Spatial concentration and firm-level productivity in France

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Motivation

An old story…

- Interest of economists for clusters and agglomeration economies is not new

- MAR-type externalities:

- inputs, workers, knowledge
- matching, sharing, learning (Duranton, Puga, 2003)

- Jacobs' externalities: urbanization economies

…but a recent public interest

- Interest of public authorities for clusters is much more recent
- Public sustain to clusters can take various forms (« Kompetenznetze » in Germany, « Pôles de compétitivité » in France)
- Rationale for those policies: if agglomeration externalities exist, and if they are not well internalized by firms, public intervention in order to maximize social welfare

Empirical questions

- Do agglomeration economies exist in France and how large are they?
- Given this measure, is the geography of economic activities optimal?

Main results

- Localization economies do exist in France…
- …but they are non linear
- Given the estimated bell-shaped gains to agglomeration, French firms seem to have quite well internalized localization economies in their location decisions…
- …which casts doubt on the adequacy of clusters policies devoted to increase the size of existing clusters

Empirical strategy

A production function approach…

$$Y_{it} = A_{it} K^{\alpha}_{it} L^{\beta}_{it} ,$$

- $Y_{it,}$ value added of firm *i* at time *t*
- $K_{it,}$ capital of firm *i* at time *t*
- $L_{it,}$ employment of firm *i* at time *t*
- $A_{it,}$ TFP of firm *i* at time *t*

…wich decomposes firms TFP

$$A_{it} = \varphi AGGL^{\delta}_{iszt} \, DIV^{\gamma}_{iszt} \, U_{it}$$

- $AGGL_{iszt}$ localization variable(s) for firm *i*, from industry *s*, in region *z* at time *t*

- DIV_{iszt} urbanization variable(s) for firm *i*, from industry *s*, in region *z* at time *t*

Estimation issues (1)

$$y_{it} = \delta\, aggl_{iszt} + \gamma\, div_{iszt} + \alpha k_{it} + \beta l_{it} + u_{it}$$

with $u_{it}=u_i+v_{it}$

- u_i potentially correlated with all the regressors (firms, entrepreneurs and locations fixed characteristics),
- v_{it} potentially correlated with all the regressors too (cyclical effects)

Estimation issues (2)

- To remove firms fixed effects: first differencing

- To control for simultaneity bias: instrumenting first differenced variables by lagged level in *t-2*

=> GMM approach

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Data

The Annual Business Surveys

- Balance-sheet data (capital employees, value added, aggregate wages etc.)
- Firms bigger than 20 employees
- Period: 1996-2004

The variables

- Localization economie:

- $loc_{iszt}=ln(employees_{szt} – employees_{iszt}+1)$

- Urbanization economies:

- $urb_{szt}=ln(employees_{zt} – employees_{szt}+1)$
- $div_{szt}=ln(1/Herfindahl\ of\ sectoral\ diversity)$

- Porterian economies:

- $comp_{szt}=ln(1/Herfindahl\ of\ sectoral\ concentration)$

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Results

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Descriptive statistics

Table 2: Summary statistics Naf 3-digit/Employment area

Variable	Observations	Mean	Std. Dev.	Min	Max
Value added	94573	2625.15	5897.22	32.39	413909.9
Firm's employment	94573	63.34	100.88	1	6616
Firm's capital	94573	2799.35	11154.95	7.30	1052349
Firm's capital intensity	94573	34.05	33.81	0.83	258.64
Firm's labor productivity	94573	39.94	18.53	11.68	161.63
# employees, other firms, same industry-area	94573	1098.82	2817.19	0	24475.01
# other firms, same industry-area	94573	18.49	48.76	0	520
# other employees, same area	94573	19885.89	24433.19	16	115785
# other firms, same area	94573	275.35	376.74	3	2164

Value-added, capital, capital intensity and labor productivity are expressed in thousands of real euros

Controlling for unobserved heterogeneity

Table 3: Fixed effects approach, Naf 3-digit/Employment Area

Model :	Dependent Variable: ln value added							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln employees	0.795[a]	0.806[a]	0.817[a]	0.753[a]	0.795[a]	0.803[a]	0.817[a]	0.753[a]
	(0.005)	(0.005)	(0.005)	(0.008)	(0.005)	(0.005)	(0.005)	(0.008)
ln capital	0.158[a]	0.159[a]	0.141[a]	0.078[a]	0.159[a]	0.159[a]	0.141[a]	0.078[a]
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)
ln (# employees, other firms, same industry-area+1)	0.005[a]	0.001	0.002	0.007[a]	0.005[a]	0.008[a]	0.002	0.005[b]
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln(# employees, other industries, same area+1)	0.071[a]	-0.008	-0.005	0.025	0.076[a]	0.014	-0.036[c]	0.024
	(0.003)	(0.020)	(0.019)	(0.016)	(0.003)	(0.020)	(0.019)	(0.016)
ln competition					-0.001	-0.024[a]	-0.003	0.009
					(0.004)	(0.004)	(0.005)	(0.006)
ln sectoral diversity					-0.018[a]	0.031[b]	-0.032[b]	0.002
					(0.005)	(0.014)	(0.013)	(0.010)
Time fixed effect	yes	yes	yes	yes	yes	yes	yes	yes
Employment area fixed effects	no	yes	yes	no	no	yes	yes	no
Industry fixed effects	no	no	yes	no	no	no	yes	no
Firm fixed effects	no	no	no	yes	no	no	no	yes
N	94573	94573	94573	94573	94573	94573	94573	94573
R^2	0.789	0.810	0.833	0.421	0.789	0.810	0.833	0.421

Note: Standard errors in parentheses. [a], [b] and [c] respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are corrected to take into account individual autocorrelation.

Controlling for simultaneity- Second stage regressions

Table 4: Instrumental variables approach, Naf 3-digit/Employment Area

Model :	Dependent Variable: Δ ln(value added)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ ln(employees)	0.512[a]	0.894[a]	0.896[a]	0.896[a]	0.512[a]	0.898[a]	0.90[a]	0.898[a]
	(0.009)	(0.077)	(0.077)	(0.099)	(0.009)	(0.083)	(0.082)	(0.106)
Δ ln(capital)	0.071[a]	0.214[a]	0.215[a]	0.216[a]	0.071[a]	0.211[a]	0.212[a]	0.212[a]
	(0.006)	(0.024)	(0.024)	(0.031)	(0.006)	(0.024)	(0.024)	(0.030)
Δ ln(# employees, other firms, same industry-area+1)	0.006[a]	0.050[a]	0.051[a]	0.051[b]	0.006[a]	0.042[b]	0.043[b]	0.043[c]
	(0.002)	(0.019)	(0.019)	(0.024)	(0.002)	(0.020)	(0.020)	(0.025)
Δ ln(# employees, other industries, same area+1)	0.012	-0.013	-0.015	-0.016	0.016	0.101	0.098	0.101
	(0.015)	(0.113)	(0.113)	(0.157)	(0.015)	(0.140)	(0.140)	(0.195)
Δ ln (competition)					-0.001	0.039	0.045	0.039
					(0.005)	(0.034)	(0.033)	(0.047)
Δ ln (sectoral diversity)					0.011	-0.098	-0.098	-0.092
					(0.009)	(0.091)	(0.091)	(0.129)
Sargen-Hansen test/p-value				0.738				0.798
N	54991	54991	54991	54991	54991	54991	54991	54991
R^2	0.123	0.024	0.023	0.022	0.123	0.019	0.017	0.019

Note: Standard errors in parentheses. [a], [b] and [c] respectively denoting significance at the 1%, 5% and 10% levels. (1) and (5) simple OLS, (2) and (6) are IV, with standard errors taking into account individual auto-correlation, (3) and (7) are GMM, with standard errors taking into account individual auto-correlation, (4) and (8) are GMM with Moulton standard errors.

Marginal effects and explanatory power

Employment area/Naf 3	Département/Naf 3	Employment area/Naf 2	Département/Naf 2
3.03%	4.75%	3.89%	13.60%

Variable	Employment area/Naf 3	Département/Naf 3	Employment area/Naf 2	Département/Naf 2
employees	119.94%	149.58%	160.71%	174.67%
capital	36.04%	35.50%	43.72%	46.01%
# employees, other firms, same industry-area	5.52%	6.85%	5.70%	14.70%

Note: The table reads as follows: for a firm, all other things being equal, a standard-deviation with respect to the mean of the number of own employees generates, at Naf 3-digit/Employment area level, an increase of value-added by 119.94%.

Alternative specification

Table 5: Instrumental variables approach, Naf 3-digit/Employment Area

	Dependent Variable: Δ ln(value added)							
Model :	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ ln(employees)	0.512[a]	0.953[a]	0.955[a]	0.950[a]	0.512[a]	0.940[a]	0.943[a]	0.940[a]
	(0.009)	(0.084)	(0.084)	(0.108)	(0.009)	(0.085)	(0.085)	(0.109)
Δ ln(capital)	0.071[a]	0.228[a]	0.229[a]	0.228[a]	0.071[a]	0.227[a]	0.228[a]	0.227[a]
	(0.006)	(0.025)	(0.025)	(0.032)	(0.006)	(0.025)	(0.025)	(0.031)
Δ ln(specialisation)	0.006[a]	0.060[a]	0.061[a]	0.059[b]	0.006[a]	0.051[b]	0.052[b]	0.051[c]
	(0.002)	(0.021)	(0.021)	(0.027)	(0.002)	(0.021)	(0.021)	(0.027)
Δ ln(density)	0.024	-0.040	-0.048	-0.044	0.028[c]	-0.041	-0.040	-0.035
	(0.016)	(0.086)	(0.085)	(0.117)	(0.016)	(0.092)	(0.092)	(0.127)
Δ ln(competition)					-0.001	0.054	0.055	0.053
					(0.005)	(0.034)	(0.034)	(0.048)
Δ ln(sectoral diversity)					0.011	-0.027	-0.028	-0.030
					(0.009)	(0.082)	(0.082)	(0.117)
Sargan-Hansen test/p-value				0.713				0.832
N	54991	54991	54991	54991	54991	54991	54991	54991
R^2	0.123	0-.007	0-.009	0-.006	0.123	0-.005	0-.007	0-.005

Note: Standard errors in parentheses. [a], [b] and [c] respectively denoting significance at the 1%, 5% and 10% levels. (1) and (5) simple OLS, (2) and (6) are IV, with standard errors taking into account individual auto-correlation, (3) and (7) are GMM, with standard errors taking into account individual auto-correlation, (4) and (8) are GMM with Moulton standard errors.

Multi-plant firms

Table 8: Multi-plants firms and agglomeration economies

Model :	Dependent Variable: Δ ln(value added)			
	Employment area/Naf 3	Département/Naf 3	Employment area/Naf 2	Département/Naf 2
Δ ln(employees)	0.748^a	0.847^a	0.828^a	0.834^a
	(0.107)	(0.105)	(0.101)	(0.112)
Δ ln(capital)	0.223^a	0.207^a	0.226^a	0.223^a
	(0.026)	(0.024)	(0.025)	(0.024)
Δ ln(# employees, other firms, same industry-area+1)	0.040^c	0.076^b	0.054	0.190^a
	(0.023)	(0.033)	(0.035)	(0.066)
Δ ln(# employees, other industries, same area+1)	0.073	0.002	-0.042	-0.115
	(0.164)	(0.136)	(0.161)	(0.146)
Δ ln(competition)	0.103^b	0.090^b	0.083^c	0.028
	(0.043)	(0.040)	(0.047)	(0.048)
Δ ln(sectoral diversity)	-0.090	-0.132	0.049	-0.222
	(0.112)	(0.084)	(0.116)	(0.145)
Sargan-Hansen test/p-value	0.583	0.194	0.074	0.252
N	76209	86180	88458	92765
Centered R^2	0.057	0.041	0.048	0.035

Note: standard-errors in parentheses ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard-errors are Moulton's standard-errors.

Firms or employees externalities?

Table 10: Employees, firms and agglomeration economies

Model:	Dependent Variable: Δ ln(value added)			
	Employment area/Naf 3	Département/Naf 3	Employment area/Naf 2	Département/Naf 2
Δ ln(employees)	0.923^a	0.958^a	1.020^a	1.026^a
	(0.110)	(0.101)	(0.107)	(0.111)
Δ ln(capital)	0.222^a	0.198^a	0.226^a	0.197^a
	(0.032)	(0.028)	(0.035)	(0.032)
Δ(ln(Mean size of other firms, same industry-area+1)	0.052^c	0.084^b	0.094^c	0.191^b
	(0.028)	(0.039)	(0.050)	(0.086)
Δ ln(# other firms, same industry-area+1)	0.077	0.115	0.040	-0.164
	(0.074)	(0.115)	(0.154)	(0.299)
Δ ln(# employees, other industries, same area+1)	0.058	0.021	-0.144	-0.012
	(0.229)	(0.177)	(0.224)	(0.219)
Δ ln(competition)	0.032	0.034	0.041	0.073
	(0.054)	(0.052)	(0.056)	(0.088)
Δ ln(sectoral diversity)	-0.097	-0.121	0.047	0.024
	(0.145)	(0.114)	(0.146)	(0.244)
Sargan-Hansen test/p-value	0.531	0.210	0.816	0.349
N	54991	61332	62305	64714
Centered R^2	0-.000	0-.002	0.038	0.054

Note: standard-errors in parentheses ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard-errors are Moulton's standard-errors.

Externalities and distance

Table 11: Agglomeration externalities and distance/"Market potential"

Model:	Dependent Variable: Δ ln(value added)			
	Employment area/Naf 3	Département/Naf 3	Employment area/Naf 2	Département/Naf 2
Δ ln(employees)	0.932^a	1.047^a	0.984^a	0.973^a
	(0.133)	(0.119)	(0.104)	(0.103)
Δ ln(capital)	0.203^a	0.169^a	0.227^a	0.215^a
	(0.039)	(0.032)	(0.028)	(0.027)
Δ ln(# employees, other firms, same industry-area+1)	0.048^c	0.095^b	0.051	0.161
	(0.027)	(0.042)	(0.038)	(0.104)
Δ ln(# employees, same industry, all other areas weighted by distance+1)	-0.104	-0.306	0.087	0.025
	(0.258)	(0.230)	(0.106)	(0.159)
Δ ln(# employees, other industries, same area+1)	0.089	0.119	-0.102	-0.103
	(0.167)	(0.149)	(0.117)	(0.120)
Δ ln(competition)	0.045	0.049	0.035	-0.007
	(0.048)	(0.045)	(0.052)	(0.053)
Δ ln(sectoral diversity)	-0.079	-0.109	0.096	-0.110
	(0.125)	(0.106)	(0.117)	(0.173)
Sargan-Hansen test/p-val	0.806	0.605	0.394	0.132
N	54991	61332	62305	64714
Centered R^2	0.007	0-.038	0-.014	0-.007

Note: standard-errors in parentheses. ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard-errors are Moulton's standard-errors.

Is bigger always better? (1)

Table 12: Localization economies vs Congestion effects

Model	Dependent Variable: Δ ln(value added)	
	Employment area/Naf 3	Département/Naf 3
Δ ln(employees)	0.923[a]	0.960[a]
	(0.114)	(0.104)
Δ ln(capital)	0.225[a]	0.198[a]
	(0.032)	(0.029)
Δ ln(# employees, other firms, same industry-area+1)	-0.251[b]	-0.247[a]
	(0.110)	(0.086)
Δ ln(# employees, other firms, same industry-area+1)^2	0.085[b]	0.078[a]
	(0.040)	(0.028)
Δ ln(# employees, other firms, same industry-area+1)^3	-0.006[c]	-0.005[b]
	(0.003)	(0.002)
Δ ln(# employees, other industries, same area+1)	0.107	0.028
	(0.227)	(0.171)
Δ ln (competition)	0.031	0.051
	(0.051)	(0.045)
Δ ln (sectoral diversity)	-0.150	-0.141
	(0.135)	(0.108)
Sargan-Hansen test/p-value	0.983	0.665
N	51491	60062
Centered R^2	0-.004	0.000

Note: standard-errors in parentheses [a], [b] and [c] respectively denoting significance at the 1%, 5% and 10% levels. Standard-errors are Moulton's standard-errors.

Is bigger always better? (2)

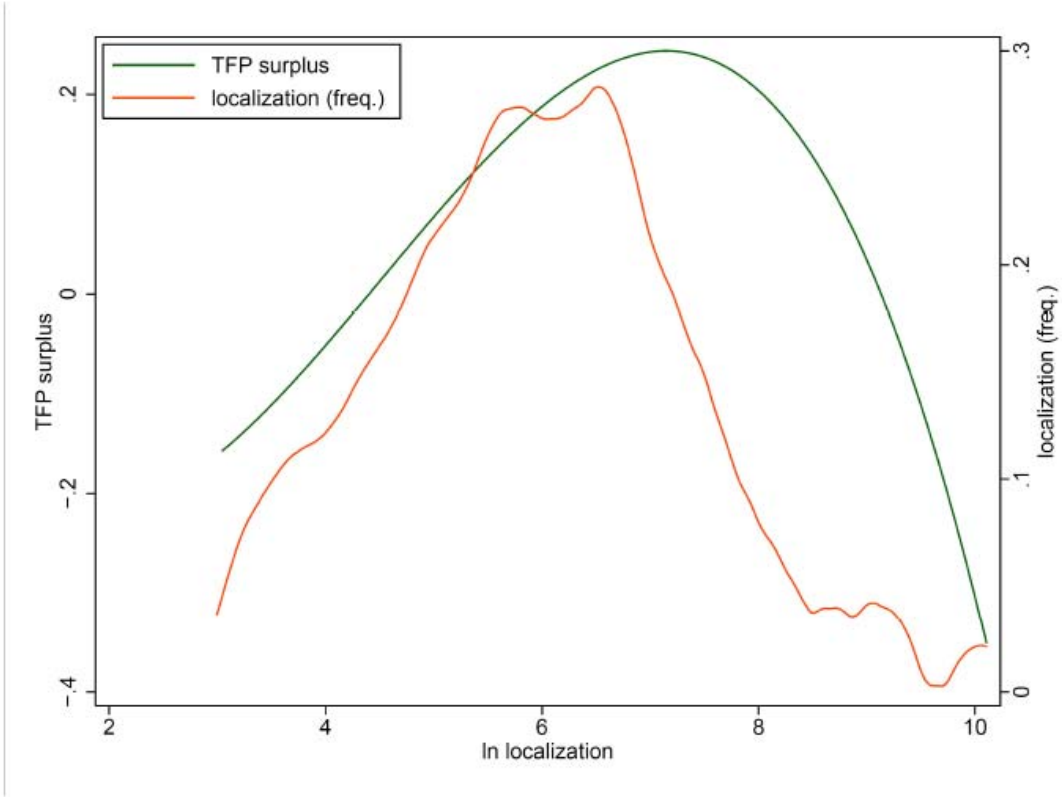

Figure 1: Localization economies - Employment Area/Naf 3-digit

Is bigger always better? (3)

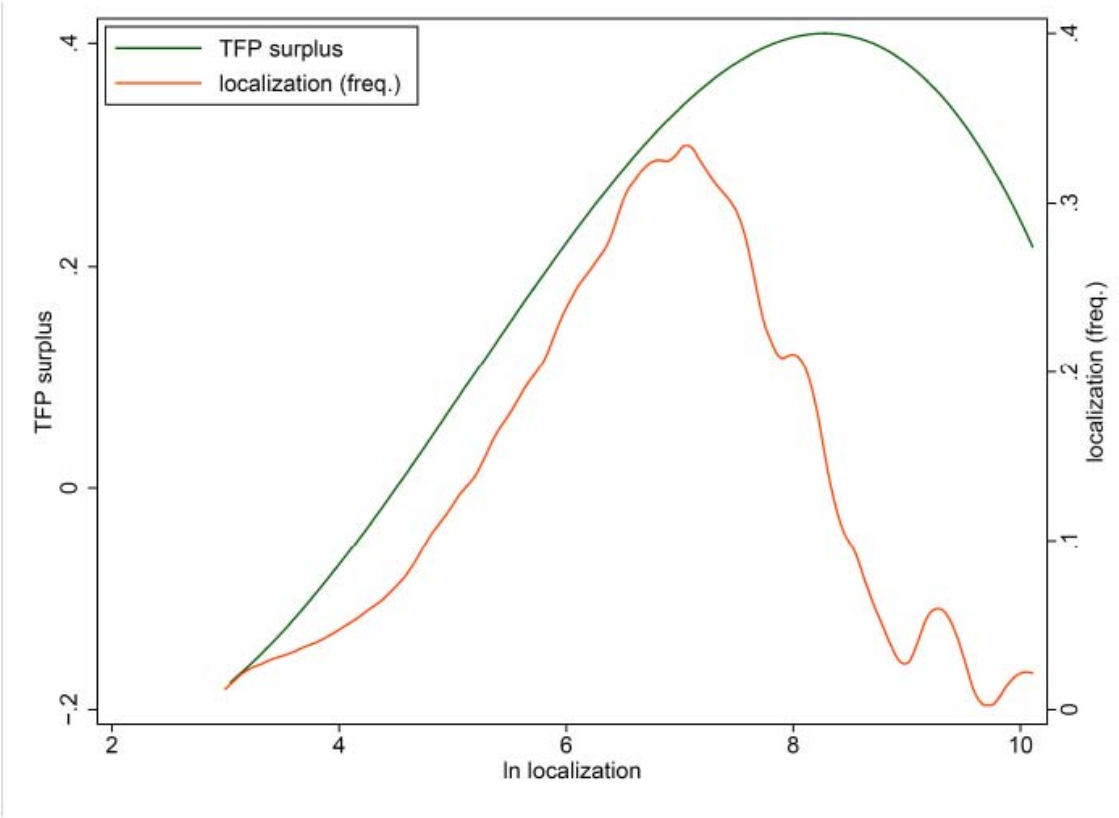

Figure 2: Localization economies - Département/Naf 3-digit

Are firms spatially rational?

- **At EA/Naf3 level :**
- Estimated peak: 1270 employees
- Observed peak: 650 employees
- Productivity gain from the oberved to the estimated peak: 2.1%
- Productivity gain from 0 to the estimated peak : 25%

- **At Dep/Naf3 level :**
- Estimated peak : 3920 employés
- Observed peak : 1180 employés
- Productivity gain from the oberved to the estimated peak : 6.2%
- Productivity gain from 0 to the estimated peak : 47%

Conclusive remarks

- At firm level, MAR-type externalities do exist but no evidence of urbanization economies
- Localization economies are non linear: there is a point from which congestion costs become bigger than MAR-type externalities
- French firms seem to have internalized quite well the gains from location choice => Geography matters a lot but very few gains to expect from a more agglomerated one
- What should public policies do in that context? Rather than reinforcing the « attractivity » of territories, shifting the estimated peak on the right => infrastructure policies etc.