Pest dispersion as a spatial interaction: The case of *Flavescence Dorée*

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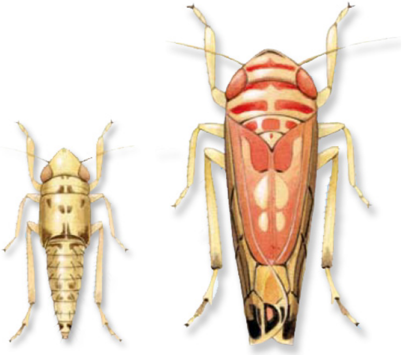
Flavescence Dorée

- Bacterial disease of vines
- High quantitative loss
- No cure actually
- Mandatory vines removal, treatment against vector

Scaphoideus Titanus



Economic considerations

Two opposite externalities from treatments

- Reduced risk for neighboring vineyards:

$$\text{Social benefit} > \text{Private benefit}$$

- Environmental damage on ecosystems:

$$\text{Social cost} > \text{Private cost}$$

$\Rightarrow$ Strong societal debate about compulsory treatment


VOILÀ COMMENT ON TRAITE CEUX QUI NE VEULENT PAS TRAITER !
SANCTIONS
DELIGNE
CentreFrance

Outline

Linear probability model

The probability of infection for a given vineyard i

$$p_i = b(\boldsymbol{x}_i; \boldsymbol{\beta}) + \tau t_i + \theta \sum_{j \in N_i} (t_j/n) + \rho \sum_{j \in N_i} (p_j/n) + \varepsilon_i$$

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$$\text{with:} \quad \frac{\partial p_i}{\partial t_i} = \underbrace{\tau}_{\textit{direct}} + \underbrace{(\rho / n)\theta}_{\textit{first order}} + \underbrace{(\rho / n)^2 \sum_{j \in N_i} \psi_j}_{\textit{higher orders}}$$

Micro-economic program

$$\max_{t_i \in [0,1]} \left\{ \mathbb{E}[\pi_i] \equiv (1 - p_i) r_i - c \cdot t_i \right\}$$

Corner solutions allow to define differentiated behaviors

Micro-economic program

$$\max_{t_i \in [0,1]} \left\{ \mathbb{E}[\pi_i] \equiv (1 - p_i) r_i - c \cdot t_i \right\}$$

Corner solutions allow to define differentiated behaviors

Farseeing behavior: treatment if $\frac{c}{r_i} < \mid \tau + (\rho/n)\theta + (\rho/n)^2 \sum \psi_j \mid$

Myopic behaviour: treatment if $\frac{c}{r_i} < \mid \tau + (\rho/n)\theta \mid$

Naive behaviour: treatment if $\frac{c}{r_i} < \mid \tau \mid$

Social planner perspective

Max. expected profits simultaneously with an additional social cost

$$\max_{\{t_\ell\}_L} \left\{ \mathbb{E}[\Pi] \equiv \sum_\ell \left[(1 - p_\ell) r_\ell - (c + \omega) t_\ell \right] \right\}$$

Social planner perspective

Max. expected profits simultaneously with an additional social cost

$$\max_{\{t_\ell\}_L} \left\{ \mathbb{E}[\Pi] \equiv \sum_\ell \left[(1 - p_\ell) r_\ell - (c + \omega) t_\ell \right] \right\}$$

It is socially optimal that treated vineyards are such that:

$$\underbrace{\frac{\omega}{r_i}}_{+} + \underbrace{\sum_{j \neq i} \frac{\partial p_j}{\partial t_\ell} \times \frac{r_j}{r_i}}_{-} + \frac{c}{r_i} < \ | \ \tau + (\rho/n)\theta + (\rho/n)^2 \sum \psi_j \ |$$

Simulations

Parameters β, τ, θ and ρ are estimated econometrically

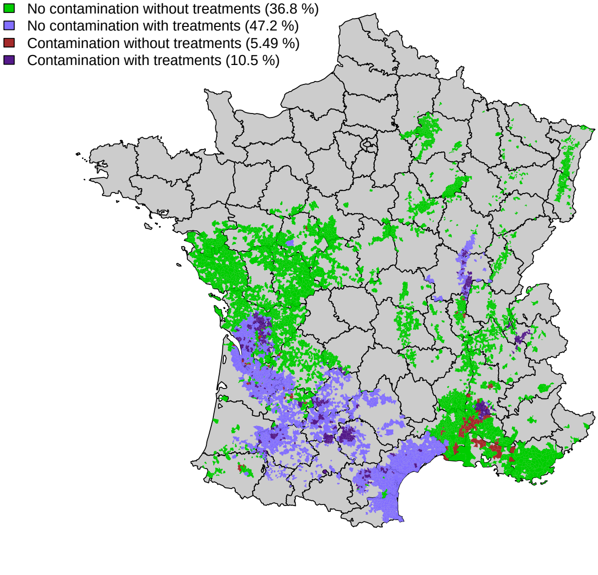
Average returns estimated from vineyard prices $r_i = v_i \times (\delta - \gamma)$

Additional assumptions:

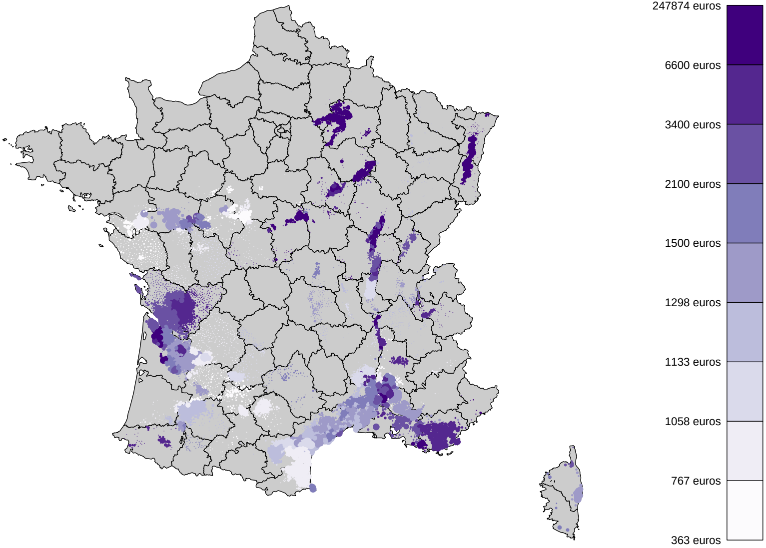
- Capitalization factor $\delta - \gamma = 0.02$
- FD contamination means 5 years of production loss
- Private cost of treatment $c = 25$ euros/ ha
- Social cost of treatment $\omega \in [0, 300]$ euros/ ha

Outline

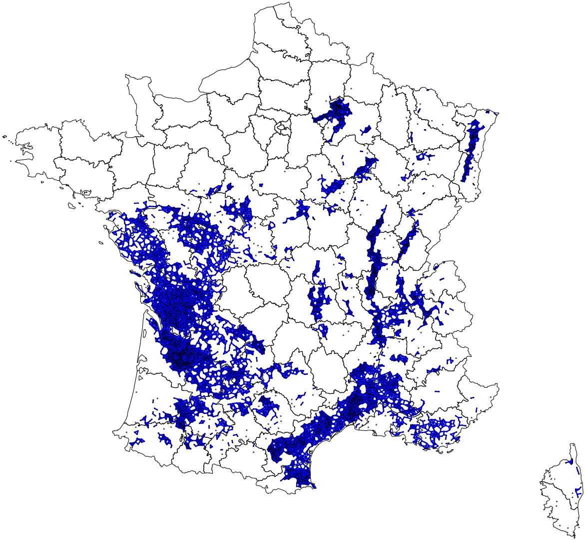
2013-2016 contamination, compulsory treatments



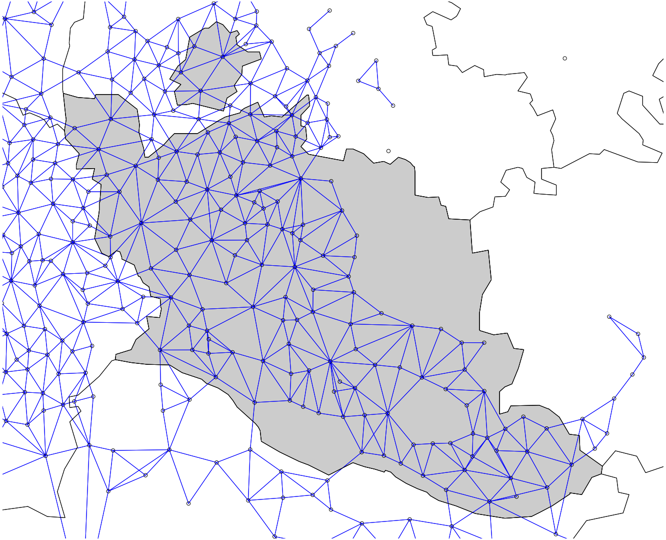
Annual returns per hectare in 2016



Spatial weight matrix



Spatial weight matrix (zoom)



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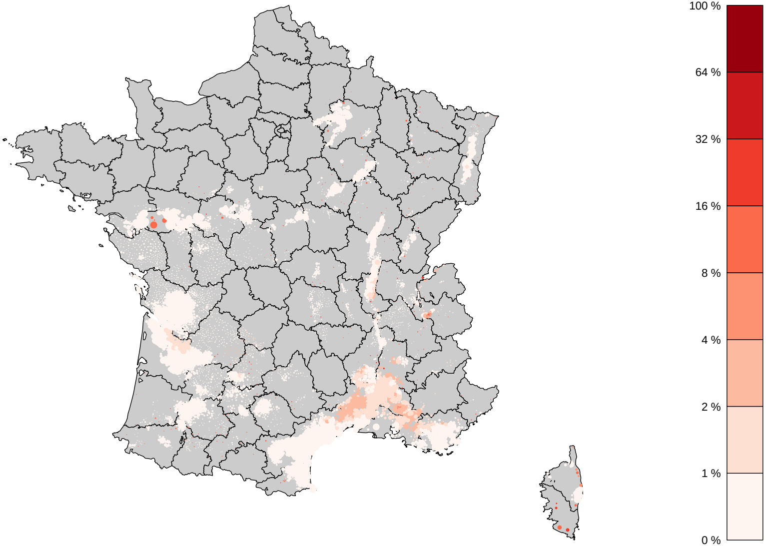
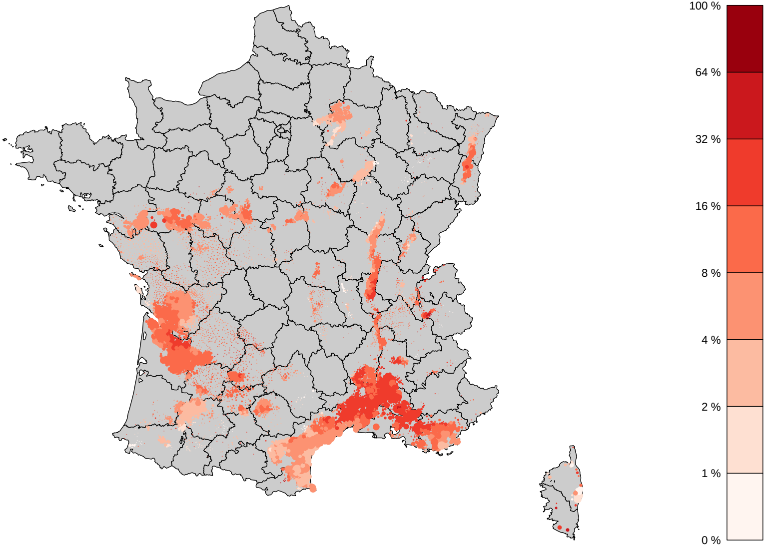
Spatial econometric estimation

Coef	(I)	(II)	(III)	(IV)
τ	-0.31^{**}	-0.27^{**}	-0.48^{**}	-0.52^{**}
	(0.117)	(0.093)	(0.103)	(0.094)
θ	-0.15^{**}	-0.1^{**}	-0.04^{**}	-0.2^{**}
	(0.118)	(0.094)	(0.107)	(0.094)
ρ	$+0.64^{**}$	$+0.71^{**}$	$+0.62^{**}$	$+0.27^{**}$
	(0.018)	(0.017)	(0.013)	(0.064)
N	6672	6672	6672	6672
pred	77.1	75.2	72.9	73.5
W	Contg	Dist	Contg	Contg
Method	MCMC	MCMC	AML	GMM

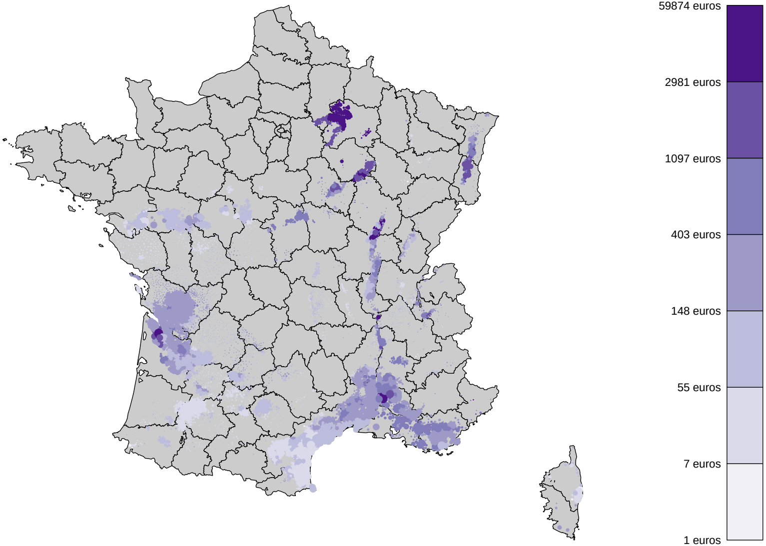
Proba of contamination with compulsory treatment



Proba of contamination without treatment

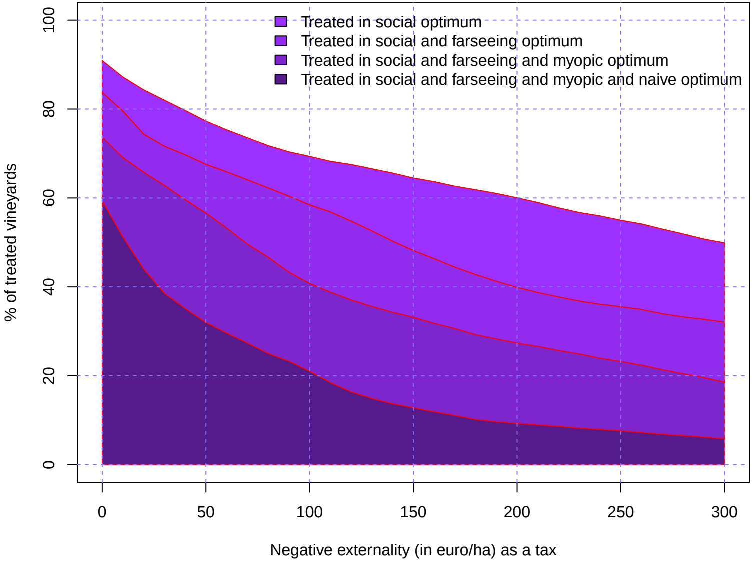


Expected value of treatment

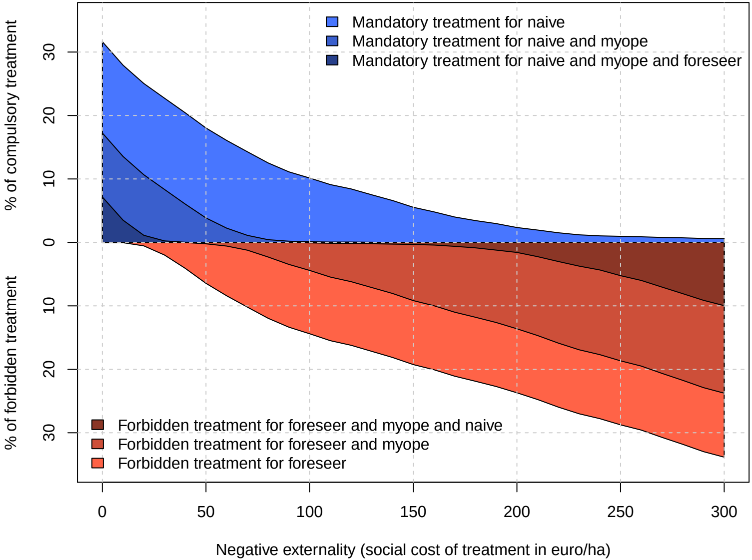


Outline

A tax is not a solution



Spatial mismatch



Outline

Summary

- Naive and myopia behaviors could be good for the environment but can be used to justify mandatory treatment
- Mandatory treatment is justified for naive behavior without social cost of treatments (on around 30% of vineyards)
- Forbidden treatment is justified for farseeing behavior with high social cost of treatment (on around 30% of vineyards)

Perspectives

- Endogenous prospecting efforts with fine-scale data
- Strategically consistent behavior, endogenous land use
- Increase the robustness checks and policy scenarios

Thank you