

The Geography of Industrial Efficiency in mid-19th Century France

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Introduction

The French industrialization was a slow and continuous process. It accelerated during the first half of the 19th century and diffused from specific areas of the country – headed by northern France.

Why did the industries come to be so heavily concentrated in the northern part of France?

Efficiency analysis

We use the Stochastic Productivity Frontier (SPF) technique (Aigner et al., 1977) to capture the inefficiency of industries. The inefficient industries will negatively deviate from the frontier of production, while efficient industries will remain close to it.

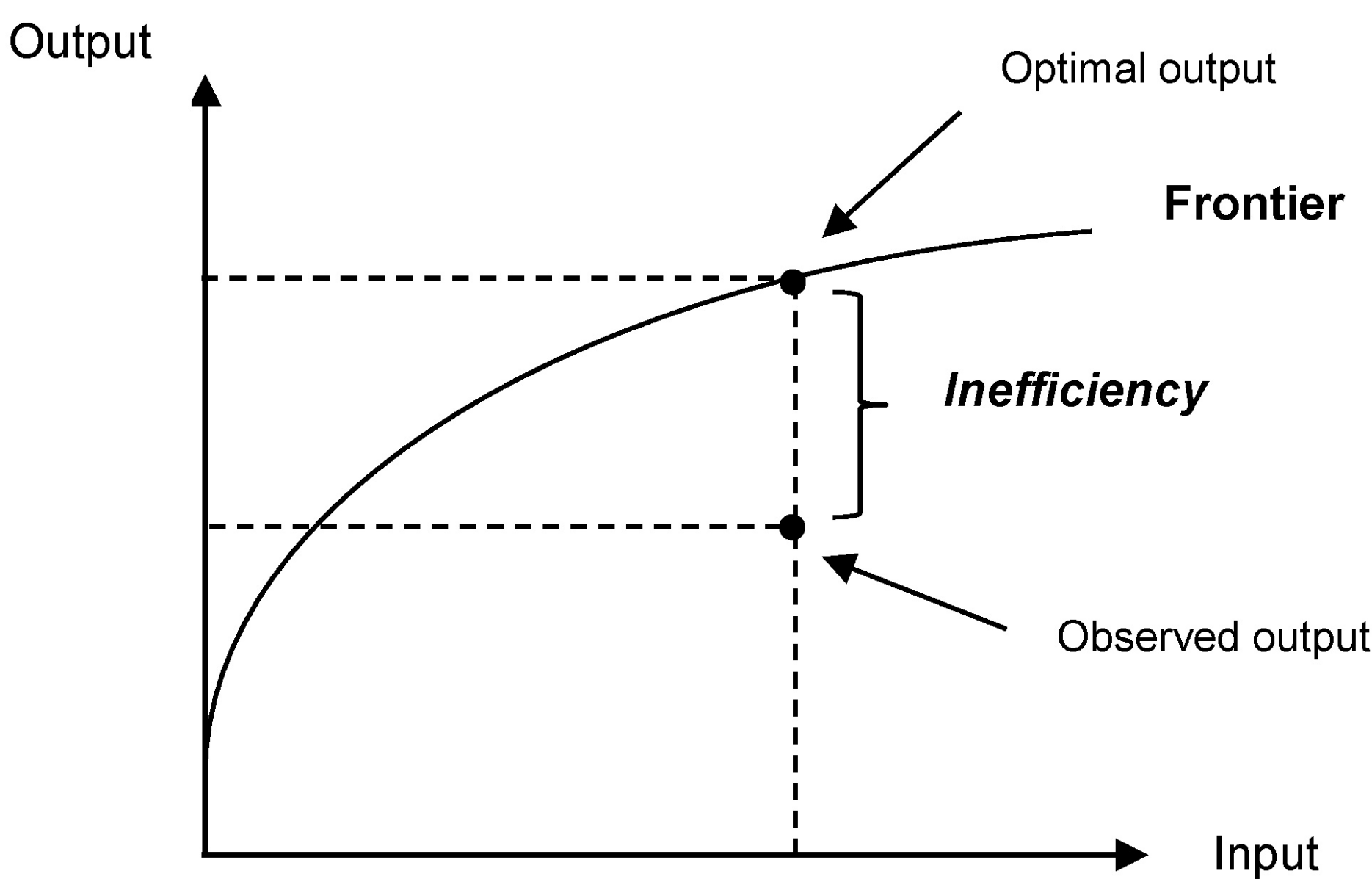


Figure 1 - The productivity frontier

Research objectives

According to Boucekkine et al. (2007), the industrialization was fostered by the rise in literacy rates triggered by the democratization and the spread of primary education.

This paper:

- identifies the distribution of strengths and weaknesses of French industries by measuring the efficiency of manufactures;
- investigates to what extent the distribution of education influenced the location and efficiency of French industries.

Formally, we estimate the following production function:

$$\log(y) = \log f(x) - u + v$$

where $f(x)$ is the production frontier, u is the inefficiency term, and v represents the measurement errors. Note that we can obtain an inefficiency term for every observations.

The SFP method allows us to capture the exogenous role played by education. The inefficiency term u in the previous equation can be written:

$$u = \delta Z + \epsilon$$

where the term Z represents the literacy rate, and ϵ is the measurement error. The sign of the parameter δ indicates the effect of literacy rate on inefficiency.

Preliminary results

Using county-level data for 89 départements from the *Statistique Générale de la France*, we find that the manufactures located in the northeastern side of a line going from St-Malo to Genève are more efficient (see Figure 2).

Moreover, we show that endowments in education strongly explain the location of these industries. In the following table, the negative sign of literacy mean variable indicates that a higher level of education reduces the inefficiency term u .

	Estimate	Std. Error	z value
(Intercept)	-0.138***	0.033	-4.173
log (Labor)	0.112***	0.019	5.832
log (Capital)	0.793***	0.022	35.290
log (Material)	0.178***	0.017	10.715
I (0.5 * log (Labor) ²)	-0.069***	0.015	-4.477
I (0.5 * log (Capital) ²)	0.314***	0.024	12.939
I (0.5 * log (Material) ²)	0.256***	0.015	16.703
I (log (Labor) * log (Material))	-0.051***	0.011	-4.608
I (log (Labor) * log (Capital))	0.074***	0.015	4.854
I (log (Labor) * log (Material))	-0.263***	0.017	-15.615
Z_Literacy_mean	-0.091***	0.027	-3.350
sigmaSq	2.908***	0.689	4.223
gamma	0.941***	0.015	61.019

Robust standard errors: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Education favored the efficiency of French industries during the process of industrialization

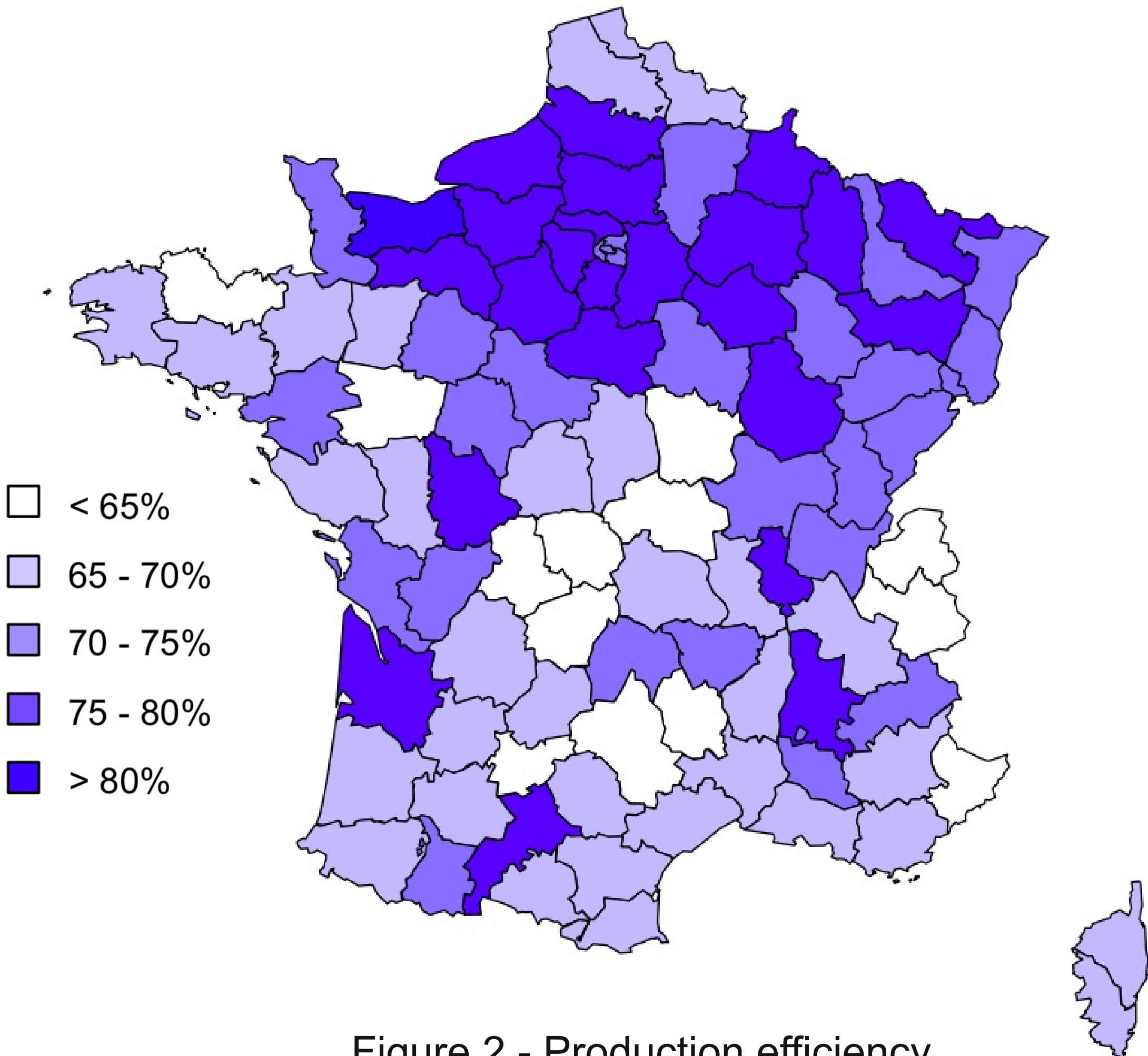


Figure 2 - Production efficiency

Bibliography:

- Aigner, D., C. K. Lovell, and P. Schmidt (1977), "Formulation and estimation of stochastic frontier production function models," *Journal of Econometrics*, 6(1): 21–37.
- Boucekkine, R., D. de la Croix, and D. Peeters (2007), "Early Literacy Achievements, Population Density, and the Transition to Modern Growth," *Journal of the European Economic Association*, 5(1): 183–226.