The market organization in the wine industry.
Farms, merchants, & cooperatives

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AAWE Annual Conference 2018
Cornell University (Ithaca)
June 11th, 2018
The industrial organization of the wine sector may be quite complex, but relatively similar across different countries.

At the farm level, producers grow grapes.

Then, grapes are processed to make wine.

1. At the farm level, in vertically-integrated firms (VI). In alternative,
2. they can be delivered to a wine-cooperative (Coop); or,
3. sold in the spot market to wine-making firms (IOF).

Cooperatives process the grapes of their members, but

- may also buy grapes from non-members (usually ≤ 50%).

They can then sell the wine (bottled or bulk) to wine-merchants or retailers.

Wine-merchants, on the other hand, can

- buy grapes (and make wine) or bulk wine which they bottle and sell to retailing outlets.
Figure: Simplified market organization
### Table: Names of firms producing wines in different countries

<table>
<thead>
<tr>
<th>Firms</th>
<th>France</th>
<th>Italy</th>
<th>Spain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grapes production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vine-grower (Farm)</td>
<td>Viticulteur (Producteur)</td>
<td>Viticolto (Produttore)</td>
<td>Viticultore</td>
</tr>
<tr>
<td>Wine production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winery (VI)</td>
<td>Vigneron</td>
<td>Vinificatore</td>
<td>Bodega (Cosechero)</td>
</tr>
<tr>
<td>Cooperative (Coop)</td>
<td>Cave coopérative sociale</td>
<td>Cantina cooperativa</td>
<td>Bodega</td>
</tr>
<tr>
<td>Wine-merchant (IOF)</td>
<td>Négociant (N. vinificateur)</td>
<td>Vinificatore industriale</td>
<td>Bodega elaboradora</td>
</tr>
</tbody>
</table>
In this ongoing project we investigate the following questions.

1. First of all, WHICH firms decide to vertically integrate, i.e., to make wine ‘in-house’?

2. If a farm decides NOT to make wine in its own premises, should it JOIN a cooperative to invest collectively and forward vertically-integrate to make wine together with other farms? Or, would it be better to SELL its grapes to other wine-making firms, in the spot market or through (short- or long-term) contracts?

3. What are the benefits and costs of each option, and what explains individual farms’ choices?

4. Last, are these choices affected when QUALITY is an important dimension in wine production?
**Motivation**

## Contribution I

- Extending recent contributions in trade theory, we develop a model with the following main ingredients:
  - First of all, to make or sell wine (or to process/market any raw commodity), a firm needs to make a fixed investment, equal for every firm.
  - Firms are heterogeneous, and so only more productive (or bigger) firms can reach the scale needed to have positive returns from the fixed investment.
  - The firms that do not find it profitable to make wine in-house can then have their grapes processed elsewhere.
  - This can happen by selling them to specialized ‘private’ wine-makers (IOFs), or by delivering them to a wine-making cooperative.

- We are thus developing a **theoretical model** to explain the overall industrial organization of the wine sector.

- Moreover, we are collecting **data** to empirically test the model’s main predictions.
Work still in progress, but preliminary results show that:

- more efficient farms are able to vertically integrate, while less efficient ones do sell grapes downstream.
- If the downstream firm is a cooperative, it will offer a higher price compared to an IOF, so that there will be more aggregate production, in other words, there will be more entry (or less exit) into the farming sector.
- However, the effect on the VI firms is the opposite, since fewer firms will decide to invest on wine-making.

Notice that (caveats):

- We only have one firm downstream, so that we do not consider the possible competition among different firms downstream.
- In addition, we do not consider yet that wine-merchants can also backward-vertically integrate by entering into grapes growing.
Literature, I

- **Contractual view of VI (Williamson)**
  - Hazards of idiosyncratic exchanges:
  - competitive markets $\rightarrow$ agreements $\rightarrow$ bilateral monopoly,
  - $\rightarrow$ hold-up.

- **Incomplete contracting view of VI (Grossman-Hart-Moore)**
  - Contracts are incomplete,
  - $\rightarrow$ ownership assigns residual rights of control,
  - $\rightarrow$ modifying incentives to invest and efficiency.

- **Other explanations for VI in agriculture**
  - Transaction costs in LDCs;
  - direct selling, e.g., Agbo et al., JEBO, 2015;
  - resource-based and TC (Traversac et al., FP, 2011).

- **Trade literature (Melitz)**
  - firms are heterogeneous in their efficiency,
  - they face the same fixed costs of exporting,
  - $\rightarrow$ only efficient firms export.
The model

The model, I

BASIC STRUCTURE
The major assumptions of the model are the following.

- An exogenous set of heterogeneous producers (or farms).
- Each producer is growing grapes with a general technology represented by a cost function with both variable and fixed costs.
- There is a fixed cost of entry and a production cost for each stage of production.
- Producers are heterogeneous in the variable cost component. The variable cost of producing grapes is $\theta \frac{x^2}{2}$, where
  - $\theta$ is an idiosyncratic productivity shock, and
  - $x$ the quantity of grapes.
- One unit of grapes $\Rightarrow$ one unit of wine, at cost $c$. 

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DEMAND SIDE

- Demand for wine: a representative consumer (with taste for variety) has quadratic utility
  \[ u = x_0 + \alpha Q^c - \frac{b}{2} \left( \sigma \int_{\Omega} q^c(\omega)^2 d\omega + (1 - \sigma)Q^c \right) \]

  where \( \omega \) indexes each variety of wine and the outside good \( x_0 \) is taken as the numeraire.

- Consumer has revenue \( Y \), so that the budget constraint is
  \[ Y = x_0 + \int p(\omega)q^c(\omega)d\omega. \]

  With \( L \) consumers, the demand for \( \omega \) is
  \[ p(\omega) = a - \tilde{b}(\sigma x(\omega) + (1 - \sigma)X) \]

  where \( \tilde{b} = b/L \), \( x(\omega) = Lq^c(\omega) \) is the individual production, and \( X = LQ^c = L\int_{\Omega} q^c(\omega)d\omega \) is the aggregate production of wine.
The model, III

- Each firm is identical ex-ante and receives a noisy signal $\nu$ of their productivity $\theta$ and the law of $\theta$ conditionally on $\nu$ is $G(\theta/\nu)$ (draw iid for each firm with law $F(\nu)$).
- Based on this signal, each firm has to decide whether to enter by
  - producing grapes and wines (Vertical Integration), or
  - only grapes (Non-Vertical Integration),

by paying entry costs, respectively $E_{VI}$ and $E_{NVI}$.

- Once it has entered, it discovers its productivity $\theta$ and has then to decide either to stay or to exit the market (if productivity is too low to be profitable).
- As in Melitz (2003), there is endogenous entry, but:
  - firms are heterogeneous ex-ante, and decide entry based on $\nu$;
  - they realize their productivity $\theta$ only after entry occurs;
  - → possible overlap between distributions of productivity for $VI$ and $NVI$;
  - overlap → no perfect sorting, as in Ulyssea (2018).
The model, IV

If the firm does NOT vertically integrate it faces a downstream firm — called $F$ — that will buy at price $w$ the grapes to produce wine with unit cost $c^F$ and fixed cost $K$.

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**Figure:** The decisions at the farm’s level

Vertical Integration (VI)

In-house

Off-farm

Supply a downstream firm $F$ (NVI)
The model, V

- The downstream firm can be either
  - an **Investor Owned Firm** (IOF), which maximizes its own profit when choosing $w$, or
  - a **Cooperative** (Coop), which will choose $w$ to maximize members’ profits under a budget constraint.
- The firm $F$ will produce a quantity $X^F$ and a VI firm with index $\omega$ will produce a quantity $x(\omega)$.
- Hence aggregate production on the market is

$$X = X^F + \int_{\text{set of VI firms}} x(\omega) d\omega,$$

$$X = X^F + X^{VI},$$

that is, the sum of production by firm $F$ (either an IOF or a Coop) and the aggregate production of VI firms denoted $X^{VI}$. 
The profit expression is

$$\max_p \pi = p(x)x - \theta \frac{x^2}{2} - cx - f_{VI},$$

which FOC is

$$(p' - \theta)x + p - c = 0,$$

that gives

$$x(\theta) = \frac{\alpha}{2\tilde{b}\sigma + \theta},$$

where $\alpha = a - c - \tilde{b}(1 - \sigma)X$.

Notice that production is decreasing in $\theta$, the productivity.
The VI firm, II

- We can check that $\pi$ is decreasing in $\theta$ (envelope theorem), so that there exists a **threshold of types** $\hat{\theta}$ indifferent between producing and exiting the market:

$$\pi_{VI}(\hat{\theta}) = 0.$$

- Notice that $\hat{\theta}$ is a decreasing function of $X$ (through $\alpha$):
  - if market aggregate production increases, this generates a **selection effect** in favor of the more efficient VI firms that stay on the market.
  - Note that the aggregate quantity $X^{VI}$ depends on the aggregate $X^F$:
    - directly (negatively), because if firm $F$ increases its production (by offering a larger $w$ to farmers) it would directly depress the production of VI firms (substitution effect in final demand), and
    - indirectly, through changes in $\hat{\theta}$.

(Recall that $\hat{\theta}$ is decreasing in $X = X^F + X^{VI}$.)

- We thus have the following.
The VI firm, III

**Proposition 1.** The selection effect - the extensive margin - reinforces the fact that $X^{VI}$ decreases each time $X^F$ increases.

Therefore, the selection effect magnifies the (intuitive) direct negative relationship between $X^F$ and the aggregate quantity $X^{VI}$ of VI firms (because $\hat{\theta}$ is endogenous).

What about the total effect on $X$?

**Proposition 2.** An increase in $X^F$ leads to an increase in $X$. Consequently, for the VI sector there is more competition, and thus lower size and profit per firm, i.e., a lower $\hat{\theta}$. 
The VI firm, IV

- Suppose that $X^F$ increases for whatever reasons (e.g., a move from an IOF to a Coop, for instance).
  - Despite having $X^{VI}$ decreasing, nevertheless $X$ increases.
  - Individual $x_{VI}$ decreases (i.e., smaller size for VI firms), so does their profit $\pi_{VI}$;
  - in the end, this makes $VI$ less interesting (both $\hat{\theta}$ and $\pi_{VI}$ decrease).
- In brief, the change from an IOF to a Coop does NOT benefit $VI$ firms, thus inducing less entry into vertical integration.
- We thus get a result similar to that established by Fulton & Giannakas (2013):
  - in a different setting, they show that the presence of a Coop raises the price $w$, which however may NOT benefit all upstream farmers.
- In our setting, the price increase does NOT benefit the $VI$ farmers.
The grapegrower, I

- The market price for grapes is $w$ and thus the grower chooses how much to produce:
  \[
  \max_x wx - \theta \frac{x^2}{2} - f_{NVI},
  \]
  and the FOC gives
  \[
  x = \frac{w}{\theta}.
  \]

- The profit obtained is thus
  \[
  \pi_{NVI}(\theta) = \frac{w^2}{2\theta} - f_{NVI},
  \]
  which is decreasing in $\theta$, increasing and convex in $w$.

- Moreover, the threshold type $\tilde{\theta}$ is such that
  \[
  \pi_{NVI}(\tilde{\theta}) = 0 \Rightarrow \tilde{\theta} = \frac{w^2}{2f_{NVI}}.
  \]
Entry, I

- For a firm with signal $\nu$, the expected profit of entry under VI is

$$V_{VI}(\nu) = \int_0^{\hat{\theta}} \pi_{VI}(\theta)dG(\theta/\nu),$$

while under NVI it is:

$$V_{NVI}(\nu) = \int_0^{\bar{\theta}} \pi_{NVI}(\theta)dG(\theta/\nu).$$

- Entry in VI occurs if

$$V_{VI}(\nu) - E_{VI} \geq \max (V_{NVI}(\nu) - E_{NVI}, 0),$$

while entry in NVI occurs if

$$V_{NVI}(\nu) - E_{NVI} \geq \max (V_{VI}(\nu) - E_{VI}, 0).$$
Entry, II

- Assuming that $E_{VI} > E_{NVI}$, that is, that the entry cost is larger under $VI$, if entry occurs in both situations then there exist two thresholds, $\nu_1$ and $\nu_2$, such that $\nu_1 < \nu_2$ and

\[
egin{align*}
V_{NVI}(\nu_2) &= E_{NVI}, \\
V_{VI}(\nu_1) &= V_{NVI}(\nu_1) + E_{VI} - E_{NVI}.
\end{align*}
\]

- Therefore,
  - all firms with a sufficiently good signal, i.e., $\nu \leq \nu_1$, enter into $VI$,
  - while others with not too high signals ($\nu_1 \leq \nu \leq \nu_2$) enter into $NVI$.
The IOF would like to buy grapes at price $w$ from a set
$\Phi = [\theta, \tilde{\theta}(w)]$ of grapegrowers. The quantity to be traded is

$$X^F(w) = \int_{\Phi} \frac{w}{\theta} dG_{NVI}(\theta).$$

And the profit is:

$$\max_w \pi^F = p(X^F)X^F - (w + c^F)X^F - K$$

s.t.

$$p(X^F) = a - \tilde{b}(\sigma X^F + (1 - \sigma)X).$$
The model

The problem when $F$ is an IOF

**$F$ is an IOF, II**

- The FOC for the atomistic firm is
  \[
  \left[ p'(X^F)X^F + p(X^F) - w - c^F \right] X^{F'}(w) = X^F,
  \]
  or equivalently
  \[
  MR = MC + \frac{X^F}{X^{F'}(w)},
  \]
  where $MR = p'(X^F)X^F + p(X^F)$ is the marginal revenue, and $MC = w + c^F$.  

- Standard FOC for a monopsony, with a **double incentive** to reduce production:
  - to extract surplus from consumers (downstream), and
  - surplus from suppliers/farmers (upstream).

Having computed $w$, $X^F$ and $X^{VI}$ we then go back to the thresholds $\nu_1$ and $\nu_2$ that can be found by solving Eqs. (1) and (2).
**Remark 1** Notice that $X^F(w)$ has two components:  

i) the **intensive margin**, a direct positive effect because an increasing procurement price $w$ will induce existing upstream firms to produce more; and  

ii) the **extensive margin**, an ‘indirect’ positive effect because an higher procurement price will induce more (inefficient) farmers to stay in business ($\tilde{\theta}(w)$ is increasing in $w$) instead of exiting.
When the firm $F$ is a COOP, I

- The Coop would choose the grape price $w$ to maximize members’ profit subject to the budget constraint:

$$
\max_w \int_{\Phi} [\pi_{NVI}(\theta)] \, dG_{NVI}(\theta),
$$

subject to:

$$
p(X^F)X^F = \left( w + c^F \right) X^F + K,
$$

$$
X^F(w) = \int_{\Phi} \frac{w}{\theta} \, dG_{NVI}(\theta).
$$
When the firm $F$ is a COOP, II

- As the profit $\pi_{NVI}(\theta)$ and $X^F(w)$ are both increasing in $w$, the solution is straightforward.
  - The Coop chooses the largest $w$ compatible with the budget constraint.
  - Assume that $p(X^F)X^F - (w + c^F)X^F$ is concave then it can have two intersection points at most with $K$ and the Coop will choose the largest one in order to maximise $X^F$ and thus profits for members.
  - By contrast, the IOF choose the price that maximizes $p(X^F)X^F - (w + c^F)X^F$ which is necessarily on the left to the $w$ chosen by the Coop.

$\Rightarrow$ we thus get the result that the IOF underproduces compared to the Coop.
The main results (proofs to be completed) are the following.

1. The **Coop over-produces** with respect to the IOF, that is, \( X_{Coop}^F > X_{IOF}^F \),
   - In effect, for the IOF – as a monopsonist – it is impossible to extract all the farmers’ surplus with a unique price \( w \); it thus distorts downwards the price offered to supplier in order to maximize its profit.
   - The Coop however does NOT suffer from this problem as it does not try to extract surplus from the farmers; instead, it offers a surplus maximizing price to the farmers (\( w_{Coop} \)) which is larger than that offered by the IOF, i.e., \( w_{Coop} > w_{IOF} \).
2. Hence there are more active firms with a Coop than with an IOF, and so the thresholds are such that $\tilde{\theta}_{Coop} > \tilde{\theta}_{IOF}$.

- This in turn generates more entry for grapegrower when you have a Coop ($\nu_2$ is larger for a Coop).
- Which implies that there is less entry into VI probably, i.e., $\nu_1$ is probably lower.

- Does this mean that there is less product diversity for the consumers?
- Could we have some negative impact on welfare with a Coop in such a case?
- To be investigated...
Quality

Table: Distribution of wine production (in 000 Hl) across quality and firms (Italy, 2012)

<table>
<thead>
<tr>
<th>Wine</th>
<th>VI</th>
<th>IOF</th>
<th>Coop</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table</td>
<td>2,907 (17%)</td>
<td>6,421 (38%)</td>
<td>7,587 (45%)</td>
<td>16,916 (100%)</td>
</tr>
<tr>
<td></td>
<td>(24%)</td>
<td>(62%)</td>
<td>(34%)</td>
<td>(38%)</td>
</tr>
<tr>
<td>PGI</td>
<td>3,709 (29%)</td>
<td>1,683 (13%)</td>
<td>7,377 (58%)</td>
<td>12,770 (100%)</td>
</tr>
<tr>
<td></td>
<td>(30%)</td>
<td>(16%)</td>
<td>(33%)</td>
<td>(28%)</td>
</tr>
<tr>
<td>PDO</td>
<td>5,746 (38%)</td>
<td>2,210 (14%)</td>
<td>7,332 (48%)</td>
<td>15,289 (100%)</td>
</tr>
<tr>
<td></td>
<td>(46%)</td>
<td>(21%)</td>
<td>(33%)</td>
<td>(34%)</td>
</tr>
<tr>
<td>Total</td>
<td>12,364 (27%)</td>
<td>10,315 (23%)</td>
<td>22,297 (50%)</td>
<td>44,977 (100%)</td>
</tr>
<tr>
<td></td>
<td>(100%)</td>
<td>(100%)</td>
<td>(100%)</td>
<td>(100%)</td>
</tr>
</tbody>
</table>

Adapted from Mazzarino & Corsi, 2015.
Quality, I

1. Quality in wine markets has an important role.

- When quantity-efficient heterogeneous producers, only more productive firms can vertically integrate, i.e., pay the fixed-cost investments.

- What if quality-efficient producers?
  - Can a relatively (small but) high quality firm be able to VI into wine-making?
  - Which producers would be attracted into the Coop?
  - Which would sell their grapes into the spot market?

- What is the relevant metrics to use when comparing the performance of IOF and Coop firms?
  - Which is the relevant ‘IOF’? The VI farm or the wine-merchant?
  - Pennerstopf & Weiss (2012), for instance, consider a mixed-oligopoly and compare an IOF to a Coop. Theirs is, in fact, a VI firm.
2. Model

- Now farms are heterogeneous in exogenous quality potential.
- Each farm produces one unit of production, with cost $\delta s$, where $s$ is the idiosyncratic quality shock.
- Farmers are ex-ante identical, but receive a noisy signal $\nu$, based on which and after paying the entry costs $E_{VI}$ and $E_{NVI}$, decide whether to enter into VI or not (NVI).
- Representative consumer has quadratic utility, with taste for variety, and revenue $Y$. The WTP for one unit of quality $s(\omega)$ is
  \[ p(\omega) = \alpha + \beta s(\omega) - \gamma N. \]
- Downstream, the firm $F$ produces a quantity $N^F$ with average quality
  \[ S^F = \frac{1}{N^F} \int_{\Omega^F} s(\omega) d\omega. \]
3. The VI firm’s problem

- The profit expression is the following:

\[
\pi_{VI}(s) = p(s) - \delta s - c - f_{VI}.
\]

- If we define the cut-off type \( \hat{s} \) such that \( \pi_{VI}(\hat{s}) = 0 \), we can rewrite the profit for a quality-s firm as

\[
\pi_{VI}(s) = (\beta - \delta)(s - \hat{s}).
\]

- There are two possible cases.
  - \( \beta > \delta \) Quality-friendly environment. The profit \( \pi_{VI}(s) \) is increasing in \( s \), and only firms with \( s > \hat{s} \) are active in equilibrium: \( N_{VI} = \int_{\hat{s}}^{s_M} dG_{VI}(s) \).
  - \( \beta < \delta \) Quality-hostile environment. The profit \( \pi_{VI}(s) \) is decreasing in \( s \), and only firms with \( s < \hat{s} \) are active in equilibrium (because of lower costs): \( N_{VI} = \int_{0}^{\hat{s}} dG_{VI}(s) \).
4. The NVI firm’s problem

- The profit is the following:

\[
\pi^{NVI}(s) = w - \delta s - c - f_{NVI}.
\]

- The equilibrium now depends on the pricing scheme chosen by the firm \( F \).

\[ w = w_0 \] If constant price, \( F \) will attract only low quality farms.

\[ w = w_0 + w_1 s \] If bonus for quality, the \( F \) will attract

- high-quality farms if \( w_1 > \delta \), and
- low-quality farms if \( w_1 < \delta \).

- Also, entry is costly → they need to be ensured ex-post positive profits.

- Timing issue: commitment by the \( F \)? Long-term contracts?

- If we assume that bonus for quality is endogenously determined in equilibrium, we have the following profit (\( \tilde{s} \) is the threshold):

\[
\pi^{NVI}(s) = (w_1 - \delta)(s - \tilde{s}).
\]
5. (Very) Preliminary results

- Still many issues to be solved, but so far we have obtained similar results to the case of quantity-efficiency.
- Indeed, given that the Coop offers higher prices for grapes, the IOF underproduces compared to the Coop.
- To be continued ...
- Regarding quality, one aspect is of interest:
  - is quality influencing organizational form, or
  - is the organizational form influencing quality?
  - Some (e.g., Giraud for Burgundy) argues for the latter.
  - We model the first.
  - It may be good to test which one theory is confirmed by the data.
1. A more realistic Coop

- Our Coop maximizes members’ profits.
- However, to have a more realistic model we need to introduce some disadvantages for the Coop as well.
- One could argue, for instance, that the coop is less efficient, that is the marginal cost of producing wine $c^F$ is larger for the Coop than for the IOF because of:
  - internal lack of cost minimization,
  - horizon and free-riding problems,
  - costs of collective decision-making,
  - management capture, etc.
Caveats

2. Competition

- Downstream we have only ONE firm $F$.
- It should be possible to introduce MORE winemaking firms like $F$ of different nature (IOF or Coop)
  → need to have a simple model on how hererogenous farmers NVI will select one or the other firm(s) $F$.
- We want to compare these different firms, looking at whether and how they differ in arranging their procurement from NVI upstream farms.
- There are different options. See Figures (3), (4), and (5), representing different competitive situations and possible modeling choices.
Figure: Vertical integration with $F$ in ‘isolation’ (L or R)
Issues: Downstream competition

Figure: Vertical integration with Downstream competition

\begin{itemize}
\item $f_1 \ldots f_N$
\item $Vl_1$
\item $Coop$
\item $IOF$
\item $Vl_2$
\item $D$
\end{itemize}
Figure: Vertical integration with Upstream & Downstream competition
Concluding remarks

- These are preliminary results of an ongoing project.
- We need to complete the theoretical investigation, but also to test our model predictions with the data.
- In particular, we would like to explore and test the predictions about the impact of fixed costs, heterogeneity, market competition, etc.
- In terms of further theoretical modeling, we would like to extend the model to consider different aspects. For instance,
  - the impact of quality,
  - the increase of market size (globalization) and competition,
  - what happens when downstream market, e.g., retailing sector, requires further investments, such as advertising, distribution investments, etc.;
  - what is the role and impact of regulations, for instance PDO regulations.