Explaining vineyard specialization in the province of Barcelona (Spain) in the mid-19th century

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Main historical features of the Catalan vineyard specialization

- There is a strong consensus among economic historians that vineyard specialization was a key factor in the relatively early beginning of industrialization and modern economic growth in Catalonia (Spain).
- Brandy and wine exports deepened regional specialization and offered an increasing number of working people a way to earn their living, thus avoiding the Malthusian fate typically associated with fast population growth.
- It started very early, in the 17th century, and advanced slowly but steadily during the 18th and 19th centuries, until the phylloxera crisis (1867-1890) which was eventually overcome.
- Wine growing was always combined with cereals and other crops in Catalan agrarian landscapes, which were hardly ever devoted to monoculture.
- Vineyard specialization remained locally diverse, and sometimes changed location over its long history.

A historical model to explain wine specialization in the Barcelona province in 1860

- It is now time for a deeper exploration.
- The multidisciplinary team of the research project SEJ2006-15108-C02-01/GEOG has started to build and assess an econometric model to explain the local differences in vineyard or cereal specialization in the nearly 300 municipalities of the province of Barcelona in 1860.
- This is a historical model that does not aim at explaining any type of vineyard specialization, but the role played by a specific set of factors throughout the long-lasting spreading of vines in the province of Barcelona up to 1860.
- From a historical point of view we distinguish two main driving forces: 1) the «Boserupian» push of population increase and 2) the demand pull of a «Smithian-type» of growth. Both operate in an already «organic» agrarian economy.
- The combined outcome of these two main drivers of vineyard specialization became locally and temporarily diverse, according to the role played by two other conditional factors that modulated their territorial impact: 3) the agro-ecological and 4) socio-economic land endowments (Figure 1).

III. Assessing the degree of coverage of cereal consumption by local production, and wine growing as the main driving force behind agrarian specialization (and we are going to present only maps)
Correlation between % of cropland devoted to vines or cereals: $R^2 = 0.9181$

The role of natural endowment

Water stress (subtracting to the rainfall from January to June the Thornwaite Potential Evapotranspiration (PET))

Municipal vineyard specialization in 1858

% of slope

The role of natural endowment

Agrological aptitude of soils, combining slope and rainfall

Frost risk
IV. Explaining the regional pattern of vineyard specialization

- In this (second) test we check the explanatory capacity of vineyard specialization by considering three main sets of variables: 1) population densities or increases; 2) terrestrial time-distances from seaports, and 3) agro-climatic endowment for wine growing:

\[ FRWI = P1 \cdot PRVI + POPDEN; W1 \cdot HABTAIMDIS; W2 \cdot WTSTR; W3 \cdot SLOP; W4 \cdot FRSTRIS; (2) \]

- PRVI: % of cropland devoted to vineyards
- POPDEN: population density in 1860; WCPDEN: population density weighted by contiguous municipalities in 1860; and IPPOPGR: population growth rate prior to 1718-1860
- HABTAIMDIS: the time-distances to the nearest harbour in hours following the existing roads and ways before the railways (1824-38)
- WTSTR: water stress during the growth period of wheat from January to June, that has been calculated subtracting from the mean monthly rainfall in mm the Thornwaite Potential Evapotranspiration (PET)
- SLOP: municipal mean slope of lands in %
- FRSTRIS: the average number of months with a mean minimum temperature below 7°C, which entails a frost risk

All results are significant and signs are as expected, except in (a) where population density appears negatively linked to vineyard specialization (and the check for spatial autocorrelation reinforces that). Not discarding the localities with higher populations densities, whose economy was dominated by industrious activities, may render negative the correlation.

The first way round to overcome this is: using the population growth rate for the previous period 1718-1860, like in (b), (c) and (d): the sign turns out to be positive and the overall significance is higher.

A second way round is leasing the sample. If population densities greater than 70 inhab./km² are omitted as in (c) and (d), all the signs remain as expected and the significance increases again, albeit within smaller samples. All the agro-ecological variables give the expected signs, meaning that winegrowing was carried out by poor peasants on poor, sloping and drier soils (while grain was sown on better lands by wealthy landowners). Frost risk limited the spread of vines in the northern and colder areas of the province.

Finally, the commercial push driving forces is measured through the hourly-distances either to Barcelona or the nearest harbour, according to time-tables published in 1824-1838 before the railways. With distances ranging up to 33 hours, the mean time-distance was 15.9 h to the nearest harbour and 11.7 to Barcelona. The variable shows the expected negative impact, thus confirming the high relative cost of transporting bulky and low value-to-weight commodities over terrestrial short distances in an already extensive economy.
V. Conclusions and prospects for future research

- The overall outcome suggests that the direct pulling force from market incentives had to combine with agro-ecological land endowment in vineyard or grain specialization, together with the pushing effect exerted by previous population growth, in order to jointly move the agrarian system towards the specialization degrees in vines attained in 1860 in the province of Barcelona.

- The adjusted R² levels—from 0.608 to 0.826—are very successful bearing in mind that the intention was merely to establish the weight of this driving forces that jointly set up the context in which economic agents took the decision of planting (or not) more and more vines.

- However, the explanatory power of this set of environmental, commercial and demographic variables can still be enhanced, because the model has had to omit for the moment another important socio-institutional factor due to the lack of statistical data: the inequality of land ownership.

- This significant results can also be seen as an indirect confirmation of the Heckscher-Ohlin theoretical explanation of commercial specialization, by means of the relative factor endowments of land and labour. However, our main aim is to understand how these different land-labour ratios historically arose at a local level in the Western Mediterranean bioregion over a long historical period.

IV. Explaining the degree of coverage of cereal consumption by locally grown production

- we assembled a set of 285 observations which we will try to explain following this model:

\[

d Pract: \text{PERCOV} = a_1 + a_2 \cdot IRHAPC + a_3 \cdot DFHAPC + a_4 \cdot WTSTR + a_5 \cdot SLOF + \varepsilon (1)
\]

- PERCOV: % of coverage of human-edible cereal consumption by local production

- IRHAPC and DFHAPC: number of hectares per capita sown with grain in each municipality, distinguishing whether they were irrigated (IR) or dry-farming (DF)

- WTSTR: water stress during the growth period of wheat from January to June—this is calculated subtracting from the mean monthly rainfall in mm the Thornwaite Potential Evapotranspiration (PET)

- SLOF: municipal mean slope of lands in %

Table 5. Land allocation and land suitability for grain cultivation as the principal determinants of the degree of coverage of cereal consumption by local production in the municipalities of the province of Barcelona towards 1860

<table>
<thead>
<tr>
<th></th>
<th>B1</th>
<th>B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>38.21***</td>
<td>38.28***</td>
</tr>
<tr>
<td>Total hectares per capita sown with cereals (CHAPC)</td>
<td>286.72**</td>
<td>281.25**</td>
</tr>
<tr>
<td>Irrigated total hectares per capita sown with cereals (CHAPC)</td>
<td>-49.98*</td>
<td>-49.98*</td>
</tr>
<tr>
<td>Nonirrigated hectares per capita sown with cereals (NHAPC)</td>
<td>2.25</td>
<td>2.25</td>
</tr>
<tr>
<td>Dry-farming hectares per capita (DFAPC)</td>
<td>-1.85</td>
<td>-1.85</td>
</tr>
<tr>
<td>Irrigated hectares per capita (IHAPC)</td>
<td>302.77**</td>
<td>302.77**</td>
</tr>
<tr>
<td>Dry-farming hectares per capita (DFAPC)</td>
<td>172.26</td>
<td>172.26</td>
</tr>
<tr>
<td>Irrigated nonirrigated hectares per capita (IHAPC)</td>
<td>-0.51</td>
<td>-0.51</td>
</tr>
<tr>
<td>Dry-farming nonirrigated hectares per capita (DFAPC)</td>
<td>-1.85</td>
<td>-1.85</td>
</tr>
<tr>
<td>Mean water stress from January to June in mm (WTSTR)</td>
<td>0.24***</td>
<td>0.24***</td>
</tr>
<tr>
<td>Mean slope of lands in % (SLOF)</td>
<td>-1.17</td>
<td>-1.17</td>
</tr>
<tr>
<td>Mean slope of lands in % (SLOF)</td>
<td>-0.52***</td>
<td>-0.52***</td>
</tr>
<tr>
<td>Mean slope of lands in % (SLOF)</td>
<td>-1.44*</td>
<td>-1.44*</td>
</tr>
<tr>
<td>Number of observations</td>
<td>385</td>
<td>385</td>
</tr>
</tbody>
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The estimated coefficients give the expected signs, and the adjusted R² of 0.77 is significant enough. So, the need to import different amounts of wheat was inversely related to the quantity and quality of cropland devoted to cereal cultivation by the local population. Slope and water stress also played a role. But how can the different institutionalized intensities of specialization in vine cultivation be explained?