"Goths and Vandals" or "Civilized" Farmers? Common Lands and Agricultural Productivity in Early-Twentieth-Century Spain

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By analyzing the different factors affecting labor agricultural productivity in early-twentieth-century Spain, this article shows that common lands were not detrimental to agricultural development. Even though privatization fostered output per worker by bringing more land into cultivation, the role of the commons as provider of pasture and fertilizing materials counteracted that effect, especially in humid regions. The supposed advantages of dismantling the communal regime are thus not supported by the data.

Introduction

The privatization of common lands has traditionally been considered a precondition to foster agricultural productivity and economic growth. Liberal thinkers and agrarian reformers, such as Arthur Young, eagerly advocated for the privatization of the commons on the theoretical grounds of facilitating the adoption of more advanced farming methods and thus raising efficiency.[1] Even though concerns about the subsequent deprivation of the peasantry, exemplified by the work of the Hammonds (Hammond and Hammond 1911), loomed in the public minds, several authors in the 1960s and 1970s supported the liberal views and the inevitability of the privatization process (Chambers and Mingay 1966; McCloskey 1975).[2] According to these critics, apart from preventing individual entrepreneurship and encouraging overexploitation, the ambiguity of the implied ownership rights and the need to reach consensus impeded the diffusion of agricultural improvements.[3]

However, recent research has started to deconstruct the negative image surrounding the communal regime. According to this view, common property regimes do not need to be inefficient and/or unsustainable and, therefore, the persistence of common lands can be compatible with economic development. In this sense, while British

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1. For a critical overview of Young's writings, see Allen (1982) and Allen and O'Grada (1988).

2. For a recent reaffirmation of this view, see Overton (1996: 18–20). Regarding the inevitability of enclosure, it has been argued that, although hindering efficiency due to higher transport and transactions costs, the open field system was relatively efficient during the Middle Ages because, in the absence of insurance markets, scattered landholdings provided a risk-insurance mechanism for farmers. However, this institution would be no longer necessary as modern markets for savings and insurance developed. See McCloskey (1975, 1991).

3. Individual private rights also permit using land as collateral when accessing the credit market. On this issue, see Federico (2005: 120). The supposed overexploitation of these resources, known as the "tragedy of the commons," was influentially put forward by Hardin (1968).

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agricultural productivity stagnated during the golden era of the enclosure movement, significant growth had already taken place before that period and improvements in farming methods had been actually implemented in open fields (Allen 1992, 1999, 2001). Likewise, the long-standing belief that rents increased after privatization is not accounted for by growing productivity, but mostly by inflation and by lands being freed from tithe, not to mention a significant redistribution of the existing agricultural income from tenants to landowners (Allen 1992; Clark 1998).[4] Recent research on continental commons has also contributed to this positive reassessment of the role of the commons (De Moor 2009; De Moor, Shaw-Taylor, and Warde 2002; Vivier 1998). Similarly, McKean (1986) shows that, in Japan, common meadows and forests were also efficiently managed by rural villages for centuries. It should be stressed that a crucial factor behind these findings is that, contrary to previous belief, the commons were not open-access resources, but were conscientiously regulated by the village community (Allen 2001: 4; De Moor 2009: 4–10). Access limits were widespread, both in terms of who was entitled to use the commons and what (and how much) could be extracted from them. Assemblies of users, by-laws, courts, and self-monitoring mechanisms were set up accordingly to secure the proper management of the system. Even though the view that enclosure did not foster economic growth has almost become the new paradigm (Allen 2003), the lack of agreement between historians, especially focusing on the British case, still prevents making a definitive assessment of this issue.

This paper seeks to contribute to this debate by analyzing the effect that the privatization of common lands had on labor agricultural productivity in nineteenth- and early-twentieth-century Spain. Displacing the lens of the economic historian to other areas is especially relevant because the "successful" English example was followed by agricultural reformers all across continental Europe (Clark 1998: 74; Demélas and Vivier 2003). In this sense, by providing pasture, wood, fertilizer, and fuel, together with the possibility of temporary cropping, common lands were a key component in the organic-based Spanish preindustrial economy (Iriarte 2002).[5] These communal resources were actually a crucial element of an organic system in which agricultural activity was completely integrated with cattle breeding and forestry. However, the strong liberal bias toward the supposed benefits of enclosure, exemplified by the well-known Young's words comparing "the Goths and Vandals of open fields" with "the civilization of enclosures,"[6] was widely echoed by Spanish liberalism. The Ministry of Development in 1872, for instance, regarded the communal regime as a harmful remnant of a primitive rural culture that had to be replaced by individual property

4. Instead of focusing on efficiency, other scholars, in the spirit of the Hammonds' pioneering contribution, have stressed the negative impact that the loss of common rights had on the living standards of the lower rural classes (Humphries 1990; Neeson 1993; Tan 2002). These claims, nonetheless, have also been contested (Clark and Clark 2001; Shaw-Taylor 2001).

5. Pasture seems to be, nonetheless, the most important use on the commons. See GEHR (1999, 2002).

6. Quoted in Allen and O'Grada (1988: 97).

rights if economic progress wanted to be unleashed.[7] The transformations resulting from the emergence of the new liberal state, together with increasing market pressures, triggered the gradual dismantling of common lands throughout the nineteenth and early twentieth centuries. Despite numerous warnings arising from the local rural communities, the liberal state actively promoted this process, particularly by passing the so-called General Disentailment Act in 1855.[8] Interestingly, the intensity of the privatization process, together with the agricultural performance of each region, was geographically diverse.[9]

In order to analyze the distinctive effect of privatization on agricultural productivity, this article exploits a dataset at the provincial level at 1900 and 1930. Apart from quantifying the stock of common lands and agricultural productivity, it draws on data on the different inputs affecting the level of agricultural output. This includes information on agricultural labor force, diverse types of land, and capital, both in terms of livestock and of modern inputs such as artificial fertilizers and modern plows, threshing machines, and tractors. By considering the commons as another productive factor, this paper aims to assess their effect on agricultural productivity. Given their role as provider of pasture, the link between common lands and livestock is also included in the analysis. The results show that, on average, the different stock of common lands did not explain the differences on the levels of output per worker between provinces. Even though privatization fostered labor productivity by bringing more land into cultivation, the role of the commons as provider of pasture and fertilizing materials counteracted that effect, especially in humid regions. The supposed advantages of dismantling the communal regime are thus not supported by the data, so liberal thinkers either were simply wrong or, given who mostly benefited from the sales, were seeking to promote vested interests.

Common Lands, Agrarian Reform, and Agricultural Modernization in Spain

Sharing the same enlightened spirit prevalent in Europe, Spain also bred its own Arthur Youngs. Gaspar Melchor de Jovellanos was actually the leading figure when advocating the need for agricultural reforms in the last third of the eighteenth century (Robledo 1993). Interestingly, Jovellanos also intensely traveled across Spanish regions and the information gathered, together with his impressions, which he kept in a diary, served as a source of material for his subsequent writings (Caso González 2000). Although it is unclear whether Jovellanos got to directly know Young's work, he shared both

7. Quoted in Sanz Fernández (1985: 165). Similar statements by prominent liberal figures can be found all over the nineteenth century. See, e.g., Moreno (1998) and Gómez Urdañez (2002).

8. Examples of the contemporary opposition to the liberal policies can also be found in Simón Segura (1973), Montiel (1992), Linares (1995, 2001), Sánchez Salazar (1995), Gómez Urdañez (2002), Serrano Álvarez (2005), and Lana (2008).

9. For a detailed account of this process and an analysis of the factors behind the diverse regional persistence of the communal regime in Spain, see Beltrán Tapia (2015a).

the physiocrats' idea about the important role of agriculture and Smith's view on the role of economic freedom (Grice-Hutchinson 1993: 140). However, the discussion of foreign ideas, including those of Young's, was a major activity in the Sociedades de Amigos del País (Societies for Friends of the Country), economic societies that sprang up all over Spain during the second half of the eighteenth century in an attempt to find solutions to the nation's economic problems (ibid.: 64). In any case, Young's work and that of other English liberals praising the benefits of enclosure became, directly or indirectly, increasingly influential among Spanish liberals from the late eighteenth century onward. The journal *Semanario de Agricultura y Artes*, for instance, which ran from 1797 to 1808, published translations of Young's work (Almenar 2000: 19). In this sense, after having read Young's writing, Canga Arguelles, a prominent liberal figure who wrote the preamble to the Constitution of 1812, wondered at the ability of the English farmer to increase yields (Sidney Smith 2000: 320).

Jovellanos's ideas, as reflected in the *Informe sobre el Expediente de Ley Agraria*, included the superiority of private property over other property regimes and, accordingly, the application of market mechanisms for the land factor or, in his own words, "the suppression of the obstacles which prevent the free action of the individual interest" (1795: 10).[10] Although some timid attempts were made trying to distribute private user rights over the commons during the 1760s and 1770s, his political stance only gradually crystallized throughout the nineteenth century, driven not only by market pressures and ideological considerations, but also by the fiscal problems of both the Crown and municipalities.[11] This period certainly witnessed a massive privatization process: around 10 million hectares changed hands between 1770 and 1930 (Rueda Herranz 1997). The privatization of property rights was also paralleled by a privatization of the user rights over the remaining commons. The success of the privatization process was geographically uneven (GEHR 1994). The dismantling of the communal regime was particularly intense in some areas of the central and the southern half of the country, while common land persistence was especially high in northwestern Spain.[12]

The reasons behind this diverse outcome have been analyzed elsewhere (Beltrán Tapia 2015a). What it is interesting to stress now is that the literature on the Spanish case, while regretting the potentially negative effects on the living standards of the rural poor, has mainly agreed with contemporary commentators about the necessity of removing old barriers for land to become a perfectly marketed commodity (García Sanz 1985; Herr 1974, 1989; Simpson 1995). The usual argument is that these reforms, although probably not able to significantly change farming methods and raise productivity, would have helped agriculture to feed a doubling population and meet an increasing international demand for Mediterranean products such as wine or olive oil. In this view, the negative consequences of enclosure on the bottom part of the population were viewed as the price to help bring about the market mechanisms

10. My translation.

11. For summaries of the process during the nineteenth century, see Iriarte (2002) and Beltrán Tapia (2015a). For a review of the policies carried out in the 1760s–1770s, see Nieto (2002: 276–79).

12. The regional picture was definitely more complex. See GEHR (1994) for a more detailed description by region.

required for a better allocation of resources. However, the appropriateness of having the commons dismantled has been subjected to mounting criticism.

Broadly speaking, the interpretation of this Spanish historical episode has followed a similar evolution as the one on the English enclosures. While contemporaneous agrarian reformists and liberal elites encouraged privatization, this stance was strongly resisted in other spheres. This criticism peaked at the end of the nineteenth century and first decades of the twentieth century coinciding with the end of the process and the realization of its poor results (Carrión 1932; Costa 1898). Although heavily influenced by this school of thought, the first wave of professional historians, instead of revaluating the role of the commons, negatively stressed the way the disentailment was carried out, which was seen as a lost opportunity to promote a more equal access to land (Malefakis 1970; Simón Segura 1973; Tomás y Valiente 1978). A different view nonetheless emerged from the 1970s onward. Perhaps influenced by Anglo-American historians and social scientists, the focus shifted to the potential positive effects of private property and market mechanisms (García Sanz 1985; Herr 1974, 1989; Simpson 1995). However, as pointed out in the preceding text, a new wave of researchers has revaluated the contribution of the commons by considering its central role for the sustainability of the whole agrarian system.[13]

By providing pasture and fertilizing materials, as well as constituting a reserve of arable land, the commons were a key element within the agrarian sector, which can only be properly understood as an integrated system where arable pasture and forest land complemented one another. Commons in Spain not only indirectly provided manure by feeding livestock, but also by supplying organic fertilizers obtained from the decomposition of different varieties of fern, which was a fundamental element of the Atlantic areas (Balboa and Fernández Prieto 1996). This agrarian system was not only integrated through space but also through the different seasons.[14] Importantly, commons were not, as often wrongly assumed, an open-access resource, but were subject to tight formal and informal regulations and enforcement mechanisms, thus ensuring that user rights were appropriately enjoyed. Furthermore, the expansion of arable land is likely to have quickly run into diminishing returns as marginal lands were put under the plow.

Some studies have especially stressed how the liberal reforms, by favoring arable land and reducing pasture land, may have negatively affected livestock numbers (Garrabou and Sanz Fernández 1985; GEHR 1979; González de Molina and Pouliquen 1996). The importance of the commons for maintaining livestock was well known by contemporaries. During the nineteenth century, multiple warnings were raised over the damage that an excessive reduction of the commons would cause on the possibility of keeping adequate numbers of livestock and on agricultural yields (Artiaga and Balboa 1992: 103). An official report about the province of Teruel in the mid-nineteenth

13. See, among others, Balboa (1999), González de Molina (2001), Linares (2001), Moreno (1998, 2002), Jiménez Blanco (2002), Iriarte (1998, 2002), Serrano Álvarez (2005), and Lana (2008). This line of research is heavily influenced by Wrigley (1988).

14. For a thorough description of how this integrated agrarian system worked, see Linares (2001: 24).

century is highly eloquent: "every first-quality land is already under cultivation;... and even some plots which should only be employed as pasture or waste land have unfortunately been ploughed and now they are useless for either of them."[15] The opposition to the sales was indeed widespread in the responses given by municipalities to the questionnaire sent by the Parliament in 1851 regarding this issue (Gómez Urdañez 2002; Moral Ruíz 1979; Sánchez Salazar 1995). Those answers stressed the crucial functions fulfilled by the commons mentioned in the preceding text but especially pointed to the common fear that privatization, and subsequent plowing up of new land, would break down the mixed husbandry and forestry equilibrium, thus reducing the availability of manure and subsequently agricultural yields. The same idea can be found in the writings of prominent Spanish economists and social reformers in the early twentieth century such as Joaquin Costa (1911) or Flores de Lemus (1926). Although it seems that livestock density maintained its importance between the mid-eighteenth and mid-nineteenth century, the plowing of new arable land between 1860 and 1880, coinciding thus with the peak of the privatization process, may have reached a threshold that made the preservation of livestock numbers impossible (García Sanz 1994: 91–92). It is also likely that the expansion of arable land was detrimental to the maintenance of traditional transhumant practices, thus leading to a reduction in livestock density. However, this relationship remains unclear because the reduction in pasture could have been counterbalanced by an expansion of fodder crops and by an expanding demand for animal energy (García Sanz 1985: 37). In this sense, the maintenance of the livestock density between 1750 and 1865 would have been compatible with the expansion of arable land due to simultaneous changes in the relative composition of the herd between different species. This process was reflected in the expansion of animals employed in agricultural tasks, especially mules that were particularly well adapted to work in the semiarid conditions that characterize most of Spain (García Sanz 1994: 91–95; Garrabou and Sanz Fernández 1985: 121).[16] Fueled by an increasing demand for working animals, meat, and dairy products, livestock numbers recovered previous figures during the first decades of the twentieth century, which also led to an expansion of fodder crops.[17]

To sum up, in order to fully examine the effect of privatization in Spanish agriculture, this paper proposes to examine three different potential channels: first, the hypothesis that the commons, as defended by many liberal thinkers, were directly harmful to agricultural productivity; second, the possibility that, by expanding the area under cultivation, privatization positively contributed to a rise in productivity; and third, the indirect link through which, by supporting livestock density, these collective resources may have sustained agricultural development.

15. Quoted in Moral Ruíz (1979: 35). My translation.
16. While oxen and mules gained relative importance, sheep became less and less important over time. The evolution of pigs was different because, although it suffered significantly during the second half of the nineteenth century, its growth afterward was extremely fast. See GEHR (1979: 155–56).
17. GEHR (1978, 1979).

Methodology

Common Lands and Agricultural Productivity

The effect of the persistence of common lands on agricultural productivity can be assessed by framing it within the context of agricultural modernization. Despite being traditionally considered as a failure due to its inability to fulfill the functions forcefully put forward by Johnston and Mellor (1961), Spanish agriculture nonetheless underwent significant transformations from 1860 onward.[18] Not only arable land increased considerably, but the crop-mix evolved toward more market-oriented products. Likewise, artificial fertilizers and modern machinery were increasingly applied, especially during the first decades of the twentieth century. Other improvements were the expansion of irrigation and the reduction of fallow. The geographical distribution of these transformations was nonetheless extremely varied. The transformation of the organic agriculture starting in the nineteenth century mostly affected the irrigated lands of the Mediterranean periphery and the Ebro valley, as well as the dry-farmed cereal crops of the latter region and the north of Castile. Furthermore, large-scale farms in southern Spain began mechanizing their operations. As for the rest of Spain, the agrarian sector went on as in the nineteenth century, increasing their productions and transforming their methods basically leaning on the typical methods of an organic agriculture. Agricultural productivity therefore evolved differently depending on the region analyzed.

By considering the commons as another productive factor, this paper assesses their distinctive effect on agricultural labor productivity. The employment of partial productivity measures has been criticized on the grounds that, apart from responding to diverse environmental contexts, different productivity levels may not be the result of technical change or improved efficiency, but the outcome of employing more of other inputs. As Federico (2005: 69) points out, if blessed by a rich endowment of land, output per worker can be relatively high in backward economies or, alternatively, yields per hectare can be higher in densely populated countries that are able to work the land more intensively. The model developed here takes into account the relative contribution of different inputs and therefore attempts to avoid that problem. In order to do so, a detailed panel dataset on the different inputs involved in the agricultural production process is gathered at the provincial level in two different periods (1900 and 1930) and contrasted with information on agricultural labor productivity.[19] Focusing on cross-regional differences during the period between 1900 and 1930 assures that the potential ultimate effect of the developments taking place throughout the nineteenth century is taken into account. This approach also enables the possibility of contrasting the role of the surviving commons in a dynamic period characterized by the increasing diffusion of modern agricultural inputs. The sources and methodology

18. See Bringas (2000), Pujol et al. (2001), Carmona and Simpson (2003), Clar and Pinilla (2009), and Lana (2011) for recent discussions on these issues applied to the Spanish context.

19. Unfortunately, no information on agricultural production is available for 1860. The employment of labor productivity as a measure of agricultural productivity follows a long tradition among economic historians (Allen 1992, 2000; O'Brien and Prados de la Escosura 1992; Van Zanden 1991).

employed to compile the data, as well as summary statistics of all the variables, are presented in Appendix A.

Drawing on previous literature based on the Cobb-Douglas production function (Craig, Pardey, and Roseboom 1997; Hayami and Ruttan 1985),[20] an empirical exercise is thus carried out to uncover the causes behind different levels of labor productivity by estimating a model that attempts to explain variation in productivity across regions and over time:

$$ln(Y)_{it} = \beta_0 + \sum \beta_j ln\left(X_j\right)_{it} + \sum \delta_{k_i} + \alpha_t + u_{it}$$

where Y refers to agricultural productivity measured by output per worker. Given that the levels of output depend on the crop mix, the whole agricultural sector has been considered when accounting for the numerator.[21] This choice is also forced by the impossibility of distinguishing between the fraction of the labor force devoted to either farming, cattle breeding, or forestry. Likewise, even though the commons were primarily used as a source of pasture, some of them were allocated for cultivation among neighbors but the available information cannot discriminate between them.

The right-hand side of the equation contains the set of input factors, X_j, potentially contributing to agricultural productivity divided by the size of the agricultural labor force measured by the economically active male agricultural population.[22] On the one hand, three different types of land are considered: arable land, common land, and other types of land comprising pastures, meadows, and uplands.[23] Regarding the arable land and given the importance of considering differences on the quality of different land types (Craig et al. 1997: 1069), the fraction of land left fallow, as well as the fraction of irrigated land, is included in the analysis as interaction

20. This model has been more recently applied to labor productivity differentials across Europe from 1950 to 2000 (Martin-Retortillo and Pinilla 2012).

21. In this sense, it has been argued that narrowing agricultural practice down to the arable sector prevents a proper assessment of relative agricultural performance because it produces biases toward the practices of any of the regions involved in the comparison (Kander and Warde 2011: 10).

22. The lack of consistency between censuses regarding female working population advises to rely only on male workers, a usual procedure both in Spanish and international historical literature (Erdozáin and Mikelarena 1999; Nicolau 2005; O'Brien and Prados de la Escosura 1992; Prados de la Escosura 2008; Van Zanden 1991). In any case, employing the total agricultural labor force instead does not change the results of the analysis. Consistency between censuses also recommends using data of 1877 instead of 1860. It seems nonetheless that the population distribution did not change much between 1860 and 1877, while there was enough variation between 1877 and 1900. Ideally, the labor input should be converted into hours actually worked in agriculture, but it has not been possible to establish regional differences in working intensity. However, this approach has the advantage of allowing labor productivity to be lower where underemployment was an important issue.

23. The communal regime in Spain involved two main types of access to the land: a direct but regulated access for all members of the community (*comunales*) or a temporary cession of user rights to particular individuals in exchange for a monetary income (*propios*). The privatization process not only affected their property rights but also the way these resources were used and, consequently, the proportion of private user rights over the remaining commons grew over time (GEHR 1999). In order to take this distinction into account, adding an interaction term between the stock of common lands and the importance of collective user rights was considered but, because this variable always turned out to be statistically insignificant and did not affect the outcome of the analysis, it has been removed for the reported results.

terms. On the other hand, the stock of capital is split up between livestock, which is measured in live weights, and modern inputs. The latter separately include both artificial fertilizers, measured in equivalent nutrient units of nitrogen, phosphorous, and potash, and modern machinery, which accounts for the use of modern plows, threshing machines, and tractors.[24]

However, inputs' choice and agricultural productivity may depend on external factors, such as the constraints imposed by the economic, social, or environmental context where farmers are immersed.[25] In order to deal with this source of endogeneity and given the wide geographical and climatic differences that characterize the diverse Spanish areas, a set of time-invariant environmental and geographical controls, δ_k, will be included in the specification. These variables include average monthly rainfall and its interaction with the coefficient of variation of monthly rainfall, average temperature, altitude, a ruggedness index, the pattern of population settlement, distance to big cities, and a dummy for those provinces with access to the sea.[26] Likewise, a dummy for the year 1930, α_t , is also considered in order to account for technological progress or increasing market integration. Lastly, the error term, u_{it}, represents random disturbances that are uncorrelated with the other variables.

Furthermore, in order to account for other potential influences coming from outside the agricultural sector, an augmented model will be considered by expanding the set of X_j. On the one hand, Schultz (1964) forcibly contends that, by facilitating the acquisition of useful knowledge, higher educational levels enhance agricultural productivity. The stock of human capital, proxied by literacy rates, is thus included in the model. On the other hand, the existence of market incentives is usually seen as a major factor behind variations in land and labor productivity (Hayami and Ruttan 1985). Demand from the nonagricultural sector both increases the incentives to raise productivity and facilitates the reallocation of surplus labor. Likewise, the industrial sector provides artificial fertilizers and modern machinery, thus easing the constraints imposed by the inelastic supply of internally generated inputs.[27] The urbanization rate is employed in order to account for the new opportunities created by economic

24. The series for modern plows, thresher machines, and tractors are collapsed together under the category of modern machinery by employing average prices provided by Martínez Ruíz (2000: 90, 144). Although this category omits other type of farm equipment and therefore is a crude indicator of total capital, it can be safely assumed that it is an adequate proxy for the use of modern machinery. Given that the numbers in 1900 require taking some arbitrary decisions, robustness checks using different figures were employed and the results remained unaltered.

25. The importance of "state" variables, defined as "constraints, incentives, available technology, physical environment and political environment," in empirical research dealing with agricultural productivity is analyzed in Mundlak (2001: 20).

26. Rainfall, rainfall variation, and temperature account for climatic factors affecting yields. Terrain ruggedness not only influences agricultural productivity by determining the arability of land, but also transportation costs. The altitude variable complements terrain ruggedness in these two aspects and adds the potential for extreme weather. The population settlement pattern may have an effect on the ability to effectively work distant plots. Coastal provinces and distance to big cities, namely Madrid, Barcelona, and Bilbao, are intended to complement the urbanization variable when accounting for access to markets.

27. An advanced industrial economy may also contribute to agricultural growth by supporting effective transportation and communication systems and by fostering agricultural research (Hayami and Ruttan 1985: 132).

development. Lastly, there is a wide literature debating how both different levels of access to land and farm size may affect agricultural efficiency (Deininger and Feder 2001; Eastwood, Lipton, and Newell 2010). Inequality in access to the land, and indirectly farm size, is thus accounted for as the fraction of landowners over active agricultural population.[28]

The previous specification may nonetheless suffer from reverse causality problems, potentially biasing the estimated coefficients. First, although what is being tested here is the effect of common lands on agricultural productivity, it is plausible that, in those areas with better agricultural potential, privatization pressures were more intense (Allen 1992; Clark 1998). Second, as well as the nonagricultural sector may foster agricultural development, growth in agricultural productivity may increase the demand for industrial products and release labor force for other sectors (Johnston and Mellor 1961; Timmer 2002). Third, it may be the case that higher levels of educational attainments foster output per hectare and per worker but a more advanced agricultural economy may also facilitate both the supply and the demand for human capital (Huffman 2001). Lastly, similar arguments can be made regarding the relationship between inequality and agricultural productivity. In order to address these concerns, a two-stage instrumental variable approach, where the previous variables are considered as potentially endogenous and instrumented by their lagged values in 1860 and 1900, respectively, will be implemented.

Common Lands and Livestock

According to the arguments outlined in "Common Lands, Agrarian Reform, and Agricultural Modernization in Spain," the commons played an essential role as providers of pasture, so that link should be analyzed in order to fully assess the influence of common lands on output per worker. The contribution of the stock of common lands to support livestock is assessed by estimating the following model:[29]

$$ln(Y)_{it} = \beta_0 + \beta_1 ln(X)_{it} + \sum \theta_j ln\left(Z_j\right)_{it} + \sum \delta_{ki} + \alpha_t + u_{it}$$

While Y is the importance of livestock measured in live weight and X the stock of common lands,[30] Z_j refers to other potential determinants of livestock numbers as discussed by the literature. Apart from the commons, pastures, meadows, and forests owned privately were used to support livestock, so a proxy accounting for this variable is considered. The role of the arable land is, however, more complex. Although the expansion of crop land may have reduced the stock of spontaneous pastures, it may also have contributed to feeding livestock by producing fodder. Likewise, the proper cultivation of arable land also demanded draft energy, which in turn increased the

28. Data on landownership is only available for 1860 and 1920. Therefore, linear interpolation is employed to estimate that figure for 1900 and, for 1930, the data on 1920 is used.

29. Data sources and how the different variables are constructed are explained in Appendix A.

30. The importance of collective user rights on the common was also considered but, because it was insignificant in all specification, it was dropped from the model.

demand for working animals, especially in a period when tractors were still rare artifacts (Martínez Ruiz 2000).[31] However, some crops, such as vines or olive trees, made little use of animal power (Kander and Warde 2011: 4–5),[32] so the relative importance of these cultivations should be taken into account.[33] Furthermore, it is important to note that customary practices allowed livestock to be fed in the area of arable that was left as fallow. However, Federico (2005: 88) argues that fallow produced only a meager pasture, so any substitute would be welcome, providing that the nutrients extracted from the soil by farming could be reintegrated. The diffusion of new rotations first and of chemical fertilizers later would ease these constraints. In this sense, although the coexistence of organic and modern modes of productions has been widely found in the literature, the diffusion of chemical fertilizers, thresher machines, and tractors, by making manure and animal draft energy less necessary, may have reduced the demand for livestock (Knibbe 2000; Olmstead and Rhode 2001). In order to control for these hypotheses, proxies accounting for these potential determinants of livestock density are included.

As in the previous exercise, the potential effect of technological progress or increasing market integration, as well as climatic and geographical differences, is accounted by considering a time dummy for 1930 (α_t) and a set of time-invariant provincial characteristics (δ_k).[34] Likewise, an augmented model is preferred again because livestock numbers could have also been influenced by other factors than those purely input related. The pull of urban markets, for instance, may increase incentives not only to raise agricultural productivity by employing more animals in agricultural tasks, but also to directly increase the production of meat and dairy products (GEHR 1979; Van Zanden 1991). Moreover, commercial networks facilitate the purchase of fodder, easing land, either arable or pasture land, from the constraint to feed animals. These trends will be proxy by urbanization rates.[35] Arguments similar to those already made in the previous empirical exercise also justify considering literacy rates and levels of access to land when explaining livestock numbers. Lastly, in order to avoid endogeneity and further test the robustness of this analysis, an instrumental variable approach will be implemented using the lagged values of these three variables, together with that of the commons, as instruments.

31. In 1932, only an average of one tractor for every 5,128 hectares was available (Martínez Ruiz 2000: 132).

32. It is true, however, that in areas where vines and/or olive trees were relatively abundant, the animal energy applied to these crops could be a significant part of the total draft energy. For instance, in the provinces of Badajoz, Cáceres, and Huelva, these two crops accounted for 22, 14, and 18 percent, respectively, of all work carried by yuntas (teams of draft animals). See Dirección General de Agricultura 1935.

33. A series accounting for the importance of vines and olive trees have been assembled using data from GEHR (1991).

34. These are the same as in the previous empirical exercise. Climatic conditions, together with geographical features conditioning market access, clearly influenced livestock densities in Spain. On this issue, see Simpson (1995: 103), Gallego (2001), and González de Molina (2001).

35. Note that the possibility of accessing other markets is also controlled by including distance to big cities and the coastal dummy in the set of controls referred to in the preceding text.

TABLE 1. *Commons and agricultural productivity, 1900–1930*

	Dependent variable: Agrarian output / Active agricultural population					
	OLS			*IV*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Commons	0.02	0.03	0.07*	0.02	0.03	0.09*
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
Other inputs	Yes	Yes	Yes	Yes	Yes	Yes
State variables	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes
Observations	89	89	89	89	89	89
R-squared	0.75	0.76	0.85	0.75	0.76	0.85

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level. A time dummy for 1930 is included in all specifications. Other inputs refer to arable land, including its interaction with the fraction left fallow and irrigated; pastures, meadows, and forests; livestock; chemical fertilizers; and modern machinery. All input variables are computed in relation to the labor force and expressed in natural logs. State variables refer to urbanization, literacy, and access to land. The instruments are the lagged values of the endogenous variables (commons, urbanization, literacy, and access to land). Controls include temperature, rainfall, rainfall interacted by its coefficient of variation, ruggedness, altitude, population settlement pattern, distance to Madrid or Barcelona, and a coastal dummy. See Table 1.B in Appendix B for the full specification.

Results

Table 1 reports the results from estimating the equation explained in the preceding text.[36] While column (1) shows the estimated coefficients of the baseline specification accounting for the different inputs affecting labor agricultural productivity, columns (2) and (3) add the state variables and the climate and geographical controls, respectively. The model employed accounts for 85 percent of the variation in productivity, which suggests that it fits remarkably well the subject under study. The two-stage IV approach, reported in columns (4) to (6), mostly confirms the results obtained using OLS. Contrary to the liberal ideology, the commons did not seem to have been directly detrimental to labor productivity. The coefficients are always positive but hardly statistically significant, although it should be noted that, when the effect of the state variables is controlled for, their positive impact becomes significant. The comparison with the estimated effect of pastures and forests held under private

36. Apart from pooled OLS, a random-effects model was estimated but the coefficients hardly changed. Likewise, a fixed-effects model was also considered. The estimated effect of the commons on agricultural productivity was even higher and statistically significant (0.16**). I have nonetheless preferred to report the pooled OLS model. The privatization process took mainly place before 1900, so the variation between 1900 and 1930 is relatively small. A fixed-effects model, however, only considers variation within provinces and hence disregards the variation across provinces. Including the control variables explained in the previous section allows for mitigating the concerns coming from potential omitted variable bias, while still taking advantage of the cross-sectional variation in the data. In addition, the reported results provide the more conservative evaluation of the positive contribution of the commons. The full specification is reported in Table 1.B in Appendix B.

TABLE 2. *Enclosure and arable land expansion, 1860–1930*

	Dependent variable: Expansion of arable land (% of total land)	
	1860–1900	*1900–1930*
Privatization of the commons (% of total land)	0.34*	0.16
	(0.20)	(0.54)
Observations	46	46
R-squared	0.06	0.00

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level. For simplicity, the intercept is not reported.

property, which is always negative, is also revealing. Columns (3) and (6) highlight that the supposed negative link between the commons and efficiency was rather reflecting the environmental conditions in which these resources were immersed than their actual productivity. Once climate or geographical variables are taken into account, the commons actually seem to have a positive influence on the agricultural sector. Given that the direct effect of livestock on agricultural productivity is already accounted for, this positive impact of the commons is explained, as argued in "Common Lands, Agrarian Reform, and Agricultural Modernization in Spain," by their role as provider of organic fertilizer based on different types of fern, especially in humid Spain.[37]

It is true nonetheless that one of the declared aims of the disentailment was to put more land under the plow.[38] The estimated coefficient on arable land is positive and significant and, therefore, by converting pasture and scrubland into cultivated land, privatization may have indirectly favored agricultural productivity.[39] Table 2 shows the results of regressing the fraction of land that became private on the fraction of land that was turned into crop land. Although the privatization process appears to have contributed to expanding arable land, the strength of that relationship is not that clear. Both variables show a weak positive relationship between 1860 and 1900 but the link between them completely disappears between 1900 and 1930. There is indeed evidence that the persistence of common lands, at least in some regions, was compatible with the expansion of arable land and increasing yields even in the first

37. Including the part of the agrarian output corresponding to forestry as a regressor does not significantly change the results obtained in the preceding text.

38. As shown elsewhere, apart from the need to expand arable land in dry region in order to meet the increasing demand for agricultural products, an unequal distribution of access to land was also a factor behind the massive dismantling of the communal regime in the more unequal regions. Large landowners actually promoted privatization in those areas because those resources were likely to end up in their hands. See Beltrán Tapia (2015a).

39. In this regard, putting the commons under the plow would require that yields increased more than the labor employed. However, there are no reasons why the expansion of arable land could not have equally taken place under a communal regime.

decades of the twentieth century, a period witnessing a significant modernization process.[40] Studying Navarre, Iriarte (1998: 128) shows that 40 percent of the plowing of new land between 1850 and 1935 was carried out in common lands that had been leased out. In any case, given that the estimated coefficient of arable land on output per worker is 0.30, assuming that 34 percent of the commons that were privatized helped feeding the expansion of crop land during the second half of the nineteenth century implies that, by potentially encouraging the expansion of land under cultivation, a 1 percent decrease in the stock of common lands would have increased labor productivity by 0.102 percent.[41] However, it should be noted that part of that land was kept fallow and, given that these lands show a negative relationship with output per worker, that figure should be adjusted. On average, in 1900, 36.5 percent of the arable land was left uncultivated in order to replenish soil nutrients. Therefore, the final opportunity cost of maintaining the commons derived from its potential benefit if put into tillage would be 0.071 percent.[42] When this figure is compared with the 0.09 percent effect of common lands on output per worker, the supposed advantage of expanding arable land resorting to the commons becomes negligible or even negative.[43] Furthermore, these estimates are based on the period ranging from 1900 to 1930, when the increasing availability of chemical fertilizers made the expansion of crop land on marginal lands potentially more productive. This possibility was seriously limited during the second half of the nineteenth century when extensification quickly ran into diminishing returns (González de Molina 2001: 69).

However, according to the arguments outlined in "Common Lands, Agrarian Reform, and Agricultural Modernization in Spain," the commons played an essential role as providers of pasture. Given that the previous analysis shows that livestock density was significantly associated with higher levels of agricultural productivity, the link between those collective resources and livestock numbers should be explored in order to fully assess the role of common lands on agricultural development. Table 3 reports the estimation of the model presented in "Common Lands and Livestock" that, taking into account other potential determinants of livestock density, confirms the importance of the stock of common lands in supporting livestock. The estimated coefficient, computed based on information of the early twentieth century, should be taken as a minimum. It is likely that, during the second half of the nineteenth century, the role of the commons was even more important given the lack of alternatives to organic manure and animal draft energy.

Therefore, if this indirect effect is taken into account, the positive assessment of the role of the commons on sustaining agricultural productivity becomes stronger. Given that a 1 percent increase in the stock of the commons is associated with a 0.24

40. See, e.g., Iriarte (1998: 135), Balboa (1999: 113), Linares (2001: 43), and Serrano Álvarez (2005: 445; 2014: 112–14). The expansion of cropping on land held in common was also a widespread mechanism to cope with the increasing demand for land during the eighteenth century (Sánchez Salazar 1988).

41. Arable land expansion was subject to diminishing returns, so this figure should be taken as a maximum of the actual effect.

42. The estimated coefficient on the land left fallow is −0.26.

43. It should also be taken into account that the relationship between privatization and the expansion of crop land was also very weak, statistically speaking.

TABLE 3. *Commons and livestock, 1900–1930*

	Dependent variable: Livestock (live weight)					
	OLS			*IV*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Commons	0.18***	0.24***	0.20**	0.23***	0.28***	0.24***
	(0.05)	(0.06)	(0.09)	(0.05)	(0.06)	(0.09)
Other variables	Yes	Yes	Yes	Yes	Yes	Yes
State variables	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes
Observations	89	89	89	89	89	89
R-squared	0.56	0.59	0.72	0.55	0.59	0.69

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level. A time dummy for 1930 is included in all specifications. Other variables refer to other potential determinants of livestock numbers: pastures, meadows, and forests; arable land, including its interaction with the fraction left fallow and the fraction devoted to vines and olive trees; chemical fertilizers; and modern machinery. All these variables, including the commons, are expressed in natural logs. State variables refer to urbanization, literacy, and access to land. The instruments are the lagged values of the endogenous variables (commons, urbanization, literacy, and access to land). Controls include temperature, rainfall, rainfall interacted by its standard deviation, ruggedness, altitude, population settlement pattern, distance to Madrid or Barcelona, and a coastal dummy. See Table 3.B in Appendix B for the full specification.

TABLE 4. *Common lands and labor productivity, 1900–1930*

	Direct effect	*Crop land potential*	*Sustaining livestock*	*Net effect*
Estimated effect	0.09*	−0.07*	0.07***	0.09***

*, **, or *** denotes significance at 10, 5, or 1 percent level. These figures reflect the estimated effect (in percentage points) of a 1 percent increase in the stock of common lands.

percent increase in livestock numbers, and that the estimated effect of livestock on output per worker was 0.31, the indirect effect of the commons on agricultural productivity would be 0.074. Table 4 summarizes the overall influence of the commons on agricultural productivity. These figures should not be understood literally but as an educated guide about the processes at play. In any case, because the two first effects somewhat counterbalanced each other (both in economic and statistical sense), the net effect of the stock of common lands on output per worker remains positive and significant. According to these estimates, the attack on the commons, which mostly took place during the second half of the nineteenth century, and by which 33.5 percent of these resources became private (7.7 percent of the total land), reduced Spanish labor productivity a minimum of 2.3 percent, a negligible amount but also very far from the advocated potential benefits it was supposed to bring about.

TABLE 5. *Commons and agricultural productivity in arid Spain, 1900–1930*

	Dependent variable: Agrarian output / Active male agricultural population					
	OLS			*IV*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Commons	−0.04	−0.02	0.06	−0.05	−0.04	0.06
	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.05)
Other inputs	Yes	Yes	Yes	Yes	Yes	Yes
State variables	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes
Observations	77	77	77	77	77	77
R-squared	0.80	0.81	0.87	0.79	0.81	0.86

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level. All input variables are divided between the active agricultural populations and expressed in natural logs. The instruments are the lagged values of the endogenous variables (commons, urbanization, literacy, and access to land). Controls include temperature, rainfall, rainfall interacted by its standard deviation, ruggedness, altitude, population settlement pattern, distance to big cities, and a coastal dummy. See Table 5.B in Appendix B for the full specification.

Common Lands and Agricultural Development in Arid or Semiarid Spain

Apart from the power of large landowners to promote the dismantling of the communal regime, the analysis of the factors explaining the dissimilar regional outcome of the privatization process shows a higher degree of privatization in dry regions (Beltrán Tapia 2015a). In contrast to the intensification process carried out in humid Spain, farmers in arid or semiarid regions were likely to have been compelled to the extension of cultivated land if production wanted to be increased. The commons in both areas may have subsequently played different roles, so this section explores this possibility by replicating the previous empirical exercise but leaving aside those provinces that enjoyed an Atlantic climate.[44] The importance of aridity in constraining agricultural productivity has been widely acknowledged, yet cross-country comparative studies often tend to overlook climatic and geographical differences when accounting for the backwardness of Spanish agriculture (Gallego 2001; Tortella 1994). The lack of water certainly constituted the primary restraint on agricultural yields in dry regions, which refers to most of the country. Therefore, and following the typology presented by Gallego (2001), the Atlantic provinces are dropped from the analysis.[45] The results of this exercise are reported in tables 5 to 8.

Although the results of assessing the relative importance of the different inputs on agricultural productivity remain relatively unchanged from what has been shown in

44. This exercise also serves as a robustness check of the previous results.

45. The Atlantic regions include the four Galician provinces, Asturias, Cantabria, and the three Basque provinces. See the map portraying the different climatic regions in Ninyerola, Pons, and Roure (2005).

TABLE 6. *Enclosure and arable land expansion in arid Spain, 1860–1930*

	Dependent variable: Expansion of arable land (fraction of total land)	
	1860–1900	*1900–1930*
Privatization of the commons (fraction of total land)	0.31 (0.20)	1.10* (0.63)
Observations	40	40
R-squared	0.06	0.08

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level.

the previous section, some differences are nonetheless significant. Comparing these results with those obtained with the whole sample of Spanish provinces thus unveils interesting conclusions. First, the coefficient of the common lands in table 5 is never significant, which suggests that, due to their ability to support a higher volume of biomass, the commons were more productive in humid regions, especially regarding the possibility of providing fern-based fertilizers. In this regard, when a dummy for the Atlantic provinces is interacted with the common lands and added to the regression on the whole sample, its coefficient turns to be 0.29 and highly significant, while the general coefficient on the commons is positive but not statistically significant. This result strongly confirms the importance of the commons in providing nonanimal fertilizer in humid regions. Likewise, given that in nonhumid regions privatization was more intense and that the best commons were the first to be appropriated, the previous result may as well reflect that the remaining commons were less productive (De la Torre and Lana 2000: 82). Second, the land-labor ratio now has a much larger impact on output per worker, illustrating the logic of extensification in dry areas. Therefore, the possibility of bringing land into cultivation at the expense of commons had a higher potential here.[46]

Table 6 shows that the estimated relationship between the privatization of the commons and the extension of crop land between 1860 and 1900 is not statistically significant at the 10 percent level. However, its p-value is relatively low (0.123), which, given that the coefficient hardly changes with respect to the whole sample, is likely to be the result of the loss of degrees of freedom.[47] Assuming the estimated coefficients

46. On the contrary, if we just focused on the Atlantic provinces, the coefficient on arable land would be lower than the one estimated previously (0.30) because excluding those provinces raises the coefficient to 0.64, which implies that the humid regions are counterbalancing that effect leaving the estimated coefficient at 0.30.

47. It should be noted that, although weakly significant, the coefficient for the period 1900–1930 makes little economic or historical sense due to the fact that the amount of land privatized is really small compared to the expansion of cultivated land. In any case, in order to assess the effect of privatization, I focus on the second half of the nineteenth century, which is the period when most of the privatization took place.

TABLE 7. *Commons and livestock in arid Spain, 1900–1930*

	Dependent variable: Livestock (live weight)					
	OLS			*IV*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Commons	0.10*	0.12*	0.14	0.11**	0.14**	0.23**
	(0.05)	(0.06)	(0.09)	(0.06)	(0.07)	(0.09)
Other variables	Yes	Yes	Yes	Yes	Yes	Yes
State variables	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes
Observations	77	77	77	77	77	77
R-squared	0.54	0.59	0.75	0.54	0.58	0.69

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level. All variables expressed in natural logs. The instruments are the lagged values of the endogenous variables (commons, urbanization, literacy, and access to land). Controls include temperature, rainfall, rainfall interacted by its coefficient of variation, ruggedness, altitude, population settlement pattern, distance to bid cities, and a coastal dummy. See Table 7.B in Appendix B for the full specification.

TABLE 8. *Common lands and labor productivity in arid Spain, 1900–1930*

	Direct effect	*Crop land potential*	*Sustaining livestock*	*Net effect*
Estimated effect	0.06	−0.12***	0.06**	−0.06***

*, **, or *** denotes significance at 10, 5, or 1 percent level. These figures reflect the estimated effect (in percentage points) of a 1 percent increase in the stock of common lands.

would imply that one percentage increase in the stock of common lands entailed an opportunity cost, in terms of the efficiency loss derived of not having transformed those lands into arable lands, of 0.195 percent. However, as in the previous section, the negative effect of fallow should also be taken into account. On average, these provinces kept fallow 43.5 percent of the cultivated area in 1900, a figure higher than the national average, which reflects the tougher constraints imposed by the lack of water. The adjusted impact would thus be 0.116 percentage points.

Lastly, table 7 confirms that the estimated effect of the commons on sustaining livestock remains virtually unchanged with respect to the estimation that also includes humid regions. Taking all these considerations together, the effect of common lands on labor productivity in dry regions turns out to be different from the impact estimated in the previous section. As shown in table 8, and assuming that no direct influence exists, the net effect of the stock of common lands on output per worker is now negative: a one percentage increase on the stock of common lands reduced output per worker by 0.06 percent. However, compared to the catastrophic admonitions of liberal thinkers, the efficiency loss is almost negligible. During the second half of the nineteenth

century, when most of the attack on the communal regime took place, an average of around 41.9 percent of the commons was privatized in these provinces (around 8.1 percent of the total land). Therefore, this process contributed to increasing Spanish agricultural productivity by only 2.5 percent.[48] It should also be stressed that, given that the estimated elasticity of the extension of cultivated land on the dismantling of the commons was hardly significant, this figure should be taken as a maximum. Furthermore, as explained in the preceding text, the growing accessibility of chemical fertilizers during the first decades of the twentieth century made the expansion of crop land possible, while this strategy was much less productive during the second half of the nineteenth century, and especially so in the poor soils of dry Spain. The analysis carried out in this section also suggests that the diverse persistence of common lands, higher in humid areas and lower in arid or semiarid regions, is partly explained by the different role that these collective resources played in these different contexts, thus suggesting that, given their respective constraints, farmers all over Spain behaved somewhat sensibly when deciding whether to preserve the commons or not. This is not to deny that other factors were also affecting the privatization process, especially the more unequal access to the land prevailing in Southern Spain (Beltrán Tapia 2015a).

Conclusion

The macroevidence presented here shows that Spanish peasants were not those "Goth and Vandals" subjected to an irrational communal culture as claimed by liberal advocates, but "civilized" farmers who knew how to adapt their agricultural practices to the constraints imposed by the wider economic, social, and environmental context. Common lands were a valuable resource because, apart from sustaining livestock density, they provided significant amount of fern-based organic manure, especially in humid Spain. Surely, putting more land under the plow at the expense of the commons increased the productivity of those spaces,[49] although this effect should have been even lower during the second half of the nineteenth century, where most of the attack on the common took place, due to the impossibility of supporting that extensification with chemical fertilizers. In any case, the net gains from privatization were small or even negative depending on the region analyzed. If we took into account the necessary costs of implementing the dismantling of the commons, especially high after 1855 when, by passing the so-called General Disentailment Act, the central state became involved in the process, those partial gains would become negligible or even negative.

48. This figure is obviously based on the total average, so in provinces where privatization was more intense, the estimated effect would be higher. However, even in Ciudad Real where 20.8 percent of the total provincial land ended up in private hands, the estimated effect would imply a 1.2 percent increase in labor productivity, which is still a hardly significant figure given the amount of land transferred.

49. However, as pointed out before, there are no reasons why the expansion of arable land could not have equally taken place under a communal regime, as the successful cases of Navarre, León, and Extremadura testify (see note 40 for references).

Among others, these costs include commissioning an inventory of these resources, surveying land values, organizing auctions, fencing plots, establishing a body of public agronomists and a police civil guard, together with the subsequent legal disputes that the process involved.[50] Furthermore, this article has only focused on the effect of the commons on agricultural productivity and has therefore left aside other important issues regarding the impact of privatization. In this regard, common lands contributed to complementing household and municipal incomes, thus positively enhancing the well-being of rural communities. Not only was the intensity of privatization negatively correlated with life expectancy and heights but also with schooling expenditures and literacy rates (Beltrán Tapia 2013, 2015b). Likewise, the social networks built around the use and management of these resources fostered social capital and facilitated the emergence of agricultural cooperatives during the first decades of the twentieth century (Beltrán Tapia 2012). The commons were thus an essential part of the agricultural system and the overall functioning of local communities. By only listening to the advocates of privatization and forgetting the numerous warnings about the potential consequences of this policy, the General Disentailment Act removed that component and greatly disturbed the whole system, especially given that no other institution was established to take over the functions that the commons fulfilled. State intervention only began to slowly take care of some of these dysfunctions during the first decade of the twentieth century but, by then, most of the damage was already done.

50. For a detailed description of these costs, see Simón Segura (1973), Iriarte (1998), Balboa (1999), and Jiménez Blanco (2002). Admittedly, by improving the public knowledge about Spanish natural resources and other potential positive externalities, all these expenses were not a complete waste of public resources.

APPENDIX A

SUMMARY STATISTICS: THE AGRICULTURAL SECTOR IN SPAIN, 1900–1930

Variable	*Obs.*	*Mean*	*St. Dev.*	*Min.*	*Max.*
Labor productivity	96	1.51	0.56	0.49	2.98
Commons	92	178,106	150,950	3,355	639,302
Arable land	92	412,159	257,046	19,859	1,142,318
Fraction fallow	98	0.35	0.18	0	0.68
Irrigation	98	28,663	30,949	0	151,336
Vines and olive trees	98	61,093	64,797	25	305,150
Pastures, forests …	90	440,050	262,269	37,975	1,398,256
Labor	98	85,074	38,142	17,555	206,193
Livestock	98	52,892.6	37,469.1	9,394.5	254,820.9
Chemical fertilizers	96	3,460	4,806	24	29,982
Capital	97	2,523.8	4,567.2	0.02	26,099.9
Literacy	98	60.5	20.9	25	100
Access to land	98	28.4	14.8	2	61
Urbanization	98	26.8	19.0	2.3	74.2
Rainfall	98	53.6	20.9	28.6	117.5
Rainfall (coef. var.)	98	0.78	0.16	0.52	1.23
Temperature	98	12.9	2.2	9.7	17.4
Ruggedness	98	33.1	14.4	9.4	75.2
Altitude	98	17.4	19.2	0	70.8
Population dispersion	98	4,799	4,615	695	20,210
Distance to Mad/Bcn	98	252.6	256.4	0	1742

Sources: See text. Livestock and capital are expressed in thousands of units.

Total Agricultural Output

Data on agricultural production is taken from Gallego (1993). This author worked out information gathered by the GEHR (1991) to provide direct estimations of real agricultural output in 1900 and 1930 (in pesetas).[51] This author provides disaggregated information on the different agricultural subsectors: agriculture, livestock, and forestry.

Common Lands

Given the hybrid nature that characterized the concept of the "commons" in nineteenth-century Spain, this paper, following Iriarte (2002), identifies common lands as those lands that were collectively managed at the local level, in spite of their ownership being collective, municipal, or public. Thus, rather than using the data offered by the GEHR (1994) for the availability of common lands in Galicia, this article employs the data provided by Gallego (2007), based on the estimates made by Artiaga and Balboa (1992), that takes into account not only public lands, but also those collectively owned. Unfortunately, no data for the three provinces in the Basque Country is available. See the introduction for a discussion of this assumption. Common lands are measured in hectares.

51. The methodology employed to deflate the figures of 1930 is explained in Gallego (1993: 266–67).

However, the communal regime in Spain involved two main types of access to the land: a direct but regulated access for all members of the community (*comunales*) or a temporary cession of user rights to particular individuals in exchange for a monetary income (*propios*). The importance of collective user rights is measured by the fraction of total uses that were being enjoyed collectively (GEHR 1991). In order to avoid unexplained short-run variations in the data, the average proportion of collective practices over the periods 1861–70, 1903–13, and 1920–32 is used to account for the years 1860, 1900, and 1930, respectively. However, as mentioned in the text, this variable turned out to be statistically insignificant in all specifications so it was dropped from the analysis.

Land

Apart from the commons, two other main types of land are considered. On the one hand, following GEHR (1991), the area of forests, pastures, and meadows (*montes, dehesas y pastos*) that was not held in common is calculated by subtracting the total productive land from the arable land and the commons (GEHR 1994: 136).[52] On the other hand, arable land is also taken from Gallego (1993) and the GEHR (1994). However, the intensity of cultivation depended on the amount of land left fallow and the possibility to resort to irrigation, so the importance of both elements is estimated.

The intensity of rotations is measured through the fraction of land left fallow when cultivating cereals and leguminous plants. While data for 1930 is the average from 1930–35, the figure for 1900 is the average from the periods 1886–90 and 1903–12 (GEHR 1991). Because no data is available for 1860, the data for the period 1886–90 is used instead. The only exception is the province of Alicante, which has no data for 1886–90, so only the information in 1903–12 is employed for both 1900 and 1860.

The amount of land irrigated is taken from contemporary governmental reports (Comisión de Estadística General del Reino 1859; Dirección General de Agricultura 1935; Junta Consultiva Agronómica 1904, 1918). Irrigated area for 1930 is calculated by summing up the area irrigated for each crop. Given the lack of information regarding irrigation in some crops in this date, information from 1935 is used. Because no distinction between dry farming and irrigation is made for some crops, various decisions have been made. Among the cereals, the agronomists in charge of the report Junta Consultiva Agronómica indicates that rice, millet (*panizo*), and pearl millet (*mijo*) were cultivated in irrigated land in the early twentieth century (Junta Consultiva Agronómica 1904: 14). Together with these two cereals, all *huerta* crops are assumed to be farmed in irrigated lands, while those fruit trees expected to be cultivated in dry farming (*secano*) are left out (*higuera*, *almendro*, *castaño*, *nogal*, or *algarroba*). Given that alfalfa, a fodder crop, "was almost exclusively cultivated in irrigated land" (Dirección General de Agricultura 1935: 398), it is also assumed to be irrigated. In the case of artificial pastures, the percentage under irrigation in 1922, the only date when the area devoted to them is split up into dry farming and irrigated, is applied to the area in 1935 (GEHR 1991).[53] Particular crops presenting suspicious

52. The total productive land is the result of deducting unproductive areas, such as marshlands, waterways, and the space occupied by cities, from the provincial area. These figures are taken from Gallego (1993).

53. In some cases, the information appearing in the governmental surveys is dubious. For instance, the area devoted to artificial pastures in Asturias in 1922 is only 175 (and not irrigated) when it was 11,175 and 10,539 in 1910 and 1930, respectively (GEHR 1991: 193). Cantabria's artificial pastures are also considered to be cultivated in dry farming (384). In the Basque country, the reports systematically show that all artificial pasture is not irrigated. Strange trends are also reported for Badajoz and Cádiz (250, 344).

figures have been corrected using data from 1930. The figures so calculated are consistent with information coming from regional studies when available. The numbers obtained have been corrected if major flaws were found by looking up at regional studies.[54] For instance, Garrabou and Pujol (1987: 46) reduce the extremely high figure of Lérida in 1900. Also, Pérez-Picazo (1997: 104), Sánchez-Picón (1997: 112), Lana (1999: 366), Gallego (1986b), and Ibarra and Pinilla (1999: 407) provide more accurate figures for Murcia, Almeria, Navarra, Logroño, and Zaragoza, respectively. The divergence between the figures for Cordoba in 1860 and 1900 is likely to be a typo, so the former has also been corrected. Likewise, given its subsequent evolution, Alicante and Albacete present an extremely high number in 1900, so the information in 1914 is used instead. A case in point is that of some Atlantic regions in 1860. The historical source assigns them with large amounts of irrigated area, especially devoted pastures. It seems, however, that some of them were not proper irrigation systems but areas that simply took advantage of the humid weather. Given that these areas do not generally appear as irrigated in the historical sources used for 1900 and 1930, a conservative approach has been taken regarding these regions and, subsequently, the figures for La Coruña, Lugo, Orense, and León have been corrected. Lastly, given its subsequent evolution, the source for 1860 is also likely to have overestimated the irrigated area in provinces such as Guadalajara, Palencia, Salamanca, Soria, Teruel, and Zamora, so the number in 1900 is used instead.

Labor Supply

The size of the agricultural working population is taken from different population censuses as collected by Rosés et al. (2010). A number of problems arise when dealing with the agricultural labor force. First, population censuses do not consistently distinguish between workers employed in agriculture, livestock breeding, or forestry. However, as mentioned in the text, this is not a problem when analyzing the whole agricultural sector. Second, the lack of consistency between censuses regarding female working population advices to rely only on male workers, a usual procedure both in Spanish and international historical literature (Erdozáin and Mikelarena 1999; Nicolau 2005; O'Brien and Prados de la Escosura 1992; Prados de la Escosura 2008 ; Van Zanden 1991). Consistency between censuses also recommends using data of 1877 instead of 1860. It seems, nonetheless, that the population distribution did not change much between 1860 and 1877, while there was enough variation between 1877 and 1900.

Livestock

Provincial numbers of horses, mules, oxen, donkeys, pigs, goats, and sheep have been taken from the livestock censuses published in 1865, 1905, and 1929 and compiled by the GEHR (1991).[55] These numbers have been transformed into a comparable figure using the live weights coefficients for each species provided by Flores de Lemus (1951) in 1917.[56] Although the size

54. I would like to thank M. J. Prados Velasco, J. A. Serrano, A. Sánchez Picón, D. Soto Fernández, and V. Pinilla for their feedback on this issue.

55. The livestock census of 1891 has being dismissed given its low quality. See GEHR (1991: 85) and Simpson (1995: 104). Livestock censuses are extensively reviewed in GEHR (1978, 1979). Although the different censuses included young animals, somewhat reducing their reliability, the different studies that have analyzed them have stressed their appropriateness to discern patterns and trends (GEHR 1978: 137; García Sanz 1994: 87).

56. This is a standard strategy in Spanish agrarian historiography. See, e.g., GEHR (1978: 150; 1991: 83), Gallego (1986a), García Sanz (1994: 91), and Simpson (1995: 103). Live weight is measured in tons using

of animals, as well as the fraction of them stabled, may have increased throughout the period, especially during the first decades of the twentieth century, these two variables are assumed to be constant due to the lack of information. Because livestock provided traction and fertilizer, this variable has been partitioned into two: draft energy and organic manure.

On the one hand, given that only horses, mules, oxen, and donkeys are able to be employed in agricultural tasks, their numbers have been transformed into potential draft power by applying the coefficients in Simpson (1987: 282).[57] On the other hand, the fertilizing capacity is measured based on the livestock total live weight calculated in the preceding text. Following the methodology employed in Gallego (1986a: 225) and Zapata (1986: 1538–39), total live weights are transformed into tons of manure depending on the intensity in the use of manure in each area.[58] In addition, in order to be able to compare the livestock fertilizer capacity with that of modern fertilizers, its actual fertilizing nutrients, in terms of phosphorus pentoxide (P_2O_5), nitrogen (N), and potassium oxide (K_2O), are computed for each type of animal. However, as mentioned in the text, multicollinearity problems prevent employing these series simultaneously in the regression analysis.

Chemical Fertilizers

Gallego (1993) provides a complete picture of the provincial consumption of modern fertilizers in 1932. It can be safely assumed that, for 1860, apart from the early diffusion of guano in a few Mediterranean provinces (see the following text), no chemical fertilizers were employed in Spanish agriculture. The situation in 1900 is somewhat different. Although their diffusion had been very slow in general terms, the use of these inputs had already progressed in several regions, especially in the Mediterranean coast and the Ebro valley (Gallego 1993). Although no information at the provincial level is available for 1900, a Spanish agronomist provides an account of the consumption of chemical fertilizers by province in 1907 and 1908 (Alonso de Ilera 1909). Given that the use of these inputs at the national level increased between 1900 and 1907/08 (Gallego 1986a: 223), the provincial figures are adapted accordingly assuming that the relative distribution between provinces did not change between those dates. The figures obtained are mostly consistent with the qualitative assessments about the importance of the use of modern inputs in each province given by agronomists in several reports conducted by the central state (Junta Consultiva Agronómica 1891, 1904).[59] Lastly, following Gallego (1986a: 224), these gross figures are converted into equivalent nutrient units of nitrogen (N), phosphorous (P_2O_5), and potash (K_2O).[60]

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the following coefficients: horses (0.326), mules (0.326), donkeys (0.172), oxen (0.371), sheep (0.030), goats (0.034), and pigs (0.077).

57. The draft energy coefficients are the following: 1 for mules, 0.75 for horses, 0.67 for oxen, and 0.47 for donkeys. Kander and Warde (2011: 23) employ slightly different coefficients for horses (1) and donkeys (0.33) reflecting perhaps their relative performance in a different environmental context.

58. Given that there is data on the actual manure consumption in 1919, the intensity on the use of manure is calculated by putting that figure in relation to the importance of livestock in that date. Logroño, Tarragona, and Valencia show dubious figures, so they are calculated as the average of the neighboring provinces.

59. Taking into account that two provinces are missed due to the lack of data (Baleares and the Canary Islands), adding up the provincial consumption so computed (122,203 tons) is relatively similar to the national figure (143,000 tons) estimated by Simpson (1995: 120–23).

60. A standard procedure widely employed in the literature See Hayami and Ruttan (1985) and Craig et al. (1997).

However, the assumption that there was no consumption of modern fertilizers in 1860 may be misleading because guano was relatively relevant in some areas during the second half of the nineteenth century (ibid.: 174). Guano was intensely used in paddy fields and orange grooves in Valencia, a region that, together with Britain, pioneered in importing guano from Africa and South America (Simpson 1995: 102).[61] Data on guano imports from Catalonia and Valencia is taken from Porqueres (1975).[62] Although no other data is available about other provinces, the bias imposed by this lack of information is negligible due to the fact that these two regions consumed 97 percent of the total Spanish imports of this fertilizer in 1862/63, a figure that had hardly decreased by 1900.[63] Given the availability of data and the need to prevent unexplained short-run variations, the average figures for the periods 1862–65 and 1895–1900 are employed. The total regional imports are allocated among each province using their relative importance in the consumption of chemical fertilizers in 1900. Finally, in order to homogenize these figures with those of chemical fertilizers, the actual chemical content of Peruvian guano is considered: nitrogen (12.3 percent), phosphorus (9.5 percent), and potassium (2.5 percent).[64] In any case, the results reported in the text remain unchanged regardless whether the series on artificial fertilizers contains guano or not.

Modern Machinery

A complete census of agricultural machinery, providing quantitative information about all sorts of different machines, is only available for 1932. Given that tracing back all this information for the previous periods is almost impossible, only three types of machinery are used as proxies for the introduction of mechanical innovations in cereal farming: modern plows, threshing machines, and tractors.[65] Given that the historical sources do not mention the presence of these innovations in any province around 1860, a value of 0 is assumed for these variables at that date. Estimations for 1900 are based on the information provided by agronomists working in each province at the end of the nineteenth century (Junta Consultiva Agronómica 1891).[66] This qualitative and quantitative information is contrasted with regional figures provided in different studies and corrected if necessary.[67]

First, except in some regions, modern plows were hardly used in 1900 (Simpson 1987: 280). Bearing this in mind, the qualitative assessments provided by agronomists point to whether

61. The first shipment of guano arrived in Valencia in 1844, only four years later than to a British port (Mateu 1993: 53).

62. I am thankful to Domingo Gallego for kindly sharing this document.

63. Around 23,098 tons of guano a year was imported into these two regions between 1862 and 1865. These figures rose during the second half of the nineteenth century and began to decrease in the 1890s to become unimportant in the first decades of the twentieth century (imports between 1895–1900 averaged 17,666 tons a year).

64. This information is available online from the Oregon State University Extension Service at http://extension.oregonstate.edu/lane/sites/default/files/documents/lc437organicfertilizersvaluesrev.pdf.

65. Modern plows refer to the sum of different types of moldboards and multiple-furrow plows. They not only achieved more depth but also turned the soil, thus bringing nutrients to the surface (Simpson 1987: 280).

66. The situation in 1890 is representative of 1900 because, apart from involving almost negligible stocks of modern machinery, imports of machinery were only significant between 1875 and 1886 because the end-of-the-century crisis and subsequent protectionism dramatically cut back imports of modern inputs (Gallego 1986a: 209; Martínez Ruiz 2000: 46).

67. Gallego (1986b), Pinilla (1995), Simpson (1987, 1996), Fernández Prieto (1997), Martínez Ruiz (2000).

or not this new equipment was completely ignored, known by a minority, and relatively or widely spread. In order to transform this qualitative information into figures, each province is classified in one of those four groups. The estimated number of modern plows is then computed by assuming that, accordingly, each group had 0, 2.5, 5, or 10 percent of the plows existent in 1930.[68]

Second, regarding more advanced agricultural machinery, it can be safely assumed that it was not employed in 1860.[69] Although their importance at the national level was still anecdotal by 1900, the diffusion of labor-saving technology had nonetheless progressed in a few provinces, especially in Cádiz and Seville (Martínez Ruiz 2000: 23–24, 49).[70] Information for 1900 is mostly qualitative but the sources sometimes stated the number of those apparatus that agronomists knew to be operating in a particular province. The total national figure obtained by this procedure is 177. Given that the total number of *locomóviles*, part of the "set" including a thresher machine, imported between 1862 and 1893 was 310, and that not all of them were likely to be operating in 1890, this figure is plausible (45–46).[71] Additional corrections have nonetheless been made. The original source in 1891 points to the existence of numerous thresher machines in the province of Barcelona. Given that Cádiz and Seville, with 30 and 90 thresher machines, respectively, were the provinces where this technology was more widespread, a figure of 30 apparatuses is assumed. Likewise, the source indicates the presence of "some" thresher machines for rice in the province of Valencia in 1891. These "some" is assumed to be 3.[72]

Third, the number of tractors is considered in order to account for the motorization of agriculture. Martínez Ruiz (2000: 114) shows that the first tractors arrived to the peninsula in 1902, so it can be safely assumed that tractors were unknown in 1860 and 1900. Complete quantitative information regarding tractors is available for 1930 (Gallego 1993).

Lastly, once a series for each of these inputs is obtained, they are collapsed together under the category of modern machinery by employing average prices provided by Martínez Ruíz (2000: 90, 144).

Other Variables

Urbanization is measured as the proportion of population living in cities bigger than 5,000 inhabitants and the gross value added by nonagricultural activities per capita, respectively (Rosés et al. 2010; Tafunell 2005). Literacy rates are taken from Núñez (1992). Inequality in access to the land is measured through the fraction of landowners over active agricultural population (Dirección General del Institutito Geográfico y Estadístico 1863, 1922). Because data on landownership is only available for 1860 and 1920, linear interpolation is employed to estimate the figure for 1900. For 1930, the information on 1920 is used.

68. When there is some doubt in ascribing one province between two groups, an average is employed.

69. The first tests applying steam engines to agriculture in Spain were carried out at the end of the 1850s and throughout the 1860s (Cabral 2000; Martínez Ruíz 2000: 28).

70. In this regard, while only 2.5 percent of the national cereal output was threshed using steam power, the province of Seville threshed 19.7 percent of its cereals by this means (Martínez Ruiz 2000: 62). By 1932, the national figure had grown to 22.3 percent (74).

71. It should be noted that *locomóviles* and thresher machines were purchased together as a "set." In this regard, Clayton, one of the British companies selling this machinery in Spain, exported the same number of threshing machines as "locomoviles" between 1861 and 1891 (Martínez Ruiz 2000: 45).

72. A different series was computed grouping threshing machines and corn shellers together but the results of the empirical analysis remain unchanged.

Regarding the time-invariant factors, average rainfall, rainfall variation, and average temperature come from long-term series data (Goerlich 2010). Likewise, while the ruggedness index quantifies terrain irregularity by comparing the altitude between neighbouring cells using GIS, altitude is measured as the fraction of provincial land over 1,000 meters (Goerlich and Cantarino 2011; INE 2000). The population settlement pattern refers to the number of hectares per parish (Comisión de Estadística General del Reino 1860). Lastly, distance to big cities, Madrid, Barcelona, or Bilbao, is computed as the minimum geographical distance from the provincial capital to any of those cities.

APPENDIX B

TABLE 1.B. *Commons and agricultural productivity, 1900–1930*

	Dependent variable: Agrarian output / Active agricultural population					
	OLS			*IV*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Commons	0.02	0.03	0.07*	0.02	0.03	0.09*
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
Arable land	0.18**	0.19**	0.30***	0.18**	0.19**	0.30***
	(0.08)	(0.08)	(0.10)	(0.07)	(0.08)	(0.08)
* % fallow	−0.34**	−0.33**	−0.26	−0.35**	−0.34**	−0.25*
	(0.15)	(0.17)	(0.16)	(0.14)	(0.15)	(0.14)
* % irrigated	0.07	0.04	−0.24	0.06	0.04	−0.28
	(0.22)	(0.22)	(0.26)	(0.23)	(0.22)	(0.22)
Pastures, forests …	−0.08**	−0.07*	−0.05	−0.08**	−0.07**	−0.03
	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)
Livestock	0.31***	0.29***	0.30***	0.31***	0.29***	0.31***
	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.05)
Chemical fertilizers	0.11***	0.11***	0.09***	0.11***	0.11***	0.09***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
Modern machinery	0.02*	0.01	0.01	0.02**	0.02	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Urbanization		0.00	0.01***		0.00	0.01***
		(0.00)	(0.00)		(0.00)	(0.00)
Literacy		0.00	−0.01***		0.00	−0.01***
		(0.00)	(0.00)		(0.00)	(0.00)
Access to land		0.00	0.00		0.00	0.00
		(0.00)	(0.00)		(0.00)	(0.00)
d_1930	−0.11	−0.10	0.12	−0.11	−0.11	0.17**
	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)	(0.08)
Controls	No	No	Yes	No	No	Yes
Observations	89	89	89	89	89	89
R-squared	0.75	0.76	0.85	0.75	0.76	0.85

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level. All input variables are divided between the active agricultural populations and expressed in natural logs. The instruments are the lagged values of the endogenous variables (commons, urbanization, literacy, and access to land). Controls include temperature, rainfall, rainfall interacted by its standard deviation, ruggedness, altitude, population settlement pattern, distance to big cities, and a coastal dummy.

TABLE 3.B. *Commons and livestock*

	Dependent variable: Livestock (live weight)					
	OLS			*IV*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Commons	0.18***	0.24***	0.20**	0.23***	0.28***	0.24***
	(0.05)	(0.06)	(0.09)	(0.05)	(0.06)	(0.09)
Pastures, forests …	0.27***	0.29***	0.37***	0.28***	0.28***	0.41***
	(0.06)	(0.06)	(0.08)	(0.06)	(0.06)	(0.08)
Arable land	0.38***	0.40***	0.27**	0.38***	0.37***	0.12
	(0.10)	(0.09)	(0.13)	(0.10)	(0.09)	(0.14)
* % fallow	− 0.15***	− 0.16***	− 0.07	− 0.15***	− 0.16***	− 0.04
	(0.03)	(0.03)	(0.05)	(0.03)	(0.03)	(0.04)
* % vines and olive trees	− 0.10***	− 0.12***	− 0.14***	− 0.09***	− 0.12***	− 0.12***
	(0.03)	(0.04)	(0.05)	(0.03)	(0.04)	(0.04)
Chemical fertilizers	− 0.11*	− 0.12*	− 0.04	− 0.11**	− 0.12**	− 0.04
	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)
Modern machinery	0.00	− 0.01	− 0.01	0.00	− 0.01	− 0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
Urbanization		0.01**	0.01**		0.01***	0.01***
		(0.00)	(0.00)		(0.00)	(0.00)
Literacy		0.00	0.01		0.00	− 0.00
		(0.00)	(0.00)		(0.00)	(0.01)
Access to land		0.17	− 0.14		− 0.07	− 1.16*
		(0.37)	(0.49)		(0.40)	(0.65)
d_1930	0.65***	0.66***	0.42	0.65***	0.70***	0.63**
	(0.21)	(0.23)	(0.28)	(0.19)	(0.21)	(0.29)
Controls	No	No	Yes	No	No	Yes
Observations	89	89	89	89	89	89
R-squared	0.56	0.59	0.72	0.55	0.59	0.69

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level. All variables expressed in natural logs. The instruments are the lagged values of the endogenous variables (commons, urbanization, literacy, and access to land). Controls include temperature, rainfall, rainfall interacted by its standard deviation, ruggedness, altitude, population settlement pattern, distance to Madrid or Barcelona, and a coastal dummy.

TABLE 5.B. *Commons and agricultural productivity in arid Spain, 1900–1930*

	Dependent variable: Agrarian output / Active male agricultural population					
	OLS			*IV*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Commons	− 0.04	− 0.02	0.06	− 0.05	− 0.04	0.06
	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.05)
Arable land	0.60***	0.60***	0.62***	0.61***	0.59***	0.63***
	(0.14)	(0.15)	(0.17)	(0.13)	(0.13)	(0.14)
* % fallow	− 0.72***	− 0.68***	− 0.58***	− 0.72***	− 0.66***	− 0.59***
	(0.21)	(0.24)	(0.20)	(0.19)	(0.21)	(0.16)
* % irrigated	0.66***	0.66***	0.20	0.74***	0.72***	0.24
	(0.24)	(0.24)	(0.26)	(0.24)	(0.23)	(0.21)
Pastures, forests …	− 0.02	0.01	− 0.01	− 0.01	0.01	− 0.01
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Livestock	0.22***	0.17***	0.26***	0.23***	0.17***	0.26***
	(0.06)	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)
Chemical fertilizers	0.10***	0.09***	0.08***	0.10***	0.09***	0.08***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Modern machinery	0.01	0.01	0.00	0.01	0.01	− 0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Urbanization		0.00	0.01***		0.00	0.01**
		(0.00)	(0.00)		(0.00)	(0.00)
Literacy		0.00	− 0.00		0.00	− 0.01
		(0.00)	(0.00)		(0.00)	(0.01)
Access to land		0.00	0.00		0.00	− 0.00
		(0.00)	(0.00)		(0.00)	(0.00)
d_1930	− 0.17*	− 0.19*	− 0.00	− 0.18**	− 0.20**	0.08
	(0.09)	(0.10)	(0.17)	(0.09)	(0.09)	(0.18)
Controls	No	No	Yes	No	No	Yes
Observations	77	77	77	77	77	77
R-squared	0.80	0.81	0.87	0.79	0.81	0.86

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level. All input variables are divided between the active agricultural populations and expressed in natural logs. The instruments are the lagged values of the endogenous variables (commons, urbanization, literacy, and access to land). Controls include temperature, rainfall, rainfall interacted by its standard deviation, ruggedness, altitude, population settlement pattern, distance to big cities, and a coastal dummy.

TABLE 7.B. *Commons and livestock in arid Spain*

	Dependent variable: Livestock (live weight)					
	OLS			*IV*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Commons	0.10*	0.12*	0.14	0.11**	0.14**	0.23**
	(0.05)	(0.06)	(0.09)	(0.06)	(0.07)	(0.09)
Pastures, forests …	0.28***	0.37***	0.25**	0.28***	0.35***	0.14
	(0.08)	(0.09)	(0.10)	(0.08)	(0.08)	(0.13)
Arable land	0.47***	0.46***	0.33**	0.46***	0.45***	0.10
	(0.11)	(0.10)	(0.13)	(0.11)	(0.10)	(0.19)
* % fallow	− 0.07*	− 0.05	− 0.03	− 0.08**	− 0.06	0.04
	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)
* % vines and olive trees	− 0.07*	− 0.05	− 0.06	− 0.06*	− 0.05	− 0.06
	(0.04)	(0.05)	(0.05)	(0.03)	(0.04)	(0.05)
Chemical fertilizers	− 0.09	− 0.06	− 0.01	− 0.09	− 0.07	− 0.07
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Modern machinery	0.01	− 0.00	− 0.00	0.01	− 0.00	− 0.00
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Urbanization		0.00	0.01		0.00	0.02***
		(0.00)	(0.00)		(0.00)	(0.00)
Literacy		0.01**	− 0.00		0.01*	− 0.03**
		(0.00)	(0.01)		(0.00)	(0.01)
Access to land		− 0.10	− 0.09		− 0.28	− 0.37
		(0.43)	(0.44)		(0.48)	(0.68)
d_1930	0.51**	0.25	0.51	0.52**	0.31	1.44***
	(0.25)	(0.29)	(0.35)	(0.23)	(0.28)	(0.54)
Controls	No	No	Yes	No	No	Yes
Observations	77	77	77	77	77	77
R-squared	0.54	0.59	0.75	0.54	0.58	0.69

Robust standard errors between brackets; *, **, or *** denotes significance at 10, 5, or 1 percent level. All variables expressed in natural logs. The instruments are the lagged values of the endogenous variables (commons, urbanization, literacy, and access to land). Controls include temperature, rainfall, rainfall interacted by its coefficient of variation, ruggedness, altitude, population settlement pattern, distance to bid cities, and a coastal dummy.

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