Exploring resilience and competitiveness of wine estates in Languedoc-Roussillon in the recent past: a multi-level perspective

Maddy Tintinger, Nina Graveline

Exploring Resilience and competitiveness of wine estates in Languedoc-Roussillon in the recent past: a multi-level perspective

Maddy Tintinger[1], Nina Graveline[1]

[1] *UMR Innovation, INRAE Montpellier, France*

***Corresponding author:** nina.graveline@inrae.fr

Keywords: competitiveness, resilience, yield, price, climate change.

Abstract:

The Languedoc-Roussillon, south west Mediterranean, wineries are facing a decline in wine yields particularly Protected Geographical Indication (PGI) wine yields. Climate change is one of the many factors and its effect is also expected to increase in the future. There is also structurally a large heterogeneity of yield profiles among terroirs, varieties and strategies of winegrowers. To investigate the link between yield, competitiveness and resilience multiple approaches have been combined in an observatory of wine yields and competitiveness for Pays d'Oc (PGI) wines. The resilience concept can be approached by the operational tool of trajectories. The present work aims at analyzing individual trajectories of PGI wine growers' to characterize the resilience of these farming systems. By analyzing individual data (toll data) of wine production over 9 years we suggest a methodology to represent their inter annual trajectories.

Introduction:

Climate change is already affecting wine production in many places in the world. While the impacts of climate change are numerous (quality, diseases, increasing extreme climatic risks) the yield remains one of the important concerns to secure the revenues of the growers (Van Leeuwen & Darriet, 2016). Confirmed and long lasting decrease of yields threatens estates and the competitiveness of the wine products for the downstream value chain.

Maintaining the competitiveness over the long term can be assumed to be one of the key factors for being adapted to global changes and climate changes in particular. To embrace the long-term time integration performance of a company or a sector, the resilience concept is interesting to express "the capacity of social, economic and ecosystems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure as well as biodiversity in case of ecosystems while also maintaining the capacity for adaptation, learning and transformation" (IPCC, 2022). Individual performance of wine estates is obviously driven by the capacity to – at least- maintain yields whatever the economic model of the producer is : grape grower, wine producer of non GI or GI wines – PDO[1] or PGI). Also, yields are a key determinant of the competitiveness of PGI wines on the markets: constant volumes are necessary to ensure the sustainability of commercial relations each year. Past experiences have shown that exceptional yearly drops in the volumes of PGI Pays d'Oc supplied on international markets have implied a durable loss of market share and consequently drops in the prices for producers[2]. Other components then yield are key for the individual competitiveness of vineyards that are relative to the management and economics of the vineyard. These characteristics include ensuring correct prices and reliable and diversified markets for their wine, diversifying their products or activities, enlarging or reducing the area they crop.

[1] Protected Denomination of Origin

[2] Oral communication, experts of the Pays d'Oc Wine value chain

Different long-term strategies can be distinguished by setting different levels in the essential components that are mean yields, market positioning (GI and ecologic labels) & prices and areas. The specific question we investigate here is whether we can identify specific trends in wine production trajectories that inform about climate change adaptation or at least resilience?

In a previous work (Tintinger, 2020) that analysed FADN panel data (Farm Accountancy Data Network) we showed that the net margin is strongly correlated to yield for PGI wines. Said differently, the net margin of estates specialized in PGI is particularly sensitive to yield declines. We also showed that price evolutions have compensated the effect of yield losses for the majority of types, but the remaining question is *for how long*?

To investigate these adaptation mechanisms two options are possible: resorting to farmer surveys or analysing existing data sets after combining them. The two last years complicated severely the field work and hampered field surveys, before all during lockdowns in 2020. While surveys enable to design tailored questionnaires, existing and official data bases have the advantage to be quality checked and enable to have panel data i.e. observations that are repeated for multiple years. For the study of the dynamic evolution of farming systems addressing concept such as resilience or trajectories, panel data bases are a precious source of information. For the reasons cited above, in this work, we developed an approach based on combining different datasets that enable to have a good picture of wine production from 2012 to 2020 in the former region of Languedoc-Roussillon.

After presenting the method and the region under study we give some insights on selected results.

Materials and methods

Wine production at the individual level is characterized by areas, quantity produced and producer prices per type of wine. A necessary refinement is to look at the diversification of wines types, at least between PGI and PDO – characterized by lower yields, nearly half as much as PGI, and higher prices. An important share of winegrowers crop both PGI & PDO, because they are differently exposed to risk and are a good complement.

We characterize individual trajectories by assessing the 9-year evolution of the key variables: area cropped with wine, yield (quantity produced by hectare), producer prices. The evolution can be positive (increase) or negative (decline) and is assumed to qualify different types of evolutions of the performance of estates. For instance, those that support decreasing yields in PDO & PGI wines and decreasing prices, those that support increasing yields in PGI & PDO and increasing prices etc. Allocating each individual estate in one of these trajectories should inform us about the importance (number) of estates or of areas experiencing each trend. The next step is to characterize these estates with other variables (terroir or market strategies) to investigate potential drivers or explicative variables of these estate trajectories.

The different data sources and bases will be presented next. The overview of the connexion of the data are presented on Figure 1 and show that multiple scales can be investigated. Figure 1 provides an overview of the database and the connections. Three different scales are distinguished (i) the farm scale (the company) sometimes related to a production union (coop), (ii) the markets are the scale at which prices have been collected in this study and (iii) the territory is the scale of the biophysical information (climatic information).

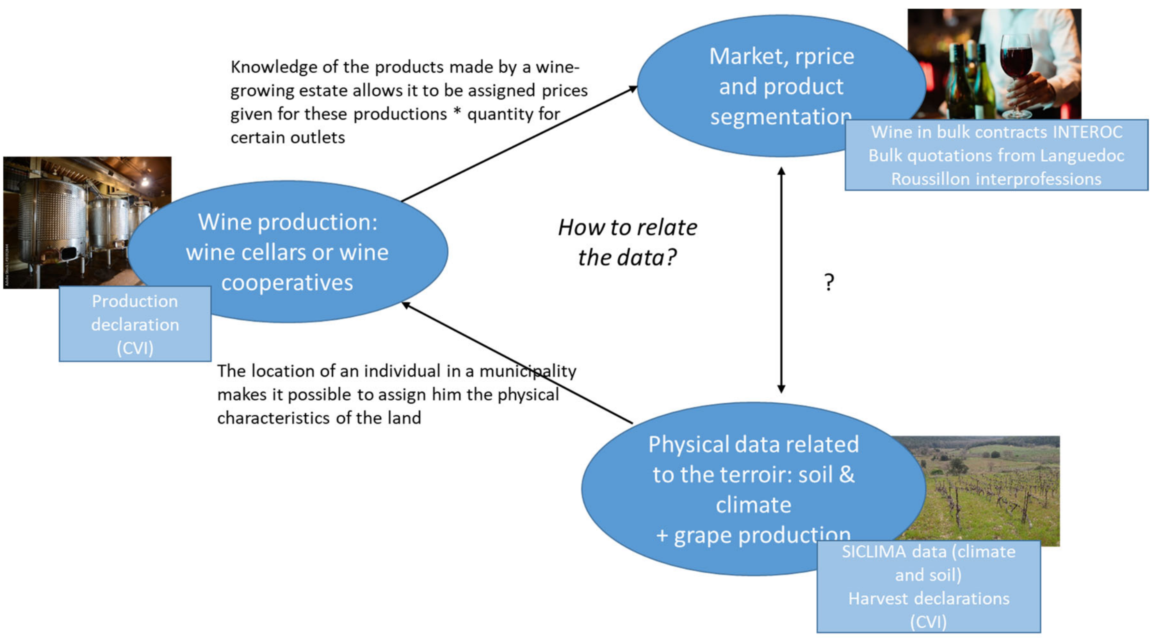

Figure 1. Overview of the different data base and the connexion

The database has been developed in the perspective of multiple analysis within the framework of an observatory of wine competitiveness and yields. Therefore, no unique scale is chosen. However, in this work the farm scale is considered.

The main source of data of this work is the CVI ("Casier Viticole Informatisé") which is collected by the toll to be able to monitor the individual wine production. The CVI entails different databases, but here we use the Harvest Declaration ("Déclaration de Récolte") and the Wine production Declaration ("Déclaration de production". This data is obtained after undergoing a specific process of state secured data because personal data is included in this base. Prices are not included in these databases, which is one limitation for our approach, which we raise partially.

The climatic data characterizes all years with 8 different variables: Huglin index (thermal index), Hot days and Very hot days, Frost days, Frequence and Severity of Late frost, Severity of Heat stress, water balance. This data is obtained from Fernandez-Mena et al. (in prep) who process SAFRAN data (Vidal et al., 2010) and soil water holding capacity (Styc, Lagacherie, 2019) at a grid level of 8km × 8 km. The limitation of this data is that the pixel of 64km² is gross considering the variability of the slopes, landscapes, environment of the Languedoc terroirs. However, no systemic climate data exist at a thinner pixel. This grid is then intersected with the municipalities in order to be able to associate climate data to vineyards/farms for which the municipality is known. The limit is that the municipality of the farm correspond to its declared economic siege which does not fit necessarily with the entire parcels that the estate crops. The diversity of the parcels conditions can be an important component of vineyard resilience or way of hampering specific climatic conditions and will be overlooked here.

Prices are characterized by an important number of different sources, because no existing uniform database exist. Data is collected with inter-branch organisations: INTEROC, CIVL, CIVR, INTERRHONE and INTERVINS Sud-Est. Bottle prices have been collected thanks to FranceAgriMer Data per GI. We estimate the bottle prices when FranceAgriMer does not collect the data. We estimate the bottle price by multiplying the bulk price by 2.2 if the product is PDO, 2.1 if the product is PGI and 1.8 if the product is Pays d'Oc PGI.

However, for some market segment we were not able to collect any price information. To estimate missing producer prices and also to address the question of how prices are determined some interviews were conducted with experts in the field and references in the literature were looked for. A wine merchant, a researcher, a wine professional organism manager, and a wine broker were interviewed beginning 2022. From these interviews the following assumptions were taken: Bulk price is higher when vintage has a low harvest, and at reversely, is lower when the harvest is high. Increase in price can cause a loss of market share and lower price limit investment at farm level. Price needs to be stable to maintain market share and the possibility to invest.

Results and discussion:

1) Evolution of the competitiveness 'components and heterogeneity at farm level : yield, area and price

The general trends can be observed on Figure 2 for the different key variables.

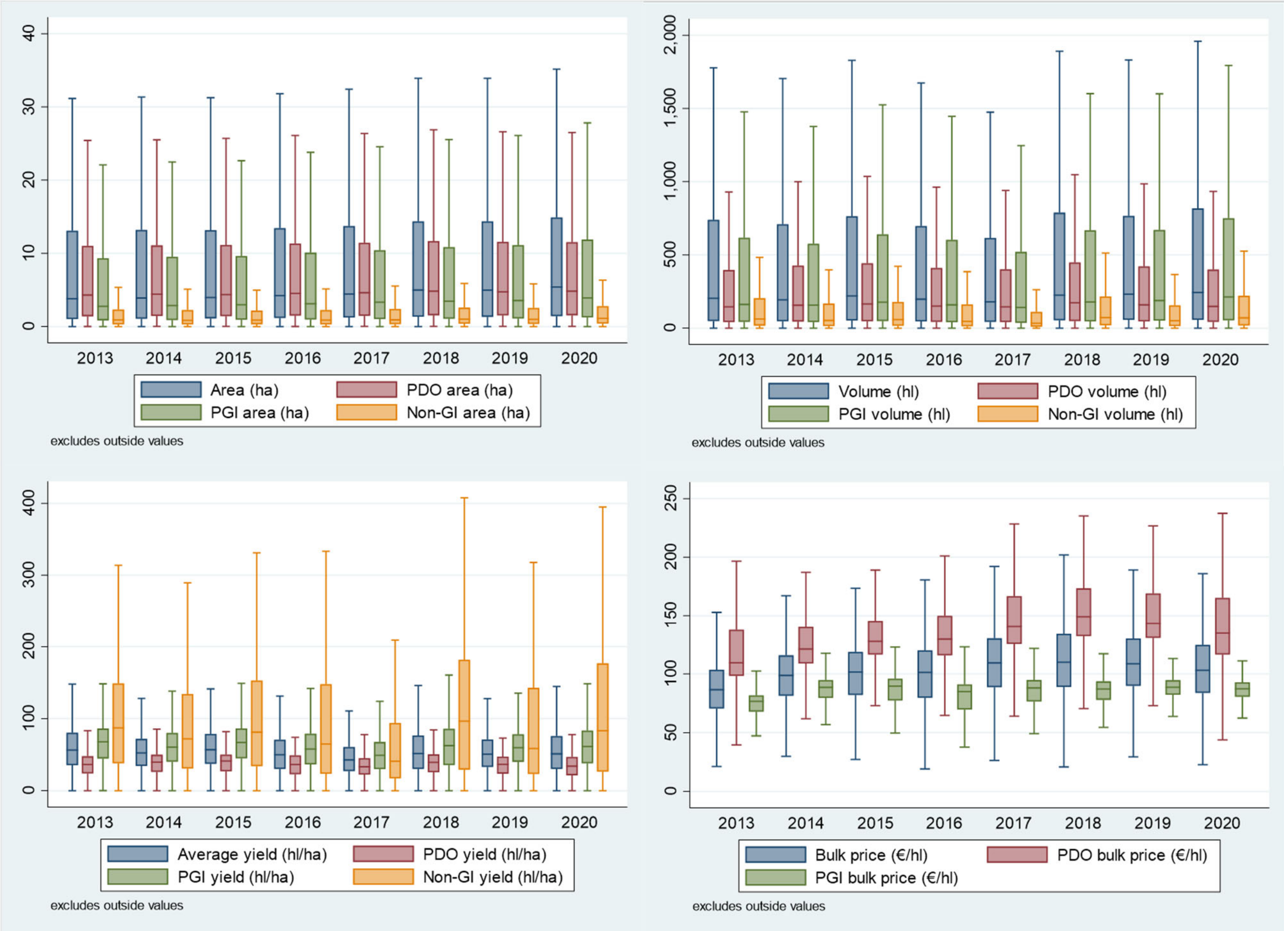

Figure 2. Evolution of harvested area and volume, yield and bulk price (total and per type of GI)

Area per estate increased on average, and this is more pronounced for PGI areas. The third graph shows that PDO yield is constant while PGI yield has a higher variability. The fourth graph shows that PDO bulk price is higher and more variable than PGI bulk price.

2) Identification of individual trajectories respective to yields

We now focus on specialized GI estates that have more than 90% of their area with GI wines in 2020. We distinguish 8 trajectories differentiating the trend in yields for PDO & PGI and in mean prices (weighted average) overlooking the trend in area. Table 1a,b,c show the number and importance of estates and their main characteristics in each of the 8 trajectory.

The majority of estates (57% of volume produced by PGI-specialized estates and 51% of PGI estates in number) shows the following trajectory: increase in prices, decrease in PGI yields but increase in PDO yields. The third more important trajectory gather 22% of the volumes (24% of PGI estates) and correspond to an increase in prices, higher PGI & PDO yields. The estates trajectories have among the highest Soil Water holding capacity but also the lower water balance (i.e. the higher water stress).

43% of PGI-estates (49% of volume) are in municipalities having the 25% higher SWHC, while 20% of estates (12% of volumes) are in municipalities having the 25% lower SWHC. The first group of estates has a higher yield on average (64hl/ha vs 50hl/ha) and a higher Huglin index (2468 vs 2433).

Regarding estates with increasing and lower PGI-yield, the increase in price compensates on average the lower PGI-yield. Nevertheless, the increase in prices does not compensate the decreasing PDO yields when PGI-yield increased. This is particularly true for estates in municipalities with the lowest SHWC.

Similar analysis can be conducted with other types of estate (specialized PDOs and mixed vineyard with balanced production of PDO & PGI).

Table 1. Statistical results for PGI estates: all the PGI estates, The PGI estates in the municipality having the 25% lower Soil Water Holding Capacity and the PGI estates in the municipality having the 25% higher Soil Water Holding Capacity.

			Nb of estates	Total Area (kha)	Total volume (khl)	Mean area (SD)	Mean yield (SD)	SHWC	Huglin index	Price evo.	Avg yield evo.	Water balance
A - Results for all PGI-specialized estates												
↘ in prices	↘ in PGI yield	↘ PDO yield	710	8.3	441	12.2 (16.8)	49.1 (26.6)	85 (15)	2417 (153)	-0.08 (0.28)	-0.08 (0.08)	-155 (71)
		↗ PDO yield	296	3.4	206	11.8 (15.4)	54.7 (47.9)	88 (16)	2389 (183)	-0.15 (0.64)	-0.03 (0.08)	-156 (68)
	↗ in PGI yield	↘ PDO yield	321	3.5	171	11.1 (15.8)	45.0 (27.0)	82 (13)	2381 (156)	-0.59 (7.11)	-0.04 (0.11)	-160 (69)
		↗ PDO yield	203	2.0	100	9.6 (13.5)	19.4 (28.1)	87 (13)	2363 (206)	-0.07 (0.14)	+0.06 (0.08)	-134 (88)
↗ in prices	**↘ in PGI yield**	↘ PDO yield	680	6.7	322	9.8 (15.0)	43.5 (26.1)	84 (14)	2412 (156)	+0.13 (0.27)	-0.09 (0.12)	-159 (64)
		↗ PDO yield	**7761**	**64.2**	**4178**	**7.9 (15.0)**	**57.7 (29)**	**93 (16)**	**2469 (138)**	**+0.12 (0.26)**	**-0.08 (0.10)**	**-166 (58)**
	↗ in PGI yield	↘ PDO yield	1487	9.5	334	6.3 (10.3)	30.4 (19.1)	83 (14)	2355 (148)	+0.11 (0.34)	-0.14 (0.26)	-159 (71)
		↗ PDO yield	**3632**	**25.9**	**1609**	**6.7 (11.5)**	**55.4 (34.1)**	**92 (16)**	**2427 (164)**	**+0.37 (2.96)**	**+0.05 (0.18)**	**-163 (67)**
B - Results for PGI-specialized estates in municipality having the 25% higher soil water holding capacity									2468			
↘ in prices	↘ in PGI yield	↘ PDO yield	229	3.1	185	10.3 (15.9)	41.7 (25.4)	106 (6)	2459 (144)	-0.06 (0.07)	-0.08 (0.08)	-147 (93)
		↗PDO yield	107	1.5	98	8.6 (16.9)	57.6 (29.0)	108 (7)	2447 (153)	-0.11 (0.29)	-0.03 (0.06)	-161 (73)
	↗ in PGI yield	↘ PDO yield	95	0.9	41	5.3 (9.3)	29.0 (18.9)	104 (4)	2387 (178)	-0.07 (0.20)	-0.03 (0.11)	-139 (89)
		↗ PDO yield	58	0.6	31	7.1 (12.2)	57.7 (34.9)	105 (5)	2400 (246)	-0.05 (0.06)	+0.06 (0.06)	-127 (107)
↗ in prices	↘ in PGI yield	↘ PDO yield	176	2.0	105	12.7 (16.9)	48.0 (27.0)	106 (6)	2426 (168)	+0.14 (0.14)	-0.07 (0.08)	-169 (74)
		↗ PDO yield	3490	32.2	2 175	12.8 (16.7)	54.7 (33.3)	109 (7)	2477 (140)	+0.11 (0.17)	-0.07 (0.08)	-177 (68)
	↗ in PGI yield	↘ PDO yield	676	3.0	105	10.8 (14.2)	46.1 (28.4)	105 (4)	2321 (146)	+0.35 (1.36)	-0.18 (0.19)	-167 (69)
		↗ PDO yield	**1639**	**12.4**	**831**	**9.4 (13.0)**	**51.4 (28.8)**	**109 (7)**	**2436 (173)**	**+0.12 (0.16)**	**+0.05 (0.14)**	**-177 (73)**
C - Results for PGI-specialized estates in municipality having the 25% lower soil water holding capacity									2433			
↘ in prices	↘ in PGI yield	↘ PDO yield	210	2.1	95	9.7 (12.3)	48.0 (27.3)	69 (5)	2377 (142)	-0.12 (0.49)	-0.10 (0.08)	-153 (33)
		↗ PDO yield	76	0.6	29	9.1 (13.9)	56.2 (94.1)	70 (5)	2337 (189)	-0.14 (0.90)	-0.04 (0.09)	-147 (57)
	↗ in PGI yield	↘ PDO yield	103	1.1	48	10.6 (16.3)	40.9 (25.0)	69 (6)	2351 (128)	-0.13 (0.38)	-0.05 (0.13)	-169 (31)
		↗ PDO yield	44	0.4	20	8.9 (12.2)	43.5 (24.1)	70 (4)	2287 (174)	-0.04 (0.04)	+0.09 (0.12)	-145 (47)
↗ in prices	↘ in PGI yield	↘ PDO yield	223	1.6	62	7.6 (13.0)	43.1 (26.5)	70 (5)	2392 (152)	+0.10 (0.08)	-0.10 (0.18)	-152 (39)
		↗ PDO yield	**1402**	**8.1**	**503**	**5.2 (9.6)**	**54.4 (29.1)**	**70 (4)**	**2452 (125)**	**+0.11 (0.34)**	**-0.09 (0.17)**	**-148 (38)**
	↗ in PGI yield	↘ PDO yield	360	2.6	73	7.2 (10.7)	29.3 (18.7)	69 (5)	2316 (137)	+0.14 (0.26)	-0.16 (0.21)	-165 (36)
		↗ PDO yield	**632**	**3.1**	**151**	**4.5 (8.4)**	**46.3 (33.3)**	**70 (5)**	**2404 (156)**	**+0.12 (0.12)**	**+0.04 (0.16)**	**-149 (41)**

Conclusion

In this study we showed how combining agronomic, economic and climatic data can be operationalized to study the question of the evolution of wine production over a decade or trajectories of estates. The result on the most frequent trajectory (Increase in prices, decrease in PGI yields & increase in PDO yields) confirms and adds to the results obtained from FADN analyses (Tintinger, 2020).

Combining different databases is an interesting approach to understand and infer the production dynamics and determinants. This offers a multitude of analytical options. This is what we show with the adoption of a multilevel analysis: for instance, in Tintinger (2020) the analysis of the RICA with very few estates but detailed accountancy information is complementary to CVI data that enables to have all estates with very detailed information on yields and areas but no precise information on prices and proxies of economic variables.

References:

Fernandez-Mena H., Guilpart, N., Lagacherie P., Plaige M., Dumont M., Gautier M., Touzard JM, Hannin H., Gary, C.. Clustering of climate and soil zones involved in grapevine yield-gaps. Application to Languedoc-Roussillon region (France). In prep.

IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

Styc, Q., Lagacherie, P., 2019. What is the best inference trajectory for mapping soil functions: an example of mapping soil available water capacity over Languedoc Roussillon (France). Soil Syst. 3, 34

Tintinger M. Competitiveness and resilience in Languedoc-Roussilon in the context of climate change. Master Thesis. 2020

Van Leeuwen, C., and Philippe D.. "The impact of climate change on viticulture and wine quality." *Journal of Wine Economics* 11.1 (2016): 150-167.

Vidal, J. P., Martin, E., Franchistéguy, L., Baillon, M., & Soubeyroux, J. M. (2010). A 50-year high-resolution atmospheric reanalysis over France with the Safran system. *International Journal of Climatology*, 30(11), 1627-1644.