medieval Reconquest, generated agglomerated settlement patterns similar to Southern Italian agro-towns lasting well into the 20th century (Oto Peralías, 2018, Alvarez Nogal et al., 2020).

5) The results: intercropping in the 1930s

We run eq.(1) for a total of 710 zones. We drop the 28 non-wine producing zones and, for lack of data for controls, 57 others, scattered all over the country (with a small cluster on the Eastern border), which accounted for 4% of Italian wine output. The most accurate measure of the diffusion of intercropping is the share on output, which takes into account the density of plants and their productivity. We report the results of our baseline OLS specification in Table 3, starting with the share of scattered population only (column 1) and then adding first the economic controls (column 2) and then the three sets of geographical ones (columns 3 to 5)[19].

TABLE 3

Intercropping and the settlement pattern

Dependent Variable:	% Intercropped Grapes				
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
a) Settlement pattern					
Scattered population (%)	0.890***	0.421***	0.237***	0.330***	0.314***
	(0.053)	(0.070)	(0.068)	(0.063)	(0.065)
Agricultural employment (%)		-0.157*	-0.017	-0.070	-0.071
		(0.082)	(0.078)	(0.072)	(0.075)
Agricultural population density		0.003	0.021	0.010	0.003
		(0.028)	(0.027)	(0.028)	(0.028)
b) Crop mix					
Wine specialisation		-0.062	-0.289***	-0.203***	-0.184***
		(0.068)	(0.073)	(0.066)	(0.066)
c) Risk variables					
Hail risk		0.113***	0.069**	0.066**	0.048
		(0.028)	(0.027)	(0.031)	(0.030)
Tenants		0.544***	0.599***	0.412***	0.480***
		(0.118)	(0.110)	(0.111)	(0.113)

[19] For the sake of readability, we present results in a compact format without displaying the full set of geographic dummies. We report the full results in the Appendix A2, where we also report further robustness checks. First, following Conley (2008), we also adjusted standard errors allowing for spatial autocorrelation to take place at very different distances around any given agrarian zone (from 25 to 500 km). Results with so-called Conley standard errors are insensitive to such an adjustment, suggesting little role for unobservable variables clustered at the spatial level. Second, since our dependent variable cannot take values smaller than 0 and greater than 1, we ran Tobit regressions censoring the dependent variable between 0 and 1. Again, results are qualitatively analogous (if not better) than the baseline OLS regressions.

Sharecroppers		0.511***	0.339***	0.132	0.171**
		(0.079)	(0.075)	(0.083)	(0.082)
Agrarian Family Income		0.005	0.000	0.005	0.006*
		(0.003)	(0.003)	(0.003)	(0.003)
d) Transport costs					
Ruggedness		-0.269**	0.008	-0.148	-0.124
		(0.121)	(0.123)	(0.107)	(0.113)
e) Scale variables: wine growing					
Farm Size		-0.005***	-0.004***	-0.005***	-0.006***
		(0.002)	(0.001)	(0.001)	(0.001)
Landownership Value		0.013	0.008	-0.002	-0.001
		(0.009)	(0.009)	(0.008)	(0.008)
Landownership Value Inequality		0.142	-0.010	-0.017	-0.067
		(0.199)	(0.184)	(0.180)	(0.184)
f) Scale variables: wine processing					
Quality Wine		-0.080***	-0.024	-0.032	-0.037*
		(0.022)	(0.022)	(0.021)	(0.021)
'Fattorie'		0.048***	0.033**	0.031**	0.045***
		(0.015)	(0.013)	(0.015)	(0.016)
Cooperative Wineries		0.253***	0.195***	-0.018	0.012
		(0.065)	(0.064)	(0.111)	(0.097)
g) Environment					
Temperature		-0.013*	0.009	-0.002	0.002
		(0.007)	(0.008)	(0.007)	(0.007)
Rainfall		0.404***	0.298***	0.292***	0.348***
		(0.036)	(0.036)	(0.037)	(0.037)
Soil texture (% Clay)		0.393*	0.850***	0.408*	0.626**
		(0.230)	(0.223)	(0.246)	(0.245)
h) Geography					
North-South Dummies	NO	NO	YES	NO	NO
Pre-Napoleonic States (1796)	NO	NO	NO	YES	NO
Risorgimento States (1859)	NO	NO	NO	NO	YES
Constant	0.174***	-0.336*	-0.249	-0.264	-0.342*
	(0.018)	(0.179)	(0.193)	(0.179)	(0.180)
N. of Observations	751	710	710	710	710
Adjusted R^2	0.244	0.581	0.643	0.669	0.653
F-Statistic	283.849	113.070	137.407	102.359	114.239

Note: Robust standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The overall performance of the model, as measured by the R2 and the F-statistics, is good and our variable of interest is always highly significant. A coefficient around 0.3 implies that an increase in one standard deviation of the share of scattered population leads to an increase of 6.5% in the share of output from intercropping, amounting to 16% of the standard deviation of the dependent variable. These results are robust to the inclusion of the two controls for the potential bias from census data, which are never significant. The share of wine on total GSP (Wine specialization) is negative as expected and strongly significant in the specifications with the geographical controls. This is reassuring for our hypothesis of a two-steps decision process, as the variable is aimed at capturing all determinants of the choice of wine production in the first step (resource endowment, market access, trade policy and so on).

The other variables offer many insights on the determinants of the choice between specialized and intercropping.

a) Risk appears to have been an important factor in household decisions. An increase in one standard deviation in hailstorms probability explains ca. 10% of the variation of intercropping across the country[20]. The capacity to withstand risk seems to have affected the choice of the cultivation pattern especially via the access to land. In fact, the agrarian family income is not significant, while, as expected, tenants and sharecroppers, *ceteris paribus*, took fewer risks than owners. In presence of capital market imperfections, pervasive in developing economies, the cost of credit (and therefore insurance) is inversely proportional to land assets (Suesse and Wolf, 2020), making alternative forms of insurance such as intercropping more attractive for asset-poor family farmers. However, fixed-rent tenants were slightly more prudent than sharecroppers, in contrast with the stress on risk as an explanation for the choice of sharecropping vs. fixed-rent tenancy in the literature (Allen and Lueck, 2002, and Federico 2005). This result can be explained by a key provision of the sharecropping contract (*mezzadria*) in Central Italy. The landlords, who were arguably less risk-averse than peasants, exerted quite strong control on the allocation of land and they had an informal obligation to help sharecropping tenants with loans and subsidies if the harvest failed. Fixed-rent contracts, which prevailed in other regions, did not feature these obligations and thus tenants bore the whole burden of crop failures.

[20] Analogous results are obtained by using as climatic risk variable Storm, the unfiltered measure of severe thunderstorms regardless they could convey hail stones, from which Hail risk has been derived.

b) Ruggedness is negative, as expected but it becomes not significant if we add geographical controls. We speculate that its effect on transportation costs was compensated by differences across zones in the endowment of rural roads and trails from century-old investments.

c) Somewhat unexpectedly the size of estates did not matter: the average value of estates ('Landownership value') is not significant even when corrected with distribution ('Landownership value inequality'). These results are consistent with the ambiguous effects of the economic size of the estate (i.e., scale effects in processing as opposed to larger financial clout to hedge risks of large landowners) and indirectly confirms the relevance of institutional factors and historical legacies in explaining the significant geographical dummies. In contrast, the negative and significant coefficient of the productive units ('Farm size') confirms the relevance of scale effects in cultivation and implies that the large estate effect prevailed over the tiny plot one[21]. This result is confirmed by the coefficients of 'Cooperative wineries' and '*Fattorie*', which shows that the availability of centralized facilities for processing removed the constraint to intercropping from limited production. On the other hand, intercropping was negatively correlated to the production of quality wine, at least in some specifications. From a purely technical point of view, nothing prevented the production of high-quality wine from intercropped grapes, provided that all stages of production were strictly controlled, as in the '*fattorie*' of the Chianti area[22]. However, monitoring was expensive, and producing quality wine raised the scale threshold for profitable processing, making intercropping more difficult. In theory, the quality premium for the wine of a given area might have affected negatively intercropping also by increasing the opportunity cost of land and thus, ceteris paribus, the incentive for specializing the farm in wine-growing. This latter effect, however, should be already captured, at least in part, by the variable 'Wine specialization'.

[21] Including in the regression the square of Farm size results in a non-significant coefficient, ruling out non-linear effects.

[22] Intercropping was indeed widespread in at least some other areas producing renowned wines for the market, in addition to Chianti, such as Orvieto and the withe wines of Treviso (Conegliano and Valdobbiadene), as well as the high-quality wines of the province of Verona (both reds, like Bardolino, Valpolicella and Valpantena and whites, like Soave). For the latter we even have some hard data from a 1939 official survey ('I vini pregiati della provincia di Verona'): the whole province produced 327 thousand hectoliters of 'vini pregiati' or quality wines (out of a total output of 460 thousand hectoliters). Since specialized production accounted for just 130 thousand hectoliters, the majority of quality wine output must have come from intercropped vines.

d) The results for testing environmental determinants confirm Marescalchi's suggestion on the role of soil humidity in determining the choice of the *piantata* (with Rain and Soil texture positive and significant) but not the hypothesis about the need for tree shade in hot climates (Temperature is not significant)[23].

Tab 4 reports the results of a robustness check with three different and arguably less precise dependent variables, the share of intercropped acreage on total wine-producing acreage (column 1 with only economic controls, column 2 adding geographical dummies), the share of intercropped vines on total vines (columns 3 and 4) and the density of vines, in thousands per hectare (columns 5 and 6).

TABLE 4

Intercropping and the settlement pattern: robustness checks
Alternative measures of intercropping

Dependent Variable:	% Intercropped Area		% Intercropped Vines		Vine Density	
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
a) Settlement pattern						
Scattered population (%)	0.239***	0.360***	0.157**	0.253***	-1.257**	-2.454***
	(0.070)	(0.064)	(0.067)	(0.062)	(0.550)	(0.566)
b) Crop mix						
Wine specialisation	-0.416***	-0.345***	-0.229***	-0.190***	1.828***	1.247*
	(0.078)	(0.066)	(0.073)	(0.068)	(0.638)	(0.642)
Other settlement pattern variables	YES	YES	YES	YES	YES	YES
Other economic variables	YES	YES	YES	YES	YES	YES
Environmental variables	YES	YES	YES	YES	YES	YES
North-South Dummies	YES	NO	YES	NO	YES	NO
Pre-Napoleonic States (1796)	NO	YES	NO	YES	NO	YES
Constant	-0.303	-0.109	-0.249	-0.176	10.634***	8.818***
	(0.205)	(0.191)	(0.204)	(0.181)	(1.681)	(1.640)
N. of Observations	710	710	710	710	710	710
Adjusted R^2	0.682	0.717	0.592	0.627	0.648	0.621
F-Statistic	193.752	166.049	82.691	65.368	106.807	71.199

Robust standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Changing dependent variables does not affect the main results: our variable of interest is always highly significant and correctly signed (density of vines is negatively related to intercropping), and the other key

[23] A non-linear specification with squared climatic variables does not yield any significant change.

variable, the specialization in wine is likewise correctly signed and (almost) always highly significant and economically relevant.

Last but not least, Table 5 reproduces Table 3 (with share of output as dependent variable) with the IV estimates and the exposure to Barbary piracy as an instrument.

TABLE 5

Intercropping and the settlement pattern: robustness checks

Instrumenting the share of scattered population

Dependent Variable:	% Intercropped Grapes				
	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV
a) Settlement pattern					
Scattered population (%)	2.169***	1.177***	1.185**	0.621**	0.610**
	(0.293)	(0.302)	(0.549)	(0.256)	(0.259)
b) Crop mix					
Wine specialisation		-0.064	-0.260***	-0.197***	-0.177***
		(0.080)	(0.086)	(0.067)	(0.068)
Other settlement pattern variables	NO	YES	YES	YES	YES
Other economic variables	NO	YES	YES	YES	YES
Environmental variables	NO	YES	YES	YES	YES
North-South dummies	NO	NO	YES	NO	NO
Pre-Napoleonic States (1796)	NO	NO	NO	YES	NO
Risorgimento States (1859)	NO	NO	NO	NO	YES
Constant	-0.184**	-0.653***	-0.357	-0.339*	-0.426**
	(0.077)	(0.212)	(0.222)	(0.187)	(0.192)
Observations	751	710	710	710	710
Adjusted R^2	-0.263	0.498	0.525	0.657	0.641
F-statistic	54.631	86.389	92.865	92.924	103.768
First stage statistics:					
Exposure to Barbary piracy	0.018***	0.018***	0.010***	0.018***	0.018***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Underidentification test:					
Kleibergen-Paap rk LM statistic	52.57	39.53	11.84	36.04	37.02
Weak identification test:					
Kleibergen-Paap rk Wald F statistic	67.18	46.53	11.72	39.76	41.63

Robust standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The first stage statistics confirm the validity of the instrument and rule out the possibility of weak identification. Remarkably, the exposure to Barbary piracy retains sufficient strength to significantly predict the settlement pattern within macro-areas and within historical polities even after we remove a substantial part of its variation across Italy by including geographic controls (columns 3 to 5). The coefficients of the scattered population are higher than the comparable OLS estimates – roughly double for each specification. If anything,

omitted variables would be biasing downwards the OLS coefficients. All other variables bar one (sharecroppers) are very similar. These results lend strong support for a causal interpretation of the settlement pattern as a driver of the adoption of vine intercropping.

6) The results: the demise of intercropping

As said, intercropping started to decline after World War Two and disappeared in the 1990s. This epoch-making change coincided with a period of fast growth and structural transformation for Italy, the so called 'economic miracle'. From 1951 to 1971 GDP per capita almost tripled and agriculture fell from 23% of Value Added in 1951 to 7.5% in 1971 (Baffigi, 2015). Farmers migrated to cities and Southerners to the North: the agricultural workforce shrank from 44% to 18% of total employment (Broadberry, Giordano and Zollino, 2013) and scattered population declined from 11.5 to 4.7 million Italians (from 24% to 9% of population).

In a fast-growing and modernizing country, viticulture thrived (Tirone, 1975, Corsi et al., 2018, Pomarici et al 2021 and, for area-studies, Besana and Locatelli 2019, Maffi 2019, Mocarelli and Vazquez Pineiro 2019, Dell'Osa 2019). Production grew from about 50 million hl in the early 1950s to almost 70 million in the 1970s (ISTAT, on line tab 13.14), thanks to a massive improvement in yields of specialized vineyards, especially in the North East. Real prices for common wine were quite low relative to their peaks of the 1880s, but still rising relative to their pre-war levels (ISTAT 1985). Total demand initially increased, as rising incomes made wine affordable to large swathes of the population, but since the late 1960s consumers, especially urban ones, became more discerning. They started to drink less but better wine and their choice was made easier by legislation to protect high-quality wine. Some well-known wines, such as Chianti, had been already subject to specific measures before the war but a nation-wide law was issued only in 1963, thirty years later than the comparable French one. It distinguished quality wines, labelled DOC (*denominazione di origine controllata* - or approved origin) and top-quality wines, or DOCG (*denominazione di origine controllata e garantita* - or approved and guaranteed origin) and specified the area of production and the variety of grapes for each of them. These DOC and DOCG wines accounted for 5% of total output in 1970 (Corsi et al., 2018).

The conventional wisdom lists the increase in demand for quality wine as one of the causes of the decline in intercropping, jointly with the domestic and European policies and the belated effects of phylloxera

(Desplanques 1956, Tirone 1975 and 1996, Ferrario 2019). The disease had arrived in Italy in the 1880s, and fifty years later the insect had been detected in almost all provinces (Federico and Martinelli 2018). It spread more slowly than in France, also thanks to intercropping, but by 1948 it had already forced to eradicate 94,000 hectares of specialized vineyards and 300,000 hectares of intercropped ones, i.e. about 10% of the pre-war acreage, while 109,000 hectares of vineyards (11.2% of the total) and almost one million of hectares of intercropped acreage (32.4%) were infected (Spagnoli, 1948). As in France, replanting gave the opportunity to substitute the *piantate* with vineyards, which accounted for 54% of the eradicated vines but for 67% of the newly planted ones. The switch to specialized cultivation was particularly attractive in areas of production of high-quality wines, where the opportunity cost of land was high.

The substitution of intercropped vines with specialized vineyards was strongly fostered by national and European policies. In the 1950s, intercropping was considered by experts a relic of the past and the revamped and augmented extension services strongly criticized farmers who still clung to the tradition. The two *Piano verde* (plans for agriculture) of 1961-1965 and 1966-1970 offered generous loans for replanting vines in specialized vineyards, with limitations to the varieties which could be planted. The demise of intercropping was accelerated by the sudden change in incentives in the late 1970s, when the European community reacted to an overproduction of wine by prohibiting new plantations outside the DOC and DOGC areas and by subsidizing the extirpation of vines. Of course, the old intercropped vines were the first to go.

These sector-specific trends did contribute to the decline of intercropping, but they cannot explain it entirely. The decline started before the adoption of pro-vineyard policies and, above all, proceeded at different rates across the country, as highlighted by Map 1. In theory, regional differences in the rate of decline could reflect differences in the shares of quality wine and/or in the pattern of diffusion of the phylloxera, but our model suggests an alternative explanation. The regional rates of decline must have depended on changes in the share of scattered population. We test our hypothesis by re-running our baseline model (eq 1) with a Fixed Effects panel regression approach and by estimating the dynamic model

$$\Delta INTERCROPPING_{i,t} = \alpha + \beta\, \Delta SCATTERED_{i,t} + \gamma' \boldsymbol{X_{i,t}} + \varepsilon_{i,t} \quad (2)$$

where Δ is the First Differences operator, *i* denotes the unit of analysis (here provinces, rather than the agrarian zones used in the previous section) and *t* denotes time periods. Unfortunately, there are sizeable data

constraints for the number of observations, the choice of periodization and the set of controls **X**. The official agricultural statistics published yearly figures of grape production from specialized and intercropping vines only at provincial level (i.e., 91 observations rather than almost 800) and the series were severely discontinued by the change in definition in 1969. Population censuses reported data on scattered population in 1951, 1961 and 1971, but data on other dimensions of rural life like agricultural contracts, farm size and land inequality are unavailable or incomparable across the censuses. Unfortunately, there are neither data on the composition of agricultural output at provincial level in the period, nor suitable data on average income of agricultural families, size of farms, the number of fattorie and on the diffusion of the phylloxera after 1948 [24].

The vector of controls **X** includes time dummies for 1960 and 1970, the number of tractors, and two (allegedly imperfect) measures of quality wines and of cooperative wineries, as well as factors capturing heterogeneity in the decline of intercropping across macro-regions. The Time dummies capture the nation-wide impact of changes in legislation since the 1960s, of the protection of quality wines and of the incentives to substitute vineyards to intercropping, as well as the expansion of alternative forms of insurance against risk provided by financial development – and thus their expected signs are negative. The availability of tractors may have affected negatively intercropping for technical and economic reasons. The rows of trees in the fields made the use of tractors more difficult, while deep ploughing with tractors damaged the roots of vines and trees (Desplanques 1956). Furthermore, tractors reduced the time for transportation– they were more suitable for moving around in the countryside than mopeds or cars. We have only information on the number of cooperative wineries per province in each year (from Federazione Italiana delle Cantine Sociali, 1974), which we weight by year of foundation in order to better approximate the greater productive capacity of the most established ones. Unfortunately, there is no data on provincial output of quality wine until the 1980s and thus we measure it very imperfectly by combining the number of typical wines at the 1933 Siena exhibition and the approval dates of DOC wines [25].

[24] We have also dropped the time-invariant variables hail, ruggedness, temperature, soil texture – which are now captured by the FE.

[25] We have, first, matched all DOC wines existing in 2011 with the names of wines present at the Siena exhibition of typical wines in 1933, and then added them up at provincial level (following present-day official definitions) to measure quality wines in 1951. Second, for 1961 we added to the previous figure the wines not present in Siena but recognized as DOC between 1966-1970 (during the first five years when this was possible). Finally, quality wines in 1971 are the

The reduction in geographical detail causes a substantial loss of statistical precision and thus should bias our coefficients against finding statistical significance. The geographical aggregation, jointly with the forced omission of some variables, explains the lowish R2, especially for the First Differences version. In spite of the low geographical detail, the results of both the Fixed Effects panel regression (cols 1 to 3) and the First Differences dynamic specification of eq.2 (cols 4 to 6) are consistent with our previous analysis (Table 6).

In both cases, we first explore time and geographic effects. In the FE specification we interact the geographic dummies[26] with the time effects, allowing the latter to vary across macro-areas (i.e., searching for area-specific differences in rates of decline). Column 1 shows that the decline accelerated during the 1960s, driven by a particularly fast abandonment of intercropping in the North. The average Italian province (with no differences between the Centre and the South) had 5.6% fewer grapes produced from intercropping in 1970 than in 1950, but for Northern provinces the decline was 19.2% (13.6%+5.6%), and had begun in 1960 with an average 6.2% decline. In the FD specification (column 4) we only have two cross-sections and one decade dummy (capturing 1960-1970 differences with respect to 1950-1960). Limited temporal variation does not allow to estimate time trends with precision, but also in this specification we find a faster decline between the two periods in the North than elsewhere.

In the other columns we include our variable of interest, which is positive and highly significant and remains so also after adding the controls (cols 3 and 6). With just three time periods, the preferability of the FE over the FD estimator is unclear. The fact that the coefficients of scattered population are almost identical with either specification is therefore very reassuring. The coefficient of the FD specification with controls implies that one point decline in the share of scattered population caused an almost equivalent (0.6 points) absolute decline in the share of intercropping. Thus, an increase in one standard deviation in the (negative) change of the share of scattered population between censuses accounted for about half the decline in intercropping at the average, a substantial economic effect.

previous ones plus those who received a DOC between 1971 and 1975 (which we assume to have been already on the market by 1971 and having begun the legal process for getting recognition). See the Appendix A3 for further details.

[26] North and South are defined as in the cross-sectional analysis of section 5, with Central Italy as the reference category.

TABLE 6

The decline of intercropping, 1950-1970

Dependent variable:	% Intercropped grapes			Δ% Intercropped grapes		
	FE	FE	FE	FD	FD	FD
	(1)	(2)	(3)	(4)	(5)	(6)
Scattered Population		0.729***	0.605***		0.723***	0.603**
		(0.220)	(0.223)		(0.259)	(0.271)
Agricultural employment			-0.021***			-0.029***
			(0.007)			(0.006)
Tractors (000s)			-0.006*			-0.007**
			(0.004)			(0.003)
Cooperative Wineries			0.001			0.002
			(0.009)			(0.009)
Quality wine			0.013			0.014
			(0.010)			(0.009)
North				-0.062**	-0.074***	-0.056*
				(0.025)	(0.027)	(0.029)
South				0.006	-0.017	-0.009
				(0.028)	(0.029)	(0.030)
Time Effects						
1960	-0.009	0.032	0.023			
	(0.021)	(0.027)	(0.027)			
1970	-0.056**	0.040	0.029	-0.037	-0.024	-0.015
	(0.025)	(0.039)	(0.039)	(0.027)	(0.028)	(0.028)
1960 * North	-0.062**	-0.074***	-0.058**			
	(0.025)	(0.027)	(0.029)			
1970 * North	-0.136***	-0.172***	-0.130***	-0.012	-0.024	-0.012
	(0.036)	(0.038)	(0.043)	(0.038)	(0.039)	(0.039)
1960 * South	0.006	-0.017	-0.009			
	(0.028)	(0.030)	(0.031)			
1970 * South	0.033	-0.028	-0.017	0.021	0.007	0.000
	(0.026)	(0.034)	(0.036)	(0.044)	(0.046)	(0.048)
Constant	0.418***	0.275***	0.281***	-0.009	0.032	0.022
	(0.007)	(0.044)	(0.050)	(0.021)	(0.028)	(0.028)
N. of Observations	273	273	273	182	182	182
Adjusted R^2	0.406	0.453	0.464	0.128	0.168	0.179
F-statistic	12.224	12.158	9.773	8.195	8.934	6.754

Note: Robust standard errors clustered at the province level in parentheses. Columns (1) to (3) report the coefficients obtained with the Fixed Effects estimator for a panel data with three periods (1950, 1960 and 1970). Columns (4) to (6) report the results obtained with the First Differences estimator (i.e., pooled OLS with two cross sections of first differences, 1970-1960 and 1960-1950). In the latter case, time effects refer to decadal change rather than specific decade effects, but we report them as in the table to improve readability (i.e., the '1970'dummy should be interpreted as a '1960-1970' dummy). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The coefficient of the agricultural workforce is negative (ceteris paribus a decline in workforce augmented intercropping), but very small. The variable 'Tractors' is negative, as expected. The coefficients of cooperative

wineries have a positive sign, as theory suggests and consistently with our results for the 1930s, but they lack statistical significance, maybe because of substantial measurement error. Conversely, the coefficients of quality, while not significant, are not even of the expected sign. Our variables might fail to sufficiently approximate the temporal and spatial variation in the development of post-war quality wines. Alternatively, these results might suggest that intercropping did not pose an obstacle to the development of quality wine. Intercropping was negatively correlated with quality only in (initial) levels, but not that much in trends.

7) Conclusions.

In the last decades a vast literature in economic history and in agricultural economics has explored the motivations of traditional agricultural practices, showing that allegedly irrational behavior could be understood with simple economic reasoning (Federico 2005). This paper contributes to this literature by focusing on a traditional practice, the scattering of vines across fields rather than concentrating them in specialized vineyards, as it is common now. We have argued that scattering was an additional risk-minimizing strategy, on top of the basic diversification of the crop mix. Once decided the composition of desired output, and thus the number of vines, farmers sought additional protection against localized adverse weather conditions. However, intercropping increased the time and thus the cost of transportation and it was rational only where dwellings of agricultural population were close enough to the fields as to make this insurance strategy profitable. Thus, intercropping was widely adopted in Centre and North-East Italy, where peasants lived in houses scattered in the fields, and not in most of the South, where casual agricultural workers were concentrated in large urban centers.

The case of intercropping speaks to the literature on economic development and modernization of peasant societies. Intercropping in the early 1930s was the rational choice in a world which was soon to disappear thanks to the fast growth during the 'economic miracle'. The massive migrations to cities, supplemented by sector specific factors such as the spread of phylloxera and European agricultural policies, made intercropping no longer profitable. Another century-old agricultural activity, the raising of silkworms for the production of cocoons, experienced a similar decline from the early 20th century, as it was too labour intensive to be profitable in a modernizing country (Federico 1993, 1997). Interestingly, also mulberries were scattered across fields and in quite a few areas they were used as support for vines. However there was an

essential difference between silk and wine. The end of local supply of cocoons caused the silk production to disappear and now Italian fashion industry imports all its raw material. In contrast, the Italian viticulture transformed itself. Production was concentrated in specialized vineyards and producers invested heavily in new varieties of grapes, advanced machinery for processing and marketing – so that Italy now is a world leader in the production of quality wine which it exports all over the world.

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APPENDIX

This Appendix includes the following sections:

A.1 Variables, Sources and Summary Statistics for the Cros-Sectional Analysis – Intercropping in the 1930s (Corresponding to Sections 4 and 5 in the text).

A.1.1. Dependent Variables.

A.1.2. Independent Variables. Includes Maps A1 and A2 (pre-Unification polities in 1796 and 1859) and Map A3 (Exposure to Barbary Piracy).

A.1.3. Summary Statistics

A.1.4. Literature.

A.2 Extended Tables for the Cross-Sectional Analysis – Intercropping in the 1930s (Corresponding to sections 4 and 5 in the text).

A.3 Variables, Sources and Summary Statistics for the Dynamic Analysis – Intercropping between the 1950s and 1970s (Corresponding to Section 6 in the text).

A.3.1 Dependent Variable.

A3.2. Independent Variables. Includes Estimate of Temporal Variation in Quality Wine with extended List of DOC Appellations by province at 1950 constant borders matched with their presence at the First Exhibition on Typical Wines at Siena in 1933.

A3.3. Summary Statistics.

A3.4 Literature.

A.4 Estimate of the Vineyard area in the early 19th century (Corresponding to Map 1 in the text).

A.5 A Model of the Intercropping Choice.

A. 1. VARIABLES, SOURCES AND SUMMARY STATISTICS FOR THE CROSS-SECTIONAL ANALYSIS – INTERCROPPING IN THE 1930S (SECTIONS 4 AND 5).

In this section we present the variables used in the paper, explain how they have been constructed and identify their sources. Unless otherwise stated, all variables are measured at the agrarian zone level. We present also summary statistics of all the variables used from the comparable sample of 710 observations for which we have data about all variables, i.e., the one used in columns 2 to 6 in Table 3 in the body of the paper.

A. 1.1. Dependent Variables.

1. ***% Intercropped Grapes*** measures the share of grapes produced in intercropped vineyards in 1929. Data come from the so-called 1929 Agrarian Cadastre (ISTAT 1932-1936), a highly detailed national survey of all crops and land uses, which included additional physical, economic and agricultural information referred to the year 1929. Data were published at the municipality and agrarian zone level in 94 provincial volumes. ISTAT (1932-1936) provides aggregate output figures (in quintals), yields per hectare of specialised vineyards and the hectares of both specialised and intercropped vineyards. This allows us to obtain output in intercropped vines by difference. The 1929 Agrarian Cadastre considered different subcategories of vine-planting techniques. The group of "specialised vineyards" included, in addition to plots exclusively growing vines (*superficie integrante specializzata*), also other fields with vines planted among some olive trees or other tree crops, provided that grapes were the most important product of the plot (*superficie integrante a coltura mista prevalente*). The acreage of a plot was classified as an "intercropped vineyard" if vines in tree crop fields were a secondary product (*superficie ripetuta in altre colture legnose specializzate*), if they were grown among arable fields (*superficie ripetuta in coltura promiscua* – the overwhelming bulk of the intercropping category, with 97% of the acreage) or in the edge of fields or alone (*superficie ripetuta nelle tare e sparse*).

2. ***% Intercropped Area*** measures the share of all area with vines that was cultivated in an intercropped form. The source is, again, the 1929 Agrarian Cadastre (ISTAT,1932-1936).

3. ***% Intercropped Vines*** measures the share of vines that were planted in intercropped fields. The number of vines and their planting technique is reported in the 1929 Agrarian Cadastre (ISTAT, 1932-1936).

Vine density measures the number of vines (measured in thousands) per hectare in fields with vines. Intercropping is negatively correlated with vine density, and hence we expect anything having a positive impact on intercropping to have a negative impact on vine density.

A. 1.2. Independent Variables.

1. ***Scattered Population (%)*** measures the share of population living dispersed in the countryside in April 1931. For a given level of population density, the more people living dispersed, the closer the average peasant is to his plots. Dispersed or scattered population was defined by the 1931 Population Census as all inhabitants not living in "centres". A dwelling or a group of neighbouring dwellings was defined as a "centre" if it was physically close to at least one public space of agglomeration where social interaction could take place, like a church, a station, a school, a state office, a shop and the like, and considering the geographical conditions of the municipality. For example, small groups of dwellings in mountainous or remote areas were defined also as "centres", since they served as a social and economic reference point to surrounding dispersed dwellings, even if they lacked the aforementioned elements. Thus, the definition of a centre had nothing to do with the population size of a settlement, but was rather defined on geographic and social bases. Those "centres" were identified on a case by case basis by a special commission working for the 1931 Population Census. A municipality could have several "centres" (often, it had many ones). See ISTAT (1935) for further methodological details. Although the data were originally published in a specific Population Census volume (ISTAT, 1935), we actually digitized them from the provincial

volumes of the Agrarian Cadastre (ISTAT, 1932-1936), where they were also published along with additional geographical and demographic information.

2. ***Agricultural Employment (%)*** measures the share of agriculture in total employment. We measure it with the share of families whose family head was classified as employed in agriculture in April 1931 from the 1931 Population Census. We need to rely on household level measures of employment because occupational information at the individual level is not available at agrarian zone level in the 1931 Population Census. An alternative measure, the share of members of families whose family head was employed in agriculture, is very correlated with this one and yields similar results. We digitized the data from the provincial volumes of the 1931 Population Census (ISTAT, 1931-1935).

3. ***Agricultural Population Density*** measures the density of agricultural employment per hectare. We construct this variable by dividing the number of members of families whose family head was employed in agriculture in April 1931 (which we think approximates better the size of the agricultural labour force as required by any measure of density than the mere number of families) divided by total agricultural and forest land. Data on members of agricultural families come from provincial volumes of the 1931 Population Census (ISTAT, 1931-1935). Data on agricultural and forest land are taken from the provincial volumes of the Agrarian Cadastre (ISTAT, 1932-1936).

4. ***Wine Specialisation*** measures the share of wine and related products (and by-products) in agricultural Gross Saleable Production (GSP) in 1929. In particular, it is the ratio of the sum of the value of wine output, table grapes for direct consumption, wine grapes for direct consumption, the value of bottling and ageing attributed to quality wines (estimated using provincial shares from the 1980s applied to the late 1920s), and the value of marc and dregs over total agricultural Gross Saleable Production. For further details on the procedures and methods of the estimate, see the online appendix to Martinelli (2014).

5. ***Hail risk*** is a measure of the probability of having hailstorms, computed dividing the number of severe thunderstorms compatible with hail formation occurred between 2004 and 2014 in an agrarian zone by its total area. Satellite detections of severe thunderstorms (potentially conductive to hailstorms) are based on overshooting cloud tops (Bedka, 2011). Since not all such thunderstorms led to actual hailstorms, Punge et al. (2017) filtered them to obtain an 11-year dataset of storms whose updraft velocity in the core was large enough to support hailstone growth. At the present moment, this is the most refined measure of the probability of experiencing a hail event with high spatial accuracy. As a robustness check, we also used in the analysis the non-filtered dataset. Results (available upon requests) were qualitatively very similar. We thank Heinz Jürgen Punge, Susanna Mohr and Michael Kunz for sharing with us both datasets and for introducing us to the methodological details (and challenges) of measuring hail hazard.

6. ***Tenants*** measures the share of rented tenants in the population of decision-making farmers (i.e., rented tenants, sharecroppers, owner operators and operators holding a mix of these contractual arrangements) in April 1936. We take these data from the 1936 Population Census (ISTAT, 1939), since it provides higher detail than the 1931 Census on the occupational structure of agricultural employment at the agrarian zone level.

7. ***Sharecroppers*** measures the share of sharecroppers in the population of decision-making farmers (i.e., rented tenants, sharecroppers, owner operators and operators holding a mix of these contractual arrangements) in April 1936. As with *Tenants*, we take these data from the 1936 Population Census (ISTAT, 1939).

8. ***Agrarian family income*** measures the income of agricultural families in 1929, measured in thousand Italian lire. We estimate it by dividing the value of total agricultural output (GSP, estimated by Martinelli, 2014) by the number of families with a family head employed in agriculture in 1931 (from the Population Census in ISTAT 1931-1935).

9. ***Ruggedness*** is a measure of the terrain ruggedness of the agrarian zone. We computed it as the average difference in altitude between several points within the agrarian zone, measured in km. We relied on four variables related to altimetry: the maximum altitude of a municipality (Max_{abs}), the minimum altitude (min_{abs}), the maximum prevailing altitude (Max_{prev}) and the minimum prevailing altitude ($_{prev}$). These variables, computed by the Italian Geographical Military Institute, were published in the provincial volumes of the 1929 Agrarian Cadastre (ISTAT, 1932-1936) for each of the 7313 Italian municipalities. The first two variables measure, respectively, the maximum and minimum altitude reached by any point within a municipality. "Prevailing" altitudes were defined as the upper and lower bounds within most of the municipality laid – hence, avoiding outliers. Although we do not have more specific information on this point, we assume that 50% of the municipality laid within the "prevailing" maximum and minimum altitudes of the municipality: 25% laid between the absolute and prevailing maxima altitudes and another 25% laid between the absolute and prevailing minima altitudes. Hence, we compute our measure of ruggedness at the municipality level as $0.25(Max_{abs}-Max_{prev})+0.5(Max_{prev}-min_{prev})+0.25(min_{prev}-min_{abs})$. The agrarian zone level measure (the one we use in the regressions) is the weighted average of municipality level measures, using total municipality area as weights. The original data were in meters, but in order to produce easily readable coefficients, we transform our final variable in kilometres.

10. ***Farm size*** measures the size in hectares of the average farm, as published in the 1930 Census of Agriculture (ISTAT, 1935b).

11. ***Landownership value*** measures the average land rent per private ownership at the end of the 1930s, which is a proxy of the economic (rather than physical) size of landownerships, unitary rents being a way of adjusting size by value. What was called ownership of "entities" (mostly public land) is excluded from this measure. Most public ownerships consisted in large forests and their use was subject to a decision-making process quite different from that of private lands (where all wine production took place), and hence it seems reasonable to exclude them. The main source is a special national Inquiry on the distribution of landownership carried out by the Italian National Institute of Agrarian Economy immediately after WWII

(INEA, 1946-1948). Although our measure refers to the late 1930s (see Martinelli, 2016 for a discussion of the source and its main features), we have no reason to think that there were major changes across the country between the early and the late 1930s.

12. ***Landownership value inequality*** measures the Gini coefficient of the distribution of rent per private ownership at the end of the 1930s as computed by Martinelli (2016) from INEA (1946-1948). It is a measure of the inequality of private landownership distribution adjusting hectares by their value – and hence is a more precise measure of the economic inequality in the distribution of landownership. Note that this measure, as the previous one, refers to landownerships and not farms. The former could own several of the latter – as indeed was the case in many parts of the country where landownership and landholding distributions were significantly different (in particular, in Central Italy). See the discussion in Martinelli (2016) for further details.

13. ***Quality wine*** measures the presence of quality wine. Quality is difficult to measure, and in Italy there were no systematic statistics on a related measure (production of wine with an Appellation) until the 1970s-1980s. We proxy the quality of local production with a dummy variable indicating whether in the agrarian zone there was at least one wine producer attending the First National Exhibition of Typical Wine held in Siena in August 1933. 'Typical wine' was an usual way of labelling high-quality wine during this period. The list of attendees is from Comitato Esecutivo (1933). Given contemporary and subsequent information, the distribution of our measure of quality wine seems quite reasonable (see Federico and Martinelli, 2018 for a discussion of quality wine before the post-WWII boom). Our measure of quality wine roughly matches the distribution of the areas that later obtained an Appellation. We tested the robustness of our results by constructing also a continuous variable, this time including the number of producers present in the Siena Fair. The results were very similar to the ones obtained using our preferred dichotomous variable and hence we do not report them in the paper.

14. ***'Fattorie'*** measures the number of "fattorie" (i.e., central management and processing units on which several peasant farms dependend) per 100 farms in March 1930. We take the provincial number of "fattorie" ("amministrazioni di 1º grado") from the provisional figures of the 1930 Census of Agriculture published in the 1931 March issue of the official agricultural bulletin, BMSAF (ISTAT, 1931). Although provisional, these figures are the only source for some of the data collected as part of the Census of Agriculture, like the number of "fattorie" for most of the country. As a measure of the intensity of "fattorie" we normalize it by the provincial number of farms (from the definitive 1930 Census of Agriculture figures in ISTAT, 1935b) and multiply by 100. We hence obtain the average number of "fattorie" per 100 farms. For Central Italy (Tuscany, Marche and Umbria), where the presence of "fattorie" in agricultural organization was most important, we can rely on more geographically detailed figures. The ISTAT published in 1939 for this area a specific elaboration of the Census of Agriculture data (Albertario, 1939). Data were published at agrarian region level (an intermediate unit between provinces and agrarian zones, encompassing the agrarian zones within a province that shared roughly similar physical characteristics - mountains, hills or plains). In addition, Albertario (1939) presents also more detailed data for 5 agrarian zones. It turns out that 3 of these agrarian zones coincide totally with the agrarian regions they belong, but we can still split two agrarian regions (hills of the province of Florence and of Pisa) into the agrarian zone with detailed information (Colle Piano del Valdarno Superiore and Bassa Collina della Val d'Era e Sterza, respectively) and the rest of the agrarian region. By these means we can have data referred to 35 units rather than to the original 15 provinces. Given that the three regions considered had 49% of Italy's "fattorie" (but just 10% of all farms), this higher precision seems particularly adequate.

15. ***Cooperative wineries*** measures the potential share of wine output produced in cooperative wineries. We compute it as the ratio between the productive capacity of local cooperative wineries in 1929 (from Friedmann, 1929) and the 1923-1928 average wine output from the 1929 Agrarian Cadastre (ISTAT, 1932-1936). There were 95 cooperative wineries, most of them in Emilia and Trentino Alto Adige. We assume that the productive capacity is a reasonable proxy of actual wine production (not available to us), especially when compared with the 1923-1928 output average.

16. ***Temperature*** measures the average yearly temperature, measured in Celsius degrees. We collected the monthly average maximum and minimum day temperature data between January 1936 and December 1939 for 714 climatic observation stations across the country from official meteorological publications (Ministero dei Lavori Pubblici, 1936-1939). Since temperature changes with altitude because of changes in atmospheric pressure, we standardized temperatures by reducing them at the sea level. We did this by applying to the altitude of climatic observation stations the Environmental Lapse Rate (-0.65 degrees per additional 100 meters of elevation), a standard measure of the rate at which temperature decreases with altitude. We then used the latitude and longitude coordinates of stations and municipalities (the latter from the geographic information section of the 1929 Agrarian Cadastre, ISTAT, 1932-1935) to spatially interpolate the temperature pattern of all the 7313 municipalities existing in Italy at that time. We did it by means of Inverse Distance Weighting within 100 km. Hence, data from all stations within 100 km from a given municipality are used in the estimate of the latter's temperature. The closer a station is, the larger the weight it receives in producing the final estimate (weights being denoted by the inverse of distances). Finally, we re-adjusted municipality temperature at sea level by altitude using the midpoint between the maximum and minimum prevailing altitudes of each municipality (see the discussion of Ruggedness for further details). We finally computed the agrarian zone level temperatures by weighting each municipality value by area. Eventually, we averaged over all months to obtain a 1936-1939 yearly average.

17. ***Rainfall*** measures the yearly average rainfall between 1936 and 1939, in thousand mm (per square meter). We collected data on the rainfall regime from Ministero dei Lavori Pubblici (1936-1939). In particular, we collected monthly data on the total amount of rain (measured in mm) and the number of rainy days in 1936, 1937, 1938 and 1939 for 4632 climatic observation stations across Italy. We allocate most of these stations to municipalities (with the exception of few cases, where we were unable to do so due to lack of information). When we find more than one station in a municipality, we take the average of them. We then assign municipality values to agrarian zones, taking averages when more than a municipality within the agrarian zone has rainfall data. By considering just one value per municipality in the computation of the

agrarian zone value, we avoid overrepresenting the data of largest cities which often had several stations. Finally, we interpolate data from neighbouring stations for the agrarian zones without climatic observation stations.

18. ***Soil Texture (% Clay)*** is a measure of soil physical properties based on the share of soil particles smaller than 0.002 mm (known as clay) in topsoils. It is derived from raster files available at the European Soil Database (ESDAC) website and extracted at the agrarian zone level by means of QGIS. Soil texture is determined by the size and composition of the different particles present in soils. Sandy soils are composed by relatively large particles, which (owing to the irregular shape of particles) leave a lot of empty space between grains and therefore retain less water (and less moisture). Clay soils are made by the smallest possible particles (those with a diameter smaller than 0.002 mm), which results in more compact, heavier and less permeable soils. As a consequence, clay soils are also associated with a higher capacity to retain water and moisture. We use therefore the share of topsoil being clay as a measure of soil texture.***Geography (North and South)*** are dummy variables defined following present-day conventional macro-regions. North includes all agrarian zones that belong to the regions of Piedmont (inclusive of the Aosta Valley before WWII), Lombardy, Liguria, Tridentine Venetia (the name of Trentino-Alto Adige before WWII), Veneto or venetia (inclusive of the province of Udine before WWII), Venetia Julia (which was either lost to Yugoslavia or under unclear sovereignty after WWII, and hence from practical purposes omitted from much of the analysis owing to missing data on some variables) and Emilia. South includes all agrarian zones of Abruzzi and Molise, Campania, Apulia, Lucania (the name of Basilicata before WWII), Calabria, Sicily and Sardinia.
19. ***Geography (historical polities)*** are dummies defined on the base of pre-unitary historical polities, either the traditional regional states at the end of the Ancien Régime ('Pre-Napoleonic States', at 1796 borders) or the peninsular states existing after the rearrangement that followed the Napoleonic wars ('Risorgimento states', at 1859 borders). We assign an agrarian zone to a pre-unitary polity on the base of geography. For much of Italy this was straightforward, but in some cases an agrarian zone included areas belonging to two or more states. In those cases, we assign the agrarian zone to the state that had the larger share of its

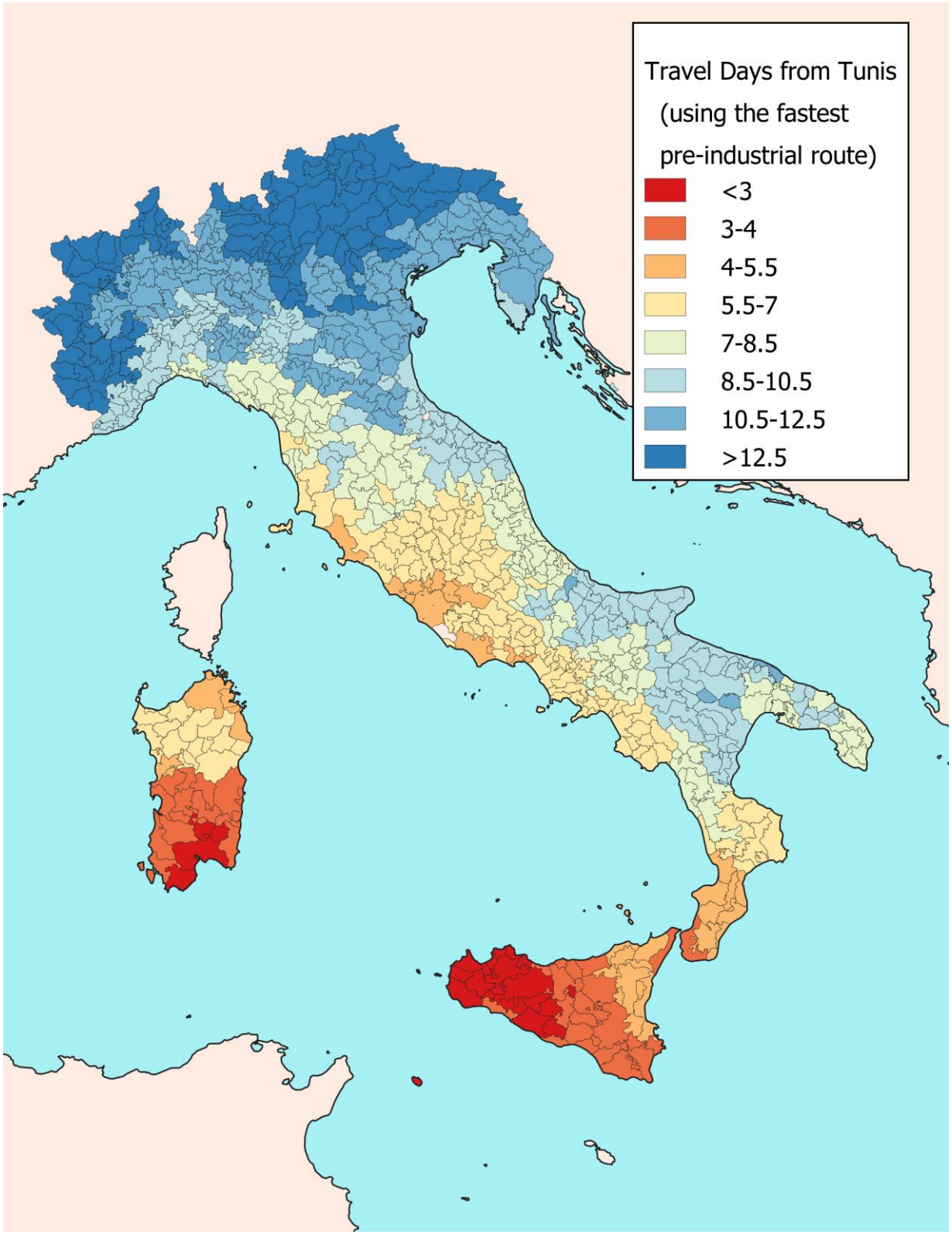
territory. This is was the case in the very complex territorial arrangements of present-day north-western Tuscany, and this also is why the area in the Papal enclaves in the Kingdom of the Two Sicilies (Pontecorvo and Benevento) are coded as belonging to the latter rather than to the former. In some other cases, we have merged two polities into a single one, owing to an exceedingly complex geography and avoiding having too many small polities with a single agrarian zone. This was the case of the Principality of Piombino and State of the 'Presidi' (1796), formally two states (sharing territory over the island of Elba) but under Bourbon control at the end of the period. Similarly, the two independent (but institutionally similar and geographically intertwined) Prince-Bishoprics of Trent and Brixen were formally independent but are considered a single polity. When a polity changed borders between 1796 and 1859, we have coded them as different polities (e.g., the Duchy of Modena and Reggio). We have also added year labels to polities existing just in one of the two periods for expositive clarity, like with 'Republic of Venice (1796)' or with 'Kingdom of Lombardy-Venetia (1859)'. In three cases there is no layer because borders (according to our definition, based on agrarian zones) did not change: the Papal States, the Duchy of Parma and Piacenza and the Kingdom of Two Sicilies. Below we reproduce in the maps A1 and A2 our coding of agrarian zones into historical polities for both periods.

MAP A1. ITALY IN 1796

MAP A2. ITALY IN 1859

20. ***Exposure to Barbary Piracy*** measures the shortest travel time (by sea and/or land) from Tunis, capital of Barbary piracy in the late Middle Ages and Early Modern period, to any point of Italy using the fastest preindustrial transportation mean. We rely for this on Roman transport technology, as estimated with ORBIS – the Stanford Geospatial Network Model of the Roman World (http://orbis.stanford.edu/), which takes into account the speed of different transportation means, the strength and direction of sea streams, the existence of Roman roads and topography. For agrarian zones with no travel node in ORBIS, we estimated the as the crow-flies shortest distance to the closest travel node in the Roman transport network and assumed that Pirates used the fastest land transport technology included in ORBIS (i.e., land raids took place by foot, at 30 km/day). The result of the estimate is shown in map A3.

MAP A3. EXPOSURE TO BARBARY PIRACY



A. 1.3. Summary Statistics.

Summary Statistics					
Variable	Obs.	Mean	Std. Dev.	Min.	Max.
% Intercropped grapes	710	0.429	0.394	0.000	1.000
% Intercropped area	710	0.525	0.421	0.000	1.000
% Intercropped vines	710	0.366	0.371	0.000	1.000
Vine density	710	3.368	3.021	0.048	10.844
Scattered population (%)	710	0.283	0.217	0.000	0.940
Agricultural employment (%)	710	0.543	0.160	0.032	0.892
Agricultural population density	710	0.821	0.519	0.033	4.102
Wine specialisation	710	0.163	0.149	0.000	0.818
Hail risk	710	0.933	0.464	0.000	3.549
Tenants	710	0.113	0.133	0.000	0.715
Sharecroppers	710	0.252	0.257	0.000	0.949
Agrarian Family Income	710	9.286	4.237	0.698	33.353
Ruggedness	710	0.239	0.195	0.002	0.957
Farm Size	710	7.905	7.247	0.747	71.325
Landownership Value	710	1.166	1.648	0.024	12.398
Landownership Value Inequality	710	0.763	0.068	0.563	0.967
Quality Wine	710	0.266	0.442	0.000	1.000
'Fattorie'	710	0.329	0.655	0.000	4.950
Cooperative Wineries	710	0.009	0.076	0.000	1.345
Temperature	710	12.527	3.066	-1.771	25.525
Rainfall	710	1.061	0.371	0.285	2.507
Soil texture (% Clay)	710	0.281	0.060	0.135	0.438
North	710	0.414	0.493	0.000	1.000
South	710	0.396	0.489	0.000	1.000
Republic of Genoa (1796)	710	0.032	0.177	0.000	1.000
Duchy of Milan (1796)	710	0.054	0.225	0.000	1.000
Grisons (1796)	710	0.006	0.075	0.000	1.000
Republic of Venice (1796)	710	0.101	0.302	0.000	1.000
Prince-Bishoprics of Trent and Brixen (1796)	710	0.008	0.092	0.000	1.000
Princely County of Tyrol (1796)	710	0.011	0.106	0.000	1.000
Duchy of Modena and Reggio (1796)	710	0.025	0.157	0.000	1.000
Republic of Lucca (1796)	710	0.004	0.065	0.000	1.000
Grand Duchy of Tuscany (1796)	710	0.058	0.233	0.000	1.000
Principality of Piombino and State of the 'Presidi' (1796)	710	0.003	0.053	0.000	1.000
Papal States	710	0.146	0.354	0.000	1.000
Kingdom of Two Sicilies	710	0.356	0.479	0.000	1.000
Kingdom of Lombardy-Venetia (1859)	710	0.161	0.367	0.000	1.000
Princely County of Tyrol (1859)	710	0.020	0.139	0.000	1.000
Duchy of Parma and Piacenza	710	0.021	0.144	0.000	1.000
Duchy of Modena and Reggio (1859)	710	0.028	0.166	0.000	1.000
Grand Duchy of Tuscany (1859)	710	0.063	0.244	0.000	1.000
Exposure to barbary piracy (days of travel to Tunis with the	710	8.870	3.019	1.650	15.415

fastest pre-industrial technology)

A. 1.4. Literature

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A. 2. EXTENDED TABLES FOR THE CROSS-SECTIONAL ANALYSIS – INTERCROPPING IN THE 1930S (SECTIONS 4 AND 5).

TABLE A1
(COMPARE WITH TABLE 3 IN THE TEXT)
Intercropping and the settlement pattern

Dependent Variable:	% Intercropped Grapes				
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
a) Settlement pattern					
Scattered population (%)	0.890***	0.421***	0.237***	0.330***	0.314***
	(0.053)	(0.070)	(0.068)	(0.063)	(0.065)
Agricultural employment (%)		-0.157*	-0.017	-0.070	-0.071
		(0.082)	(0.078)	(0.072)	(0.075)
Agricultural population density		0.003	0.021	0.010	0.003
		(0.028)	(0.027)	(0.028)	(0.028)
b) Crop mix					
Wine specialisation		-0.062	-0.289***	-0.203***	-0.184***
		(0.068)	(0.073)	(0.066)	(0.066)
c) Risk variables					
Hail risk		0.113***	0.069**	0.066**	0.048
		(0.028)	(0.027)	(0.031)	(0.030)
Tenants		0.544***	0.599***	0.412***	0.480***
		(0.118)	(0.110)	(0.111)	(0.113)
Sharecroppers		0.511***	0.339***	0.132	0.171**
		(0.079)	(0.075)	(0.083)	(0.082)
Agrarian Family Income		0.005	0.000	0.005	0.006*
		(0.003)	(0.003)	(0.003)	(0.003)
d) Transport costs					
Ruggedness		-0.269**	0.008	-0.148	-0.124
		(0.121)	(0.123)	(0.107)	(0.113)
e) Scale variables: wine growing					
Farm Size		-0.005***	-0.004***	-0.005***	-0.006***
		(0.002)	(0.001)	(0.001)	(0.001)
Landownership Value		0.013	0.008	-0.002	-0.001
		(0.009)	(0.009)	(0.008)	(0.008)
Landownership Value Inequality		0.142	-0.010	-0.017	-0.067
		(0.199)	(0.184)	(0.180)	(0.184)

f) Scale variables: wine processing				
Quality Wine	-0.080***	-0.024	-0.032	-0.037*
	(0.022)	(0.022)	(0.021)	(0.021)
'Fattorie'	0.048***	0.033**	0.031**	0.045***
	(0.015)	(0.013)	(0.015)	(0.016)
Cooperative Wineries	0.253***	0.195***	-0.018	0.012
	(0.065)	(0.064)	(0.111)	(0.097)
g) Environment				
Temperature	-0.013*	0.009	-0.002	0.002
	(0.007)	(0.008)	(0.007)	(0.007)
Rainfall	0.404***	0.298***	0.292***	0.348***
	(0.036)	(0.036)	(0.037)	(0.037)
Soil texture (% Clay)	0.393*	0.850***	0.408*	0.626**
	(0.230)	(0.223)	(0.246)	(0.245)
h) Geography				
North		-0.133***		
		(0.038)		
South		-0.402***		
		(0.042)		
Republic of Genoa (1796)			0.265***	
			(0.056)	
Duchy of Milan (1796)			0.292***	
			(0.060)	
Grisons (1796)			-0.037	
			(0.093)	
Republic of Venice (1796)			0.267***	
			(0.044)	
Prince-Bishoprics of Trent and Brixen (1796)			0.510***	
			(0.143)	
Princely County of Tyrol (1796)			0.187**	
			(0.092)	
Duchy of Modena and Reggio (1796)			0.412***	
			(0.062)	
Republic of Lucca (1796)			0.171	
			(0.113)	
Grand Duchy of Tuscany (1796)			0.440***	
			(0.057)	

Principality of Piombino and State of the 'Presidi' (1796)				0.259* (0.155)	
Duchy of Parma and Piacenza				0.392*** (0.079)	0.319*** (0.079)
Papal States				0.419*** (0.050)	0.335*** (0.048)
Kingdom of Two Sicilies				0.005 (0.029)	-0.059** (0.029)
Kingdom of Lombardy-Venetia (1859)					0.210*** (0.041)
Princely County of Tyrol (1859)					0.334*** (0.097)
Duchy of Modena and Reggio (1859)					0.344*** (0.057)
Grand Duchy of Tuscany (1859)					0.307*** (0.056)
Constant	0.174*** (0.018)	-0.336* (0.179)	-0.249 (0.193)	-0.264 (0.179)	-0.342* (0.180)
N. of Observations	751	710	710	710	710
Adjusted R^2	0.244	0.581	0.643	0.669	0.653
F-Statistic	283.849	113.070	137.407	102.359	114.239

Note: Robust standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

TABLE A2
(COMPARE WITH TABLE 3 IN THE TEXT)

Intercropping and the settlement pattern: robustness checks
Robustness to spatial autocorrelation:
Conley standard errors computed at different distance cutoffs

Dependent variable:	% Intercropped Grapes					
	(1)	(2)	(3)	(4)	(5)	(6)
Distance cutoff	0 km	25 km	50 km	125 km	250 km	500 km
a) Settlement pattern						
Scattered population (%)	0.237***	0.237***	0.237***	0.237***	0.237***	0.237***
	(0.067)	(0.077)	(0.091)	(0.092)	(0.073)	(0.073)
Agricultural employment (%)	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017
	(0.077)	(0.080)	(0.085)	(0.087)	(0.081)	(0.072)
Agricultural population density	0.021	0.021	0.021	0.021	0.021	0.021
	(0.027)	(0.030)	(0.031)	(0.027)	(0.024)	(0.013)
b) Crop mix						
Wine specialisation	-0.289***	-0.289***	-0.289***	-0.289**	-0.289**	-0.289*
	(0.072)	(0.079)	(0.092)	(0.120)	(0.136)	(0.151)
c) Risk variables						
Hail risk	0.069***	0.069**	0.069**	0.069**	0.069***	0.069***
	(0.027)	(0.030)	(0.032)	(0.033)	(0.025)	(0.018)
Tenants	0.599***	0.599***	0.599***	0.599***	0.599***	0.599***
	(0.108)	(0.117)	(0.123)	(0.128)	(0.134)	(0.116)
Sharecroppers	0.339***	0.339***	0.339***	0.339***	0.339***	0.339***
	(0.074)	(0.083)	(0.096)	(0.108)	(0.113)	(0.099)
Agrarian Family Income	0.000	0.000	0.000	0.000	0.000	0.000
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
d) Transport costs						
Ruggedness	0.008	0.008	0.008	0.008	0.008	0.008
	(0.122)	(0.137)	(0.147)	(0.145)	(0.152)	(0.160)
e) Scale variables: wine growing						
Farm Size	-0.004***	-0.004***	-0.004***	-0.004**	-0.004**	-0.004**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Landownership Value	0.008	0.008	0.008	0.008	0.008	0.008
	(0.009)	(0.009)	(0.010)	(0.012)	(0.014)	(0.014)
Landownership Value Inequality	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010
	(0.181)	(0.201)	(0.215)	(0.213)	(0.170)	(0.147)
f) Scale variables: wine processing						
Quality Wine	-0.024	-0.024	-0.024	-0.024	-0.024	-0.024
	(0.022)	(0.022)	(0.025)	(0.025)	(0.024)	(0.025)
'Fattorie'	0.033**	0.033**	0.033**	0.033***	0.033***	0.033***
	(0.013)	(0.013)	(0.013)	(0.012)	(0.012)	(0.012)
Cooperative Wineries	0.195***	0.195***	0.195***	0.195***	0.195***	0.195***
	(0.063)	(0.065)	(0.067)	(0.070)	(0.072)	(0.060)
g) Environment						
Temperature	0.009	0.009	0.009	0.009	0.009	0.009
	(0.008)	(0.009)	(0.009)	(0.008)	(0.008)	(0.007)

Rainfall	0.298***	0.298***	0.298***	0.298***	0.298***	0.298***
	(0.035)	(0.040)	(0.045)	(0.046)	(0.044)	(0.035)
Soil texture (% Clay)	0.850***	0.850***	0.850***	0.850***	0.850***	0.850***
	(0.220)	(0.255)	(0.283)	(0.321)	(0.284)	(0.269)
h) Geography						
North	-0.133***	-0.133***	-0.133***	-0.133***	-0.133***	-0.133***
	(0.037)	(0.041)	(0.047)	(0.050)	(0.043)	(0.042)
South	-0.402***	-0.402***	-0.402***	-0.402***	-0.402***	-0.402***
	(0.041)	(0.046)	(0.053)	(0.058)	(0.049)	(0.034)
Constant	-0.249	-0.249	-0.249	-0.249	-0.249	-0.249
	(0.191)	(0.205)	(0.227)	(0.229)	(0.201)	(0.183)
Observations	710	710	710	710	710	710
R^2	0.653	0.653	0.653	0.653	0.653	0.653

Note: Conley Spatial HAC (Heteroskedasticity and Autocorrelation Consistent) standard errors in parentheses. Conley standard errors have been computed allowing for spatial correlation in the error term taking place at increasingly large distances. In column 1 we impose a distance cutoff of 0 km (i.e., no spatial autocorrelation at all), and its standard errors are therefore analogous to those in Table 3 column 3. In column 6 we impose a distance cutoff of 500 km, meaning that we allow for the error term of any agrarian zone to be spatially correlated with the error term of all agrarian zones located within a 500 km radius from it, with weights in the variance covariance matrix linearly decreasing until the distance threshold. Columns 2 to 5 represent intermediate cases.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

TABLE A3
(COMPARE WITH TABLE 3 IN THE TEXT)

Intercropping and the settlement pattern: robustness checks
Robustness to Tobit regressions,
with the dependent variable left-censored at 0 and right-censored at 1

Dependent Variable:	% Intercropped Grapes				
	(1) Tobit	(2) Tobit	(3) Tobit	(4) Tobit	(5) Tobit
a) Settlement pattern					
Scattered population (%)	1.108***	0.557***	0.327***	0.471***	0.443***
	(0.067)	(0.089)	(0.085)	(0.081)	(0.083)
Agricultural employment (%)		-0.170	0.003	-0.099	-0.094
		(0.107)	(0.100)	(0.092)	(0.098)
Agricultural population density		0.016	0.041	0.019	0.010
		(0.038)	(0.035)	(0.036)	(0.037)
b) Crop mix					
Wine specialisation		-0.077	-0.393***	-0.260***	-0.236**
		(0.094)	(0.100)	(0.091)	(0.092)
c) Risk variables					
Hail risk		0.120***	0.062*	0.078**	0.047
		(0.034)	(0.032)	(0.037)	(0.037)
Tenants		0.575***	0.636***	0.423***	0.525***
		(0.149)	(0.138)	(0.139)	(0.142)
Sharecroppers		0.509***	0.292***	0.050	0.113
		(0.101)	(0.093)	(0.101)	(0.100)
Agrarian Family Income		0.005	-0.000	0.006	0.007*
		(0.004)	(0.004)	(0.004)	(0.004)
d) Transport costs					
Ruggedness		-0.263*	0.083	-0.219	-0.164
		(0.150)	(0.149)	(0.133)	(0.139)
e) Scale variables: wine growing					
Farm Size		-0.010***	-0.010***	-0.010***	-0.011***
		(0.003)	(0.003)	(0.003)	(0.003)
Landownership Value		0.030***	0.021**	0.010	0.010
		(0.010)	(0.010)	(0.009)	(0.009)
Landownership inequality		0.480*	0.291	0.271	0.184
		(0.259)	(0.237)	(0.234)	(0.238)
f) Scale variables: wine processing					
Quality Wine		-0.091***	-0.019	-0.031	-0.038
		(0.028)	(0.028)	(0.026)	(0.026)
'Fattorie'		0.052***	0.037**	0.032*	0.050***
		(0.018)	(0.015)	(0.017)	(0.018)

Cooperative Wineries	0.443***	0.351***	0.099	0.129
	(0.132)	(0.125)	(0.175)	(0.147)
g) Environment				
Temperature	-0.019**	0.009	-0.013	-0.005
	(0.009)	(0.010)	(0.009)	(0.009)
Rainfall	0.512***	0.378***	0.365***	0.442***
	(0.045)	(0.044)	(0.044)	(0.046)
Soil texture (% Clay)	0.302	0.906***	0.054	0.363
	(0.304)	(0.289)	(0.312)	(0.310)
h) Geography				
North		-0.159***		
		(0.041)		
South		-0.497***		
		(0.046)		
Republic of Genoa (1796)			0.377***	
			(0.066)	
Duchy of Milan (1796)			0.341***	
			(0.069)	
Grisons (1796)			-0.056	
			(0.125)	
Republic of Venice (1796)			0.304***	
			(0.051)	
Prince-Bishoprics of Trent and Brixen (1796)			0.566***	
			(0.162)	
Princely County of Tyrol (1796)			0.232**	
			(0.109)	
Duchy of Modena and Reggio (1796)			0.508***	
			(0.072)	
Republic of Lucca (1796)			0.256**	
			(0.124)	
Grand Duchy of Tuscany (1796)			0.568***	
			(0.067)	
Principality of Piombino and State of the 'Presidi' (1796)			0.341	
			(0.236)	
Duchy of Parma and Piacenza			0.488***	0.379***
			(0.083)	(0.084)

Papal States				0.553***	0.427***
				(0.058)	(0.056)
Kingdom of Two Sicilies				0.084*	-0.021
				(0.044)	(0.042)
Kingdom of Lombardy-Venetia (1859)					0.225***
					(0.048)
Princely County of Tyrol (1859)					0.382***
					(0.112)
Duchy of Modena and Reggio (1859)					0.413***
					(0.069)
Grand Duchy of Tuscany (1859)					0.380***
					(0.069)
Constant	0.060**	-0.688***	-0.590**	-0.428*	-0.541**
	(0.026)	(0.245)	(0.260)	(0.239)	(0.240)
Estimated variance of the regression	0.179***	0.092***	0.076***	0.070***	0.075***
	(0.010)	(0.006)	(0.005)	(0.005)	(0.005)
Observations	751	710	710	710	710
Pseudo-R^2	0.173	0.556	0.660	0.703	0.663
F-statistic	275.079	76.300	89.140	69.366	77.510

Note: Robust standard errors in parentheses. Of 710 observations, 152 are left-censored (i.e., all grapes were produced from specialized vineyards) and 21 are right-censored (i.e., all grapes were produced from intercropped vines).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

TABLE A4
(COMPARE WITH TABLE 4 IN THE TEXT)

Intercropping and the settlement pattern: robustness checks
Alternative measures of intercropping

Dependent Variable:	% Intercropped Area		% Intercropped Vines		Vine Density	
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
a) Settlement pattern						
Scattered population (%)	0.239***	0.360***	0.157**	0.253***	-1.257**	-2.454***
	(0.070)	(0.064)	(0.067)	(0.062)	(0.550)	(0.566)
Agricultural employment (%)	0.013	-0.056	-0.039	-0.091	-0.268	0.708
	(0.075)	(0.068)	(0.080)	(0.072)	(0.569)	(0.585)
Agricultural population density	0.016	-0.005	0.008	0.005	-0.389*	-0.469**
	(0.026)	(0.027)	(0.027)	(0.028)	(0.209)	(0.223)
b) Crop mix						
Wine specialisation	-0.416***	-0.345***	-0.229***	-0.190***	1.828***	1.247*
	(0.078)	(0.066)	(0.073)	(0.068)	(0.638)	(0.642)
c) Risk variables						
Hail risk	0.062**	0.061**	0.059**	0.050*	-0.053	-0.104
	(0.027)	(0.031)	(0.027)	(0.030)	(0.198)	(0.244)
Tenants	0.596***	0.402***	0.609***	0.377***	-3.002***	-1.659*
	(0.106)	(0.106)	(0.111)	(0.115)	(0.799)	(0.879)
Sharecroppers	0.456***	0.233***	0.246***	0.052	-3.047***	-1.658**
	(0.074)	(0.083)	(0.078)	(0.083)	(0.612)	(0.754)
Agrarian Family Income	-0.005*	0.001	-0.002	0.002	0.033	-0.007
	(0.003)	(0.003)	(0.003)	(0.003)	(0.027)	(0.028)
d) Transport costs						
Ruggedness	0.086	-0.151	-0.036	-0.180*	-0.727	0.487
	(0.122)	(0.108)	(0.125)	(0.104)	(1.020)	(0.953)
e) Scale variables: wine growing						
Farm Size	-0.006***	-0.006***	-0.004***	-0.006***	0.015	0.042***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.011)	(0.013)
Landownership Value	0.017**	0.009	0.016*	0.014*	0.002	-0.091
	(0.008)	(0.007)	(0.009)	(0.009)	(0.058)	(0.057)
Landownership Value Inequality	0.084	0.025	0.017	-0.016	-0.862	-1.030
	(0.181)	(0.177)	(0.190)	(0.187)	(1.361)	(1.525)
f) Scale variables: wine processing						
Quality Wine	-0.010	-0.011	-0.032	-0.037*	0.048	0.169
	(0.023)	(0.022)	(0.022)	(0.022)	(0.179)	(0.188)
'Fattorie'	0.020	0.015	0.053***	0.027	-0.078	-0.140
	(0.013)	(0.013)	(0.016)	(0.018)	(0.088)	(0.096)
Cooperative Wineries	0.140**	-0.031	0.182*	0.014	0.078	0.353

	(0.068)	(0.083)	(0.095)	(0.167)	(0.596)	(0.760)
g) Environment						
Temperature	0.017**	-0.002	0.011	-0.002	-0.249***	-0.098
	(0.008)	(0.007)	(0.008)	(0.007)	(0.079)	(0.063)
Rainfall	0.368***	0.345***	0.274***	0.256***	-2.511***	-2.746***
	(0.036)	(0.039)	(0.036)	(0.036)	(0.274)	(0.309)
Soil texture (% Clay)	0.532**	-0.166	0.647***	0.470**	-0.810	0.847
	(0.231)	(0.263)	(0.218)	(0.234)	(1.728)	(2.143)
h) Geography						
North	-0.098***		-0.051		-0.649**	
	(0.035)		(0.040)		(0.285)	
South	-0.406***		-0.336***		2.778***	
	(0.042)		(0.042)		(0.387)	
Republic of Genoa (1796)		0.350***		0.293***		-0.434
		(0.045)		(0.058)		(0.328)
Duchy of Milan (1796)		0.310***		0.262***		-0.790***
		(0.055)		(0.063)		(0.296)
Grisons (1796)		-0.157**		-0.069		-0.550
		(0.062)		(0.053)		(0.428)
Republic of Venice (1796)		0.353***		0.288***		-1.190***
		(0.043)		(0.044)		(0.263)
Prince-Bishoprics of Trent and Brixen (1796)		0.546***		0.469***		-1.871*
		(0.109)		(0.162)		(1.099)
Princely County of Tyrol (1796)		0.189*		0.191**		0.292
		(0.103)		(0.078)		(0.694)
Duchy of Modena and Reggio (1796)		0.423***		0.282***		-1.113***
		(0.053)		(0.079)		(0.407)
Republic of Lucca (1796)		0.366***		0.095		0.080
		(0.085)		(0.116)		(0.652)
Grand Duchy of Tuscany (1796)		0.494***		0.438***		-0.680
		(0.052)		(0.061)		(0.443)
Principality of Piombino and State of the 'Presidi' (1796)		0.286*		0.082*		1.721*
		(0.163)		(0.045)		(0.908)
Duchy of Parma and Piacenza		0.496***		0.351***		-1.876***
		(0.059)		(0.077)		(0.352)
Papal States		0.472***		0.285***		-0.971**

		(0.052)		(0.049)		(0.472)
Kingdom of Two Sicilies		0.060*		-0.050*		1.668***
		(0.034)		(0.027)		(0.303)
Constant	-0.303	-0.109	-0.249	-0.176	10.634***	8.818***
	(0.205)	(0.191)	(0.204)	(0.181)	(1.681)	(1.640)
N. of Observations	710	710	710	710	710	710
Adjusted R^2	0.682	0.717	0.592	0.627	0.648	0.621
F-Statistic	193.752	166.049	82.691	65.368	106.807	71.199

Note: Robust standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

TABLE A5
(COMPARE WITH TABLE 5 IN THE TEXT)

Intercropping and the settlement pattern: robustness checks

Instrumenting the share of scattered population

Dependent Variable:	% Intercropped Grapes				
	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV
a) Settlement pattern					
Scattered population (%)	2.169***	1.177***	1.185**	0.621**	0.610**
	(0.293)	(0.302)	(0.549)	(0.256)	(0.259)
Agricultural employment (%)		-0.546***	-0.530*	-0.222	-0.226
		(0.179)	(0.306)	(0.152)	(0.154)
Agricultural population density		-0.070	-0.066	-0.021	-0.029
		(0.043)	(0.060)	(0.039)	(0.040)
b) Crop mix					
Wine specialisation		-0.064	-0.260***	-0.197***	-0.177***
		(0.080)	(0.086)	(0.067)	(0.068)
c) Risk variables					
Hail risk		0.086**	0.061*	0.058*	0.039
		(0.033)	(0.032)	(0.032)	(0.032)
Tenants		0.411***	0.429***	0.363***	0.437***
		(0.135)	(0.161)	(0.115)	(0.116)
Sharecroppers		0.143	-0.039	0.015	0.056
		(0.156)	(0.225)	(0.116)	(0.116)
Agrarian Family Income		-0.005	-0.008	0.002	0.002
		(0.005)	(0.006)	(0.004)	(0.004)
d) Transport costs					
Ruggedness		-0.228*	-0.123	-0.152	-0.131
		(0.135)	(0.139)	(0.105)	(0.111)
e) Scale variables: wine growing					
Farm Size		-0.005***	-0.006***	-0.005***	-0.006***
		(0.002)	(0.002)	(0.001)	(0.001)
Landownership Value		0.005	0.007	-0.004	-0.004
		(0.009)	(0.009)	(0.009)	(0.008)
Landownership Value Inequality		0.756**	0.656	0.192	0.152
		(0.302)	(0.422)	(0.241)	(0.251)
f) Scale variables: wine processing					
Quality Wine		-0.093***	-0.054*	-0.036	-0.043*
		(0.026)	(0.030)	(0.022)	(0.022)
'Fattorie'		0.051***	0.032*	0.030*	0.046***
		(0.017)	(0.017)	(0.016)	(0.017)
Cooperative Wineries		0.316***	0.306***	0.028	0.062
		(0.071)	(0.091)	(0.122)	(0.106)
g) Environment					
Temperature		0.001	0.010	0.001	0.006
		(0.009)	(0.008)	(0.008)	(0.008)

Rainfall	0.345***	0.265***	0.272***	0.330***
	(0.048)	(0.046)	(0.040)	(0.040)
Soil texture (% Clay)	0.458*	0.568*	0.354	0.569**
	(0.237)	(0.296)	(0.240)	(0.242)
h) Geography				
North		-0.179***		
		(0.046)		
South		-0.282***		
		(0.085)		
Republic of Genoa (1796)			0.258***	
			(0.054)	
Duchy of Milan (1796)			0.308***	
			(0.058)	
Grisons (1796)			-0.054	
			(0.101)	
Republic of Venice (1796)			0.267***	
			(0.044)	
Prince-Bishoprics of Trent and Brixen (1796)			0.517***	
			(0.153)	
Princely County of Tyrol (1796)			0.154	
			(0.106)	
Duchy of Modena and Reggio (1796)			0.386***	
			(0.072)	
Republic of Lucca (1796)			0.162	
			(0.120)	
Grand Duchy of Tuscany (1796)			0.444***	
			(0.058)	
Principality of Piombino and State of the 'Presidi' (1796)			0.199	
			(0.161)	
Duchy of Parma and Piacenza			0.388***	0.314***
			(0.081)	(0.082)
Papal States			0.420***	0.335***
			(0.050)	(0.048)
Kingdom of Two Sicilies			0.029	-0.033
			(0.029)	(0.031)
Kingdom of Lombardy-Venetia (1859)				0.213***
				(0.041)
Princely County of Tyrol (1859)				0.321***
				(0.106)

Duchy of Modena and Reggio (1859)					0.324*** (0.064)
Grand Duchy of Tuscany (1859)					0.301*** (0.059)
Constant	-0.184** (0.077)	-0.653*** (0.212)	-0.357 (0.222)	-0.339* (0.187)	-0.426** (0.192)
Observations	751	710	710	710	710
Adjusted R^2	-0.263	0.498	0.525	0.657	0.641
F-statistic	54.631	86.389	92.865	92.924	103.768
First stage statistics:					
Exposure to Barbary piracy	0.018*** (0.002)	0.018*** (0.003)	0.010*** (0.003)	0.018*** (0.003)	0.018*** (0.003)
Underidentification test:					
Kleibergen-Paap rk LM statistic	52.57	39.53	11.84	36.04	37.02
Weak identification test:					
Kleibergen-Paap rk Wald F statistic	67.18	46.53	11.72	39.76	41.63

Note: Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A. 3. VARIABLES, SOURCES AND SUMMARY STATISTICS FOR THE DYNAMIC ANALYSIS – INTERCROPPING BETWEEN THE 1950S AND 1970S (SECTION 6).

A. 3.1 Dependent variables

1. ***% Intercropped grapes*** measures the share of grapes produced in intercropped vineyards at provincial level (with provinces defined at post-WWII borders). The source is official agricultural statistics, after WWII published in a Yearbook of Agricultural Statistics (ISTAT, 1953, 1962 and 1970). The definition of intercropped production was based on the one established by the 1929 Agrarian Cadastre. We gathered data for three years: 1950, 1960 and 1968 (the last year with consistently comparable data). Each of those years is close enough to be comparable to the census years (1951, 1961 and 1971) where we can find data on the settlement pattern – our main variable of interest.

A. 3.2 Independent variables

1. ***Scattered Population*** measures the share of population living dispersed in the countryside in 1951, 1961 and 1971, derived from population censuses (ISTAT, 1958, 1969, 1976).

2. ***Agricultural Employment*** measures the share of agriculture in total employment in 1951, 1961 and 1971, from the population censuses (ISTAT, 1957, 1969, 1976).

3. ***Tractors (000s)*** measures the number of tractors, measured in thousands, in 1950, 1960 and 1970, from ISTAT (1953, 1962, and 1972).

4. ***Cooperative wineries*** measures the density of cooperative wineries in a province in the years 1950, 1960 and 1970, at constant 1951 borders. We measure it by the number of individual cooperative wineries multiplied by the number of years since the foundation in each of the relevant years of our panel (1950, 1960 and 1970). The main source is a list of cooperative wineries by municipality with their year of foundation published in Federazione Italiana delle Cantine Sociali (1974, pp. 115-156). Our measure, cooperative-years by province, should better approximate the aggregate productive capacity of cooperative wineries in a province (the ideal measure, that unfortunately is not available) than the simple number of cooperatives. That is because older cooperatives were larger than younger ones, and often their larger size was the product of the most successful cooperatives being the result of the merger of several local cooperatives, and hence of the reduction in the

provincial number. The same publication includes in another section the productive capacity of some cooperative wineries, but unfortunately not all. Visual inspection suggests that towards the end of the period there was a boom in the foundation of small cooperatives. Provinces such as Bolzano and Modena had a well-established cooperative tradition, and already in the 1930s a large share of their wine was being processed by cooperative wineries, but in the 1974 list they appear to have had a small number of cooperatives (which over time had developed into larger region-wide establishments). We have also used as a robustness check the simple number of cooperatives and the main results do not change: the coefficient of cooperative wineries is still insignificant, and the other variables are unaffected. Yet, the sign of the latter is negative, instead of positive, as theory should predict. We take this as evidence that our correction goes into the right correction in approximating the economic incidence of cooperative wineries, although data constraints prevent us from measuring it with greater precision.

5. ***Quality wine*** measures the presence of quality wine in a province over the time span of the time series analysis. The optimal measure should be the share of quality wine over wine output in a given province in a given year, unfortunately we do not have such information, and our estimate relies on exploiting different sources of information at our disposal. Our procedure follows different steps.

We begin by defining the existence of a 'quality wine' today by having an official Appellation approved by the government. Today all Appellations have been unified into a single category, Protected Appellation (*Denominazione di Origine Protetta* or DOP), which includes the traditional categories of Controlled Appellation (*Denominazione di Origine Controllata* or DOC) and its higher quality subset, Guaranteed and Controlled Appellation (*Denominazione di Origine Controllata e Garantita* or DOCG), both instituted in 1963 and enforceable since the 1967 vintage.

We gather the whole list of wines having a DOP approved in the present days from a 2011 list by the Ministry of Agriculture published in the Official Gazette:

https://www.gazzettaufficiale.it/do/atto/serie_generale/caricaPdf?cdimg=11A16146001000101100001&dgu=2011-12-20&art.dataPubblicazioneGazzetta=2011-12-20&art.codiceRedazionale=11A16146&art.num=1&art.tiposerie=SG

The list mentions all provinces where a given Appellation is present.

We gather the date of approval of the original DOC/DOCG decree from another list, the official sample of all official regulations of Appellations, gathered from the website of the Ministry of Agriculture:

https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/4625

The list includes the date of approval of the highest 'traditional' Appellation achieved. In few cases, the regulation file of a formerly DOCG wine includes only the date of the decree upgrading it from DOC to DOCG. In these few cases, we have searched the (earlier) date of first approval of the lowest possible definition of quality wine (DOC) from a variety of sources.

The first list includes Appellation and provinces (but no dates or origin), while the second list includes Appellations and dates of approval (but no systematic information on the relevant provinces). Combining these sources, we build a database with the number of wines with an Appellation per province and year, since our unit of observation is the province. Some wines can span over different provinces, i.e. Chianti Classico is divided between the provinces of Florence and Siena, and therefore it is possible that the same wine appears in multiple provinces.

Unfortunately, we don't have systematic statistics on all quality wines, so it is not possible to measure the geographically disaggregate incidence of quality wines by either production or acreage.

A first count results in 409 Appellations, resulting in 645 Appellation-province observations. The number of existing appellations is obviously an imperfect measure of the importance of quality wines, since it might just reflect regulatory fragmentation. At the same time, the overall picture seems consistent with the qualitative evidence. The provinces with the largest number of Appellations are Asti (22), Verona (22), Roma (20), Alessandria (19), Siena (19), Cuneo (18) – all provinces with a well-established high-quality wine tradition.

Since there are more provinces today than in the 1950s-1970s, we match present day provinces to 1950s borders. This is not problematic since most of the new provinces were carved out from a single pre-existing province – rather than more complex admixtures.

This requires further cleaning the data, in order to duplicate wine counts. For example, the wine Appellation "Lessona" was produced in the provinces of Biella and Vercelli (at 2011), but we need to consider it as a single

wine-province when working with 1950 borders (when he present-day province of Biella belonged to the province of Vercelli).

The resulting database (at 1950 provincial borders) consists in the original 409 Appellations distributed into 580 Appellation-province observations. The difference in the number of observations between the 1950 and 2011 definition of provinces is mostly caused by the repetition of region-wide Appellation in the relatively numerous Sardinian provinces recently instituted.

The next step is tracing the existence of these present-day quality wines into a more distant past – in order to exploit time variation. We do so by relying on the first (more or less) systematic compilation of quality wines – namely being mentioned as participating in the First Exhibition of Italian Typical Wines at Siena in 1933. We rely for mentions search on the exhibition's official catalogue (Comitato Esecutivo, 1933).

We code presence at the 1933 Siena Exhibition in several steps.

First, we code all wines mentioned in the initial list of wines, classified into broad categories ('vini da pasto' – red and white, 'vini da pesce', 'vini d'arrosto', 'vini da dessert', 'vini con spuma naturale'), listed alphabetically within each category and including a description of its main characteristics (pp. 7-48 in the Exhibition's catalogue). Among those characteristics we focus on the reported production zone.

When the reported name is common to several more specific wines in the 2011, we code them all as being present at the Exhibition. For example, the Catalogue mentions 'Aglianico' as being produced in the provinces of Potenza, Avellino and Benevento. In 2011, there are 3 wines with this common label: 'Aglianico del Taburno' (produced in the province of Benevento), 'Aglianico del Vulture' and 'Aglianico del Vulture Superiore' (both produced in the province of Potenza). In this case, we code all three wines as being present at the exhibition. Since there is no wine in 2011 in the province of Avellino with the name Aglianico (or vaguely evocative of this name), we consider it as not present in 2011, and believe that this was an early and non-established form of advertising local wines by taking advantage of geographical proximity to more renowned ones.

Conversely, sometimes we have a more specific definition in the 1933 catalogue than in the 2011 Appellations (and least at the general level): today there is just one broad Appellation 'Chianti', although in 1933 this is

broken down in what eventually will be several marketing subcategories: Chianti Colli Aretini, Chianti Rufina, etc. Since this are defined at a geographical level, this allows to code all Chianti-province observations as being already present in 1933. 'Chianti Classico' is a different wine from 'Chianti' – also present in 1933.

In other cases, the 1933 definition is a generic name based on the vine variety attached to a broad geographical defintion, like Merlot delle Venezie. Since present-day Appellations cannot be exclusively named after the vine type, we don't find it in the present-day list. But we have 'Delle Venezie DOC', produced in many provinces. Hence, we code 'Merlot delle Venezie' (produced in just three provinces) to be equivalent to 'Delle Venezie DOC' in the provinces of production of the former. Similarly, we consider 1933 varieties like 'Marzemino Trentino' as equivalent to present-day 'Trentino'. Indeed, in those cases, often names very similar or equivalent to those used in 1933 are used today for marketing those wines along the more generic official name of the relevant Appellation.

We code all provinces sharing an Appellation as present in the 1933 Exhibition if the wine is mentioned, even if in the section on its characteristics just a subset of the 2011 provinces is explicitly mentioned. We interpret this absence as lack of precise information on actual production zones.

In few cases, we have been able to unambiguously match 1933 and 2011 wines even if the names were not obvious. For example, the 1933 mentions 'Spumante Trentino (Ferrari)', thus including the name of a major producer, which today happens to belong to the Appellation 'Trento DOC' – and not 'Trentino', as one could think from a simple reading of the name.

In other cases, the present-day Appellation makes a specific mention of a sub-variety of a specific wine. We match them even if in the original list there is just mention of the broad family. For example, we consider the 'Elba Aleatico Passito' as corresponding to the 1933 wine 'Aleatico di Portoferraio' (in the island of Elba).

This first matching results in 173 province-wines existing in 2011 already existing in 1933.

Second, we code also the wines mentioned in a second list of the Catalogue. At p. 49-54 we have a list arranged by region of 'Typical wines per production zone' – this time without any information on their characteristics. Most of them are mentioned in the first list, but some are not. Although there is no indication of provinces where they were produced, often recognising them is straightforward.

For example, we consider the 1933 wine type ‘Cortese’ (from Piedmont) to be equivalent to the 2011 Appellation ‘Gavi o Cortese di Gavi’. As in the previous list, some 1933 wines are missing in 2011 (e.g., ‘Mottalciata’).

This allows us to include 5 more Appellations as already present in 1933.

Third, we rely on a third list published in the Exhibition’s Catalogue reporting all the individual participants, their municipality of origin and the wine types they exhibited (p. 58-188). The list is arranged by region and province. As a curiosity, the list includes the renowned liberal economist (and later President of the Republic) Luigi Einaudi – who produced ‘Barbera’ and ‘Dolcetto’ in his estate at Dogliani.

Although many of the names of wines attached to many exhibitors were included in the previous two lists of the Catalogue, there are also different ones, and often they match the 2011 Appellations.

For example, most of the Appellation of the region of Abruzzi (Cerasuolo d’Abruzzo, Montepulciano d’Abruzzo and Trebbiano d’Abruzzo) were not included in the first two lists of typical wines, but were present at the Exhibition as it is clear by the numerous producers that exhibited them (as included in the third list).

In most cases, a given typical wine was presented by participants from most of the provinces that in 2011 were included in a single relevant Appellation. We code the wine as existing in 1933 even if there was not participant from a given province, provided the wine was present at the exhibition and can be unambiguously matched with a 2011 Appellation.

In some cases, the information is not precise but nonetheless allows to match the wines. For example, in the province of Salerno we have the Appellation ‘Costa d’Amalfi’, which we match to the (much more appealing) 1933 name ‘Divina Costiera’ – Costiera Amalfitana being a widespread form of referring to Costa d’Amalfi.

We code as present in 1933 all the Appellations based on ‘Vin Santo’ wines (a form of raisin wines, today with several DOCs in Tuscany), even if we only have generic names in the original Catalogue (i.e., without reference to the specific regions and wine types they are associated today). The Catalogue makes specific reference to several ‘high quality Vini Santi’ from Tuscany and Venetia being present at the Exhibition. Even if they were not exactly labelled as Vin Santo del Chianti or Vin Santo di Montepulciano, omitting them seems an excessively restrictive interpretation.

Finally, we look at the wines presented by a list of private wineries at p. 195. This allows us to identify 'Vini di Montepulciano' as a specific wine type (i.e., different from Vino Nobile di Montepulciano, also distributed by the same winery), which we code as equivalent to the Appellation 'Rosso di Montepulciano'.

All this allows us to identify 52 more province-wine observations, leaving a total count of 229 wine-province observations of present-day Appellations found at the Typical Wines Exhibition of Siena in 1933. This is equivalent to 39% of the total 580 wine-province observations of Italian quality wines existing today.

Now, the share of present-day quality wines already found in 1933 declines with the year they were recognised as 'quality wines'. 284 observations received an Appellation recognition in the first 15 years of the 'modern' Appellation system, i.e., before 1981. 185 of them (65%) can be already identified in the 1933 Exhibition.

If we further inspect the dynamics of implementation of the modern Appellation system during its first 15 years, we find this pattern further reinforced. In the first five years of the Appellation system (1966-1970), 127 Appellations were recognized, 103 of them being present at Siena in 1933 (81%). Between 1971 and 1975, we find 119 new Appellations, and 69 of them were at the Siena Exhibition (58%). And in 1976-1981 we have 38 new Appellations, with just 13 as 'historical' high-quality wines (34%). Only 15% of the wines which received an Appellation after 1981 were found in the Siena catalogue.

We interpret this evidence as showing three points: 1) quality wines were already being produced in 1933, if not substantially along the intensive margin certainly at least in the extensive margin; 2) the first wave of recognition of Appellations sanctioned the 'historical' quality wines, along with other quality wines that had emerged in the 20 years after WWII; 3) as we move forward in time, the number of 'new' quality wines actually increase: more and more of the newest Appellations are genuinely 'new' – rather than belated recognitions of traditional high-quality varieties.

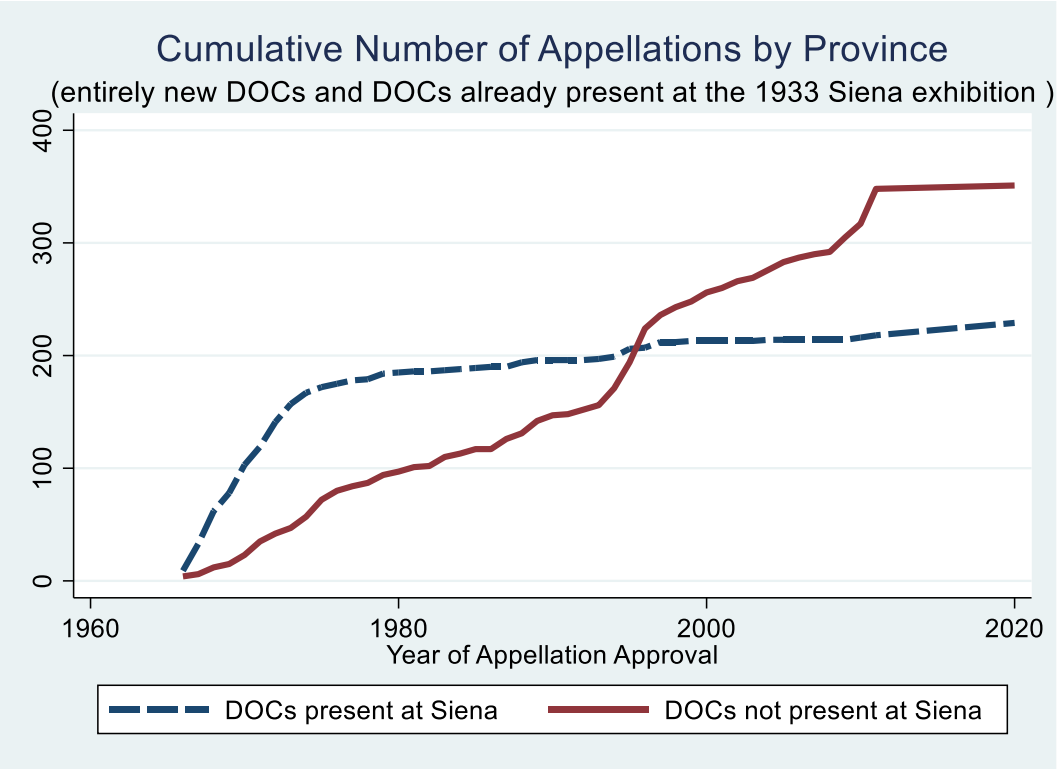
We quantify the temporal evolution of quality wines by exploiting this evidence. The process of receiving an Appellation happens with a bureaucratic delay. Hence, we assume that Appellations recognized between 1966 and 1970 (both years inclusive) are representative of the quality wines present in 1960 (few years earlier), along with those already present at Siena in 1933. All Appellations granted between 1971 and 1975 are counted as a measure of provincial quality wines in 1970. For 1950, immediately after WWII, we assume that the

number of provincial wines present at Siena and eventually recognised in the Appellation system are an acceptable approximation.

With these insights, we define the existence of quality wine at each time interval in the following way.

We consider that a quality wine existed in a province in 1950 (and, for that matter, in 1960 and 1970) if it was present at the 1933 exhibition and eventually it was granted a DOC. The other quality wines existing in 1960 are, in addition to those already present in 1950, those who received the title of DOC in the first 5 years of the new legal framework for Appellations (i.e., between 1966 and the end of 1970). Similarly, we define quality wines existing in 1970 those that existed in 1960 or that were granted a DOC in the five years comprised between 1971 and the end of 1975. With definition A, there were 229 quality wines in 1950, 252 in 1960 and 301 in 1970. With this definition, there were 229 province-quality wines in 1950, 252 in 1960 and 301 in 1970. We add up all quality wines existing in a given province in 1950, 1960 and 1970 to produce our time-variant provincial measure of intensity of 'Quality wine'.

The graph below represents the temporal evolution of approval of Appellations by province, distinguishing Appellations whose wines we matched to a typical wine present at the 1933 Siena Exhibition on Typical wines from DOCs without such a 'historical' background. The graph clearly shows that the two sets of Appellations follow a very different temporal pattern of DOC recognition. Almost all of the quality wines with a long tradition (at least, circulation before WWII) were recognised as DOCs very soon after the implementation of the new legal framework protecting quality wines in 1963/1967.



We reproduce below the detailed results of our estimate.

Appellation	Year of DOC recognition	Year of DOCG recognition	Province (2011 borders)	Province (1950 borders)	Presence at the 1933 Siena Exhibition on Typical Wines (0=NO, 1=YES)
ABRUZZO	2010		Chieti	Chieti	0
ABRUZZO	2010		L'Aquila	L'Aquila	0
ABRUZZO	2010		Pescara	Pescara	0
ABRUZZO	2010		Teramo	Teramo	0
AGLIANICO DEL TABURNO	1986	2011	Benevento	Benevento	1
Aglianico del Vulture	1971		Potenza	Potenza	1
AGLIANICO DEL VULTURE SUPERIORE	1971	2010	Potenza	Potenza	1
ALBA	2010		Cuneo	Cuneo	0
ALBUGNANO	1997		Asti	Asti	0
ALCAMO	1972		Palermo	Palermo	0
ALCAMO	1972		Trapani	Trapani	0
ALEATICO DI GRADOLI	1972		Viterbo	Viterbo	0

ALEATICO DI PUGLIA	1973		Bari	Bari	1
ALEATICO DI PUGLIA	1973		Brindisi	Brindisi	1
ALEATICO DI PUGLIA	1973		Foggia	Foggia	1
ALEATICO DI PUGLIA	1973		Lecce	Lecce	1
ALEATICO DI PUGLIA	1973		Taranto	Taranto	1
ALEZIO	1983		Lecce	Lecce	0
Alghero	1995		Sassari	Sassari	0
Alta Langa	2002	2011	Alessandria	Alessandria	0
Alta Langa	2002	2011	Asti	Asti	0
Alta Langa	2002	2011	Cuneo	Cuneo	0
ALTO ADIGE	1975		Bolzano	Bolzano	1
AMARONE DELLA VALPOLICELLA	1968	2010	Verona	Verona	1
Amelia DOC	1989		Terni	Terni	0
ANSONICA COSTA DELL'ARGENTARIO	1995		Grosseto	Grosseto	1
APRILIA	1966		Latina	Latina	0
APRILIA	1966		Roma	Roma	0
ARBOREA	1987		Oristano	Cagliari	0
Arcole DOC	2000		Verona	Verona	0
Arcole DOC	2000		Vicenza	Vicenza	0
Asolo Montello e Colli Asolani	1977		Treviso	Treviso	0
ASSISI	1997		Perugia	Perugia	0
ASTI	1967	1993	Alessandria	Alessandria	1
ASTI	1967	1993	Asti	Asti	1
ASTI	1967	1993	Cuneo	Cuneo	1
Atina	1999		Frosinone	Frosinone	0
AVERSA	1993		Caserta	Caserta	0
AVERSA	1993		Napoli	Napoli	0
BAGNOLI DI SOPRA O BAGNOLI	1995		Padova	Padova	0
BAGNOLI FRIULARO	1995	2011	Padova	Padova	0
Barbaresco	1966	1980	Cuneo	Cuneo	1
BARBERA D'ALBA	1970		Cuneo	Cuneo	1
Barbera d'Asti	1970	2008	Alessandria	Alessandria	1
Barbera d'Asti	1970	2008	Asti	Asti	1
BARBERA DEL MONFERRATO	1970		Alessandria	Alessandria	1
BARBERA DEL MONFERRATO	1970		Asti	Asti	1
BARBERA DEL MONFERRATO SUPERIORE	1970	2008	Alessandria	Alessandria	1

BARBERA DEL MONFERRATO SUPERIORE	1970	2008	Asti	Asti	1
BARCO REALE DI CARMIGNANO	1975		Prato	Firenze	0
BARDOLINO	1968		Verona	Verona	1
BARDOLINO SUPERIORE	1968	2001	Verona	Verona	1
BARLETTA	1977		Barletta-Andria-Trani	Bari	0
Barolo	1966	1980	Cuneo	Cuneo	1
BIANCHELLO DEL METAURO	1969		Pesaro e Urbino	Pesaro e Urbino	0
BIANCO CAPENA	1975		Roma	Roma	0
BIANCO DELL' EMPOLESE	1989		Firenze	Firenze	0
BIANCO DI CUSTOZA O CUSTOZA	1971		Verona	Verona	1
BIANCO DI PITIGLIANO	1966		Grosseto	Grosseto	0
BIFERNO	1983		Campobasso	Campobasso	0
Bivongi DOC	1996		Catanzaro	Catanzaro	0
Bivongi DOC	1996		Reggio Calabria	Reggio Calabria	0
BOCA	1969		Novara	Novara	1
BOLGHERI	1983		Livorno	Livorno	0
BOLGHERI SASSICAIA	1994		Livorno	Livorno	0
BONARDA DELL'OLTREPÒ PAVESE	1970		Pavia	Pavia	1
Bosco Eliceo DOC	1989		Ferrara	Ferrara	0
Bosco Eliceo DOC	1989		Ravenna	Ravenna	0
Botticino DOC	1968		Brescia	Brescia	0
BRACHETTO D'ACQUI O ACQUI	1969	1996	Alessandria	Alessandria	0
BRACHETTO D'ACQUI O ACQUI	1969	1996	Asti	Asti	0
BRAMATERRA	1979		Vercelli	Vercelli	0
Breganze DOC	1969		Vicenza	Vicenza	1
BRINDISI	1979		Brindisi	Brindisi	0
BRUNELLO DI MONTALCINO	1966	1980	Siena	Siena	1
BUTTAFUOCO DELL'OLTREPÒ PAVESE O BUTTAFUOCO	1970		Pavia	Pavia	1
CACC'E MMITTE DI LUCERA	1975		Foggia	Foggia	0
CAGLIARI	2011		Cagliari	Cagliari	0

CALOSSO	2011		Asti	Asti	0
CAMPI FLEGREI	1994		Napoli	Napoli	0
CAMPIDANO DI TERRALBA O TERRALBA	1975		Medio Campidano	Cagliari	0
CANAVESE	1996		Torino	Torino	0
CANAVESE	1996		Vercelli	Vercelli	0
Candia Colli Apuani	1981		Massa Carrara	Massa Carrara	1
CANNELLINO DI FRASCATI	1966	2011	Roma	Roma	1
CANNONAU DI SARDEGNA	1972		Cagliari	Cagliari	1
CANNONAU DI SARDEGNA	1972		Nuoro	Nuoro	1
CANNONAU DI SARDEGNA	1972		Sassari	Sassari	1
CAPALBIO	1999		Grosseto	Grosseto	0
CAPRI	1977		Napoli	Napoli	1
CAPRIANO DEL COLLE DOC	1980		Brescia	Brescia	0
CAREMA	1967		Torino	Torino	1
Carignano del Sulcis	1977		Cagliari	Cagliari	0
CARMIGNANO	1975	1990	Prato	Firenze	0
CARSO o CARSO – KRAS	1985		Gorizia	Gorizia	0
CARSO o CARSO – KRAS	1985		Trieste	Trieste	0
CASAVECCHIA DI PONTELATONE	2011		Caserta	Caserta	0
CASTEGGIO	2010		Pavia	Pavia	1
CASTEL DEL MONTE	1971		Bari	Bari	0
CASTEL DEL MONTE BOMBINO NERO	1971	2011	Bari	Bari	0
CASTEL DEL MONTE NERO DI TROIA	1971	2011	Bari	Bari	0
CASTEL DEL MONTE ROSSO RISERVA	1971	2011	Bari	Bari	0
CASTEL SAN LORENZO	1991		Salerno	Salerno	0
CASTELLER	1974		Trento	Trento	0
CASTELLI DI JESI VERDICCHIO RISERVA	1995	2010	Ancona	Ancona	1
CASTELLI ROMANI	1996		Latina	Latina	0
CASTELLI ROMANI	1996		Roma	Roma	0
CELLATICA	1968		Brescia	Brescia	1

CERASUOLO D'ABRUZZO	1968		Chieti	Chieti	1
CERASUOLO D'ABRUZZO	1968		L'Aquila	L'Aquila	1
CERASUOLO D'ABRUZZO	1968		Pescara	Pescara	1
CERASUOLO D'ABRUZZO	1968		Teramo	Teramo	1
CERASUOLO DI VITTORIA	1973	2005	Caltanissetta	Caltanissetta	1
CERASUOLO DI VITTORIA	1973	2005	Catania	Catania	1
CERASUOLO DI VITTORIA	1973	2005	Ragusa	Ragusa	1
CERVETERI	1974		Roma	Roma	0
CERVETERI	1974		Viterbo	Viterbo	0
Cesanese del Piglio	1973	2008	Frosinone	Frosinone	1
CESANESE DI AFFILE» O «AFFILE	1973		Roma	Roma	1
CESANESE DI OLEVANO ROMANO» O «OLEVANO ROMANO	1973		Roma	Roma	1
CHIANTI	1967	1984	Arezzo	Arezzo	1
CHIANTI	1967	1984	Firenze	Firenze	1
CHIANTI	1967	1984	Pisa	Pisa	1
CHIANTI	1967	1984	Pistoia	Pistoia	1
CHIANTI	1967	1984	Siena	Siena	1
CHIANTI CLASSICO	1967	1984	Firenze	Firenze	1
CHIANTI CLASSICO	1967	1984	Siena	Siena	1
CILENTO	1989		Salerno	Salerno	1
CINQUE TERRE E CINQUE TERRE SCIACCHETRÀ	1973		La Spezia	La Spezia	1
CIRCEO	1996		Latina	Latina	0
CIRÒ	1969		Catanzaro	Catanzaro	1
CISTERNA D'ASTI	2002		Asti	Asti	0
CISTERNA D'ASTI	2002		Cuneo	Cuneo	0
COLLI ALBANI	1970		Roma	Roma	1
COLLI ALTOTIBERINI	1980		Perugia	Perugia	0
COLLI ASOLANI - PROSECCO O ASOLO - PROSECCO	1977	2009	Treviso	Treviso	1
COLLI BERICI	1973		Vicenza	Vicenza	0
COLLI BOLOGNESI	1975		Bologna	Bologna	0
COLLI BOLOGNESI	1975		Modena	Modena	0
COLLI BOLOGNESI CLASSICO PIGNOLETTO	1997	2010	Bologna	Bologna	0

COLLI BOLOGNESI CLASSICO PIGNOLETTO	1997	2010	Modena	Modena	0
Colli del Trasimeno DOC	1972		Perugia	Perugia	0
COLLI DELL'ETRURIA CENTRALE	1990		Arezzo	Arezzo	0
COLLI DELL'ETRURIA CENTRALE	1990		Firenze	Firenze	0
COLLI DELL'ETRURIA CENTRALE	1990		Pisa	Pisa	0
COLLI DELL'ETRURIA CENTRALE	1990		Pistoia	Pistoia	0
COLLI DELL'ETRURIA CENTRALE	1990		Siena	Siena	0
COLLI DELLA SABINA	1996		Rieti	Rieti	0
COLLI DELLA SABINA	1996		Roma	Roma	0
COLLI DI CONEGLIANO	1993	2011	Treviso	Treviso	1
COLLI DI FAENZA	1997		Forlì-Cesena	Forlì-Cesena	0
COLLI DI FAENZA	1997		Ravenna	Ravenna	0
COLLI DI IMOLA	1997		Bologna	Bologna	0
COLLI DI LUNI	1989		La Spezia	La Spezia	0
COLLI DI LUNI	1989		Massa Carrara	Massa Carrara	0
Colli di Parma	1982		Parma	Parma	0
COLLI DI SCANDIANO E DI CANOSSA	1976		Reggio Emilia	Reggio Emilia	1
COLLI ETRUSCHI VITERBESI o TUSCIA	1996		Viterbo	Viterbo	0
COLLI EUGANEI	1969		Padova	Padova	1
COLLI EUGANEI FIOR D'ARANCIO	1969	2010	Padova	Padova	1
COLLI LANUVINI	1971		Roma	Roma	1
COLLI MACERATESI	1975		Ancona	Ancona	0
COLLI MACERATESI	1975		Macerata	Macerata	0
COLLI MARTANI	1988		Perugia	Perugia	0
COLLI ORIENTALI DEL FRIULI PICOLIT	1970	2006	Udine	Udine	0
COLLI PERUGINI	1981		Perugia	Perugia	0

COLLI PERUGINI	1981		Terni	Terni	0
COLLI PESARESI	1972		Pesaro e Urbino	Pesaro e Urbino	0
COLLI PIACENTINI	1967		Piacenza	Piacenza	0
COLLI ROMAGNA CENTRALE	2001		Forlì-Cesena	Forlì-Cesena	0
Colli Tortonesi	1973		Alessandria	Alessandria	0
COLLINA TORINESE	1999		Torino	Torino	0
COLLINE DI LEVANTO	1995		La Spezia	La Spezia	0
COLLINE JONICHE TARANTINE	2008		Taranto	Taranto	0
COLLINE LUCCHESI	1968		Lucca	Lucca	0
COLLINE NOVARESI	1994		Novara	Novara	0
COLLINE SALUZZESI	1996		Cuneo	Cuneo	0
Collio Goriziano o Collio DOC	1968		Gorizia	Gorizia	1
Conegliano Valdobbiadene Prosecco	1969	2009	Treviso	Treviso	1
CÒNERO	1967	2004	Ancona	Ancona	0
CONTEA DI SCLAFANI" o "VALLEDOLMO-CONTEA DI SCLAFANI	1996		Agrigento	Agrigento	0
CONTEA DI SCLAFANI" o "VALLEDOLMO-CONTEA DI SCLAFANI	1996		Caltanissetta	Caltanissetta	0
CONTEA DI SCLAFANI" o "VALLEDOLMO-CONTEA DI SCLAFANI	1996		Palermo	Palermo	0
CONTESSA ENTELLINA	1993		Palermo	Palermo	0
CONTROGUERRA	1996		Teramo	Teramo	0
COPERTINO	1976		Lecce	Lecce	0
Cori DOC	1971		Latina	Latina	0
CORTESE DELL'ALTO MONFERRATO	1979		Alessandria	Alessandria	1
CORTESE DELL'ALTO MONFERRATO	1979		Asti	Asti	1
CORTI BENEDETTINE DEL PADOVANO	2004		Padova	Padova	0

CORTI BENEDETTINE DEL PADOVANO	2004		Venezia	Venezia	0
Cortona	1999		Arezzo	Arezzo	0
COSTA D'AMALFI	1995		Salerno	Salerno	1
COSTE DELLA SESIA	1996		Vercelli	Vercelli	0
CURTEFRANCA	1995		Brescia	Brescia	0
DELIA NIVOLELLI	1998		Trapani	Trapani	0
Delle Venezie DOC	2020		Belluno	Belluno	1
Delle Venezie DOC	2020		Gorizia	Gorizia	1
Delle Venezie DOC	2020		Padova	Padova	1
Delle Venezie DOC	2020		Rovigo	Rovigo	1
Delle Venezie DOC	2020		Trento	Trento	1
Delle Venezie DOC	2020		Treviso	Treviso	1
Delle Venezie DOC	2020		Trieste	Trieste	1
Delle Venezie DOC	2020		Udine	Udine	1
Delle Venezie DOC	2020		Venezia	Venezia	1
Delle Venezie DOC	2020		Verona	Verona	1
Delle Venezie DOC	2020		Vicenza	Vicenza	1
Dogliani	1974	2005	Cuneo	Cuneo	0
DOLCETTO D'ACQUI	1972		Alessandria	Alessandria	1
DOLCETTO D'ALBA	1974		Asti	Asti	1
DOLCETTO D'ALBA	1974		Cuneo	Cuneo	1
DOLCETTO D'ASTI	1974		Asti	Asti	1
DOLCETTO DI DIANO D'ALBA O DIANO D'ALBA	1974	2010	Cuneo	Cuneo	1
DOLCETTO DI OVADA	1972		Alessandria	Alessandria	1
DOLCETTO DI OVADA SUPERIORE O OVADA	1972	2008	Alessandria	Alessandria	1
ELBA	1967		Livorno	Livorno	1
ELBA ALEATICO PASSITO	1967	2011	Livorno	Livorno	1
ELORO	1994		Ragusa	Ragusa	1
ELORO	1994		Siracusa	Siracusa	1
ERBALUCE DI CALUSO O CALUSO	1967	2010	Torino	Torino	1
ERBALUCE DI CALUSO O CALUSO	1967	2010	Vercelli	Vercelli	1
ERICE	2004		Trapani	Trapani	0
ESINO	1995		Ancona	Ancona	0
ESINO	1995		Macerata	Macerata	0
EST! EST!! EST!!! DI MONTEFIASCONE	1966		Viterbo	Viterbo	0
Etna con DOC	1968		Catania	Catania	1

FALANGHINA DEL SANNIO	2011		Benevento	Benevento	0
FALERIO	1975		Ascoli Piceno	Ascoli Piceno	0
FALERNO DEL MASSICO	1989		Caserta	Caserta	1
FARA	1969		Novara	Novara	1
FARO	1976		Messina	Messina	1
FIANO DI AVELLINO	1978	2003	Avellino	Avellino	1
FRANCIACORTA	1967	1995	Brescia	Brescia	1
FRASCATI	1966		Roma	Roma	1
FRASCATI SUPERIORE	1966	2011	Roma	Roma	1
FREISA D'ASTI	1972		Asti	Asti	1
FREISA DI CHIERI	1973		Torino	Torino	1
Friuli Aquileia DOC	1975		Udine	Udine	0
FRIULI COLLI ORIENTALI	1970		Udine	Udine	0
Friuli Grave DOC	1970		Udine	Udine	0
FRIULI ISONZO O ISONZO DEL FRIULI	1974		Gorizia	Gorizia	0
FRIULI LATISANA	1975		Udine	Udine	0
FRIULI O FRIULI VENEZIA GIULIA – FURLANIJA O FURLANIJA JULIJSKA KRAJINA	2020		Gorizia	Gorizia	0
FRIULI O FRIULI VENEZIA GIULIA – FURLANIJA O FURLANIJA JULIJSKA KRAJINA	2020		Trieste	Trieste	0
FRIULI O FRIULI VENEZIA GIULIA – FURLANIJA O FURLANIJA JULIJSKA KRAJINA	2020		Udine	Udine	0
FRIULI-ANNIA	1995		Udine	Udine	0
GABIANO	1983		Alessandria	Alessandria	0
GALATINA	1997		Lecce	Lecce	0
GALLUCCIO	1997		Caserta	Caserta	0
GAMBELLARA	1970		Vicenza	Vicenza	1
GARDA	1996		Brescia	Brescia	0
GARDA	1996		Mantova	Mantova	0
GARDA	1996		Verona	Verona	0
GARDA COLLI MANTOVANI	1976		Mantova	Mantova	0
Garda DOC	1996		Brescia	Brescia	0
Garda DOC	1996		Mantova	Mantova	0
Garda DOC	1996		Verona	Verona	0

GATTINARA	1967	1990	Vercelli	Vercelli	1
GAVI O CORTESE DI GAVI	1974	1998	Alessandria	Alessandria	1
GENAZZANO	1992		Frosinone	Frosinone	0
GENAZZANO	1992		Roma	Roma	0
GHEMME	1969	1997	Novara	Novara	1
Gioia del Colle DOC	1987		Bari	Bari	0
GIRÒ DI CAGLIARI	1972		Cagliari	Cagliari	1
GOLFO DEL TIGULLIO-PORTOFINO O PORTOFINO	1997		Genova	Genova	0
Grance Senesi DOC	2010		Siena	Siena	0
Gravina DOC	1983		Bari	Bari	0
GRECO DI BIANCO	1980		Reggio Calabria	Reggio Calabria	1
GRECO DI TUFO	1970	2003	Avellino	Avellino	1
GRIGNOLINO D'ASTI	1973		Asti	Asti	1
GRIGNOLINO DEL MONFERRATO CASALESE	1974		Alessandria	Alessandria	1
GROTTINO DI ROCCANOVA	2009		Potenza	Potenza	0
GUTTURNIO	2010		Piacenza	Piacenza	0
I TERRENI DI SANSEVERINO	2004		Macerata	Macerata	0
IRPINIA	2005		Avellino	Avellino	0
ISCHIA	1966		Napoli	Napoli	1
LACRIMA DI MORRO O LACRIMA DI MORRO D'ALBA	1985		Ancona	Ancona	0
LAGO DI CALDARO	1970		Bolzano	Bolzano	1
LAGO DI CALDARO	1970		Trento	Trento	1
LAGO DI CORBARA	1998		Terni	Terni	0
LAMBRUSCO DI SORBARA	1970		Modena	Modena	1
LAMBRUSCO GRASPAROSSA DI CASTELVETRO	1970		Modena	Modena	1
LAMBRUSCO MANTOVANO	1987		Mantova	Mantova	0
LAMBRUSCO SALAMINO DI SANTA CROCE	1970		Modena	Modena	1
LAMEZIA	1978		Catanzaro	Catanzaro	0
Langhe	1994		Cuneo	Cuneo	0
LESSINI DURELLO O DURELLO LESSINI	2011		Verona	Verona	1

LESSINI DURELLO O DURELLO LESSINI	2011		Vicenza	Vicenza	1
LESSONA	1976		Vercelli	Vercelli	1
LEVERANO	1979		Lecce	Lecce	0
LISON	1971	2010	Treviso	Treviso	0
LISON	1971	2010	Venezia	Venezia	1
LISON-PRAMAGGIORE	1971		Treviso	Treviso	0
LISON-PRAMAGGIORE	1971		Venezia	Venezia	1
LIZZANO	1988		Taranto	Taranto	0
LOAZZOLO	1992		Asti	Asti	0
LOCOROTONDO	1969		Bari	Bari	1
LOCOROTONDO	1969		Brindisi	Brindisi	1
Lugana DOC	1967		Brescia	Brescia	1
Lugana DOC	1967		Verona	Verona	1
MALVASIA DELLE LIPARI	1973		Messina	Messina	1
Malvasia di Bosa DOC	1972		Oristano	Cagliari	1
MALVASIA DI CASORZO D'ASTI	1968		Alessandria	Alessandria	0
MALVASIA DI CASORZO D'ASTI	1968		Asti	Asti	0
MALVASIA DI CASTELNUOVO DON BOSCO	1973		Asti	Asti	0
MAMERTINO DI MILAZZO O MAMERTINO	2004		Messina	Messina	1
MANDROLISAI	1981		Oristano	Cagliari	0
MANDROLISAI	1981		Nuoro	Nuoro	0
Maremma Toscana	2011		Grosseto	Grosseto	0
Marino DOC	1970		Roma	Roma	1
MARSALA	1969		Trapani	Trapani	1
MARTINA o MARTINA FRANCA	1969		Bari	Bari	1
MARTINA o MARTINA FRANCA	1969		Brindisi	Brindisi	1
MARTINA o MARTINA FRANCA	1969		Taranto	Taranto	1
MATERA	2005		Matera	Matera	0
MATINO	1971		Lecce	Lecce	0
MELISSA	1979		Catanzaro	Catanzaro	0
MENFI	1995		Agrigento	Agrigento	0
Merlara DOC	2000		Padova	Padova	0
Merlara DOC	2000		Verona	Verona	0
MODENA O DI MODENA	2009		Modena	Modena	0

MOLISE O DEL MOLISE	1998		Campobasso	Campobasso	0
MONFERRATO	1994		Alessandria	Alessandria	0
MONFERRATO	1994		Asti	Asti	0
MONICA DI SARDEGNA	1972		Cagliari	Cagliari	1
MONICA DI SARDEGNA	1972		Nuoro	Nuoro	1
MONICA DI SARDEGNA	1972		Sassari	Sassari	1
MONREALE	2000		Palermo	Palermo	0
MONTECARLO	1969		Lucca	Lucca	1
MONTECOMPATRI-COLONNA o MONTECOMPATRI o COLONNA	1973		Roma	Roma	1
MONTECUCCO	1998		Grosseto	Grosseto	0
MONTECUCCO SANGIOVESE	1998	2011	Grosseto	Grosseto	0
MONTEFALCO	1979		Perugia	Perugia	0
MONTEFALCO SAGRANTINO	1979	1992	Perugia	Perugia	0
MONTELLO ROSSO O MONTELLO	1977	2011	Treviso	Treviso	0
MONTEPULCIANO D'ABRUZZO	1968		Chieti	Chieti	1
MONTEPULCIANO D'ABRUZZO	1968		L'Aquila	L'Aquila	1
MONTEPULCIANO D'ABRUZZO	1968		Pescara	Pescara	1
MONTEPULCIANO D'ABRUZZO	1968		Teramo	Teramo	1
MONTEPULCIANO D'ABRUZZO COLLINE TERAMANE	1968	2003	Teramo	Teramo	1
MONTEREGIO DI MASSA MARITTIMA	1994		Grosseto	Grosseto	0
MONTESCUDAIO	1976		Pisa	Pisa	0
MONTI LESSINI	1987		Verona	Verona	0
MONTI LESSINI	1987		Vicenza	Vicenza	0
MORELLINO DI SCANSANO	1978	2006	Grosseto	Grosseto	0
MOSCADELLO DI MONTALCINO	1984		Siena	Siena	1
MOSCATO DI SARDEGNA	1979		Cagliari	Cagliari	1
MOSCATO DI SARDEGNA	1979		Nuoro	Nuoro	1
MOSCATO DI SARDEGNA	1979		Sassari	Sassari	1

MOSCATO DI SORSO – SENNORI	1972		Sassari	Sassari	1
MOSCATO DI TRANI	1974		Bari	Bari	1
MOSCATO DI TRANI	1974		Foggia	Foggia	1
Nardò	1987		Lecce	Lecce	0
NASCO DI CAGLIARI	1972		Cagliari	Cagliari	1
NEBBIOLO D'ALBA	1970		Cuneo	Cuneo	1
NEGROAMARO DI TERRA D'OTRANTO	2011		Brindisi	Brindisi	0
NEGROAMARO DI TERRA D'OTRANTO	2011		Lecce	Lecce	0
NEGROAMARO DI TERRA D'OTRANTO	2011		Taranto	Taranto	0
NETTUNO	2003		Roma	Roma	0
NIZZA	2000	2019	Asti	Asti	0
NOTO	1974		Siracusa	Siracusa	1
NURAGUS DI CAGLIARI	1974		Cagliari	Cagliari	1
OFFIDA	2001	2011	Ascoli Piceno	Ascoli Piceno	0
OLTREPÒ PAVESE	1970		Pavia	Pavia	1
OLTREPÒ PAVESE METODO CLASSICO	1970	2007	Pavia	Pavia	1
OLTREPÒ PAVESE PINOT GRIGIO	2010		Pavia	Pavia	0
Orcia	2000		Siena	Siena	0
ORTA NOVA	1984		Foggia	Foggia	0
ORTONA	2011		Chieti	Chieti	0
ORTRUGO DEI COLLI PIACENTINI O ORTRUGO – COLLI PIACENTINI	2010		Piacenza	Piacenza	0
ORVIETO	1971		Terni	Terni	1
ORVIETO	1971		Viterbo	Viterbo	1
OSTUNI	1972		Brindisi	Brindisi	0
Pantelleria DOC	1971		Trapani	Trapani	1
PARRINA	1971		Grosseto	Grosseto	0
PENISOLA SORRENTINA	1994		Napoli	Napoli	0
PENTRO DI ISERNIA O PENTRO	1983		Isernia	Campobasso	0
PERGOLA	2005		Pesaro e Urbino	Pesaro e Urbino	0
PIAVE	1971		Treviso	Treviso	1
PIAVE	1971		Venezia	Venezia	1
PIAVE MALANOTTE O MALANOTTE DEL PIAVE	1971	2010	Treviso	Treviso	1

PIAVE MALANOTTE O MALANOTTE DEL PIAVE	1971	2010	Venezia	Venezia	1
PIEMONTE	1994		Alessandria	Alessandria	0
PIEMONTE	1994		Asti	Asti	0
PIEMONTE	1994		Cuneo	Cuneo	0
PIEMONTE	1994		Novara	Novara	0
PIEMONTE	1994		Torino	Torino	0
PIEMONTE	1994		Vercelli	Vercelli	0
Pinerolese	1996		Cuneo	Cuneo	0
Pinerolese	1996		Torino	Torino	0
PINOT NERO DELL'OLTREPÒ PAVESE	1970		Pavia	Pavia	1
POMINO	1983		Firenze	Firenze	0
PORNASSIO O ORMEASCO DI PORNASSIO	2003		Imperia	Imperia	0
PRIMITIVO DI MANDURIA	1974		Brindisi	Brindisi	0
PRIMITIVO DI MANDURIA	1974		Taranto	Taranto	0
PRIMITIVO DI MANDURIA DOLCE NATURALE	1974	2011	Brindisi	Brindisi	0
PRIMITIVO DI MANDURIA DOLCE NATURALE	1974	2011	Taranto	Taranto	0
Prosecco DOC	2009		Belluno	Belluno	0
Prosecco DOC	2009		Gorizia	Gorizia	0
Prosecco DOC	2009		Padova	Padova	0
Prosecco DOC	2009		Treviso	Treviso	0
Prosecco DOC	2009		Trieste	Trieste	0
Prosecco DOC	2009		Udine	Udine	0
Prosecco DOC	2009		Venezia	Venezia	0
Prosecco DOC	2009		Vicenza	Vicenza	0
RAMANDOLO	1970	2001	Udine	Udine	0
RECIOTO DELLA VALPOLICELLA	1968	2010	Verona	Verona	1
RECIOTO DI GAMBELLARA	1970	2008	Vicenza	Vicenza	1
RECIOTO DI SOAVE	1968	1998	Verona	Verona	1
REGGIANO	1971		Reggio Emilia	Reggio Emilia	0
RENO	1987		Bologna	Bologna	0
RENO	1987		Modena	Modena	0
RIESI	2001		Caltanissetta	Caltanissetta	0
RIMINI	1996		Rimini	Forlì-Cesena	0

RIVIERA DEL BRENTA	2004		Padova	Padova	0
RIVIERA DEL BRENTA	2004		Venezia	Venezia	0
RIVIERA DEL GARDA BRESCIANO O GARDA BRESCIANO	1977		Brescia	Brescia	1
RIVIERA LIGURE DI PONENTE	1988		Genova	Genova	0
RIVIERA LIGURE DI PONENTE	1988		Imperia	Imperia	0
RIVIERA LIGURE DI PONENTE	1988		Savona	Savona	0
Roero DOCG	1985	2004	Cuneo	Cuneo	0
Roma DOC	2011		Roma	Roma	0
ROMAGNA	2011		Bologna	Bologna	0
ROMAGNA	2011		Forlì-Cesena	Forlì-Cesena	0
ROMAGNA	2011		Ravenna	Ravenna	0
ROMAGNA ALBANA	1967	1987	Bologna	Bologna	1
ROMAGNA ALBANA	1967	1987	Forlì-Cesena	Forlì-Cesena	1
ROMAGNA ALBANA	1967	1987	Ravenna	Ravenna	1
ROSAZZO	1970	2011	Udine	Udine	0
ROSSESE DI DOLCEACQUA O DOLCEACQUA	1972		Imperia	Imperia	0
ROSSO CÒNERO	1968		Ancona	Ancona	0
ROSSO DI CERIGNOLA	1974		Foggia	Foggia	0
ROSSO DI MONTALCINO	1983		Siena	Siena	0
ROSSO DI MONTEPULCIANO	1988		Siena	Siena	1
ROSSO ORVIETANO O ORVIETANO ROSSO	1998		Terni	Terni	0
ROSSO PICENO	1968		Ancona	Ancona	1
ROSSO PICENO	1968		Ascoli Piceno	Ascoli Piceno	1
ROSSO PICENO	1968		Macerata	Macerata	1
RUBINO DI CANTAVENNA	1970		Alessandria	Alessandria	0
RUCHÈ DI CASTAGNOLE MONFERRATO	1987	2010	Asti	Asti	0
S. ANNA DI ISOLA CAPO RIZZUTO	1979		Crotone	Catanzaro	0
SALAPARUTA	2006		Trapani	Trapani	0

Salice Salentino DOC	1976		Brindisi	Brindisi	0
Salice Salentino DOC	1976		Lecce	Lecce	0
SAMBUCA DI SICILIA	1995		Agrigento	Agrigento	0
San Colombano o San Colombano al Lambro DOC	1984		Milano	Milano	0
San Colombano o San Colombano al Lambro DOC	1984		Pavia	Pavia	0
SAN GIMIGNANO	1996		Siena	Siena	0
SAN GINESIO	2007		Macerata	Macerata	0
SAN MARTINO DELLA BATTAGLIA	1970		Brescia	Brescia	0
SAN MARTINO DELLA BATTAGLIA	1970		Verona	Verona	0
SAN SEVERO	1968		Foggia	Foggia	1
SAN TORPÈ	1980		Pisa	Pisa	0
SANGUE DI GIUDA DELL'OLTREPÒ PAVESE O SANGUE DI GIUDA	1970		Pavia	Pavia	1
SANNIO	1997		Benevento	Benevento	0
SANT'ANTIMO	1996		Siena	Siena	0
SANTA MARGHERITA DI BELICE	1996		Agrigento	Agrigento	0
SARDEGNA SEMIDANO	1995		Cagliari	Cagliari	0
SARDEGNA SEMIDANO	1995		Nuoro	Nuoro	0
SARDEGNA SEMIDANO	1995		Sassari	Sassari	0
SAVUTO	1975		Catanzaro	Catanzaro	1
SAVUTO	1975		Cosenza	Cosenza	1
SCANZO O MOSCATO DI SCANZO	2002	2009	Bergamo	Bergamo	0
SCAVIGNA	1994		Catanzaro	Catanzaro	0
SCIACCA	1998		Agrigento	Agrigento	0
SERRAPETRONA	2004		Macerata	Macerata	0
SFORZATO DI VALTELLINA	1968	2003	Sondrio	Sondrio	1
Sicilia DOC	1995		Agrigento	Agrigento	0
Sicilia DOC	1995		Caltanissetta	Caltanissetta	0
Sicilia DOC	1995		Catania	Catania	0
Sicilia DOC	1995		Enna	Enna	0
Sicilia DOC	1995		Messina	Messina	0
Sicilia DOC	1995		Palermo	Palermo	0
Sicilia DOC	1995		Ragusa	Ragusa	0
Sicilia DOC	1995		Siracusa	Siracusa	0

Sicilia DOC	1995		Trapani	Trapani	0
SIRACUSA	1973		Siracusa	Siracusa	0
SIZZANO	1969		Novara	Novara	1
SOAVE	1968		Verona	Verona	1
SOAVE SUPERIORE	1968	2001	Verona	Verona	1
SOVANA	1999		Grosseto	Grosseto	0
SPOLETO	2011		Perugia	Perugia	0
SQUINZANO	1976		Lecce	Lecce	0
STREVI	2005		Alessandria	Alessandria	0
SUVERETO	1989	2011	Livorno	Livorno	0
TARQUINIA	1996		Roma	Roma	0
TARQUINIA	1996		Viterbo	Viterbo	0
TAURASI	1970	1993	Avellino	Avellino	1
Tavoliere DOC	2011		Barletta-Andria-Trani	Bari	0
Tavoliere DOC	2011		Foggia	Foggia	0
TEROLDEGO ROTALIANO	1971		Trento	Trento	1
TERRA D'OTRANTO	2011		Brindisi	Brindisi	0
TERRA D'OTRANTO	2011		Lecce	Lecce	0
TERRA D'OTRANTO	2011		Taranto	Taranto	0
TERRACINA o MOSCATO DI TERRACINA	2007		Latina	Latina	0
TERRATICO DI BIBBONA	2006		Livorno	Livorno	0
TERRE ALFIERI	2009	2020	Asti	Asti	0
TERRE ALFIERI	2009	2020	Cuneo	Cuneo	0
TERRE DEL COLLEONI O COLLEONI	2011		Bergamo	Bergamo	0
TERRE DELL'ALTA VAL D'AGRI	2003		Potenza	Potenza	0
TERRE DI CASOLE	2007		Siena	Siena	0
Terre di Cosenza	2011		Cosenza	Cosenza	0
TERRE DI OFFIDA	2001		Ascoli Piceno	Ascoli Piceno	0
Terre di Pisa	2011		Pisa	Pisa	0
Terre Tollesi o Tullum DOC	2008		Chieti	Chieti	0
TINTILIA DEL MOLISE	2011		Campobasso	Campobasso	0
TODI	2010		Perugia	Perugia	0
TORGIANO	1968		Perugia	Perugia	0
TORGIANO ROSSO RISERVA	1978	1990	Perugia	Perugia	0
TREBBIANO D'ABRUZZO	1972		Chieti	Chieti	1

TREBBIANO D'ABRUZZO	1972		L'Aquila	L'Aquila	1
TREBBIANO D'ABRUZZO	1972		Pescara	Pescara	1
TREBBIANO D'ABRUZZO	1972		Teramo	Teramo	1
TRENTINO	1971		Trento	Trento	1
TRENTO	1993		Trento	Trento	0
VAL D'ARBIA	1985		Siena	Siena	1
Val d'Arno di Sopra	2011		Arezzo	Arezzo	0
VAL DI CORNIA	1989		Livorno	Livorno	0
VAL DI CORNIA	1989		Pisa	Pisa	0
VAL DI CORNIA ROSSO	1989	2011	Livorno	Livorno	0
VAL DI CORNIA ROSSO	1989	2011	Pisa	Pisa	0
VAL POLCEVERA	1999		Genova	Genova	1
VALCALEPIO	1976		Bergamo	Bergamo	0
VALDADIGE O ETSCHTALER	1975		Bolzano	Bolzano	0
VALDADIGE O ETSCHTALER	1975		Trento	Trento	0
VALDADIGE O ETSCHTALER	1975		Verona	Verona	0
Valdadige Terra dei Forti	2006		Trento	Trento	0
Valdadige Terra dei Forti	2006		Verona	Verona	0
Valdichiana toscana	1972		Arezzo	Arezzo	1
Valdichiana toscana	1972		Siena	Siena	1
VALDINIEVOLE	1976		Pistoia	Pistoia	0
VALLE D'AOSTA O VALLEE D'AOSTE	1971		Aosta	Aosta	0
VALLI OSSOLANE	2009		Verbano-Cusio-Ossola	Novara	0
VALPOLICELLA	1968		Verona	Verona	1
VALPOLICELLA RIPASSO	2010		Verona	Verona	1
VALSUSA	1997		Torino	Torino	0
VALTELLINA ROSSO	1968		Sondrio	Sondrio	1
VALTELLINA SUPERIORE	1968	1998	Sondrio	Sondrio	1
VALTÈNESI	2011		Brescia	Brescia	0
VELLETRI	1972		Latina	Latina	1
VELLETRI	1972		Roma	Roma	1
VENEZIA	2010		Treviso	Treviso	0
VENEZIA	2010		Venezia	Venezia	0
VERDICCHIO DEI CASTELLI DI JESI	1968		Ancona	Ancona	1

VERDICCHIO DEI CASTELLI DI JESI	1968		Macerata	Macerata	1
VERDICCHIO DI MATELICA	1967		Ancona	Ancona	1
VERDICCHIO DI MATELICA	1967		Macerata	Macerata	1
VERDICCHIO DI MATELICA RISERVA	1995	2010	Ancona	Ancona	1
VERDICCHIO DI MATELICA RISERVA	1995	2010	Macerata	Macerata	1
VERDUNO PELAVERGA O VERDUNO	1995		Cuneo	Cuneo	0
Vermentino di Gallura	1975	1996	Sassari	Sassari	1
VERMENTINO DI SARDEGNA	1988		Cagliari	Cagliari	1
VERMENTINO DI SARDEGNA	1988		Nuoro	Nuoro	1
VERMENTINO DI SARDEGNA	1988		Sassari	Sassari	1
VERNACCIA DI ORISTANO	1971		Oristano	Cagliari	1
VERNACCIA DI SAN GIMIGNANO	1966	1993	Siena	Siena	1
VERNACCIA DI SERRAPETRONA	1971	2004	Macerata	Macerata	0
Vesuvio	1983		Napoli	Napoli	1
VICENZA	2000		Vicenza	Vicenza	0
VIGNANELLO	1992		Viterbo	Viterbo	0
VIGNETI DELLA SERENISSIMA O SERENISSIMA	2011		Belluno	Belluno	0
VIGNETI DELLA SERENISSIMA O SERENISSIMA	2011		Padova	Padova	0
VIGNETI DELLA SERENISSIMA O SERENISSIMA	2011		Treviso	Treviso	0
VIGNETI DELLA SERENISSIMA O SERENISSIMA	2011		Verona	Verona	0
VIGNETI DELLA SERENISSIMA O SERENISSIMA	2011		Vicenza	Vicenza	0
VILLAMAGNA	2011		Chieti	Chieti	0
VIN SANTO DEL CHIANTI	1997		Arezzo	Arezzo	1
VIN SANTO DEL CHIANTI	1997		Firenze	Firenze	1
VIN SANTO DEL CHIANTI	1997		Pisa	Pisa	1

VIN SANTO DEL CHIANTI	1997		Pistoia	Pistoia	1
VIN SANTO DEL CHIANTI	1997		Siena	Siena	1
VIN SANTO DEL CHIANTI CLASSICO	1995		Firenze	Firenze	1
VIN SANTO DEL CHIANTI CLASSICO	1995		Siena	Siena	1
VIN SANTO DI CARMIGNANO	1975		Prato	Firenze	1
VIN SANTO DI MONTEPULCIANO	1996		Siena	Siena	1
VINO NOBILE DI MONTEPULCIANO	1966	1980	Siena	Siena	1
VITTORIA	2005		Caltanissetta	Caltanissetta	0
VITTORIA	2005		Catania	Catania	0
VITTORIA	2005		Ragusa	Ragusa	0
ZAGAROLO	1973		Roma	Roma	0

A. 3.3. Summary statistics of the times series

Summary Statistics					
Variable	Obs.	Mean	Std. Dev.	Min	Max
% Intercropped grapes	273	0.373	0.334	0	0.997
Scattered population	273	0.157	0.12	0.002	0.494
Agricultural Employment	273	0.35	0.264	0.01	3.494
Tractors (000s)	273	3.43	4.78	0	26.562
Cooperative wineries	273	81.806	181.375	0	1232
Quality wine	273	2.853	3.068	0	15
North	273	0.429	0.496	0	1
South	273	0.352	0.478	0	1
Δ % Intercropped grapes	182	-0.051	0.112	-0.496	0.496
Δ Scattered population	182	-0.041	0.036	-0.161	0.058
Δ Agricultural Employment	182	-0.155	0.24	-3.307	-0.021
Δ Tractors (000s)	182	3.152	3.211	0.045	16.181
Δ Cooperative wineries	182	55.813	93.383	0	539
Δ Quality wine	182	0.396	0.799	0	5

A. 3.4 Sources

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A. 4. ESTIMATE OF VINEYARD AREA IN THE EARLY 19TH CENTURY.

In this section we present the main data and criteria used in the representation of the relative importance of intercropping in all area with vines in Map 1, as well as the sources used. We also discuss here how we estimated the figures for areas without early 19th century information (which, for simplicity, in the tables below are labelled as 1830) and hence how we obtained the national estimate of specialized vineyards and areas with intercropped vines mentioned in section 2 of the paper.

Piedmont:

We have partial data for the mainland of the Kingdom of Sardinia from the General Statistics of the Kingdom, a general land survey carried out at the middle of the 18th century whose provincial results were published by Prato (1908). Intercropped area there was referred to as "alteni", which was a technique used to grow high vines and very often was associated with field crops, as explained by Prato (1908). It is possible that part of this area was actually specialized vineyard, but given the prevalence of intercropping in it, we classify it all as intercropped altogether. For the area of the city of Turin, data come from a local survey in 1833, also reported in Prato (1908). We assume that there were no major changes until 1830. We lack data for the provinces of Aosta, Valsesia and Ossola. We estimate the area of both specialized and intercropped vineyards assuming that in each area they grew in the same proportion as they did in the rest of Piedmont (for which we have data) between 1830 and 1929. We exclude from the computation of the % change the provinces of Oltre Po and Lomellina, which soon after Unification were transferred to Lombardy. The results of the estimate (in hectares) are shown in the following table.

TABLE A4.1 **Area under vines (intercropped and specialized, in hectares) in Piedmont (1830-1929)**						
	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Piedmont (without Aosta, Valsesia and Ossola)	131,702	131,072	262,774	45,415	167,793	213,208
Aosta, Valsesia and Ossola	11,939*	2,591*	14,530*	4,117	3,317	7,434
Piedmont	**143,641***	**133,663***	**277,304***	**49,532**	**171,110**	**220,642**

*Our estimate

Liguria:

For Liguria we have partial data for a limited Eastern part of the region from surveys during the French occupation, reported by Quaini (1972, p. 334-336). In particular, we are given a figure of 30,000 hectares of "*vignes*" for the whole "Département des Apennins" in 1809 (out of a total area of 416,000 hectares), from a report by the Prefect on the agricultural conditions in the Department. We are not given separate figures for intercropping and specialized vineyards, but Quaini provides a discussion of the Prefect which makes it clear that the overwhelming majority of those "*vignes*" refer to intercropped vines (to much dismay of the Prefect, who considered this a sign of backwardness). Actually, the Prefect acknowledged that growing grains between trees (vines and olive trees) was a (costly) form of insurance against tree-crop failures, the very mechanism we explore in this paper. The Department of the Apennines corresponded to the 1929 province of La Spezia, much of Massa and Carrara and parts of Genova and Parma. We are given more precise figures for the Arrondissement of Sarzana in 1812, with 4,077 hectares of specialized vineyards (*vignes*) and 29,873 of intercropped vines (*hautins – vignes sur echalas et culture melée en colline*), and a total Arrondissement area of 116,462. Since these Arrondissement figures seem more precise and the sum of areas with vines is larger than the total provided for the whole Department, we consider the former more reliable than the latter. We thus rely on the figures for the Arrondissemnt of Sarzana in order to estimate changes in the areas under scrutiny. In order to do so, we need to compute similar areas, but border changes in 1812 make it not straightforward. Indeed, in March 1812 Sarzana received a group of municipalities from what later on was to be the province of Massa-Carrara, while in December 1812 it lost municipalities that went to the newly created Arrondissement

of Spezia. Hence, we need to figure out which borders do the sources in Quaini (1972) refer to. We have actually been able to find two different complete definitions of the Arrondissment of Sarzana, with a full list of their municipalities. According to the borders defined in the decree of September 5th 1806 (published in Raccolta di Leggi, Decreti, Proclami, Manifesti, ec., pubblicati nel Bollettino delle Leggi, vol. 24, 1813, p. 123), it had an area of 63 thousand hectares. According to the borders defined in the decree of December 22nd 1812 (published in Raccolta di Leggi, Decreti, Proclami, Manifesti, ec., pubblicati nel Bollettino delle Leggi, vol. 42, 1813, p. 13), the Arrondissement had ca. 52,000 hectares. Both definitions represent far less than the Arrondissement in Quaini (1972). Having a look at the list of cantons in the Almanach Imperial 1812, it seems that the Arrondissement had the whole of what in December 1812 became the Arrondissemnt of Spezia and the area received in March 1812. Combining the areas in the decrees of 1806 and 1812 (including two municipalities that do not appear in the original lists but that were in between both areas), we obtain and area with 114,000 hectares, very similar to the figure in Quaini. It turns out that the Arrondissement of Sarzana in mid-1812 (the borders for which we have land-use data) coincided with the bulk of the 1929 province of La Spezia (excluding just the municipalities of Maissana and Varese Ligure) plus much of the agrarian zone Bassa Lunigiana (which in 1929 belonged to the province of Massa-Carrara).

Taking the Arrondissement of Sarzana thus defined, we find that in 1929 it had 2,337 hectares of specialized vineyards and 19,068 hectares of intercropped vines, against a figure of, respectively, 4,077 and 29,873 hectares. There was, therefore, a decline in both forms of vine-growing of roughly the same proportions. Assuming that the whole of Liguria followed a similar proportional change, we obtain and estimate of 60,656 hectares of intercropped vines and 17,505 hectares of specialized vineyards in 1812. We use the same proportional change for estimating the early-19th century acreages for the province of Massa-Carrara (see below).

TABLE A4.2 Area under vines (intercropped and specialized, in hectares) in Liguria (1830-1929)						
	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Arrondissement of Sarzana (including most of Bassa Lunigiana)	29,873	4,077	33,950	19,068	2,337	21,405
Liguria	**60,656***	**17,505***	**78,161**	**38,717**	**10,034**	**48,751**

*Our estimate

Lombardy:

We have been able to assemble complete data for Lombardy, although from different sources, owing to the historical political fragmentation of the area.

The first piece of evidence comes from the so-called Teresian Cadastre of the State (or Duchy, not to be confused with the Ducal province) of Milan. This polity covered the area of the 1929 provinces of Varese, Como, Milan, most of Cremona (excluding the area of Crema) and the part of Pavia east to the Ticino and North to the Po. The Cadastre was conducted between 1718 and 1760. Zaninelli (1986, ed.) reports figures recovered from archival data covering the whole Duchy, although in two separate chapters covering different areas. In a first chapter (Zaninelli, 1986) we find data for the hillside and plain areas. Data are presented grouped in 9 geographical units, which are said to correspond to several agrarian zones as defined in the agrarian cadastre. The correspondence list between agrarian zones and the units used in the study of the Teresian Cadastre is found in Zaninelli (1986, ed.) at pages 18-19. In another chapter (Bianchi, 1986), we find data for the mountain areas. Although the correspondence list also classifies the agrarian zones of the mountain areas (grouped into two broader units), Bianchi presents data for different 4 aggregates. From its description it is clear that they cannot be matched with agrarian zones. Hence, we aggregate the whole figures into a single mountain area for the graphical representation. For the hill and plain areas, we use the groupings of agrarian zones mentioned in Zaninelli, although a comparison with the areas of the 1929 agrarian zones suggests that, although there is broad matching, borders were not exactly the same (or there was considerable underestimation). In the graphical representation we also merge Casalasco with Basso Cremonese Vitato, although the former was (rather unexplainably) excluded from the groupings in Zaninelli (1986). We also

obviate (in the graphical representation) other minor border changes (few municipalities included in the Duchy of Milan, and hence on the data provided by Zaninelli, 1986, belonging to the later provinces of Bergamo – the area South the Fosso Bergamasco - and Mantua – the area around Asolo). We also obviate in the graphical representation the part of Cremona (the area around Crema) belonging to the Venetian republic and hence not covered by the Teresian Cadastre. Zaninelli includes in one of his groupings the agrarian zone to which this area belonged: most likely, this means that the agrarian zones were not necessarily entirely included in the groupings mentioned, but rather than they had some area covered. It is worth noting also that Zaninelli (1986) excludes from its disaggregated figures a small area that is said to have belonged to the mountain area. Although we are not given an explanation for this, we separate it (using the difference between the total and the sum of the 9 sub-regional figures) and aggregate it to the mountain area. In the description of the different areas, there is also an apparent overlapping of agrarian zones around Varese in the data given by Bianchi (1986) and the agrarian zones covered by Zaninelli (1986). This point is poorly explained, and we assume that this is because agrarian zones included not in their entirety parts of the areas included in either chapter. At any rate, in the whole book they treat each chapter as covering non-overlapping areas, and, despite the apparent contradictions and lack of precision in the explanation of the areas covered, we consider both areas as non-overlapping as well.

For the province of Mantova we can rely on the Austrian Cadastre of the Duchy before it was incorporated in the Lombard-Venetian Kingdom and carried out in 1775-1785. The data were published in Vivanti (1959, p. 130). The Cadastre does not report specialized vineyards, although it includes three different categories for intercropped vineyards (in arable land, in meadows and in pastures). As in 1929 specialised vineyards were less than 2% of the area with vineyards in the whole province, and as in the rest of Austrian Lombardy (as derived from the Teresian cadastre figures) just 0.6% of the area with vines was specialized vineyards, we find plausible that all vineyards were intercropped at the end of the 18th century. Hence accept the figure in Vivanti and assume no major changes up to the early 19th century.

The third piece of evidence comes from Prato (1908), which reports data for Lomellina and Oltre Po Pavese, then belonging to the Kingdom of Sardinia but later aggregated to the province of Pavia. For further details, see above the discussion on Piedmont.

For the remaining part of Lombardy, we have the data of the 19th century so-called Austrian Cadastre, carried out between the late 1810s and the early 1850s and published in an official volume on fiscal statistics (K. K. Finanzministerium, 1858). The reported figures refer explicitly (p. XII-XXX) to the part of the Lombardian-Venetian Kingdom that had not carried out not a 18th century Cadastre: hence, an aggregate including the provinces of Bergamo (except its small southern zone belonging to the Duchy of Milan), the whole provinces of Brescia and Sondrio, a small part of the province of Mantova (the westernmost district of Asola), and a small part of the province of Crema and Lodi (the aforementioned area around Crema). This source does not provide disaggregated figures for each province.

To our knowledge, separate data is only available for the province of Sondrio, published in Società Agraria della Valtellina (1858, p.32). Hence, for mapping purposes, we attribute the remaining aggregate figure in Austrian fiscal statistics to the provinces of Bergamo and Brescia (obviating that it included small bordering areas of Crema and Mantova and excluded a small area of Bergamo).

A couple of different sources for a different administrative unit of the former State of Milan confirm the main trends derived from inspection of the data in Zaninelli (1986, ed.). For the (Lombardo-Venetian) province of Milan we have the figures of the Austrian (i.e., Teresian) census of 1760 in a statistical guide (Tradati, 1848, p. 202), slightly different from the figures provided by an official and published in the standard account of Lombard agriculture in the early 19th century (Romani, 1957). Indeed, the latter provides aggregate figures for arable land with mulberries and vines, while the former breaks down arable land with mulberries (but without vines) and arable land with mulberries and vines. As a consequence, the area actually with intercropped vines (reported by Tradati, 1848) is half that provided in Romani (1957). It is still a considerable figure (ca. 20 times the area in 1929), but in the same area wine-growing was contracting (probably owning to urbanization and a shift to a different crop mix, especially intensive cattle-raising). Indeed, also specialized vineyards had collapsed by 1929 to a fifth of their early 19th century area. The area of this province corresponds to parts of the later province of Milan (excluding the area of Lodi) and the southern area of the later province of Varese.

Adding the figures from these four different sources we end up with a figure of 429,301 hectares of intercropped vine and 21,684 hectares of specialized vineyards. The total figure is ca. 50% larger than the aggregate figure for the region (without breakdown for specialized and intercropped vines) of 319 thousand

hectares in 1829 provided by the first Austrian official statistics (Romani, 1957, p. 244). Since the quality of the Austrian statistics (the famous *Tafeln*) has been debated, we do not attribute too much value to this difference. At any rate, all figures are consistent with a long-run trend of decline in Lombard viticulture. Along with this trend, we can appreciate a permanent prevalence of intercropping as the preferred planting technique between the mid-18th and mid-20th century, together with a slight upwards trend in the relative importance of specialized vineyards (consistent with the earlier industrialization and urbanization of the region).

TABLE A4.3

Area under vines (intercropped and specialized, in hectares) in Lombardy (1830-1929)

	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Lombardy (inclusive of Alto Bobbiese piacentino)	**429,301**	**21,684**	**450,985**	**155,693**	**37,179**	**192,871**

Veneto:

We have complete Cadastral information from the Austrian Cadastre, carried out between 1828 and 1849, published at municipality level in Scarpa (1963). We use the provincial summaries therein. These data are almost exactly coincident with the regional aggregate ones in K. K. Finanzministerium (1858), although we prefer those in Scarpa (1963) since they derived from a more detailed version of the same source.

TABLE A4.4

Area under vines (intercropped and specialized, in hectares) in Venetia (1830-1929)

	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Venetia	**717,163**	**14,940**	**732,102**	**584,515**	**29,016**	**613,531**

Trentino-South Tirol:

For the province of Trento we have data from the Austrian cadaster of 1859-1861 collected and published by Grandi (1976). There seems to be a mistake in the sum of the different categories of specialized vineyards: while Grandi provides different figures and percentages, the aggregate does not correspond to either. Thus we use the sum of the parts (4345 jugers) rather than the aggregate figure (3934) – this procedure is also consistent with the percentages provided by Grandi. The difference is nonetheless small.

For the province of Bolzano we rely on a national Austrian survey on wine-growing (K.K. Ackerbau-Ministerium, 1873). Although the survey also published data for the province of Trento, it classified all its vineyards as intercropped, despite mentioning that a small number of specialized vineyards had been planted in recent years. The cadastral data in Grandi (1976) confirms this prevalence of intercropping (91% of all area under vineyards). Instead, for the province of Bolzano the survey provided disaggregated figures for specialized and intercropped vineyards, showing a prevalence of the latter that was to accentuate in the next century.

TABLE A4.5

Area under vines (intercropped and specialized, in hectares)

in Trentino-S. Tirol (1830-1929)

	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Trentino-South Tirol	**31,558**	**6,574**	**38,133**	**19,238**	**12,717**	**31,955**

Venezia Julia:

For Venetia-Julia we have complete Cadastral information for the Küstenland province (coincident with the Venetia-Julia but for minor marginal areas on its borders) published in K. K. Finanzministerium (1858). More disaggregated data (but with coverage restricted to Istria rather than the whole Küstenland), in all likelihood

from the preparative works of the Cadastre, were published in the journal L'Istria (1846, p. 166-167, 183, 190-191, 197-199, 204-207, 212-213, 224-226, 240-241, 250-251 and 256-259).

TABLE A4.6

Area under vines (intercropped and specialized, in hectares) in Venetia Julia (1830-1929)

	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Venetia Julia /Küstenland	**83,981**	**10,719**	**94,700**	**34,247**	**22,261**	**56,508**

Emilian Duchies:

We don't have (useful) information from the pre-unitary Cadastrers for the Duchy of Modena and Reggio and for the Duchy of Parma and Piacenza. The earlier source for this area is a figure for the province of Reggio Emilia from 1870 published in a statistical survey of the province by the very scrupulous Prefect (Scelsi, p. 66). The source for this information is likely to be the ongoing Italian Cadastre, as Scelsi also served in other provinces where he published analogous statistical surveys relying on such a source. We assume that this figure is representative of the situation in 1830 and estimate intercropped and specialized vineyards for the rest of both Duchies using the proportional changes experienced by Reggio Emilia between 1830 and 1929. As the part of the Alto Bobbiese that in 1929 belonged to the province of Piacenza was in 1830 part of the Piedmontese province of Oltre Po, we exclude this area from both our 1929 figure and our estimate. Since Oltre Po was later aggregated to the province of Pavia in Lombardy, we have consistently included the Alto Bobbiese in Lombardy for our calculations. Confirming our figures, Spaggiari (1966) provides data from the Cadastre of Maria Luigia (around 1830) for a part of the present-day province of Parma (about a third of it), with just 253 hectares of specialized vineyards ('vigna') and 7909 hectares of 'colto arborato' – the majority of which should have been intercropped vineyards (as suggested by the figures of a municipality in the neighboring province of Piacenza, whose Cadastre, surveyed by Galli, 2004, reports just 'colto vitato'.

TABLE A4.7 Area under vines (intercropped and specialized, in hectares) in the Emilian Duchies (1830-1929)						
	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Reggio Emilia	86,237	119	86,356	101,799	467	102,266
Parma, Piacenza and Modena (without Alto Bobbiese)	182,162*	1,437*	183,599*	215,035	5,651	220,686
Emilian Duchies (without Alto Bobbiese)	**268,399***	**1,556***	**269,955***	**316,834**	**6,118**	**322,952**

*Our estimate

Papal States (and the district of Sora):

For the former Papal States we have data from the so-called Gregorian Cadastre (carried out between 1816 and 1835), published at Papal province level in Galli (1840). For the comparison with the 1929 data we exclude from the province of Forlì two agrarian zones of the so-called Tuscan Romagna, which belonged to the province of Florence until 1926.

In order to ensure comparability, we also include in 1830 the district of Sora, which belonged to the Kingdom of Two Sicilies, and exclude the district of Benvento (an exclave surrounded by the Kingdom of Two Sicilies). We take the data for Sora from Granata (1830), in all likelihood based on the so-called Murattian Cadastre carried out in 1810-1820.

TABLE A4.8 Area under vines (intercropped and specialized, in hectares) in the Papal States (1830-1929)						
	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Papal States (with the district of Sora and without Benevento)	**715,910**	**41,189**	**757,099**	**965,888**	**71,578**	**1,037,466**

Tuscany:

For most of Tuscany (i.e., the provinces of Arezzo, Pistoia, Pisa, Siena, Livorno and Florence, inclusive of the so-called Tuscan Romagna, namely the district of Rocca San Casciano annexed to Forlì in 1923) we can rely on the Tuscan Cadastre carried out between 1817 and 1834. The cadastre of the island of Elba was carried out in 1840-1842. Part of the later province of Lucca was an independent Duchy, annexed to the Grand-Duchy of Tuscany in 1847. In the area of the former duchy of Lucca the Cadastre was carried out between 1829 and 1869. We have information on the original data of the Cadastres for all this area but the province of Grosseto in the Tuscan volume of the 1880s Agrarian Inquiry (Inchiesta Jacini, 1881, p. 140). The data for the province of Grossetto can be found in the study of the Tuscan Cadastre by Pazzagli (1979). We take the data for the rest of Tuscany from Inchiesta Jacini (1881) rather than from Pazzagli because the former covers a larger area (Pazzagli's study excludes the Tuscan Romagna, the island of Elba and the whole province of Lucca).

All the cadastres considered in this region only considered categories for intercropped vineyards (actually, two different categories: vineyards intercropped in arable land and vineyards with olive trees intercropped in arable land). In 1929, only 5% of all vineyards in the Tuscany (inclusive of the Tuscan Romagna) were specialized, and both the Inchiesta Jacini (1881) and, especially, the early 20th century sources (see Federico and Martinelli 2018) mention them as a new trend. Most of the little Tuscan specialized vineyards existing around the time the 1929 Agrarian Cadastre was made seem to have followed the replanting needs induced by the phylloxera. Hence, we find it plausible assuming that in 1830 there were no specialized vineyards in Tuscany (or, if they were, the numbers were so small as to be irrelevant).

We estimate the number of hectares of intercropped and specialized vineyards in the province of Massa Carrara assuming that they followed the same relative change as the Arrondissement of Sarzana between 1812 and 1929 (see the discussion above, in the estimate for Liguria), which included much of Bassa Lunigiana (the largest agrarian zone of the three ones the 1929 province of Massa had).

TABLE A4.9

Area under vines (intercropped and specialized, in hectares) in Tuscany (1830-1929)

	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Tuscany (including Tuscan Romagna and excluding province of Massa)	400,416	0	400,416	450,246	24,912	475,158
Province of Massa	24,872*	2,196*	27,069*	15,876	1,259	17,135
Tuscany (including Tuscan Romagna)	**425,288***	**2,196***	**427,484***	**466,122**	**26,171**	**492,293**

*Our estimate.

Continental South:

For the continental part of the Kingdom of Two Sicilies, we can use the aforementioned Murattian Cadastre data published in Granata (1830). We include in this area the district of Benevento, an exclave of the Papal States, with data from Galli (1840) and exclude the district of Sora, which later was annexed to Latium (and, therefore, is included along with it in the Papal States).

TABLE A4.10

Area under vines (intercropped and specialized, in hectares) in the Continental South (1830-1929)

	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Continental South (without Sora and with Benevento)	**155,243**	**272,690**	**427,934**	**245,067**	**321,130**	**566,197**

Sicily:

For Sicily we have Sicilian Cadastre, carried out between 1810 and 1853 (but mostly in the period 1838-1853). Such data distinguish specialised vineyards from vines with other trees. Part of the latter were considered specialised in the agrarian cadastre of 1929 (when wine was the most important product of the plot), but we don't have a way to separate what part of this category was truly specialised and what part intercropped in 1830. Bearing this in mind, we classify all vines with trees as intercropping (knowing that by these means we overestimate this category in 1830).

TABLE A4.11

Area under vines (intercropped and specialized, in hectares) in Sicily (1830-1929)

	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Sicily	**46,169**	**99,231**	**145,400**	**8,038**	**193,243**	**201,281**

Sardinia:

For Sardinia we have data from the Piedmontese Cadastre, carried out between 1840 and 1851, published in 1867 at the provincial level in a report presented in 1852 to the parliament of the Kingdom of Sardinia (Despines 658-659). The cadastral figures are "vineyards without cereals" and "vineyards with cereals", leaving no room for misunderstandings[27].

TABLE A4.12

Area under vines (intercropped and specialized, in hectares) in Sardinia (1830-1929)

	1830			1929		
	Intercropped	Specialised	Total	Intercropped	Specialised	Total
Sardinia	**5,787**	**55,991**	**61,778**	**14**	**33,644**	**33,658**

[27] The same report includes as well estimates for Piedmont and Liguria, but we don't use them because i) unlike the figures for Sardinia, they were not based on cadastral surveys, ii) they do not distinguish arable land from arable land with intercropped vineyards and, finally, iii) the figure for specialised vineyards seems implausibly low - 41 thousand hectares for the whole of Piedmont - whereas the figure for Liguria seems implausibly high - 29 thousand hectares. An inspection of the output estimates included therein reveals that the figure of wine from specialised vineyards was obtained using the same yield for all continental provinces of the Kingdom, casting further doubts on its reliability.

Italy (at 1929 borders):

We present a summary of our data compilation and our estimates in the following table (all figures in hectares).

TABLE A4.13

Area under vines (intercropped and specialized, in hectares) in Italy (1830-1929)

	1830			1929			% Intercr.	% Intercr.
	Intercr.	Spec.	Total	Intercr.	Spec.	Total	1830	1929
Piedmont	143,641*	133,663*	277,304*	49,532	171,110	220,642	51.8%	22.4%
Liguria	66,656*	17,505*	78,161*	38,717	10,034	48,751	77.6%	79.4%
Lombardia (with Alto Bobbiese from Piacenza)	429,301	21,684	450,985	155,693	37,179	192,871	95.2%	80.7%
Trentino-South Tirol	31,558	6,574	38,133	192,38	12,717	31,955	82.8%	60.2%
Venetia	702,223	14,940	717,162	584,515	29,016	613,531	97.9%	95.3%
Venezia Giulia/Küstenland	83,981	10,719	94,700	34,247	22,261	56,508	88.7%	60.6%
Emilian Duchies (without Alto Bobbiese)	268,399*	1,556*	269,955*	316,834	6,118	322,952	99.4%	98.1%
Tuscany (including Tuscan Romagna)	425,288*	2,196*	427,484	466,122	26,171	492,293	99.5%	94.7%
Papal States (with the district of Sora, without Benevento and without Tuscan Romagna)	715,910	41,189	757,099	965,888	71,578	1,037,466	94.6%	93.1%
Continental South (without Sora and with Benevento)	155,243	272,690	427,934	245,067	321,130	566,197	36.3%	43.3%
Sicily	46,169	99,231	145,400	8,038	193,243	201,281	31.8%	4.0%
Sardinia	5,787	55,991	61,778	14	33,644	33,658	9.4%	0.0%
Italy	**3,068,157***	**677,937***	**3,746,095***	**2,883,905**	**934,201**	**3,818,105**	**81.9%**	**75.5%**

Note: *Our estimate. Borders of each macro-region have been adjusted as to make them entirely comparable between 1929 and 1830s (e.g., the 1929 figure for Lombardy includes data on acreage from the part of Alto Bobbiese then belonging to Piacenza, to ensure comparability with the 1830s figure).

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A. 5. A MODEL OF THE INTERCROPPING CHOICE.

We assume the peasant has two plots, of equal size and quality, located at equal distance *d* in opposite directions from the farm, where the peasant's house and all processing and storing facilities are located. Each plot has the same crop-specific probability, with independent occurrence, of experiencing a harvest failure (1-p_g for wheat and 1-p_w for wine). We abstract from the crop mix and take it as given, assuming the peasant has decided to produce a given amount of wheat (whose monetary value is represented by G, for 'grain') and a given amount of wine (represented, in monetary terms, by W, for 'wine'). Without loss of generality, we model the peasant choice as a discrete one between complete plot specialization and complete plot intercropping. The peasant has to choose between allocating one plot to each product (say plot 1 to wheat and plot 2 to vines) and growing both crops in each plot (with each plot producing half the optimal output – i.e. G/2 and W/2).

The aggregate expected utility derived from the first strategy, 'specialization', is:

(1) $E(U_s) = p_g U(G) + p_w U(W) - n_g d - n_w d$

Where n_g and n_w are the number of two-way travels (to the plot where the relevant product is grown and back to the farm) respectively needed to grow 'wheat' and 'wine'. The effort and time – and hence the disutility – associated with each travel is proportional to the distance to the plot, while it is independent from output levels. Since moving to the fields is required even in the event of crop failures, we can think of it as an upfront cost in terms of utility to be paid for following strategy 1. We express this as a disutility component (n_g+n_w) d [28].

In the intercropping strategy, the expected utility is:

(2) $E(U_i) = 2p_g U\left(\frac{G}{2}\right) + 2p_w U\left(\frac{W}{2}\right) - 2n_{gw} d$

Wine and wheat have different labor requirements and, more importantly, different work schedules throughout the year. Wine production, being a more labor-intensive production than wheat and having fixed capital investments in the form of vines which need to be taken care of throughout the year, requires a larger number of trips to the field than wheat production, which during the slack season requires little caring activities.

[28] We assume that crop failures do not generate utility.

Growing simultaneously wheat and wine in each plot requires a larger number of trips to each plot than if each plot were specialized. Some days it will be possible to perform tasks required by the two crops, but not all. The peasant will need to go to each intercropped plot n_{gw} times a year. We represent the different "tending intensity" associated with different strategies by the following inequality[29]:

(3) $n_g < n_w < n_{gw} < n_g + n_w$

The dominance of one strategy over the other is determined by the difference between their aggregate expected utilities – i.e. $\Delta=E(U_i)-E(U_s)$. Intercropping is preferred whenever $\Delta>0$, and specialization if $\Delta<0$. The decision function, using (1) and (2) and rearranging, becomes:

(4) $\Delta = E(U_i) - E(U_s) = p_g \left[2U\left(\frac{G}{2}\right) - U(G)\right] + p_w \left[2U\left(\frac{W}{2}\right) - U(W)\right] - d(2n_{gw} - n_g - n_w)$

The first two terms of the expression in the right-hand side of the equation measure the utility-premium associated with risk diversification. They are always positive, for risk-averse utility curves. The last term measures the disutility-premium associated with higher frequency of moving to the fields and larger transportation costs associated with the intercropping strategy. Equation (4) highlights that the decision of growing wheat and wine in specialized or in intercropped fields depends on the whether the magnitude of the diversification premium prevails over the disutility generated by the wider geographical dispersion of vines.

With risk-neutral utility functions, the first two terms are 0. Were this the case, Δ <0 and there would be no reason for intercropping. Hence, intercropping requires the decision-maker to be risk averse. The higher the degree of risk-aversion, the more the peasant values the insurance associated with the intercropping strategy. His preference for avoiding risk by spreading crops in different fields, "putting the same number of eggs in different baskets", is counterbalanced by the cost of doing so. For any level of risk-aversion, there is a distance to the fields such that the peasant is indifferent between the two strategies, and further increases in *d* will make specialization the dominant strategy.

We cannot measure directly the degree of risk aversion, while we can use the share of people living in dwellings scattered in the countryside as a proxy for the average distance to the fields (*d*). Everything being

[29] Note that our qualitative results would hold even with $n_g \leq n_w$ and $n_{gw} \leq n_w + n_g$ in (3).

equal, the more peasants lived close to the fields, the shorter the distance the average peasant had to travel and thus the more frequent the predicted incidence of intercropping as a cultivation technique. Our analysis also implies that over the whole range of distances there is just a single value leaving the peasant indifferent between the two strategies, explaining why we observe so often complete specialization or complete intercropping as winegrowing techniques across Italy.