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RAINFALL, THE *MÉLINE* TARIFF, AND WHEAT PRODUCTION IN MEDITERRANEAN FRANCE, 1885–1914

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Wheat production stagnated in France during the late nineteenth and early twentieth century, while cultivated acreage and wheat output declined sharply around the Mediterranean from the 1870s. Wheat output never recovered in this region despite the introduction in 1885 of tariff measures, such as the 1892 *Méline* Tariff. This paper analyses the response of Mediterranean wheat growers to changes in local rainfall and to variations of the duty on imported grains. It uses regional level data for nine administrative divisions located on or near the Mediterranean and assesses the impact of rainfall on yields. It argues that an interplay of protectionist policies and environmental conditions explain the decline of wheat production.

JEL categories: F13, N53, N93, Q17, Q54

Keywords: agriculture, climate anomalies, France, tariff, trade protection, weather

INTRODUCTION

This paper investigates the interplay of trade policy and environmental conditions on agricultural production in the case of late nineteenth and early twentieth century wheat production in Mediterranean France. This region appears suitable for such a test. Wheat was by far the most important crop in France as a whole. Wheat was likewise the dominant bread grain in the French Mediterranean regions, where its cultivation was traditionally associated with olives and

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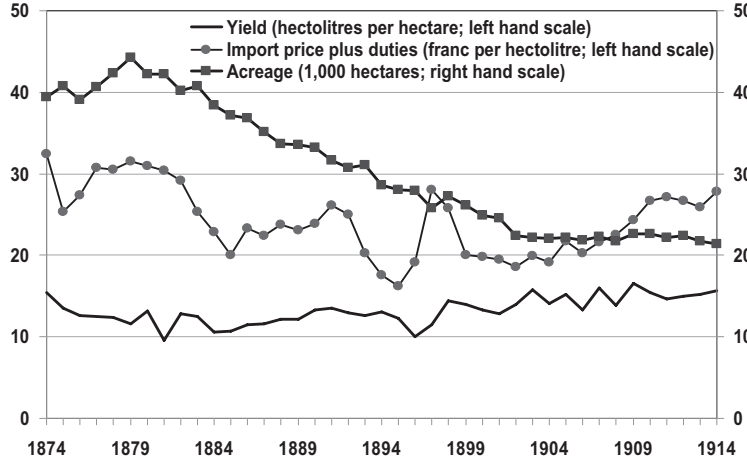

Figure 1. Acreage under wheat cultivation and average wheat yield in Mediterranean France, and price of imported wheat (including duties), 1874–1914.
Notes: Original imported wheat prices are in quintal (100 kg), which has been converted into hectolitre, assuming 75 kg per hectolitre. Agricultural output data were recorded in hectolitres; for several years, we have also information in quintal. The conversion ratio varies across regions, reflecting differences in varieties cultivated, but is stable for a given region.
Source: *Annuaire Statistique de la France*, Vol. 34 (1914).

wine. France as a whole had a structural output deficit relative to domestic consumption, particularly since the trade in cereals was liberalised after 1852. However, wheat imports were subjected from 1881 onwards to restrictions, which culminated in the '*loi du cadenas*' (outright prohibition by decree) on imports of 1898.

These trade restrictions were in the context of the 'agricultural depression' that was felt more acutely in the Midi (southern regions) than in the rest of France. Following a period of growth during 1850–70, wheat production stagnated during the last quarter of the nineteenth century. Particularly in Mediterranean France, acreage under cultivation and output fell sharply during the late 1870s and early 1880s, as Figure 1 shows. There, wheat production never recovered to its previous levels in subsequent decades. It declined further, despite the introduction, particularly from 1885, of escalating tariffs that aimed to insulate domestic market conditions and guarantee the 'right to self-sufficiency in food', which eventually culminated in the 1892 Méline Tariff.[2] Under pressure of foreign competition, wheat prices fell after 1880, only to recover partly after the turn of the century.

2 From 1892, the distinction between minimal (or conventional) and maximum (or general) tariff was abolished for agricultural produce so that France's trading partners could not secure exemptions.

Wheat prices followed the same trend, although the tariff helped to offset the fall in wheat prices relative to other commodities.[3]

The standard interpretation for the decline of production in Mediterranean France is that wheat growers diversified away from wheat as a response to new opportunities resulting from national market integration. Following the opening of new railways and the spread of irrigation, a number of districts specialised in fresh fruit and vegetables where their comparative advantage lay. After 1870, the share of vineyards, orchards, and areas of vegetables and flower cultivation increased sharply.[4] This process was particularly conspicuous in areas where average wheat yields were initially above the national average, which suggests that the decline in wheat production was due to these new opportunities. In a large section of the French Mediterranean region, especially in the mountains, the shift away from wheat production (and grain production more generally) was associated with the reallocation of labour toward other sectors, which implied migration to neighbouring towns or cities, or more distant destinations. This trend accelerated after World War I and eventually resulted in a collapse of local rural economic life.

In this paper, we consider other determinants of changes in wheat production in Mediterranean France, in particular the environmental conditions observed during the second half of the nineteenth century. There is no clear trend of rising average temperatures across Europe (as well as in most other regions of the world) for the second half of the nineteenth century.[5] Using historical documentation on floods, Barriendos and Martin identified a climate oscillation that resulted in an extremely wet period in Mediterranean Spain in 1830–70.[6] Data on rainfall are available for a limited number of meteorological stations in the south of France before the 1870s. They suggest that average rainfall did not change much, but that the variance of monthly precipitation increased. Wheat yields are highly sensitive to variations in precipitation and the moisture of soils.[7] The soils most common in the French Mediterranean region retain a relatively low degree of moisture. Hence, it would not be surprising to find that wheat cropping became uneconomical in marginal areas that had been cultivated during the comparatively wetter and colder period up to 1870, in spite of the low natural fertility and the limited moisture retention capacity of these soils. This hypothesis is supported by the fact that the decline in cultivated acreage during the late nineteenth century in the Mediterranean region was in general associated with an upward trend in land productivity.

3 Acreage, output, unit prices, and climate data are available at the regional level for the nine Mediterranean administrative districts as annual series covering the period 1879–1914.
4 Augé-Laribé, *L'évolution*, pp. 73–4.
5 Relatively few studies are available regarding climate conditions in the Mediterranean region. Moron (*L'évolution séculaire*) indicates that sea surface temperatures were well above normal values during 1870–85, and that they declined until the 1910s.
6 Barriendos Vallve and Martin-Vide, Secular climatic oscillations.
7 Greene and Maxwell, Climatic impacts; Luo *et al.*, Risk analysis.

In the absence of micro-level data, an analysis of the determinants and social consequences of the reallocation of factors previously used in agriculture is beyond the scope of this paper. Instead, we focus on other explanatory variables by investigating to what extent trade restrictions contributed to the contraction of wheat production that took place in the late nineteenth century in the Mediterranean area, as well as the high variability in climate conditions, that set the region apart from other regions in France.

The immediate purpose of this paper is to analyse the response of Mediterranean wheat producers to the effects of import protection in the context of high variability of rainfall. The paper therefore assesses the impact of rainfall variations on wheat production, but its main objective is to investigate the combined influences of climate events and changes in import tariffs on the decisions of producers as reflected in changes in cultivated acreage. We use regional level data for nine of France's 86 départements (administrative counties) located in the Mediterranean part of France. The nine départements are Pyrénées Orientales, Aude, Hérault, Gard, Vaucluse, Bouches du Rhône, Var, Alpes Maritimes, and Corse.

It is plausible that the decrease in wheat acreage in the Mediterranean region of France was influenced by the repercussions of trade policy. From 1885, French trade policy took a decisive turn towards protectionism.[8] At first, only major bread grains were involved. The tariff was gradually extended to all major crops, and the specific rates applied to different kinds of grain were fixed so as to offset the price difference between imported and domestic goods. From 1892, the 'double tariff' system was abolished and a uniform duty was – in principle – applied to all grain imports regardless of geographical origin.

Henceforward, French wheat growers producing for the market faced a risk that was much more circumscribed. After 1885, the duty on wheat imports increased substantially, but this affected grain imported under the 'general tariff', that is, from countries which either had not signed a trade agreement with France or which did not benefit from the Most Favoured Nation (MFN) clause. Since the early nineteenth century, trade policy had been in the preserve of the French government, but from 1888, supervision of trade policy gradually moved from the executive to the legislative. This process accelerated, as we will see, under Méline's tenure as head of the parliamentary tariff commission, which assumed the governmental powers in tariff matters. Hence, the tariff schedule was scrutinised by parliament during the annual discussion of the budget.[9]

Despite a rising tariff, French farmers remained to some extent dependent upon world prices until the erosion of the tariff in the first decade of the twentieth century. Price variability in wheat-exporting countries therefore exposed farmers to a second risk factor. Agricultural producers in the Mediterranean not only faced risk related to climate variations, but also risk related to the uncertainty of annual prices and therefore of income per unit of wheat produced. On the whole,

8 Dormois, La défense du travail national.
9 Perrens. *La révision tarifaire*, pp. 7 and 27.

the tariff was tailored to suit the demands of large wheat farms in northern France. They relied more extensively on purchased inputs (including wage labour, fertilisers, and agricultural machinery) and were consequently less price competitive than their smaller counterparts in southern France.

Wheat growers faced two uncertainties every year: the prospective selling price of wheat (influenced by the world price but also partly determined by the tariff) and local harvest prospects. The first can be regarded as a symmetric shock, and the second as an asymmetric shock. These shocks matter. In a Ricardian, static approach, agricultural income is a differential rent determined by natural fertility of the land. But in a dynamic approach, any deviation of agricultural income from its equilibrium level can be particularly sizable and unpredictable when producers find it difficult to form expectations on future unit prices and the variance of climate conditions is large (assuming that land productivity is largely determined by climatic conditions). Furthermore, the exposure to unexpected changes in income was particularly large when the tariff duty accounted for a large percentage of the local price. These issues are examined in the next two sections. The last section then proposes a strategy to analyse the response of wheat growers to variations in climate conditions and tariffs, as well as an interpretation of estimation results.

HISTORY AND POLITICAL ECONOMY OF THE *MÉLINE* TARIFF

Calls to insulate a national economy are always more vocal in times of economic downturn. This was also the case in France in the 1880s, in the wake of the 'European grain invasion' that ushered in an outright agricultural depression from 1885, when the imported price of wheat first slipped under 20 francs per 100 kg. The protectionist backlash in France is associated with Jules Méline (1838–1925), a textile manufacturer turned politician from the Vosges Mountains in eastern France. An avowed Republican, he engineered an 'alliance of wheat and iron' between industrial and agricultural interests in France in 1888.[10] As head of the parliamentary customs commission, Méline orchestrated the tariff bill that was enacted on 12 January 1892.

The merger of the interests of supporters of agricultural and industrial protection was not as momentous as the creation of a single pro-agriculture interest group, which materialised in the French parliament after the general elections of 1889. On the one hand, Conservative deputies challenged the constitutional set-up, established in 1875, which had left foreign affairs in general and foreign trade in particular in the preserve of the executive. They had hitherto been the more vocal advocates of agricultural protection, but they found themselves on the defensive because of the growing public acceptance of the Republican

10 Lebovics, *The Alliance*.

government. On the other hand, (moderate) Republican candidates were anxious to consolidate the peasant vote in their favour in the majority of rural constituencies. Proponents of increasing agricultural tariffs justified it on account of France's structural deficit in agricultural production and the fact that domestic grain growers faced growing competition from foreign producers. At the best of times, the country was no longer self-sufficient in bread grains, and the increasing dependency on imported grain opened a wedge in domestic markets. Wheat imports had first filled gaps in home production, but they soon displaced domestic wheat in the market.[11]

Attempts to tax wheat imports started in the early 1880s, when most of France's commercial treaties were up for renewal. Experience had shown that an *effective* protectionist policy could not be pursued so long as the 'double tariff' and the MFN clause were in force. However, the supporters of the agricultural interest failed to get their act together for the tariff revision of 1881 and were defeated by a majority made up of 'free traders' and industrial protectionists.[12] In 1885 first, and again in 1887, the agricultural protectionists finally had their way and the Chamber substantially scaled up the wheat duty, which had been set at the very low level of 0.60 francs since 1852. In fact, as highlighted by Golob, 'the *Méline* tariff was the culmination of a series of protectionist measures passed in the decade of the 1880s'.[13] This started with the law of 1881, which excluded grain and livestock from commercial treaties – but there remained the question of the MFN clause. Among other measures, the duty on wheat was raised from 0.60 to 3 francs per 100 kg in 1885 and to 5 francs in 1887. The *ad valorem* equivalents were 15.7 and 25.5 per cent, respectively. However, agricultural interests, wary of the many loopholes in the tariff legislation, continued to press for more protection in the years leading up to the parliamentary elections of 1889.

Legislators could not resist the pressure of the demands for tariff reform from both Conservative and Republican proponents. The somewhat disorganised protectionist campaign of 1881 had petered out, but came back to life in 1888 at a time when Méline became chairman of the Chamber of Deputies. Before the elections of September–October 1889, he secured a commitment from a majority of parliamentary candidates to support tariff reform regardless of their political alignment. Tariff reform thus was a life buoy to the embattled Republican party. The Republicans won a large majority of the seats (366 against 210 for their opponents), but their strongholds were among the urban working class and petty bourgeoisie; 'rural' Republicans were a minority among their supporters. By contrast, Conservatives of every hue had their base in solid rural constituencies. By December 1889, a unified agricultural interest group was formed in the Chamber, which comprised 301 legislators, either Republican or Conservative,

11 Wheat imports accounted for about 10 per cent of domestic consumption in the early 1870s, increasing to a peak of over 30 per cent in 1879, and remaining at around 15 per cent in the early 1880s.

12 An industrial and an agricultural tariff were perceived as mutually exclusive.

13 Golob, *The Méline Tariff*, p. 152.

who elected Méline as their leader. In January 1890, his parliamentary colleagues supported the creation of a Tariff Commission, comprising only eight avowed free traders out of a total of 55. In March, a debate on the renewal of the trade treaty with Turkey brought down one last obstacle to tariff reform with the resignation of the head of the government, the Liberal Tirard. Consultations with various bodies continued throughout the summer, and the government introduced its new tariff bill on 20 October 1890, which was sent to the relevant parliamentary commission for report. The Tariff Commission met throughout the winter, and Méline, as its *rapporteur général*, presented his report on 3 March 1891. Several amendments were introduced and put to the vote of the assembly until the final adoption of the new tariff on 29 December 1891. The adoption was secured by a large majority: 73 per cent of all Republican and 86 per cent of all Conservative deputies. By contrast, the new law was opposed by the representatives of only three urbanised *départements* (Paris, Lyons, and Marseilles), in all three cases with an overwhelming majority.[14]

Comparing the outcome of the vote and the concentration of large grain-growing estates across the departments reveals the influence exercised by large landowners on their constituency representative, especially in the north of the country.[15] Furthermore, northern grain growers sold their grain at less competitive prices (relative to import prices) than their southern counterparts. The stronghold of agricultural protection was therefore the Paris basin and its extensions into Normandy, Britanny, Champagne, and the Loire valley. Elsewhere, representatives of urban centres tended to take up the interests of their mostly working class constituents and opposed the bill.

Opinions of the *Méline* Tariff have varied. During his lifetime, Méline was hailed as the saviour of French agriculture. He became head of government in 1898 and served as Minister of Agriculture during World War I. His 1905 book, *Le retour à la terre et la surproduction industrielle* (The return to the land and industrial overproduction) was a national bestseller, which was translated into several languages. Most of the contemporary literature, economic or otherwise, by-and-large supported the tariff. The tariff was revised in 1910 and in 1927, but the revisions kept the basic framework of Méline's work. Only Augé-Laribé in 1912 cast doubts on the efficacy of French protectionist policy, arguing that it was responsible for the dismal economic performance of France up to World War II.[16] Méline made a comeback of sorts when Paul Bairoch, re-interpreted late nineteenth-century commercial policy and concluded that Continental tariffs had sustained economic growth in the countries where they had been adopted.[17] In recent years O'Rourke has found some merit in Bairoch's stance.[18] However, doubts remain about the

14 Journal Officiel de la République française, Chambre des députés, 29 déc. 1891 p. 2917–8.
15 When the local deputy was not himself a large landowner, as was the case in as many as 104 constituencies (out of a total of 577).
16 Augé-Laribé, *L'évolution*.
17 Bairoch, European trade policy.
18 O'Rourke, European grain invasion.

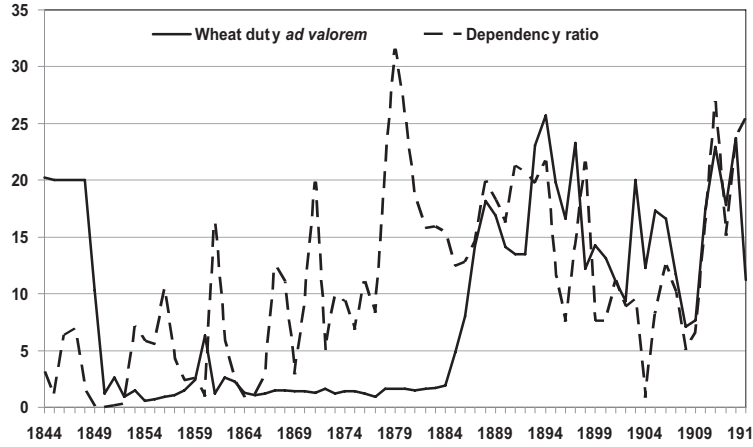

Figure 2. *Ad valorem* wheat duty and import dependency ratio, 1844–1914.
Note: *Ad valorem* calculated as final customs duties as percentage of the value of wheat imports. Import dependency ratio is defined as the share of wheat import in domestic wheat consumption.
Source: *Annuaire Statistique de la France*, Vol. 34 (1914).

effectiveness of this type of tariff, which is also found in most other countries of Continental Europe.[19] In addition, doubts remain about the price distorting effects of tariffs.

The *Méline* tariff was aimed at transferring income from consumers to agricultural producers, which implied the delinking of French wheat prices from world prices. But it is clear that world prices continued to have an impact on the domestic price level and on production conditions in France.[20] Figure 2 shows a positive but relatively weak relationship between the dependency ratio and the *ad valorem* duty on wheat imports.[21] In effect, this tariff policy encouraged hoarding. It compensated growers for their loss of income suffered in preceding years when market conditions had forced them to scale down production. But such an opportunity depended on the ability of growers to take advantage of potential gains by increasing output, which supposes that land use reallocation was possible at short notice and, more importantly, that a tradable surplus existed.

Wheat was grown almost everywhere in France, generally in a diverse range of local varieties. Throughout the nineteenth century, a substantial share of

19 Irwin, Free trade and protection.

20 For fear of the government bypassing the concerns of the assembly's majority, the 1892 law provided for close monitoring of its enforcement. It also included the possibility of suspension of wheat duties or outright prohibition of wheat imports by decree and at short notice. The government used this clause only once, in June 1898, when the tariff had to be suspended in view of very poor harvest prospects. Ironically, Méline was president of the council (head of government).

21 For the period 1885–1914, the coefficient of correlation between these variables is 0.36; the coefficient of correlation between the *ad valorem* duty and domestic wheat output is –0.29.

production was either self-consumed or sold locally (around 15–20 per cent), in most cases through quasi-barter local trade arrangements. A sizeable traded surplus originated mainly from the Paris basin, where the average size of farms, as well as average yields, was well above the French average. Such 'capitalist' farmers also had access to market information, as well as equipment (machinery and livestock), which allowed them to respond to market signals by increasing cultivated acreage at the time of spring sowing. It is therefore likely that the *Méline* tariff amounted to a transfer of income from urban consumers to the better-equipped producers. In the Mediterranean region, wheat output fluctuated more widely than in the rest of the country, because of high annual and seasonal rainfall volatility. Consequently, surpluses tended to be smaller in this region, while local crop failures had only a limited impact on overall French production.

RAINFALL AND WHEAT OUTPUT IN MEDITERRANEAN FRANCE

This section describes the climate and output data that are used for analysis of the impact of rainfall on wheat yields in Mediterranean France. The influence of climate conditions on agricultural output is relatively well documented, and there are many historical monographs with a focus on the determinants of the prices of agricultural staple products. For example, the backbone of Le Roy Ladurie's long-run history of Western Europe's climate is formed by annual records of the first day of harvesting in a number of localities going back several centuries.[22] Other historical studies have focused on extreme events, in particular exogenous shocks resulting in famines.[23] A number of studies have dissected the fluctuations of output in association with comparatively small variations in European regions of temperate climate, in the United Kingdom, France, and Germany.[24] However, a major limitation of this type of research is the use of output data aggregated at the national level and the use of national rainfall and temperature series calculated from a relatively small number of meteorological observations. The use of national aggregates is not appropriate for this study.

Cultivated acreage fell from the middle of the nineteenth century; the retreat of wheat cultivation on land with the highest natural fertility[25] resulted in a rise in average wheat yields. Regional variance was high. While Pyrénées Orientales

22 Le Roy Ladurie, *Times of Feast.*

23 By contrast, a study by Davis *et al.* (Harvests and business cycles) on the influence of weather on business cycles in the United States between 1880 and 1914 indicates that fluctuations in the cotton harvest, caused by economically exogenous factors such as weather, were the ultimate cause of most cyclical fluctuations in industrial production, while fluctuations in wheat or corn harvests had little influence.

24 Solomou and Wu, Weather effects.

25 This land probably also had the lowest slope. However, due to the paucity of available data, it is impossible to assess changes in average slope.

recorded some of the highest yields nationally, yields in most other *départments* were generally around the national average, except in Var, Corsica, and Alpes Maritimes.[26] Average yields fluctuated significantly during 1874–1914. The coefficients of variation ranged from 0.16 in Alpes Maritimes and Gard, to 0.27 in Corsica.

Monthly rainfall series are available for 11 stations located near the Mediterranean.[27] They can be used to analyse the impact of climate conditions on average yield measured at the *département* level. Information on rainfall in the main city in each of the nine *départements* is used as a proxy for the climate conditions prevailing in the whole *département*. When assessing the impact of rainfall on wheat yields, we have to account for the salient features of the Mediterranean climate. One of them is the seasonal irregularity of rainfall. Large deviations from average values have been recorded over long periods.[28] As a result, we can expect annual variations in wheat yields to be dependent on more or less abundant spring rainfall, which is the season when wheat is sown and germinates. By contrast, summer drought, a well-known feature of the Mediterranean climate, played almost no role as the wheat harvest took place in late June or early July. Downward variations in spring rainfall could seriously reduce average yield, and therefore wheat production. Alternatively, a relatively wet spring could result in a bumper crop. Rainfall volatility was particularly high in May, which can be considered as an asymmetric shock to wheat production. There was also considerable variation in average rainfall across the years and across the Mediterranean.[29] There are some similarities in rainfall patterns between neighbouring *départements* (in particular for the Gard, Vaucluse, and Bouches du Rhône), but the shocks of rainfall variation are not entirely symmetric.

The influence of temperature anomalies also needs to be considered. Above average temperatures could have a significant negative impact on yields, in particular when they occurred during the period of the year with high levels of

26 Unfortunately, available sources do not indicate how average yields were established, whether estimators relied on crop cuttings on random plots, and how reliable the results were. Some information available at the level of the *arrondissement* (subunits of *départements*) suggests that *département* level data were obtained by aggregating *arrondissement* level data.

27 Data reported in Garnier, *Mémorial de la Météorologie Nationale*, Vol. 4. The roster includes pp. 34–5 Perpignan (Pyrénées Orientales), 43–4 Castelnaudary (Aude), 53–4 Montpellier (Hérault), 61–2 Nîmes (Gard), 81–2 Avignon (Vaucluse), 87–8 Marseilles (Bouches du Rhône), 93–4 Toulon (Var), 109 Nice (Alpes Maritimes), and 115–6 Ajaccio (Corse). Data are missing for Ajaccio in 1882–84.

28 Coefficients of variation of total spring rainfall ranged between 0.32 in Castelnaudary and 0.51 in Ajaccio and Nice. Volatility was much higher in May, with CV in a range between 0.63 in Castelnaudary and 0.84 in Marseilles.

29 Another important characteristic of the Mediterranean climate is that total annual rainfall can be fairly high, in some cases, well above normal rainfall recorded in North-Western Europe, particularly on the hills close to mountain ranges (the Pyrénées, Cévennes, and Alps, in the French case). A large share of precipitation occurs during the autumn and winter months. The consequence could be severe erosion on slopes, as well as flooding in low lands, which can have adverse effects on ploughing and sowing conditions, or/and on the initial stage of plant development.

evapotranspiration (the sum of evaporation and plant transpiration) particularly in May in the case of wheat cultivation. Monthly average temperature data covering 1874–1914 are available for Perpignan, but the series for Marseilles, Nice, and Ajaccio are only available for 1898–1914.[30] Common trends in temperature anomalies are observed in these four stations scattered across the Mediterranean region. In particular, comparable peaks and troughs are observed in average temperature during May, as the coefficients of correlation between the pairs Perpignan-Marseilles, Marseilles-Nice, and Perpignan-Nice are 0.83, 0.86, and 0.75, respectively, during 1898–1914. Hence, it may not be necessary to control for local temperatures when estimating the impact of rainfall anomalies on yields. Temperature anomalies seem to have occurred as symmetric shocks, and it is sufficient to use year dummies in order to capture a possible temperature-related effect that enhanced or mitigated the impact of rainfall variation. Finally, during the late nineteenth and early twentieth century, rainfall patterns tended to show a biennial cycle in annual and spring rainfall. Therefore, we should consider the possibility that wheat growers anticipated rainfall patterns on the basis of naïve extrapolations.

The impact of rainfall on wheat yields is assessed on the basis of a log-log regression with average wheat yields in each *département* as the dependent variable, and acreage under wheat cultivation and monthly rainfall as independent, explanatory variables. The equation is estimated by pooling cross-sectional information over 30 years from the start of the import duty on wheat until the start of World War I (1885–1914).[31] *Département* dummy variables are used to capture fixed effects related to local conditions in terms of natural fertility of the soil. The *département* of Vaucluse (Avignon and its hinterland) is the comparator region, and its regional dummy variable is omitted. Time dummy variables were used to control for the possible impact of temperature anomalies, but none of the coefficients was significant. A time trend was also introduced, but the coefficient was not significant, which suggests that little technological change took place that may have impacted on wheat yields, which is consistent with prevailing conditions. Excluding variables with non-significant coefficients, the results are presented in Table 1.

The negative coefficient of acreage is consistent with the fact that marginal farms tended to have a lower average yield. The coefficients for acreage and rainfall are significant and of the expected sign. Not surprisingly, low rainfall in March and May had a negative impact on yield and output. The relatively low explanatory power of rainfall is not surprising, because soil moisture, which is the relevant consequence of rainfall, was also influenced by temperature. The coefficients of the year dummies were not significant, which suggests that the impact of temperature anomalies was limited. Other local conditions, captured by

30 Data reported in *Annuaire Statistique de la France* (various years). Data for Corsica are for Ajaccio until 1904, and for Cap Corse (the northern tip of the island) thereafter.

31 This is the reason for choosing 1885–1914. Similar results were obtained when using data covering the entire period 1874–1914.

Table 1. Estimation results (OLS, log-log), dependent variable is wheat yield

Log acreage (in hectares)	–0.198***
Year	0.004***
Log March rainfall (in mm)	0.020***
Log May rainfall (in mm)	0.026**
Dummy Alpes Maritimes	–0.654***
Dummy Aude	–0.097**
Dummy Bouches du Rhône	–0.152***
Dummy Corse	–0.820***
Dummy Gard	–0.135***
Dummy Hérault	–0.554***
Dummy Pyrénées Orientales	–0.368**
Dummy Var	–0.537***
Constant	–2.877
Observations	270
R^2	0.74

***Significant at 1%, **significant at 5%. OLS, ordinary least squares.

regional dummies, in particular soil fertility, appear to have had a more significant impact on yields.[32]

PRODUCER RESPONSES TO VARIATIONS OF RAINFALL AND WHEAT DUTIES

This section investigates the response of local wheat growers, as measured by variations in acreage under wheat to the level of the wheat duty, local prices, and rainfall, again at the level of *départements*.[33] Assuming that local producers were able to form rational or adaptive expectations, local prices are likely to have been the principal determinant in decisions to bring more or less farm land under wheat. Annual variations of local prices were in turn influenced by the prevailing wheat duty that was revised at the end of each year. On the whole, average wheat prices followed the same trend across the Mediterranean region, but market integration was far from complete.[34] Differences in price levels and

32 The results are not significant when the equation is estimated in first differences (variation of yield, acreage, and rainfall), which is not surprising, as it is the level of output relative to acreage that is sensitive to the level of rainfall.

33 Our approach is comparable with that of other studies using more recent data, such as Ghatak and Rees (Producers' response) and Parott and McIntosh (Non constant price expectations), although we analyse the data at *département* level. Analysis of micro-level acreage data would be preferable in order to take account of the heterogeneity in producers' behaviour, but such data are not available. Hence, we assume that local conditions other than the climate, such as soil fertility, were homogenous across *départements*. The significant coefficients of the regional dummies across the years in Table 1 suggest that the use of aggregate data is warranted.

34 The exact nature of wheat prices reported at *département* level in *Statistique Agricole Annuelle* (various years) is not specified. It is likely that these data are weighted averages of local wholesale prices.

Table 2. Estimation results (OLS, log-log), dependent variable is local wheat price

Log wheat local price (lagged, 1 year)	0.593***
Log wheat import price (lagged, 1 year)	0.007**
Log wheat duties *ad valorem* (lagged, 1 year)	0.025***
Constant	1.045***
Observations	270
R^2	0.45

***Significant at 1%, **significant at 5%. OLS, ordinary least squares.

annual variations persisted during the entire period. While local prices were generally superior to the import price (c.i.f.), they remained competitive after adding import duty and assumed transport costs.[35] This suggests that the exposure of Mediterranean wheat growers to unpredictable variations in duties was more substantial than was the case for other agricultural products.[36] The persistence of the intra-regional price gap and the co-movements of price levels across the Mediterranean *départements* suggest that imports had only a limited impact on price formation in this region, despite the relatively high share of the port of Marseilles in French grain imports.[37]

The relationship between local prices (the dependent variable) and the lagged value of wheat duties and import prices can be estimated on the basis of regression analysis, which should determine whether wheat growers were able to form adaptive expectations by assuming that they would have estimated the price level in year t on the basis of information available in year $t-1$. Average local prices in each of the nine *departements* are introduced as a one year lagged explanatory variable, along with the one year lagged *ad valorem* wheat duty. Table 2 shows that – as expected – both the lagged import prices (excluding duties) and the wheat duty have positive and significant coefficients. On the basis of this relationship, we can predict the local prices that could have influenced wheat growers in deciding the acreage to bring under wheat in the current year.

In order to measure the response of wheat farmers to changes in import price, import duty and climate during 1885–1914, we next use the level of acreage

It should be noted that the inclusion of local prices as explanatory variables to explain wheat yields does not affect the results in Table 1. The coefficient for price is positive and significant (either with or without a time lag), but weak.

35 One of the main complaints of agricultural interest groups was the limited applicability of discounted freight rates for agricultural produce. The standard rate for wheat in 1910 was 129 francs per ton per 1,000 km, representing about 50 per cent of the prevailing domestic price (Augé-Laribé, *L'évolution agricole*).

36 Changes in prices of wheat relative to other agricultural products probably played a role in the decision of producers to shift away from wheat cultivation and to convert arable land into vineyards, orchard, or pastures. This issue is not taken into account in the present study.

37 Information by port of entry of seaborne (as well as land-borne) trade in the *Tableau Général du Commerce de la France* does not offer the breakdown by various grains (wheat, durum wheat, barley, oats, maize, excluding flour and rice).

Table 3. Estimation results (OLS, log-log), dependent variable is wheat acreage

Log of local wheat price (lagged, 1 year)	0.34**
Log of wheat duty *ad valorem* (lagged, 1 year)	–0.176***
Log of May rainfall (lagged, 1 year)	0.042**
Log of May rainfall (lagged, 2 years)	0.037**
Dummy Alpes Maritimes	–1.273***
Dummy Aude	–0.494***
Dummy Bouches du Rhône	–0.408***
Dummy Corse	–1.349***
Dummy Gard	–0.459***
Dummy Hérault	–1.731***
Dummy Pyrénées Orientales	–2.944***
Dummy Var	–0.482***
Constant	10.724***
Observations	267
R^2	0.93

***Significant at 1%, **significant at 5%. OLS, ordinary least squares.

under wheat cultivation as an indicator of growers' response (harvested area is used as proxy for cultivated area). The aim is to assess whether the decisions of wheat farmers were influenced by their perceived exposure to risk related to the volatility of wheat yields in Mediterranean *départements*. We expect reduced cultivated acreage during years of high *ad valorem* import duties. We then regress (in log-log form) acreage (measured in hectares), as the dependent variable on the *ad valorem* duty on wheat imports and local wheat prices expressed in current francs, as the two explanatory variables, both with one year lag. Similar results are obtained when using predicted prices as explained above instead of one year lagged local prices. We also introduce monthly rainfall, the sole climate variable available for the entire period, with one and two year lags. The rationale for regressing on past climate data is that a succession of low rainfall years could push producers out of business. Hence, we do not posit that wheat growers were able to form adaptive expectations on future rainfall, although the existence of weather cycles suggests that this possibility cannot be entirely dismissed.[38] Finally, we use dummy variables for each *département* to adjust for differences in the level of acreage. Table 3 shows the estimation results.

The coefficients are significant and have the expected sign; positive for local prices and negative for wheat import duty. The coefficients for one and two year lagged rainfall in May, one of the two months identified as most critical in the yield regression, are also significant and positive, as expected, but their impact is weak. This result suggests that low May rainfall during the previous year was a disincentive to farmers to grow wheat, which eventually induced a kind of hysteresis effect.

38 Burroughs, Weather cycles.

CONCLUSION

The paper has shown that the re-introduction of tariffs on wheat imports in 1885 was a major issue in the economic history of France. While this event is generally interpreted as having sustained domestic wheat production in France, this general interpretation takes no account of the fact that the policy had different consequences across the regions in France that produced wheat. In particular, it takes no account of the differences in the environmental conditions under which wheat farmers in different regions operated. This paper has tried to capture those differences on the basis of an analysis of the uncertainties under which wheat farmers in the Mediterranean region of France operated during 1885–1914. It has drawn attention to the fact that decisions about wheat production were influenced by the symmetric impact of changes in world prices and import tariffs, as well as the asymmetric impact of climate variability.

Without doubt, aggregation at the regional level of decisions made by individual producers leads to a loss of information. In addition, annual variations of acreage in any given region were of limited extent. Nevertheless, the regression results presented in this paper suggest that the fall in wheat cultivation observed in the Mediterranean part of France during the late nineteenth century was influenced by a deterioration of climatic conditions, more specifically by rain shortfall during preceding years. However, rainfall alone seems to have had a limited impact on wheat yields and cropping options. Information on changes in the wheat duty and the expected local price of wheat also played an important role in the decisions of wheat growers to bring acreage under wheat. This suggests that wheat farmers were risk averse insofar as cultivated acreage was negatively influenced by the exposure to risk of forgone income resulting from the combined effect of the variations in the wheat duty and the unpredictability of the level of rainfall.

The interplay of climate anomalies and trade policies as determinants of producers' decisions needs to be investigated further. A possible extension of this paper would be to take account of recurrent droughts (defined as a period of more than one consecutive month of below average rainfall) and the repetition of drought years. It would then be worth exploring whether these anomalies influenced decisions by Mediterranean farmers to shift away from wheat, or to move away from agriculture altogether at the end of the nineteenth century (and in some areas into the twentieth century). Another important issue to investigate, in relation with the wheat tariff, is the magnitude of the transfers that took place across French *départements* as a consequence of the de-linking of French domestic prices from world prices, from regions of consumption to regions enjoying an exportable surplus, as well as the relationship between these flows and the vote of locally elected deputies in the decision-making process, which resulted in the adoption of the *Méline* tariff.

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