

# COMPETITION AND INNOVATION PERSISTENCE IN FRANCE

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# 1. INTRODUCTION

Large literature in empirical IO on the relationship between competition and innovation

Competition is damaging for innovation (Schumpeter,...)

Competition is good for innovation (Arrow,...)

In recent papers : an unverted-U shape relationship between competition and innovation :

- Aghion, Bloom, Blundell, Griffith, Howitt (2005)
- Askenazy, Cahn, Irac (2013)
- Rafique Hashmi (2013)
- ...

## Literature on persistence in innovation behavior

- Peeters (2005, 2009)
- Geroski, Van Reenen, Walters (1997)
- Cefis et Orsenigo (2001)
- Raymond, Mohnen, Palm, Schim van der Loef (2010)
- ...

### In this paper :

Investigating the product / process innovation behavior

- + effect of competition within industry
- + effect of competitive position of the firm (market share , technology gap)
- + effect of persistence

Large panel data for France, yearly data, 2000-2013.

## 2. INNOVATION IN THE FRENCH R&D SURVEYS

Data from annual R&D surveys in France

Firm level data

Higher frequency than in CIS - More panel data structure

But only firms doing R&D

2000 – 2013

9 374 firms with at least 3 continued years of R&D

48 520 observations.

Two main variables :

### Dummy for Product Innovation

*“During the year, did your enterprise or your group introduce **new or improved goods or services** coming from the R&D activity of your firm ?“*

*Yes or No*

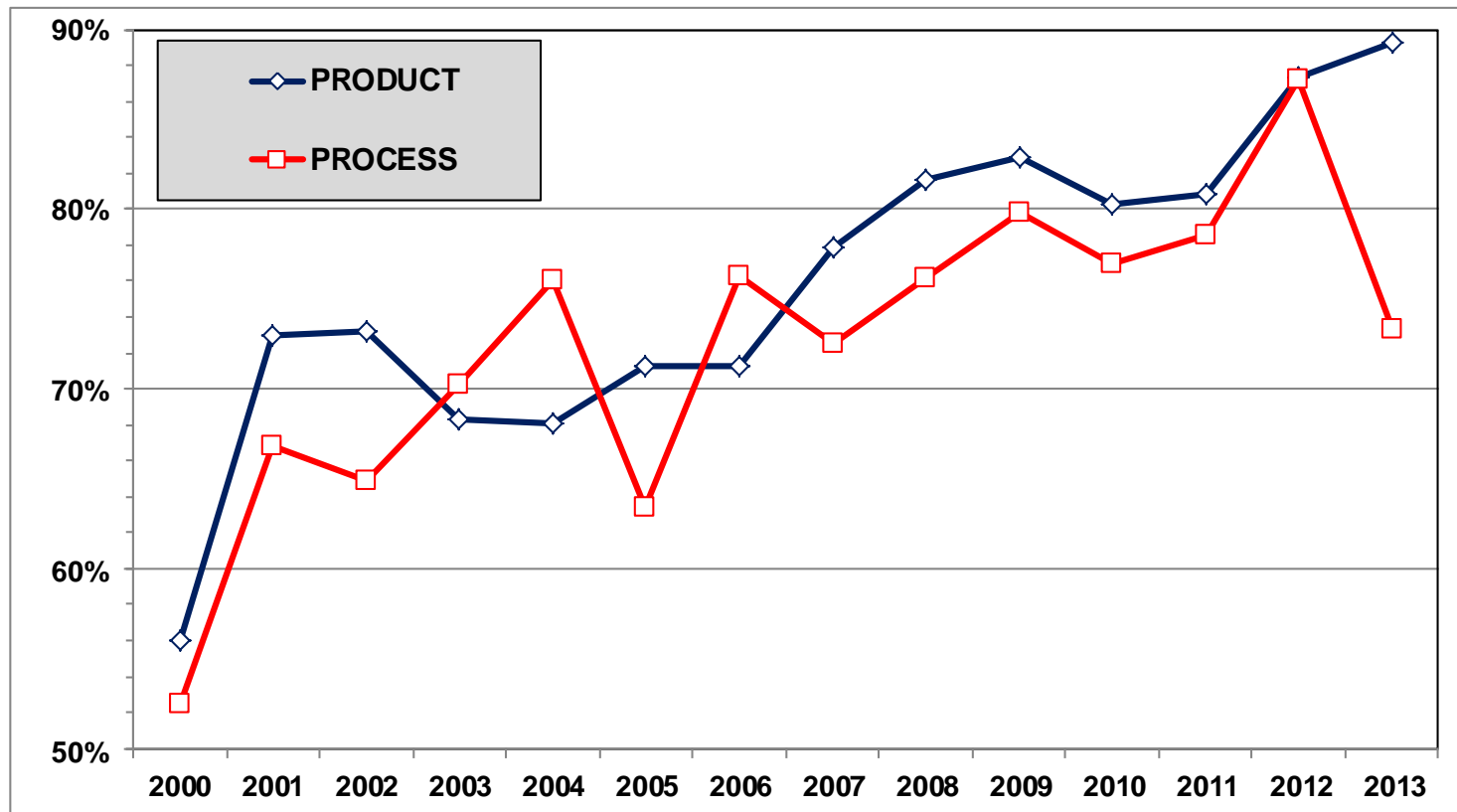
### Dummy for Process Innovation

*“During the year, did your enterprise or your group introduce **new or improved methods of producing goods or services** coming from the R&D activity of your firm ?“*

*Yes or No*

# Product and Process Innovators

(Unbalanced sample – weighted by total employment)



## Cross - Innovation rate (2000 – 2013)

	<b>None</b>	<b>Only Product</b>	<b>Only Process</b>	<b>Product and Process</b>	<b>Kendall's Tau-b</b>
All firms*	18.3%	8.7%	5.3%	67.7%	63.2%
Manufacturing*	23.0%	9.2%	6.0%	61.9%	64.6%
Services*	12.0%	8.1%	4.4%	75.5%	58.6%

\* weighted by firm's employment

Sample : 9 374 firms, 48 520 observations, 2000-2013

Manufacturing firms : 5 114 firms, 29 704 observations.

Services firms : 4 260 firms, 18 816 observations.

# Transition matrices for Product and Process Innovators

<b>PRODUCT INNOVATION</b>		
	<b>IN YEAR T</b>	
<b>IN YEAR T-1</b>	Non - Innovator	Innovator
Non - Innovator	60.0%	40.0%
Innovator	27.6%	72.4%
<b>TOTAL</b>	<b>41.5%</b>	<b>58.5%</b>

<b>PROCESS INNOVATION</b>		
	<b>IN YEAR T</b>	
<b>IN YEAR T-1</b>	Non - Innovator	Innovator
Non - Innovator	62.7%	37.3%
Innovator	29.4%	70.6%
<b>TOTAL</b>	<b>44.9%</b>	<b>55.1%</b>

Unbalanced sample : 9 374 firms, 48 520 observations, 2000-2013



# 3. MEASUREMENT OF COMPETITION

## 1. At the industry level

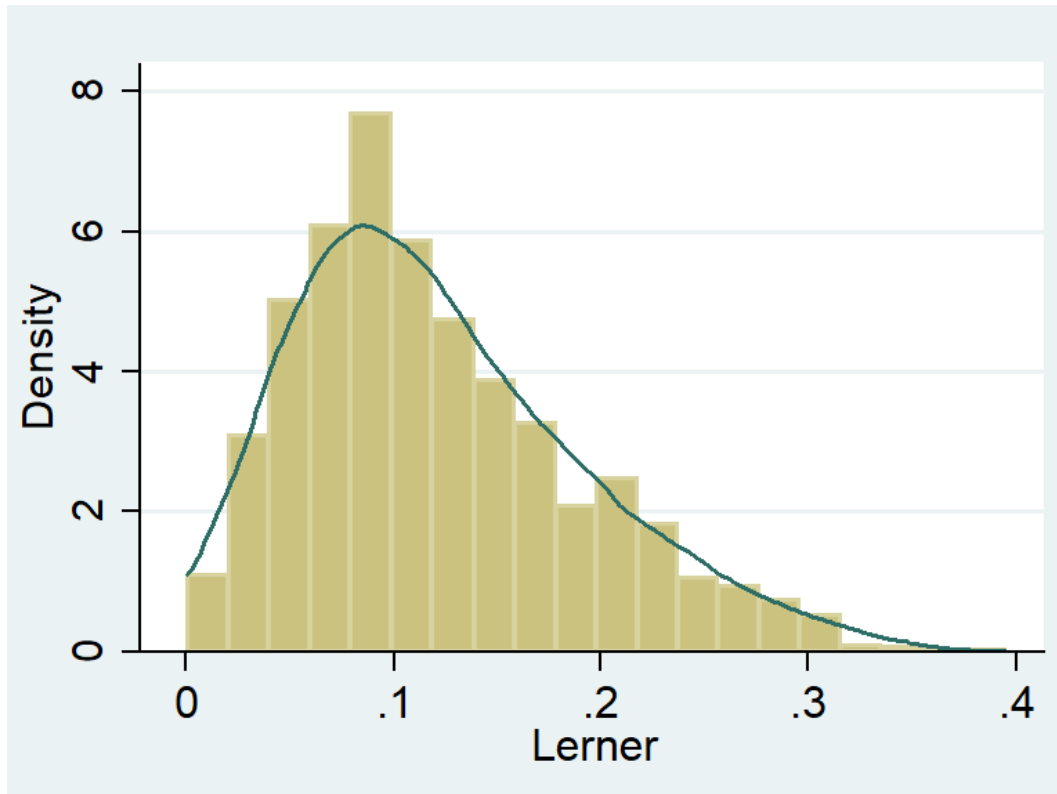
- French NA129 : 111 sectors
- Large database : 1994 – 2013, 1 290 000 obs., 100 000 firms
- Internal competition of French firms
- Classical measures : C4, HHI, Gini
- Lerner Index (industry-year average) :

$$Lerner = \frac{\textit{Operating Profits} - \textit{Financial Cost}}{\textit{Sales}}$$

- Competition Index :

$$\textit{Compet} = 1 - \textit{Lerner}$$

# Distribution of Lerner Index



Mean = 0.132

Std.Dev = 0.106

Median = 0.112

Q1 = 0.070

Q3 = 0.164

IQR = 0.095

## 2. At the firm level

- Absolute market share (relative to the total industry sales)
- Relative market share :

$$mkt\_rel_i = \frac{mkt\_share_i}{mkt\_share_{leader}} = \frac{Sales_i}{Sales_{leader}}$$

- Dummy for the leader in the sector
- Technology Gap : Distance to the Efficiency Frontier (*TFP*)

$$distance_i = \log(TFP_{MAX}) - \log(TFP_i)$$

# Mean-Difference in Competition measures

<b>PRODUCT INNOVATION</b>			
	NO	YES	Difference
<i>Compet</i>	0.8821	0.8577	-0.0245
<i>mkt_share</i>	0.0050	0.0093	0.0042
<i>mkt_rel</i>	0.0466	0.0744	0.0277
<i>leader</i>	0.0065	0.0128	0.0063
<i>distance</i>	0.8210	0.8065	-0.0145
<b>PROCESS INNOVATION</b>			
	NO	YES	Difference
<i>Compet</i>	0.8757	0.8614	-0.0143
<i>mkt_share</i>	0.0054	0.0093	0.0039
<i>mkt_rel</i>	0.0481	0.0749	0.0268
<i>leader</i>	0.0070	0.0128	0.0058
<i>distance</i>	0.8124	0.8126	0.0002*

Unbalanced sample : 9 374 firms, 48 520 observations, 2000-2013

20 131 Product innovations (41.5%)

21 769 Product innovations (44.9%)

\* : not significant at 1% level.

## 4. ECONOMETRIC ESTIMATIONS

- Separate estimations for Product / Process Innovations
- Dynamic probit model

$$Product_{i,t} = f(Product_{i,t-1}, Process_{i,t-1}, Control_{i,t}, Competiton_{i,t-1}, Time, Firm)$$

$$Process_{i,t} = f(Process_{i,t-1}, Product_{i,t-1}, Control_{i,t}, Competiton_{i,t-1}, Time, Firm)$$

- Panel Data → Individual Random effect  
→ Gauss-Hermite method (Buttler & Moffitt, 1992)
- Dynamic specification : controlling by initial values of variables (Wooldridge, 1999)

## Control variables (firm-level) :

- Size :  $Employment$  ,  $Employment^2$
- R&D intensity :  $(R\&D/Sales)$  ,  $(R\&D/Sales)^2$
- $\text{Log}(Capital/Labor)$
- Export rate

## Competition variables

- Competition index (level and squared)
- Absolute market share (level and squared)
- Relative market share (level and squared)
- Leader dummy
- Distance to the efficiency frontier

# Estimation Results and Average Marginal Effects

	PRODUCT			PROCESS		
	Estimates	Std. Error	AME	Estimates	Std. Error	AME
Product (t-1)	0.265 ***	(0.019)	0.089	0.137 ***	(0.017)	0.048
Process (t-1)	0.178 ***	(0.017)	0.060	0.358 ***	(0.018)	0.124
Product (t=0)	0.404 ***	(0.023)	0.136	0.190 ***	(0.021)	0.066
Process (t=0)	0.090 ***	(0.022)	0.030	0.289 ***	(0.022)	0.100
L (t)	0.075 *	(0.039)	0.025	0.101 ***	(0.039)	0.035
L (t-1)	0.000	(0.001)	0.000	-0.001	(0.001)	0.000
(R&D / Sales) (t)	0.811 ***	(0.165)	0.273	0.514 ***	(0.162)	0.178
(R&D / Sales) <sup>2</sup> (t)	-0.740 ***	(0.155)	-0.249	-0.372 **	(0.152)	-0.129
log(K / L) (t)	0.043 **	(0.018)	0.014	0.060 ***	(0.017)	0.021
Export rate (t)	0.178 ***	(0.050)	0.060	0.170 ***	(0.049)	0.059
Distance (t-1)	-0.070 ***	(0.024)	-0.024	-0.017	(0.023)	-0.006
Compet (t-1)	2.469 ***	(0.672)	0.831	1.299 **	(0.642)	0.449
Compet <sup>2</sup> (t-1)	-2.610 ***	(0.490)	-0.879	-1.106 **	(0.471)	-0.383
mkt_share (t-1)	2.782	(1.899)	0.937	2.483	(1.813)	0.859
mkt_share <sup>2</sup> (t-1)	-4.894 **	(2.319)	-1.648	-4.638 **	(2.258)	-1.606
mkt_rel (t-1)	1.169 ***	(0.396)	0.394	1.165 ***	(0.381)	0.403
mkt_rel <sup>2</sup> (t-1)	-1.224 ***	(0.391)	-0.412	-0.892 **	(0.380)	-0.309
leader (t-1)	0.252 *	(0.138)	0.085	0.008	(0.136)	0.003

All firms : 9 374 firms, 48 520 observations, 2000-2013.

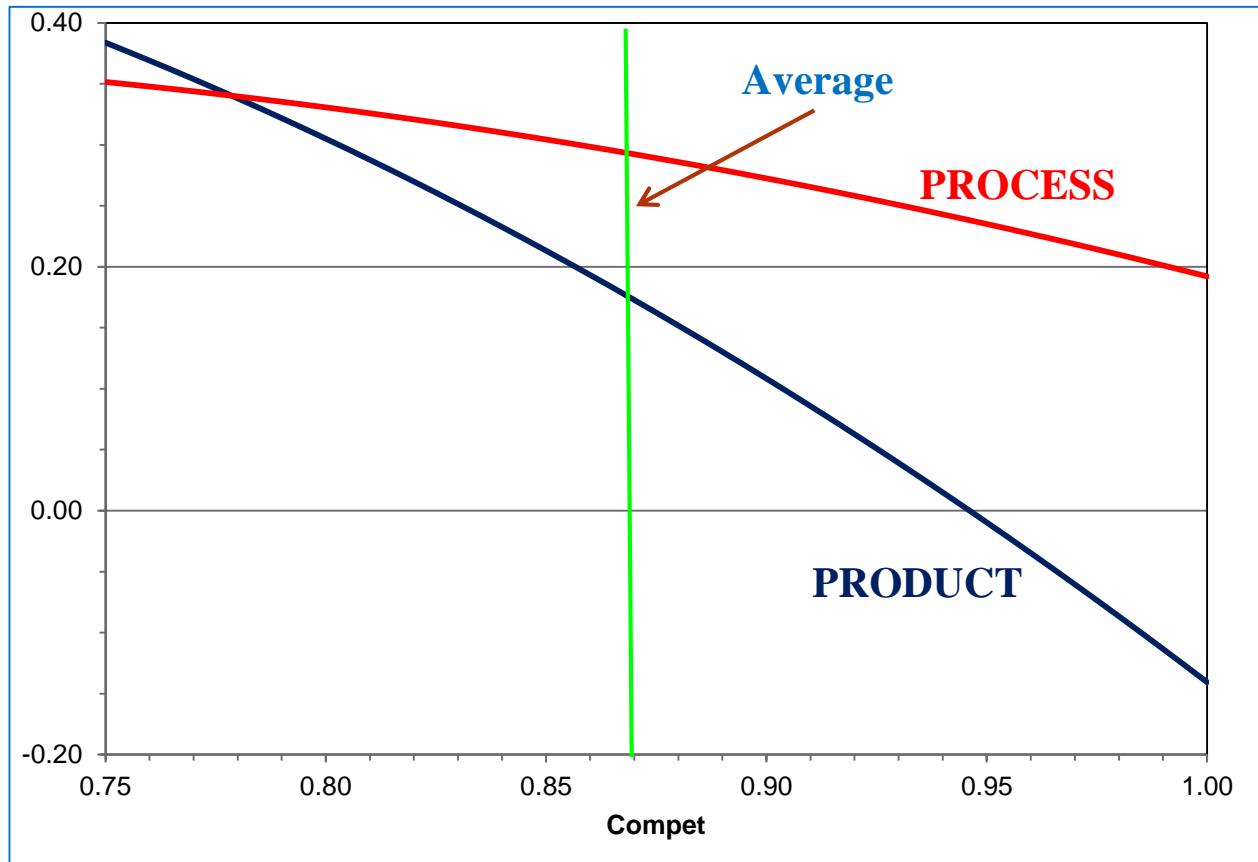
Full set of time dummies and initial value of variables not reported here.

Maximum likelihood estimation of panel probit model using Gauss-Hermite quadrature with 12 integration points.

Asymptotic standard errors in parenthesis. AME = Average Marginal Effects.

Estimates significant at 1% level : \*\*\*, at 5 % level : \*\*, at 10% level :\*.

# Effect of Competition on Innovation

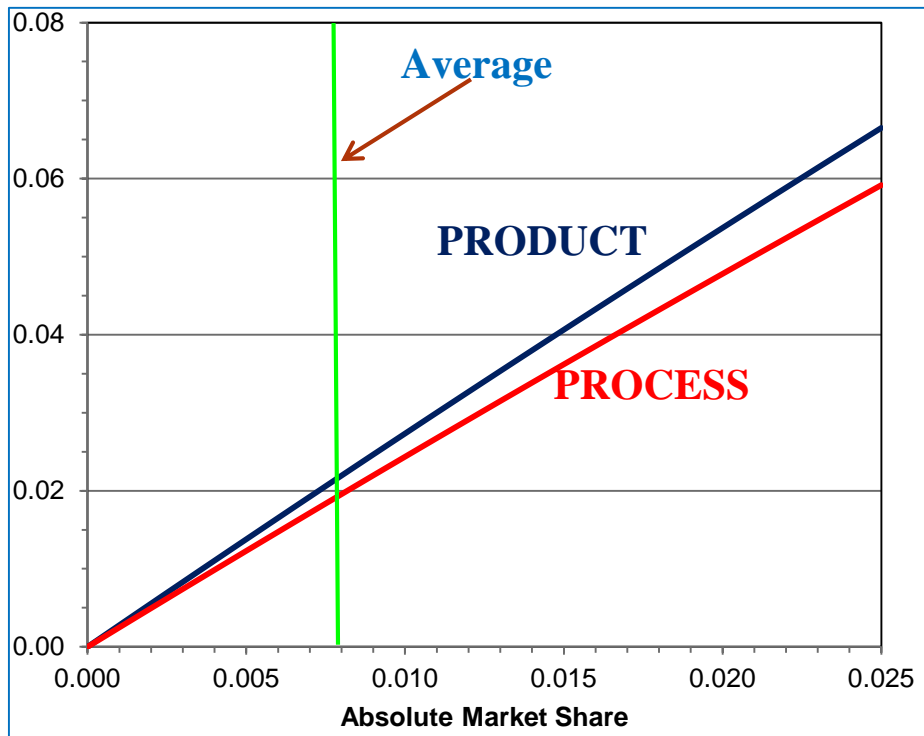


Maximum Effect :  
Product = 0.47  
Process = 0.59

Competition :  
P05 = 0.721  
P01 = 0.320



# Effect of Market Share on Innovation



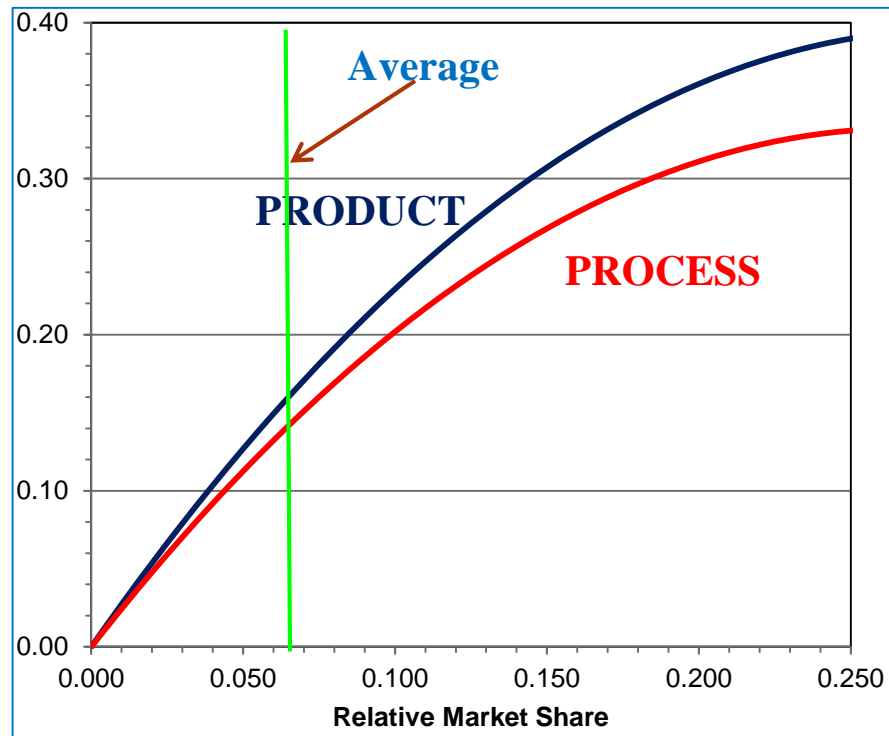
Maximum Effect :

Product = 0.28

Process = 0.27

Absolute Market Share :

P99 = 0.117



Maximum Effect :

Product = 0.48

Process = 0.65

Relative Market Share :

P95=0.323

P99 = 1.000

# 5. PRELIMINARY CONCLUSIONS

- High persistence of innovations
  - Direct persistence
  - Cross persistence (product → process, process → product)
- Industry-specific and Firm-specific measures of competition
- All have an inverted-U shape effect on innovation
- But for most of firms : negative effect of competition on innovation
- Dominant firms are more innovative
- Steeper effects for product innovation (vs process innovation)
- No cross-effect of competition and technology gap !

# Next...

- Other measure of technology structure of an industry
- Import competition or export competition of French firms
- Introducing a financial constraint
  
- Robustness to the industry classification ? Large heterogeneity within sector
  
- Different effects in
  - Manufacturing vs. Services
  - Exposed or not to foreign competition