What is the Value of Terroir? Historical Evidence from Champagne and Bordeaux

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Abstract:

The concept of geographical indications or 'terroir' refers to the special characteristics of a place that imparts unique qualities to the product (wine) produced. This paper analyses how regulations that formally establish a link between product quality and production location ('terroir') affect the price of the product. More specifically, we study how the introduction of wine geographical indications or "Appellations of Origin" in early twentieth century France influenced the price of specific wines (Champagne and Bordeaux) in the years and decades following their introduction. We find very significant effects on prices of the initial Champagne zone, but no impact on other types of wines.

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Abstract

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Keywords: geographical indications, European agriculture, regulation, wine history.

1. Introduction

A set of intriguing papers over the past decade try to provide an answer to the question "Does Terroir Matter?" (Gergaud and Ginsburgh, 2008) or "What is the Value of Terroir?" (Cross, et al., 2011).[1] These papers, and related studies such as Ashenfelter et al. (1995) and Ashenfelter (2008) focus on wine markets and regulation. Cross et al. (2011) explain how the concept of '*terroir*' (coming from the French word of '*terre*' (meaning land)) refers to the special characteristics of a place that imparts unique qualities to the product (wine) produced.

However, the issue of '*terroir*' goes beyond wine. Many other products have tried to link their quality (perceptions) to the location of their production—as reflected in the rapid spread of geographical indications (GIs). GIs are an important issue in marketing (by signaling particular aspects of the product), in economic (by presumably reducing asymmetric information), and in trade negotiations (where some countries consider GIs to be a way to solve information problems, others interpret them as pure protectionism) (Barham, 2003; Josling, 2006).[2]

As it is obvious from the trade and other disputes caused by GIs and '*terroir*', various interest groups see their territorial links as being valuable—either for themselves (if they belong to it) or for others who protect the GIs or '*terroir*'.

[1] While Gergaud and Ginsburgh (2008) and Cross et al. (2011) on the one hand, find that '*terroir*' doesn't matter, Ashenfelter and Storchmann (2010) find that it does matter.

[2] These differences of opinion have led to what Josling (2006) described as a "war on terroir". GIs are currently an issue for the ratification of the EU-Canada Comprehensive Trade and Economic Agreement (CETA), and they are being debated in the ongoing negotiations on the Transatlantic Trade and Investment Partnership (TTIP) with the United States. For wines, more multilateral agreements exist, such as the 2006 Agreement between the US and the European Community on Trade in Wine (Deconinck et al., 2015).

Several studies have tried to estimate the value of GIs. A simple indication is to look at land values in the wine producing regions. For example, in the Appellation Champagne region (the most prestigious category) land prices worth on average one million euro per hectare, while just next door (in the non-GI area) they worth on average 13,000 euro per hectare (Agreste, 2014). However, this does not seem to be the case for all GIs. A well-known example is the "Super Tuscans" case in Italy. At the beginning of the 1970s, three historical wine-making families[3] started to produce "high-quality" wines that violated traditional GI rules[4] and thus could only be classified as "low-quality" wines (or wines without GIs). However, these innovative Tuscan wines, known as "Super Tuscans", became so successful (and high–priced) that regulatory changes were introduced afterwards to accommodate the new wines. In summary, the value of GIs and '*terroir*' appears both case and time specific.

Following the seminal papers of Waugh (1928), Rosen (1974) and Ashenfelter, et al. (1995), virtually all studies on the value of GIs have used hedonic techniques where wine prices are regressed on a set of characteristics as independent variables to explain variations in price. This includes Ashenfelter (2008), Byron and Ashenfelter (1995), Combris, et al. (1997), Landon and Smith (1997), Nerlove (1995), Schamel and Anderson (2003), Schnabel and Storchmann (2010), among others. Empirical work specific to wine has focused on the reliability of expert opinion, the

[3] Piero Antinori introduced the "Tignanello", a wine produced in the heart of the Chianti Classico area but without the traditional addition of white grapes. Antinori was soon followed by Giovanni Manetti, who developed "Flaccianello della Pieve", a wine made in the Chianti Classico area from 100% Sangiovese. Meanwhile, in the coastal Tuscan area of Bolgheri, another producer, Mario Incisa della Rocchetta, started producing "Sassicaia", a wine blend combining the local Tuscan Sangiovese grape with Bordeaux varieties such as Cabernet Sauvignon or Cabernet Franc (Brachetti Montorselli, 1999; Robinson, 2006, p. 704).

[4] The strict 1967 Chianti DOC (*Denominazione di Origine Controllata*, "Controlled Denomination of Origin") production code imposed a large percentage of white grapes in the wine blending, which rendered the wine inappropriate for aging.

importance of weather variables in explaining wine prices, and whether '*terroir*', defined as specific soil characteristics, has any impact on the quality of wine. See Storchmann (2012) and Herrmann and Teuber (2011) for a detailed literature review.

In this paper, we use a different approach. We use historical data from almost a century (from 1875 to 1955) to analyse how regulations that formally establish a link between product quality and production location ('*terroir*') affect the price of the product. More specifically, we study how the introduction of wine geographical indications or "Appellations of Origin" (*Appellations d'Origine*–AO) in early twentieth century France influenced the price of specific wines (Champagne and Bordeaux) in the years and decades following their introduction. We find very significant effects on prices of Champagne (Zone 1), but no impact on other types of wines.

The remainder of this paper is organized as follows: section 2 presents the creation of AO and the historical context in which the regional boundaries of wine appellations were established at the beginning of the twentieth century in France. Section 3 describes our main data set and illustrates some descriptive statistics. Section 4 describes the empirical strategy. In section 5, we present and discuss our results. Section 6 concludes.

2. The Creation of *Appellation d'Origines* (AO)

"*No production of luxury in France is subject today to such control than fine wines and brand-spirits. Each of the elements of the production (soil, grape varieties, cultivation methods) has been defined and imposed on producers in order to get all the quality required by the appellation. And this control has not been imposed on producers, but claimed by them.*"

Joseph Capus, 1947

By the end of the nineteenth century, French vineyards were recovering from the devastating the *Phylloxera* invasion. By the beginning of the twentieth century, the recovery in production volume combined with increased wine imports led to an oversupply crisis and falling wine prices (Simpson, 2011). This crisis induced imitations of brand-name wines (to capture higher–value markets). Examples of wine imitations were false "Champagne" wines or "Bordeaux" wines, labelled and sold as Champagne or Bordeaux but produced in other parts of France (Augé-Laribé, 1950; Stanziani, 2004).

Under pressure from French producer organizations, France introduced a series of laws to reduce wine imports and to protect the interests of "quality" wine producers by linking the "quality" of the wine to its production region (the '*terroir*') and the traditional way of producing wine. The system of *Appellations d'Origine* (AO) was born (Meloni and Swinnen, 2013, 2017a).

A 1908 law delegated the public administration (i.e., a commission established by the Ministry of Agriculture) to determine areas where wines' names may benefit from a legal protection (JORF, 1908). In this way, the regional boundaries of four wine "Appellations of Origin" (*Appellations d'Origine*–AO)[5] were established between 1908 and 1911: Banyuls, Bordeaux, Champagne, and Clairette de Die (see Table 1). These first AOs covered different areas and different types of wines in France, but all had a long history in wine production. For instance, Bordeaux and Clairette de Die were known and praised since the Roman times (the latter was referred to as "Clairette de Dea Augusta") and the Champagne area was producing sparkling wine

[5] The regional boundaries of two other non-wine regions were delimited: Armagnac and Cognac. These regions are not taken into account in our analysis as they are both French brandies (not wines) located in south west France and made by distilling white wine to produce a spirit ("*eau de vie*").

since the early Medieval period (Bonal, 1984; Unwin, 1991, p. 257; Vincens et al., 1911; Wolikow, 2009).

The first AOs were from different parts of France (see Figure 3). Table 2 summarizes the main characteristics of the AO.

Banyuls (a sweet dessert wine produced in south west France) and Clairette de Die (a sparkling white wine produced in south east France) were both small wine areas (around 1,300 hectares and 1,500 hectares respectively)—representing a small fraction of the total wine produced in the respective departments. Moreover, their export market was non-existent. Interestingly, Banyuls, a wine produced in (what was considered) a "low-quality" region (the Midi wine region) managed to obtain one of the first official recognition of "quality".

On the other hand, Bordeaux (a red wine produced in the Gironde department in south west France) and Champagne (a sparkling white wine produced in north east France, mainly in the Marne and Aube departments) were centuries-old world-renowned wines. They encompassed much larger areas (around 15,000 hectares in Champagne and 140,000 hectares in Bordeaux). Both had important export markets, especially Belgium, England and the US. However, the share of exports was much higher for Champagne than for Bordeaux. Almost 70% of the Champagne wines were exported whereas only 18% of Bordeaux wines were exported (see Table 2 and Figure 2). This reflected the fact that the Bordeaux AO not only covered the "high-quality" wines (with a large export share) but also lower quality wines. In the Champagne AO there were only "high-quality" wines.

The delimitation of the Champagne AO was more controversial as winegrowers from various departments wanted to be part of it. However, a strong division of interests existed between

the large Marne Champagne houses as Veuve Clicquot or Moët&Chandon (who bought wine and grapes within the Marne and Aisne departments) and the Marne/Aisne winegrowers on the one hand; and smaller merchants (who bought the wine from other departments, e.g. the Aube) and the winegrowers of these other departments on the other hand. The large Marne Champagne houses had a great political power derived from trade—with brand names, strong reputations, and large economic benefits—and were protected by a powerful labor union, the Champagne Wines Trading Union (*Syndicat du Commerce des Vins de Champagne*). Moreover, the Marne winegrowers started to organize themselves too and, in 1904, established a new and powerful lobbying group: the Federation of Champagne Trade Unions (*Fédération des Syndicats de la Champagne*) (Wolikow, 2009). These lobbying powers joined forces and pressured the French government into imposing a delimitation that would exclude other wine producing departments (Simpson 2011, p. 150). As a result, the first 1908 Champagne AO (the "Champagne Zone 1" in our analysis) only encompassed the Marne and the Aisne departments. This completely excluded the other departments (Loubère, 1990, p. 114; JORF, 1909a).[6] However, wine producers in the excluded departments believed that they did not produce an inferior wine. These tensions, along with poor harvests in 1909 and 1910, resulted in street protests and demonstrations. As a consequence, in 1911, the government created a second AO called "Champagne Zone 2" (*Champagne 2ème zone*) encompassing the Aube, Haute-Marne and Seine-et-Marne departments (Lachiver, 1988; Leroy, 1931; Unwin, 1991).[7]

[6] Marne and Aube are two departments in north-eastern France. The Marne, located north of the Aube, is closer to Paris while the Aube is closer to Burgundy (see Figure 3).

[7] In 1926, both Marne and Aube wine producers decided to give full power to Edouard Barthe, a powerful deputy and president of the Parliamentary Commission on Beverages. He was asked to solve the conflict trough an arbitrary judgement. This resulted in the 1927 law, which (among other things) enlarged the "Champagne" wine area to include the Aube department and other communes as Bar-sur-Seine (Article 5, JORF, 1927). Therefore, the "Champagne Zone

In Bordeaux there were also conflicts among winegrowers and traders in the delimitation of the AO. There were conflicts between growers of the same area (the few large "châteaux" owners producing "high-quality" wines versus the numerous small family winegrowers producing "low-quality" wines), between growers of different areas (producing inside and outside the Gironde department), and between merchants and growers (merchants were blending Bordeaux wines with wines from outside the Gironde department). The initial proposed (but never implemented) 1909 delimitation included the departments of the Gironde, Dordogne and Lot-et-Garonne in south west France. However, the wine producers producing inside the Gironde department protested against this large delimitation and pressured the government to intervene. They were successful as the implemented 1911 delimitation was restricted to the department of the Gironde (Roudié, 1988; Simpson, 2011).

However, this reduced geographical area was still large (140,000 hectares) and heterogeneous. The Bordeaux AO wine producing area was so vast that wines could either come from the traditional Sauternes region (southeast of the city of Bordeaux along the Garonne river) producing "high quality" wines or from the Palus region (in the former seaside marshes south of Bordeaux bordering the Garonne river) producing "low quality" wines (Leroy, 1931). In order to counter these quality concerns, more production criteria were introduced in 1927 and 1935 to control the Bordeaux AO production within the area previously delimited.[8]

2" appellation disappeared, leaving only one unique "Champagne" appellation—which included all the departments, Marne, Aisne, Aube, Haute-Marne and Seine-et-Marne (Chappaz, 1951; Wolikow, 2009).

[8] Further laws were introduced to control the output within the area previously delimited. In 1927, a new law restricted appellation wines to non-hybrid grapes and allowed wine producers, on voluntary basis, to place restrictions on grape varieties and methods of viticulture used for appellation wines (Capus, 1947; JORF, 1927). Finally, a 1935 law created the Appellations of Controlled Origin (*Appellations d'Origine Contrôlées*–AOC) and the National Committee for Appellations of Origin (renamed INAO in 1947), a government branch established to administer the AOC process for "high quality" wines. This law combined several earlier regulations: it restricted production not only to specific

The government decisions regarding the Banyuls AO and Clairette de Die AO were much less controversial, as their regional boundaries were encompassing small wine areas (Vincens et al., 1911). Hence in these two AOs, the AOs cover only a small part of the department (Pyrénées-Orientales and Drôme, respectively).

In summary, as Table 2 indicates, we have three different cases and these differences may affect our calculations in the rest of the paper and/or the actual impacts. First, the "Champagne Zone 1" has 100% AO coverage in the department and the covered vineyards are almost all "high-quality" wines. Second, the Bordeaux and the "Champagne Zone 2" AOs also cover the entire departments they are associated with, but included a mixture of low and high quality wines. Third, the Banyuls and Clairette de Die AOs have a very small share of their respective department's vineyards and wine production. This implies that the average wine prices in the department may not reflect well price changes for the AOs. For this reason, we decided not to include Banyuls and Clairette de Die in our analysis.

Hence, we should except to find the strongest impacts (if the AOs do have an effect) for "Champagne Zone 1", and less for other regions (either due to imperfect indicators or because the AO effects are mitigated/constrained with a mix of poor and high quality wine in the AO). In the rest of the paper, we analyze how the AO implementation affected wine prices in Bordeaux, "Champagne Zone 1" and "Champagne Zone 2".

regional origins (through delimitation of specific areas) but also to specific production criteria such as grape variety, minimum alcohol content, and maximum vineyard yields. The wine producers were now obliged to respect specific production criteria in order to produce AOC wines, adding "controlled" to the "appellation of origin" concept (Article 19, JORF, 1935; Humbert, 2011; Loubère, 1990; Stanziani, 2004). Since our observation period ends seven years prior to the introduction of AOC, we are confident that our results capture the impact of the introduction of the "first" quality step on wine prices—the establishment of the Appellations of Origin—and not that of future AOC.

3. Data and Descriptive Statistics

We collect annual department-level data from the *Annuaire Statistique de la France*—the Statistical Yearbook of France.[9] The *départements* (departments) are administrative divisions. The data set includes 81 wine producing departments throughout our period of observation. We use 80 years of annual data: from 1875, the first year available in the *Annuaire Statistique*, until 1955, almost fifty years after the introduction of the appellations.

The variables include total wine production per departments (in hectoliters, hl), the vineyard surface area (the cultivated area under vines in hectares, ha), the wine yield (calculated as the number of hectoliters produced per hectare), the average price of wine in francs per hectoliter (which we deflated with the Consumer Price Index (1914=100) from Mitchell (1998) for our analysis),[10] and departments' total public expenditures (in francs available from 1893 to 1928)[11] (see Figure 1 for an illustration of the wine variables present in the *Annuaire Statistique*).[12]

[9] Our data set was extracted from 46 *Annuaires*: from 1878 to 1955. The *Annuaire Statistique* was published each year and contained statistics of the previous year. However, there are some exceptions, as some *Annuaires* were published two or three years after the previous one (this was the case during times of war) (Statistique Générale de la France, 1878; 1901).

[10] Even if during World War II food prices were heavily regulated, we do not have a better deflator.

[11] The departments' budgets were financed by local taxes, state transfers and borrowing and used to make investments in local public goods (e.g., roads).

[12] The data was extracted from two main sections: one section on agricultural production, and another one on the French administration and its public finances. The location of the sections changed over time thorough the *Annuaire Statistique*. For the early years, the wine variables (as wine production and wine prices) were extracted from «*Agriculture*» in section XIV; while departments' total expenditures were extracted from «*Finances et Impôts*» in section XXII. From 1901 onwards, the wine variables were extracted from: «*3^{e} Partie Production, Mouvement Economique–3A.Agriculture, Forets Pêche–Tableau 1.Production des vins par département*»; while departments' total expenditures were extracted from: «*5^{e} Partie.Gouvernement et Administration–5E.Finances des Départements et des Communes–Tableau IV.Situation financière des départements*».

Figure 5.1 shows the price gap between AO areas and control areas (i.e., non-AO areas) before and after the introduction of the AOs (represented by the vertical lines). Figure 5.2 shows the ratio of AO and non-AO average prices, and Figure 5.3 shows the same ratio but with as control only the frontier departments, i.e. departments bordering the AO areas.

These figures suggest that the price difference was small (and sometimes negative) before the AO introduction. After the AO introduction, the price difference increased strongly. The average price was around 12% before while shifting to 120% after the introduction of AO. These results still remain when only considering the frontier departments.

Hence, the AO-impact appears strong. However, there are two caveats. One is that there is significant volatility in the price gap. The "AO premium" fluctuates between 30% and 200% over the 20 year period. The second is that the effect differs strongly among the AOs. The latter is illustrated in Figures 6.1 through 6.4. These Figures and Table 3 suggest that there was only a strong AO-effect in "Champagne Zone 1". In this case, the average price difference was large before (around 72%) but was amplified to 326% after the introduction of AO. The reverse is true for Bordeaux were the average price difference dropped from around 21% to 4%.

These descriptive statistics thus indicate that there are strong effects in "Champagne Zone 1", but not in the other AOs. These observations are consistent with our expected effects as explained in section II. In the next section we test the effects with a more elaborate model.

4. Empirical Strategy

We exploit the progressive geographic implementation of AO in a differences-in-differences framework, where departments not benefiting from AO serve to control for underlying trends in the outcome variables.[13] The empirical model is as follow:

$$P_{dt} = \alpha + \delta AO_{dt} + \gamma X_{dt} + \vartheta_d + \rho_t + \varepsilon_{dt} \quad (1)$$

where P_{dt} is the average price of wine per hectoliter of department d in year t. The term AO_{dt} equals 1 if the AO was implemented in department d at time t, and 0 otherwise. The terms ϑ_d and ρ_t are fixed effects for department and year. The department fixed-effects account for regional permanent differences including, for example, fixed characteristics of the landscape and soil quality, while the year fixed-effects account for underlying trends in the outcome variables which could result from changes in consumer taste, in production process and regulations across France or in overall agricultural conditions. Our coefficient of interest is δ. It measures the impact of AO on wine prices in regions in which AO were implemented. In other words, we measure the effects on those that were assigned to treatment (ATT) as opposed to the average treatment effect (ATE).[14] The estimated impact on price of AO δ is unbiased if there are no department-level variations that are correlated with the implementation of AO and influence prices at the same time. In other words, our results are unbiased if during the year of implementation no other factors

[13] Gergaud, et al. (2015) also employ a difference-in-differences approach with endogenous treatments and analyze whether "*consumers' quality perception and/or producer investment of New York City restaurants responds to newly appearing expert opinion*".

[14] The distinction between ATE and ATT, and also between ATT and the average effects on nonparticipants (ATNT) is further detailed in Blundell and Costa-Dias (2009).

impacting price varied in regions where the implementation occurred and did not vary in all other regions. This is extremely unlikely and our reading of historical documents at the time does not suggest that other events took place at the same time. Furthermore, to verify the robustness of our results, we control for department-level confounding factors X_{dt} such as yield, production, and vine planted area. In some specifications we also include departments' total expenditures. Even if these might be endogenous to price (an increase in total expenditures might result in an increase in local taxes which, in turn, might directly affect the price of wine), in the next section we will show that adding them as control has no impact on our estimates. In some specifications, we also estimate a model allowing for a different impact of the AO on the different *J* areas having implemented an AO during our observation period. We therefore also implement the following model:

$$P_{dt} = \alpha + \sum_{j=1}^{J} \delta_j AO_{jdt} + \gamma X_{dt} + \vartheta_d + \rho_t + \varepsilon_{dt} \quad (2)$$

Our data set is at the department-level but the geographical area of AO wines could be smaller than the department. However, using historic records of AO planted area within each department we find that for both Champagne (Zone 1 and Zone 2) and Bordeaux, 100 percent of the land was producing AO wines at the time. Therefore, δ captures the ATT. All of our standard errors are clustered at the department level.

5. Controls

Before proceeding to the results, we first check that the rollout of AO is orthogonal to changes in regional and production characteristics. In theory, wine producers could change their production practise in order to benefit more substantially from the AO. For example, they could individually boost production in order to sell more wine at the new higher prices. In this case, our estimated impact would measure the net effect of a price increase due to the AO and a price decrease from the change in wine supply. Nonetheless, we test whether the impact we identify comes from the AO label and not from a decrease in production, yield or planted area, which could also inflate wine prices. Figure 4 shows the trend over time of our main control variables: production, vine planted area, yield and expenditures. The evolution is similar in the treated and control areas both prior to the rollout of AO and after. In Table 5, we formally check that the rollout is orthogonal using our baseline model (1) on the control variables. In specification 1, only the appellation dummy and the year fixed effects are included, while specification 2 also includes our control variables (except those used as the dependent variable). Clearly, the rollout is not correlated with production, vine planted area, and expenditures as none of the estimates are significant whether we include the controls or not. The rollout is however correlated with yield. This suggests the yield decreased in AO areas after they received the appellation.[15] Controlling for yield will be crucial to identify the impact of the label as opposed to the impact of the reduction in yield. This suggests

[15] However, a deliberate yield reduction by winegrowers seems improbable. Winegrowers in Champagne were already suffering from extremely poor harvests in 1907-10 (caused by a combination of *Phylloxera* and bad weather). While poor harvests normally were compensated by higher prices (due to lower supply) this was not the case in the early 20th century as wine imports from Spain, Italy and Algeria kept wine prices low—making the impact of bad harvests stronger for winegrowers. Furthermore, "maximum yield restrictions" imposed by specific production criteria (*cahier des charges* in France) would only become compulsory with the 1935 AOC law (Meloni and Swinnen, 2017a).

that production and expenditures did not change after the AO were granted and that the impact we identify comes from the AO label.

Our identification strategy also relies on the assumption that control and treated share a common trend in the outcome variables. As previously seen, Figure 5.1 shows the trend over time for the average price per hectoliter. Prior to 1908 the price in both control and treated area followed a similar pattern and eventually started to diverge as of 1908 when the first AO appeared in Champagne. During the World War I (1914–18) and the Prohibition in the United States (1920–33) the price differences collapsed. We come back to these events when we discuss our results in further details. Together, these figures suggest that our empirical approach is well suited to isolate impact of AO on the price of wine when they were first introduced, but fails to control for demand shocks in total since high quality wines appear to be impacted more severely by demand shocks. This would bias our estimated impact downwards.

5.1. Main results

Table 6 presents the ATT effects of AO on the average price of wines. In other words, it reports the average effect of AO on wine prices across all wines within departments assigned to the AO treatment group. In Table 6, specifications 1 to 3 include all departments across France. Specification 1 includes only department and year fixed-effects, while specification 2 additionally controls for the total wine production in the department, the vine planted area and the yield. Finally, in specification 3, we also include total expenditures in francs by departments. Because we do not have total expenditures for all years, this inclusion also restricts our observation period to 1893 to 1928. We find an impact of 36.3 francs per hl (p=0.06) when we do not include our control

variables, and 34.8 francs per hl (p=0.07) when we do. Once we restrict our attention to the 1893-1938 period (column 3) the ATT effect becomes 28.6 francs per hl (p=0.05), and remains identical if we further add total expenditures (column 4). While total expenditures may be endogenous, adding them as control has virtually no impact on our estimates. This represents an increase in prices of 62 percent (28.6/45.9).

While we have shown above that our control group appeared to be capturing well the overall trends in wine prices, in the second set of estimates (specifications 5 to 8) we further restrict the control group to departments whose border touches departments in treated areas. We find that the price of wine increased by 32.8 francs per hl (p=0.10) following the implementation of AO (specification 6). Further restricting the observation period to 1893 to 1928, we find an effect of 26.7 francs per hl (0.09). Restricting our attention to frontier departments does not change our results.

Finally, because the World War I (WWI) had major impacts on the demand for wines around the world, especially Champagne wines which were considered a luxurious good even at the time, we exclude these years from our observation period. Effectively, we exclude years 1915 to 1918 in specifications 9 to 12. We find that the impact is larger at 40.1 francs per hl without controls and at 38.4 francs per hl (p=0.07) once we include all of our control variables.

5.2. Heterogeneity per type of wine

The average impact we have estimated may be homogeneous across all types of AO, but it is also possible that some type of wines benefited more than others from AO. In Table 7, we interact the type of wine with the appellation dummy. We find that the increase in wine prices is almost entirely

driven by Champagne wines (Zone 1) where the AO impact on these wines is 75.9 francs per hl (p=0.00). The impacts on Champagne wines (Zone 2) is positive but not significant, while the impact on Bordeaux wines is slightly negative at -1.70 francs per hl. When we restrict our control group to frontier departments, the impacts remain similar at 74.5 per hl (p=0.00) for Champagne (Zone 1) but becomes not significant for Bordeaux and Champagne (Zone 2). Finally, when we exclude the World War I, again we find larger impacts but concentrated among Champagne wines, at 83.5 francs per hl (p=0.00).

In Table 8, we further investigate the heterogeneity of the effects by estimating the impact of AO on each type of wines separately. In doing so, we allow our control variables to have a different effect on the price of different wines and we better select our frontier control departments. We find that our main conclusion remains. AO has a large positive impact on prices of Champagne (Zone 1), but no impact on other types of wines.

5.3. Matching

In the present study, we are not worried about compositional changes between the treatment and control group. Departments cannot switch from the control to the treatment group or vice versa. However, to further ensure the comparability of the treatment and control groups over time and address the possibility of non-linearity of response with respect to X, we implement the MDID estimator suggested by Heckman et al. (1997). With panel data, the MDID estimator is (Blundell and Costa-Dias, 2009):

$$\delta^{MDID} = \sum_{d\in T}\{[P_{dt_1} - P_{dt_0}] - \sum_{j\in C} w_{dj}[P_{jt_1} - P_{djt_0}]\} \quad (3)$$

where department *d* can either be part of the treatment group *T* prior to (t_0) or after (t_1) the AO implementation, while department *j* can either be part of the control group *C* prior to (t_0) or after (t_1) year 1907. Each department *j* when compared to department *d* is attributed a specific weight w_{dj} that depends on the matching technique used. The MDID estimator controls for X semi-parametrically by ensuring that departments in the control group share the treatment group distribution for each of the characteristics contained in X. This estimator further ensures group comparability. Given the small number of control variables at our disposition, this approach is not entirely well-suited to assess the robustness of our results but nonetheless, it provides an additional check. Table 9 presents the MDID estimator using three different matching techniques: local linear regression matching, kernel matching and nearest neighbor matching with five neighbors. We find the overall impact of AO on wine prices is still highly significant and even larger when we use matching. The local linear regression estimator suggests an effect of 40.25 francs per hl (p=0.00). Using different matching techniques leads to extremely similar results, 40.24 francs per hl (p=0.00) using kernel matching and 41.46 francs per hl (p=0.00) using nearest neighbor matching.

6. Conclusions

The concept of '*terroir*' (coming from the French word of '*terre*' (meaning land)) refers to the special characteristics of a place that imparts unique qualities to the product (wine) produced. However, the issue of '*terroir*' goes beyond wine. Many other products have tried to link their quality (perceptions) to the location of their production—as reflected in the rapid spread of geographical indications (GIs).

All studies on the value of GIs have used hedonic techniques where wine prices are regressed on a set of characteristics as independent variables to explain variations in price. In this paper, we used a different approach. We used historical data from fifty years (from 1875 to 1928) to analyse how regulations that formally established a link between product quality and production location ('*terroir*') affected the price of the product. More specifically, we study how the introduction of wine geographical indications or "Appellations of Origin" in early twentieth century France influenced the price of specific wines (Champagne and Bordeaux) in the years and decades following their introduction. We find very significant effects on prices of the initial Champagne (zone 1), but no impact on other types of wines.

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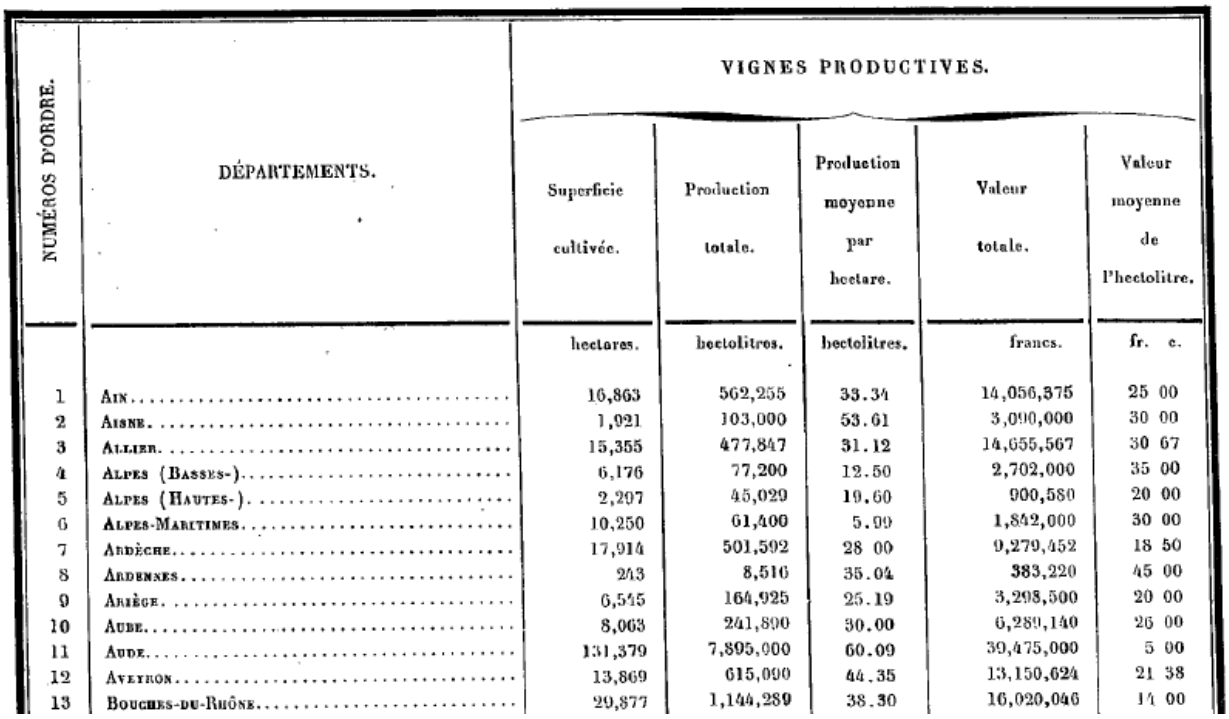
Figures

Figure 1

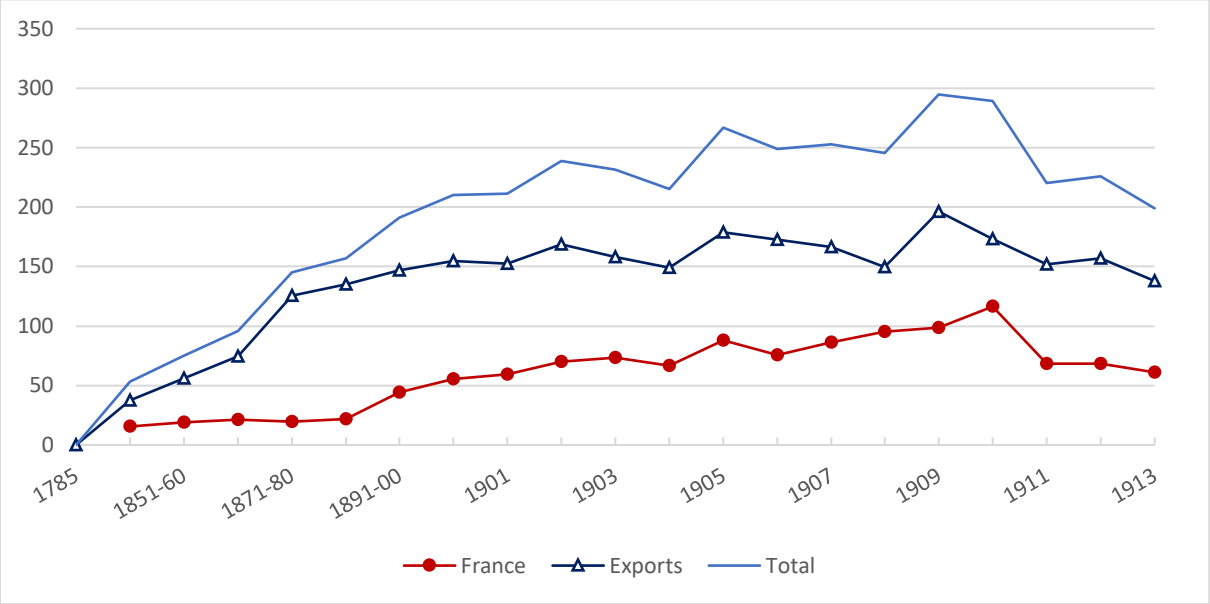
Extract from the *Annuaire Statistique de la France*, 1905, p. 148



NUMÉROS D'ORDRE.	DÉPARTEMENTS.	VIGNES PRODUCTIVES.				
		Superficie cultivée.	Production totale.	Production moyenne par hectare.	Valeur totale.	Valeur moyenne de l'hectolitre.
		hectares.	hectolitres.	hectolitres.	francs.	fr. c.
1	Ain	16,863	562,255	33.34	14,056,375	25 00
2	Aisne	1,921	103,000	53.61	3,090,000	30 00
3	Allier	15,355	477,847	31.12	14,655,567	30 67
4	Alpes (Basses-)	6,176	77,200	12.50	2,702,000	35 00
5	Alpes (Hautes-)	2,297	45,029	19.60	900,580	20 00
6	Alpes-Maritimes	10,250	61,400	5.99	1,842,000	30 00
7	Ardèche	17,914	501,592	28 00	9,279,452	18 50
8	Ardennes	243	8,516	35.04	383,220	45 00
9	Ariège	6,545	164,925	25.19	3,298,500	20 00
10	Aube	8,063	241,890	30.00	6,289,140	26 00
11	Aude	131,379	7,895,000	60.09	39,475,000	5 00
12	Aveyron	13,869	615,090	44.35	13,150,624	21 38
13	Bouches-du-Rhône	29,877	1,144,289	38.30	16,020,046	14 00

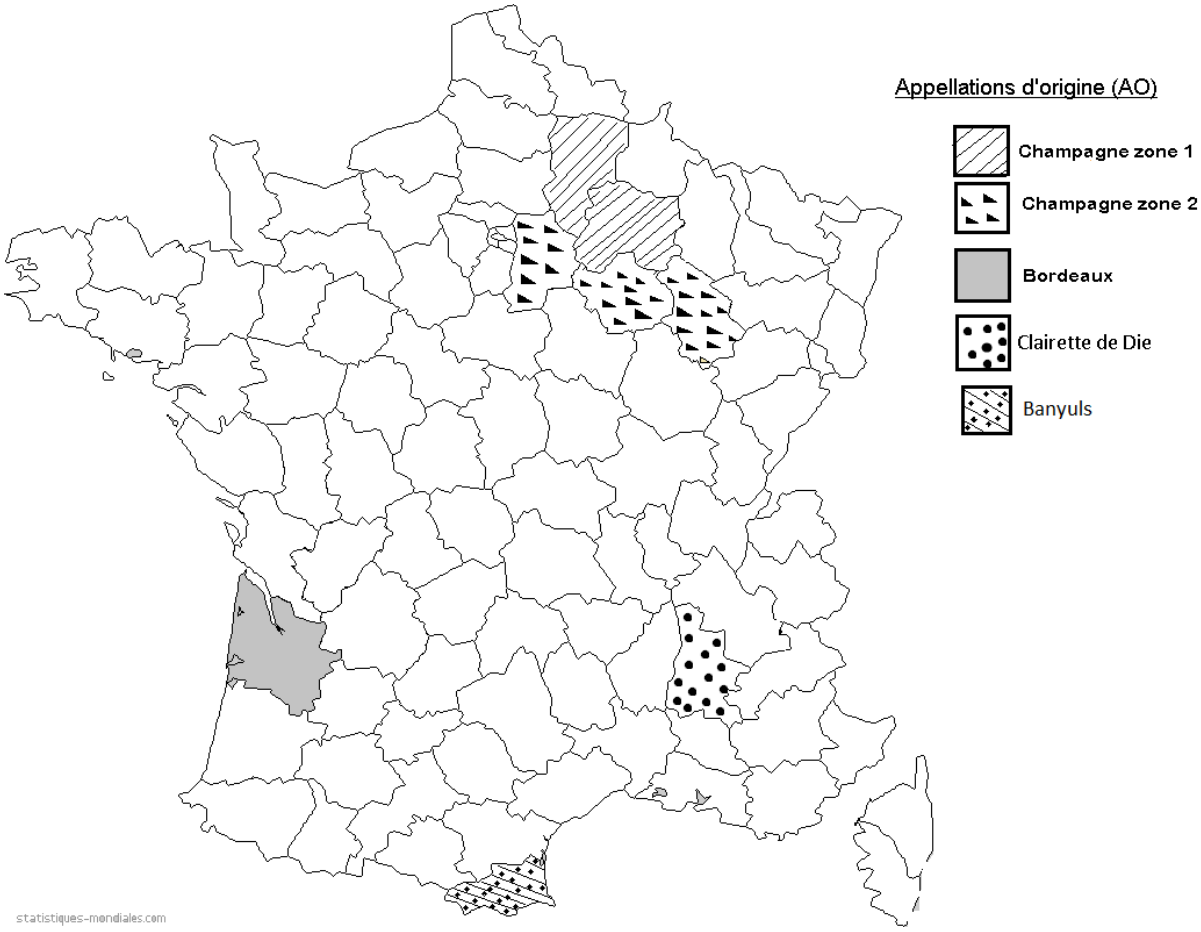
Figure 2

Domestic Sales and Exports of Champagne wine in thousands hectoliters, 1785–1913



Note: Before 1908, Champagne and sparkling wines of the Marne don't have to justify the "origin".
Sources: Bonal (1984); Simpson (2011: 136).

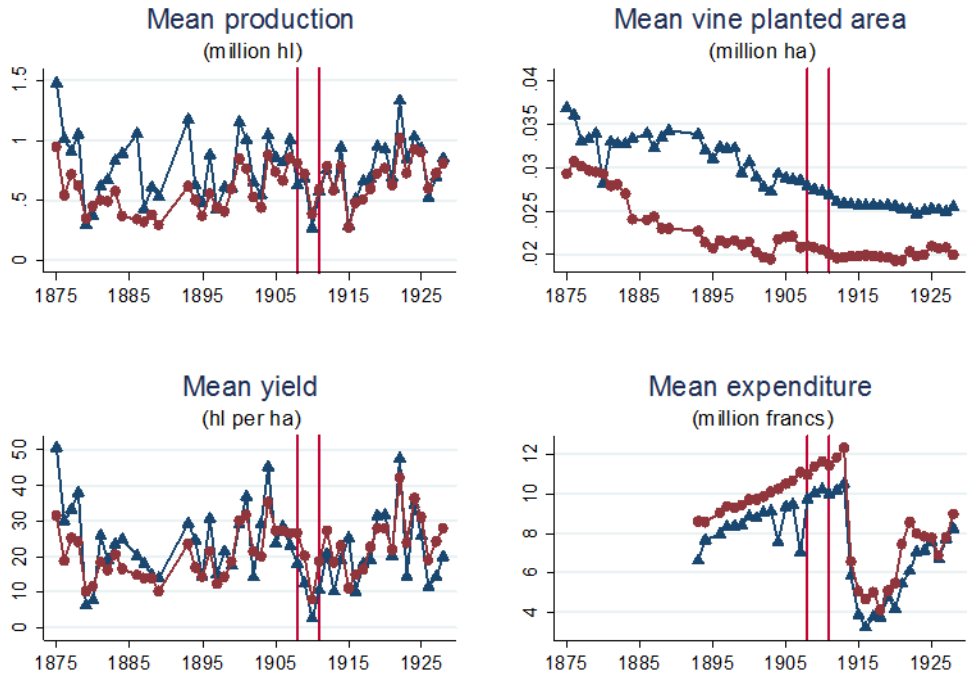
Figure 3
Appellations' location in France



Note: This figure shows the geographical position of the various areas that obtained an Appellation during our observation period. The Figure only captures the departments' location and not the actual planted vine area. "Champagne Zone 1" corresponds to the Marne and Aisne departments; "Champagne Zone 2" corresponds to the Aube, Haute-Marne and Seine-et-Marne departments; Bordeaux to the Gironde department; Clairette de Die to the Drôme department; and Banyuls to the Pyrénées-Orientales department (see Table 2).

Figure 4

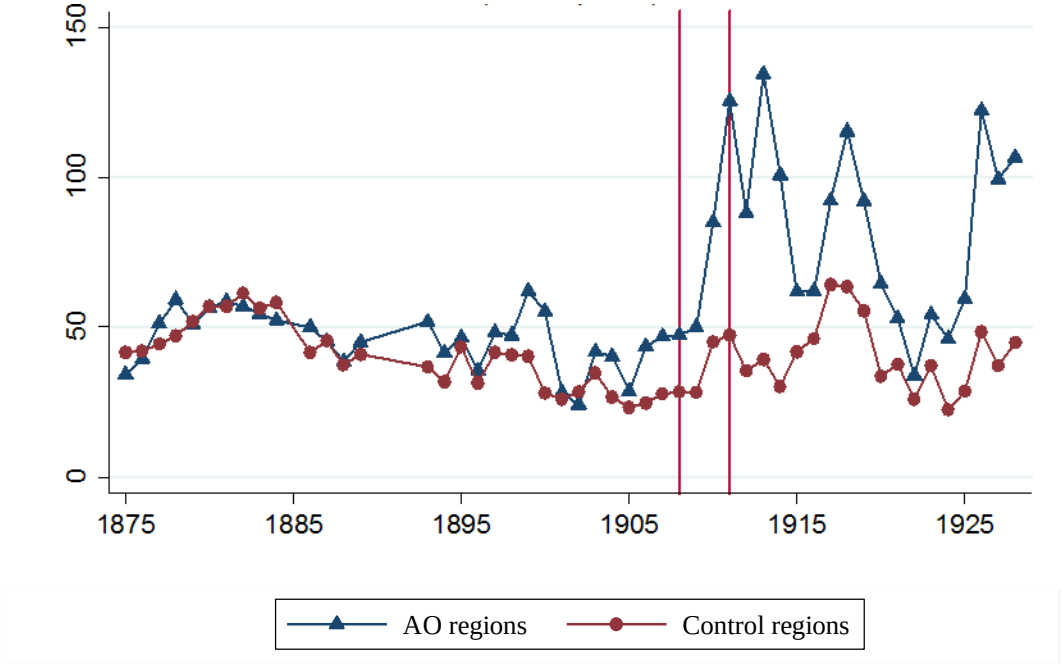
Characteristics over time by treatment status



Note: This figure shows the mean value of our control variables in treated and control areas over time. The two vertical lines mark the beginning and the end of the implementation of appellations across France during our observation period.

Figure 5.1

Average price deflated over time in Appellations area (treated) and control areas in francs per hectoliter



Note: This figure shows the average price per hectoliter of wine in treated and control areas over time. The two vertical lines mark the beginning and the end of the implementation of appellations across France during our observation period.

Figure 5.2

Ratio of Appellations and control areas average prices

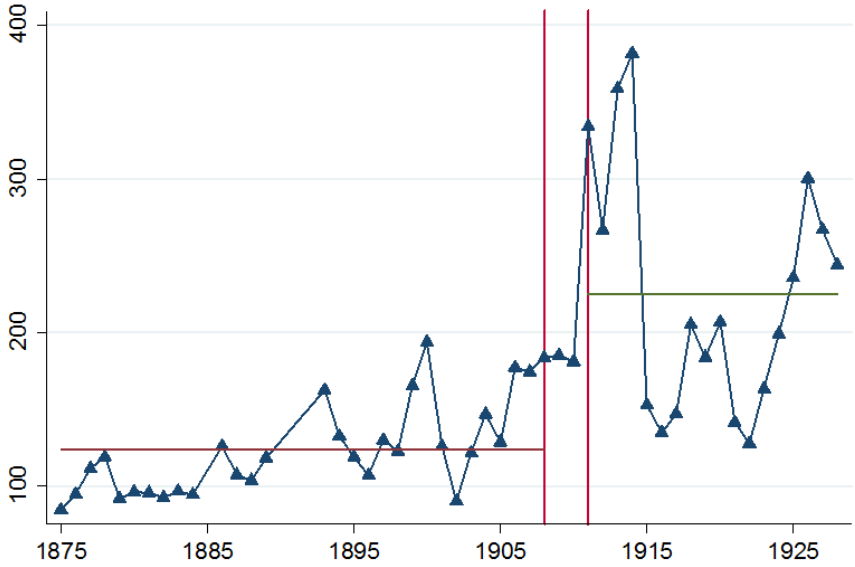


Figure 5.3

Ratio of Appellations and control areas average prices, with as control only the frontier departments

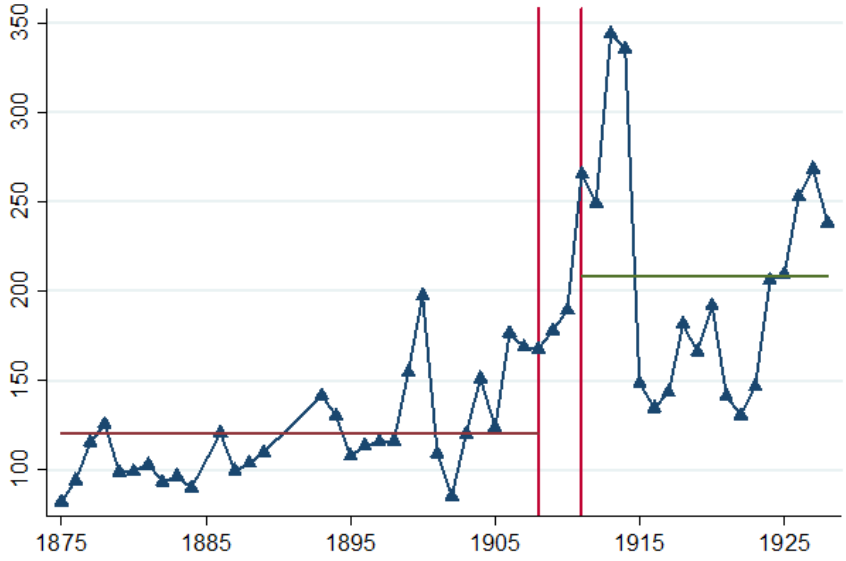


Figure 6.1

Average price deflated over time in appellations area (treated) and control areas, in francs per hectoliter

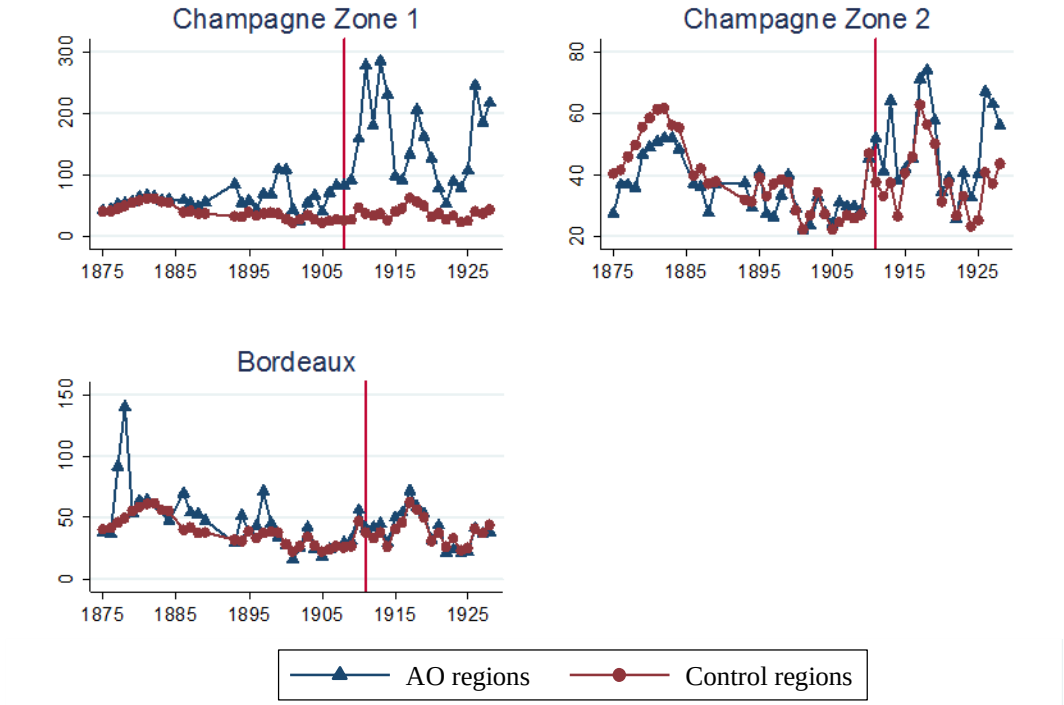


Figure 6.2

Average price deflated over time in appellations area (treated) and Frontiers departments, in francs per hectoliter

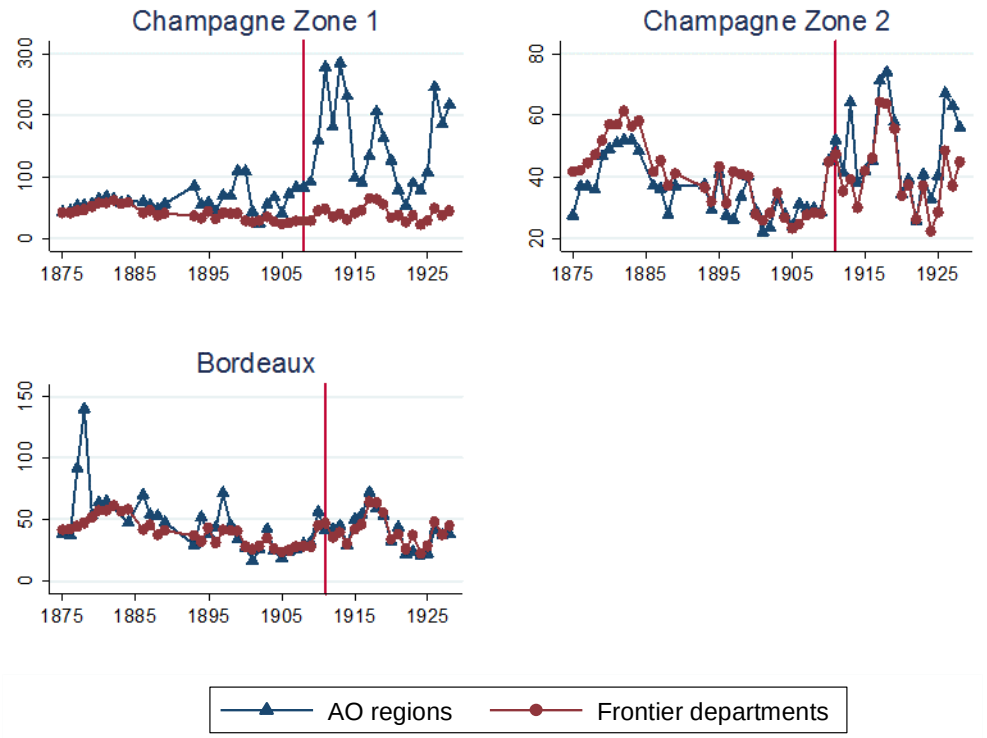


Figure 6.3

Ratio of Appellations and control areas average prices, by Appellations

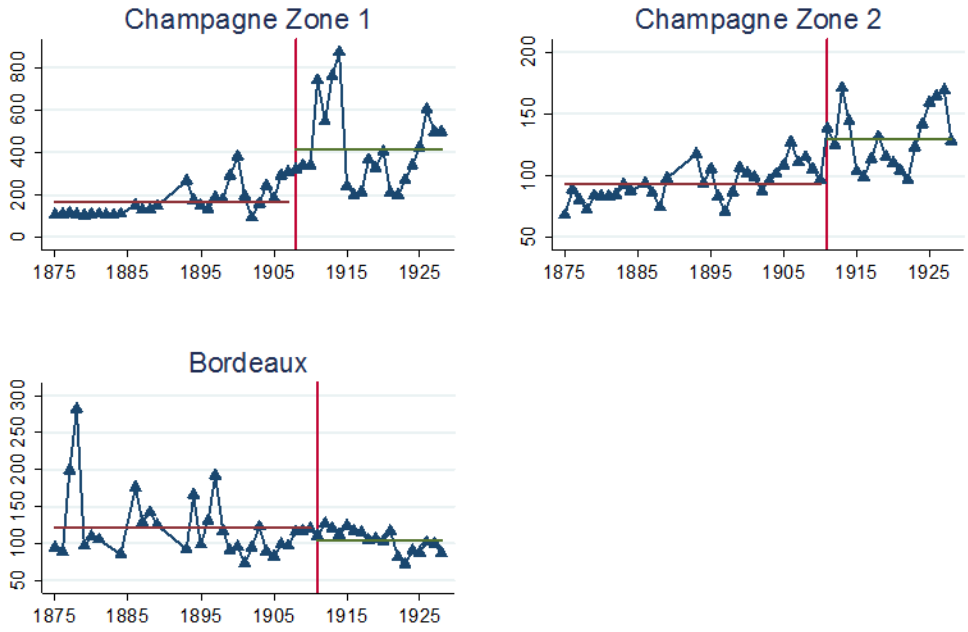
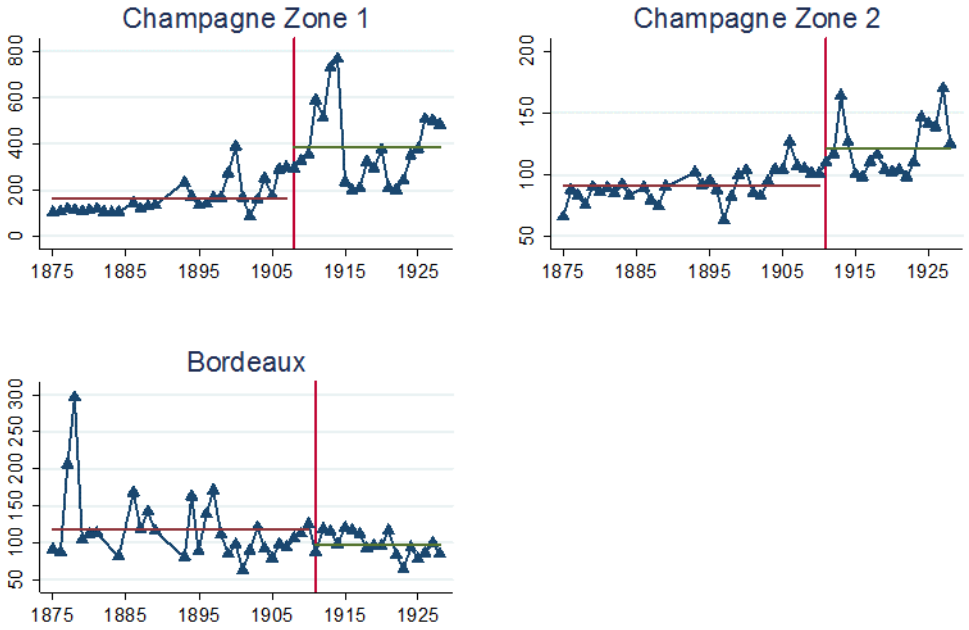


Figure 6.4

Ratio of Appellations and control areas (only frontier departments) average prices, by AO



Tables

Table 1

Chronology of Appellations of Origin wines in France, 1908-1911

Bordeaux	1911: first AO delimitation (Decree of February 18, 1911)
Champagne	1908: first AO delimitation (Decree of December 17, 1908) 1911: creation of a "Champagne Zone 2" (Decree of June 7, 1911)
Clairette de Die	1910: first AO delimitation (Decree of April 21, 1910)
Banyuls	1909: Banyuls (Languedoc-Roussillon) first AO delimitation (Decree of September, 18 1909)

Sources: JORF, 1909a, 1909b, 1910, 1911a, 1911b, 1911c.

Table 2

Appellations of Origin and Departments' Characteristics

	Departments	*Total area planted (in hectares) at the time of the introduction of the AO*	*% of department's area planted under AO at the time of the introduction of the AO*	*Share of "high quality" wines in the department*	*% of exports (1900–09)*
Appellations					
Bordeaux	Gironde	136,081	100%	Mixed	18%
Champagne Zone 1 (1908)	Aisne; Marne	1,766 13,870	100% 100%	Only "high quality" wines	68%
Champagne Zone 2 (1911)	Aube; Haute-Marne; Seine-et-Marne	5,688 3,618 1,260	100% 100% 100%	Mixed	
Clairette de Die	Drôme	16,814	9%	Mixed	-
Banyuls	Pyrénées-Orientales	61,419	3%	Mixed	-

Sources: JORF, 1909a, 1909b, 1910, 1911a, 1911b, 1911c. For exports figures see Simpson (2011, p. 128 and 136).

Table 3

Average Price Ratio

	Before the introduction of the AO (in %)	After the introduction of the AO (in %)
Appellations	12.2	120.3
Bordeaux	20.5	3.6
Champagne Zone 1	71.5	325.7
Champagne Zone 2	-7.7	29.1

Table 5

Orthogonality of the rollout to production characteristics

	Production		Vine area planted		Yield		Expenditure	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Appellation	-0.11	0.12	-0.00	-0.00**	-6.75***	-5.12***	0.31	0.32
	(0.57)	(0.19)	(0.61)	(0.03)	(0.00)	(0.00)	(0.87)	(0.87)
Area planted		23.80***				-246.00***		-6.74
		(0.00)				(0.00)		(0.89)
Yield		0.02***		-0.00***				0.057
		(0.00)		(0.01)				(0.31)
Expenditure		-0.00***		-0.00		0.02***		
		(0.00)		(0.87)		(0.00)		
Production				0.00*		10.30***		-0.57
				(0.05)		(0.00)		(0.35)
Constant	1.00***	-0.44***	0.03***	0.02***	33.00***	23.00***	8.41*	3.55
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.08)	(0.36)
Observations	3,787	2,624	3,798	2,624	3,781	2,624	3,053	2,624
Year and department FE	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.091	0.359	0.103	0.163	0.381	0.530	0.020	0.028
Number of id	83	81	83	81	82	81	90	81

Note: Robust pvalue in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6

Estimated impact of AO on wine prices (ATT)

	All observations				Frontier departments				Excluding WWI			
Period	1875-1928	1875-1928	1893-1928	1893-1928	1875-1928	1875-1928	1893-1928	1893-1928	1875-1928	1875-1928	1893-1928	1893-1928
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Appellation	36.3*	34.8*	28.6*	28.6*	33.5	32.8	26.7*	27.3*	40.1*	38.4*	31.8*	31.8*
	(0.061)	(0.069)	(0.054)	(0.054)	(0.11)	(0.10)	(0.087)	(0.088)	(0.062)	(0.071)	(0.059)	(0.059)
Production (mln hl)		0.26	-0.40	-0.38		-5.31*	-5.87***	-5.55***		0.26	-0.37	-0.37
		(0.78)	(0.72)	(0.73)		(0.050)	(0.0032)	(0.0024)		(0.81)	(0.80)	(0.79)
Area planted (mln ha)		-102***	-151**	-151**		-50.9	38.4	21.0		-101***	-143*	-143*
		(0.00)	(0.027)	(0.027)		(0.60)	(0.84)	(0.91)		(0.0045)	(0.055)	(0.055)
Yield		-0.21***	-0.27***	-0.28***		-0.32**	-0.48***	-0.49***		-0.20***	-0.27***	-0.27***
		(0.000012)	(2.3e-06)	(1.8e-06)		(0.016)	(0.0015)	(0.0014)		(3.5e-06)	(8.2e-07)	(7.7e-07)
Expenditure (mln frs)				0.029***				0.47				0.032***
				(3.3e-10)				(0.34)				(0)
Constant	36.6***	44.2***	43.9***	43.8***	37.1***	59.6***	56.1***	53.6***	36.7***	44.0***	43.6***	43.5***
	(0)	(0)	(0)	(0)	(1.8e-07)	(1.8e-07)	(7.2e-09)	(7.5e-08)	(0)	(0)	(0)	(0)
Observations	3,857	3,752	2,624	2,624	948	928	648	648	3,561	3,458	2,330	2,330
Year and department FE	yes	yes		yes	yes	yes		yes	yes	yes		yes
R-squared	0.396	0.413	0.420	0.421	0.319	0.340	0.378	0.379	0.360	0.376	0.335	0.336
Number of id	89	82	81	81	21	20	20	20	89	82	81	81

Note: All specifications include year and department dummies and standard errors are clustered at the department level. *** p<0.01, ** p<0.05, * p<0.1

Table 7

Region specific impacts of AO on wine prices (ATT)

	(1)	(2)	(3)
Bordeaux	-1.70**	-0.24	-3.54***
	(0.04)	(0.91)	(0.00)
Champagne_zone1	75.90***	74.50***	83.50***
	(0.00)	(0.00)	(0.00)
Champagne_zone2	8.21	4.71	8.72
	(0.29)	(0.57)	(0.34)
Production	0.11	-2.64*	0.54
	(0.89)	(0.054)	(0.53)
Area planted	-194.00***	-191.00	-194.00***
	(0.00)	(0.14)	(0.01)
Yield	-0.27***	-0.49***	-0.28***
	(0.00)	(0.00)	(0.00)
Expenditure	0.029***	0.50	0.032***
	(0.00)	(0.34)	(0.00)
Constant	44.50***	56.70***	44.30***
	(0.00)	(0.00)	(0.00)
Observations	2,624	648	2,330
Year and department FE	yes	yes	yes
R-squared	0.489	0.484	0.429
Number of id	81	20	81

Note: Robust pvalue in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8

Estimated impact of AO on Champagne and Bordeaux

	Champagne Zone 1				Champagne Zone 2				Bordeaux			
Period	1875-1928	1875-1928	1893-1928	1893-1928	1875-1928	1875-1928	1893-1928	1893-1928	1875-1928	1875-1928	1893-1928	1893-1928
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Appellation	95.1**	92.1**	72.6***	72.5***	4.52	4.30	5.37	5.24	-7.09***	-6.36**	1.01	0.74
	(0.032)	(0.011)	(0.0024)	(0.0025)	(0.66)	(0.64)	(0.54)	(0.56)	(0.0042)	(0.016)	(0.26)	(0.45)
Production		-86.6***	-113***	-113***		-2.82	-16.7**	-16.9**		0.86	-2.52***	-2.60***
		(0.0074)	(0.0017)	(0.0014)		(0.69)	(0.023)	(0.021)		(0.61)	(0.0091)	(0.0068)
Area planted		-1,059	1,450*	1,431*		-447	-305	-304		-191**	100	97.2
		(0.27)	(0.070)	(0.077)		(0.10)	(0.36)	(0.37)		(0.017)	(0.50)	(0.50)
Yield		-0.22	-0.18	-0.18		-0.21	-0.26	-0.25		-0.32	-0.25	-0.24
		(0.28)	(0.49)	(0.49)		(0.23)	(0.11)	(0.11)		(0.11)	(0.14)	(0.14)
Expenditure				0.078				-0.25				-0.090
				(0.86)				(0.43)				(0.25)
Constant	53.9***	95.2***	85.2***	84.3***	34.7***	56.5***	56.9***	58.4***	24.8***	51.0***	31.5***	31.9***
	(0.0055)	(0.0013)	(0.00013)	(0.00018)	(0.000080)	(0.00067)	(0.000011)	(0.000026)	(2.9e-06)	(0.0015)	(0.0097)	(0.0089)
Observations	251	231	158	158	450	450	315	315	297	297	210	210
Year and department FE	yes	yes		yes	yes	yes		yes	yes	yes		yes
R-squared	0.602	0.632	0.618	0.618	0.541	0.568	0.632	0.632	0.710	0.749	0.915	0.915
Number of id	7	6	6	6	9	9	9	9	6	6	6	6

Note: All specifications include year and department dummies and standard errors are clustered at the department level. *** p<0.01, ** p<0.05, * p<0.1

Table 9

Matching difference-in-difference estimator of AO on wine prices

	Coef.	Std. Err.	t	P>t
Local linear regression matching				
AO MDID	40.25	6.10	6.60	0.00
treated	8.23	3.87	2.13	0.03
post	-0.02	4.28	0.00	1.00
constant	36.95	2.78	13.29	0.00
Kernel matching				
AO MDID	40.24	6.07	6.63	0.00
treated	8.11	3.85	2.11	0.04
post	0.00	4.25	0.00	1.00
constant	37.07	2.77	13.4	0
Nearest neighbor matching				
AO MDID	41.46	6.12	6.78	0.00
treated	6.15	3.88	1.58	0.11
post	-1.23	4.29	-0.29	0.78
constant	39.04	2.79	13.99	0.00