

Population agglomeration, industrial variety, and enterprise performance: A multilevel study

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Purpose

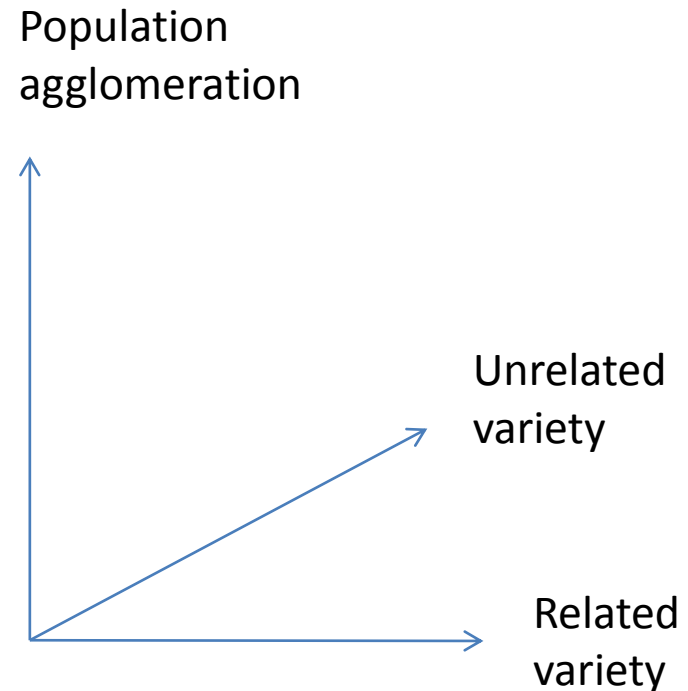
- Study how enterprises' own resources *and* geographical localization particularities are related to enterprise performance in terms of productivity and innovation
- Specifically, scrutinize how cluster characteristics can foster pecuniary and technology externalities/spillovers that can directly or indirectly benefit enterprises

Type of research

- Multilevel study
- Data basically stems from Statistics Norway's national survey: "Innovation in the business enterprise sector, 2010-2012"
- We analyze 6584 enterprises nested within numerous industries and located in 89 economic-geographical regions

Dimensions of economic-geographical clusters

- Population agglomeration/density
 - Economies of scale and pecuniary externalities by serving a large market
 - Abundant access to specialized and complementary factor conditions
- Related industrial variety
 - Technological externalities from resource sharing, or spillover, fostering innovation
- Unrelated industrial variety (as control variable)



Hypotheses

- H1: Enterprises in agglomerated regions will be more productive (in terms of revenues generated per employee) than enterprises in less agglomerated regions
- H2: Enterprises in regions with related industrial variety will have higher probabilities of generating innovations than enterprises in regions with less related industrial variety

Data

- Statistics Norway's national survey:
"Innovation in the business enterprise sector, 2010-2010"
- Division of Norway into 89 distinct economic-geographical regions, as classified by Statistics Norway (NUTS level 4, according to the EU)
- Data provided by Statistics Norway on regional population size and geographical size

Variables at region level

- Population agglomeration/density
 - Number of inhabitants divided on economic-geographical region's size
- Urelated variety (UV)
 - Shannon's entropy measure at enterprises' SIC codes at level 2 ("crude" classification of industries)
 - $UV = \sum_{k=1}^n s_{k,i} \ln(1/s_{k,i})$, $s_{k,i}$ is the share of enterprises in industrial class k in region i , if $k=0$ $\ln(1/s_{k,i})=0$, n is the number of different SIC codes at level 2

Variables at region level, ctd.

- Related variety (RV)
 - Shannon's entropy measure at enterprises' SIC codes at level 5 ("fine grained" classification of industries) minus unrelated variety (UV)
 - $RV = \sum_{k=1}^N l_{k,i} \ln(1/l_{k,i}) - UV$, $l_{k,i}$ is the share of enterprises in industrial class k in region i , if $k=0$ $\ln(1/l_{k,i})=0$, N is the number of different SIC codes at level 5

Variables at enterprise level

- Dependent variables:
 - Productivity: Revenues per employee (independent variable when measuring innovation)
 - Innovation: Dummy (yes=1, no=0) if the enterprise during the last 3 years had developed new or substantially improved products, services, or processes of production, which is new for the enterprise *and* the industry where it operates

Variables at enterprise level, ctd.

- Other control variables:
 - Multidivisional enterprise: Dummy (yes=1, no=0)
 - Size of the enterprise: Number of employees
 - R&D per employee
 - Regional R&D collaboration: Dummy (yes=1, no=0)
 - National R&D collaboration: Dummy (yes=1, no=0)
 - International R&D collaboration: Dummy (yes=1, no=0)

Analyses

- Multilevel mixed-effects linear and logistic regression carried out in Stata 13.1
- Takes account of both regional heterogeneity and heterogeneity of different industries nested within different regions

Results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
FIXED EFFECTS							
Constant	-.072** (.026)	-.096*** (.021)	-.080*** (.021)	-.036† (.021)	-.028 (.021)	-.030 (.021)	-.022 (.020)
Enterprise level							
Multidivisional enterprise			.064† (.034)	.062† (.034)	.065† (.034)	.065† (.034)	
Number of employees			.174*** (.013)	.172*** (.013)	.170*** (.013)	.170*** (.013)	
Regional level							
Urel. variation				-.041† (.023)	-.056* (.023)	-.054* (.021)	-.046* (.022)
Rel. variation				.099*** (.026)	.008 (.035)		
Population density (H1)					.128*** (.032)	.133*** (.024)	.156*** (.025)
RANDOM EFFECTS							
Residual	.971 (.017)	.686 (.014)	.659 (.013)	.659 (.013)	.659 (.014)	.659 (.013)	.686 (.015)
Regional effect	.032 (.009)	.009 (.005)	.005 (.005)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Industries within regions		.278 (.019)	.273 (.018)	.273 (.020)	.269 (.019)	.269 (.018)	.274 (.019)
Wald χ^2			264.1***	282.5***	298.9***	298.8***	43.53***
Log likelihood	-9287.1	-8785.8	-8656.7	-8650.4	-8642.6	-8642.6	-8767.2
Likelihood ratio χ^2	94.8***	1097.5***	1132.4***	1101.3***	1100.0***	1100.2***	1049.1***

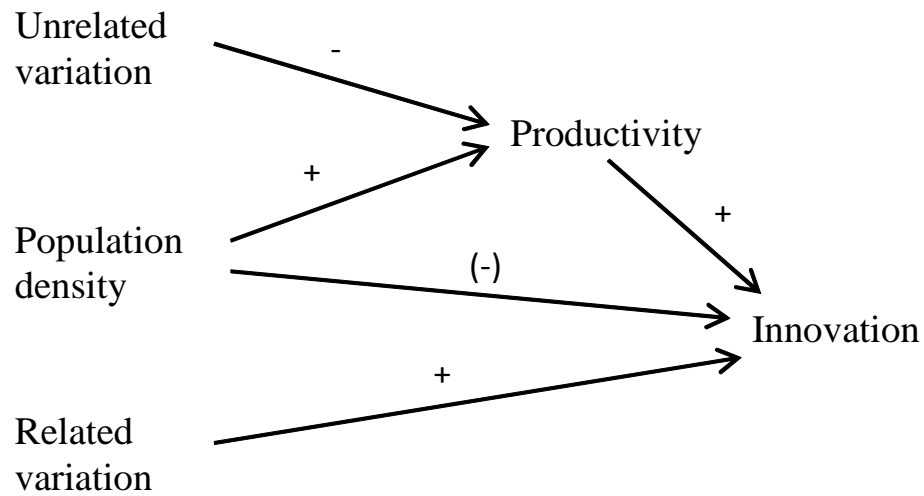
Dependent variable: Productivity. N=6584, number of economic regions=89, number of industries within economic regions=2072, † p<.10; * p<.05; ** p<.01; *** p<.001, two tailed tests of significance. Standard error in parentheses.

Results, ctd.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
FIXED EFFECTS								
Constant	-1.65*** (.056)	-1.87*** (.060)	-2.35*** (.068)	-2.35*** (.070)	-2.33*** (.069)	-2.33*** (.068)	-1.81*** (.063)	-1.80*** (.063)
Enterprise level								
Multidivisional enterprise			.075 (.124)	.075 (.124)	.062 (.124)	.063 (.124)		
Number of employees			-.061 (.050)	-.062 (.050)	-.060 (.050)	-.061 (.050)		
Productivity			.133** (.045)	.134** (.046)	.134** (.045)	.135** (.045)		
R&D per employee			1.53*** (.056)	1.53*** (.056)	1.53*** (.056)	1.53*** (.056)		
Regional R&D collab.			.547*** (.138)	.546*** (.138)	.547*** (.138)	.545*** (.138)		
National R&D collab.			.280† (.154)	.282† (.154)	.286† (.154)	.286† (.154)		
Int R&D collab.			.762*** (.159)	.761*** (.159)	.749*** (.159)	.750*** (.159)		
Regional level								
Population density				-.011 (.062)	-.177† (.094)	-.177† (.094)	-.053 (.096)	
Urel. variation				.035 (.054)	-.022 (.059)			
Rel. variation (H2)					.241* (.104)	.225* (.095)	.256** (.097)	.216*** (.063)
RANDOM EFFECTS								
Regional effect	.051 (.025)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.002 (.021)	.005 (.022)
Industries within regions		.903 (.140)	.291 (.092)	.291 (.092)	.269 (.092)	.271 (.091)	.910 (.146)	.908 (.146)
Wald χ^2			1105.8***	1105.4***	1112.1***	1111.3***	12.0**	11.76***
Log likelihood	-3076.5	-2984.1	-2191.6	-2191.4	-2188.7	-2888.8	-2976.7	-2976.8
Likelihood ratio χ^2	14.31***	199.2***	27.58***	25.54***	20.99***	21.82***	185.5***	185.3***

Dependent variable: Innovation. N=6584, number of economic regions=89, number of industries within economic regions=2072, † p<.10; * p<.05; ** p<.01; *** p<.001, two tailed tests of significance. Standard error in parentheses

Results, ctd.



Empirical Model

Results, ctd.

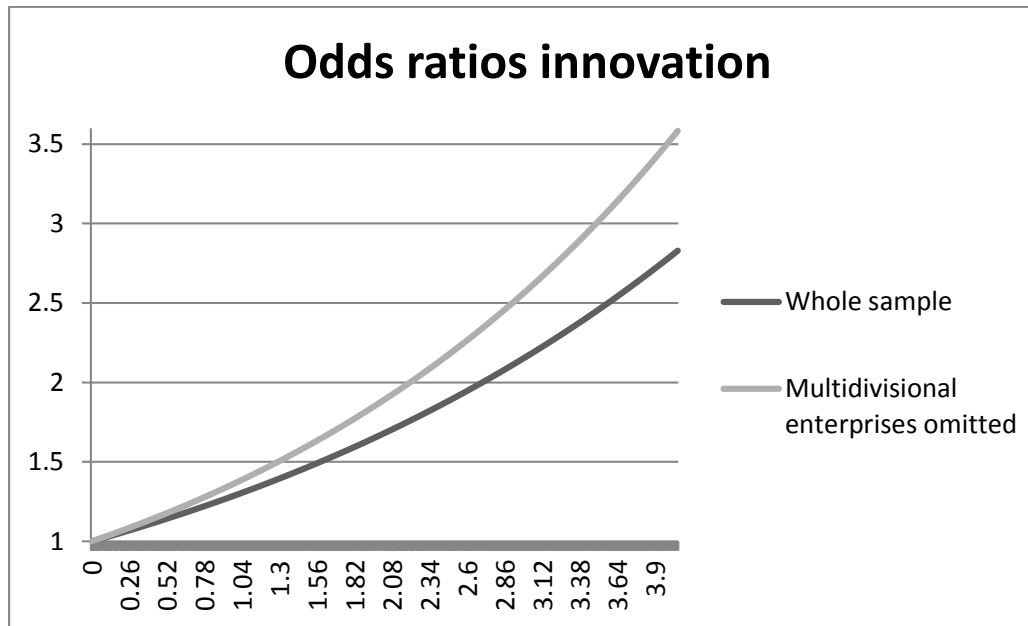
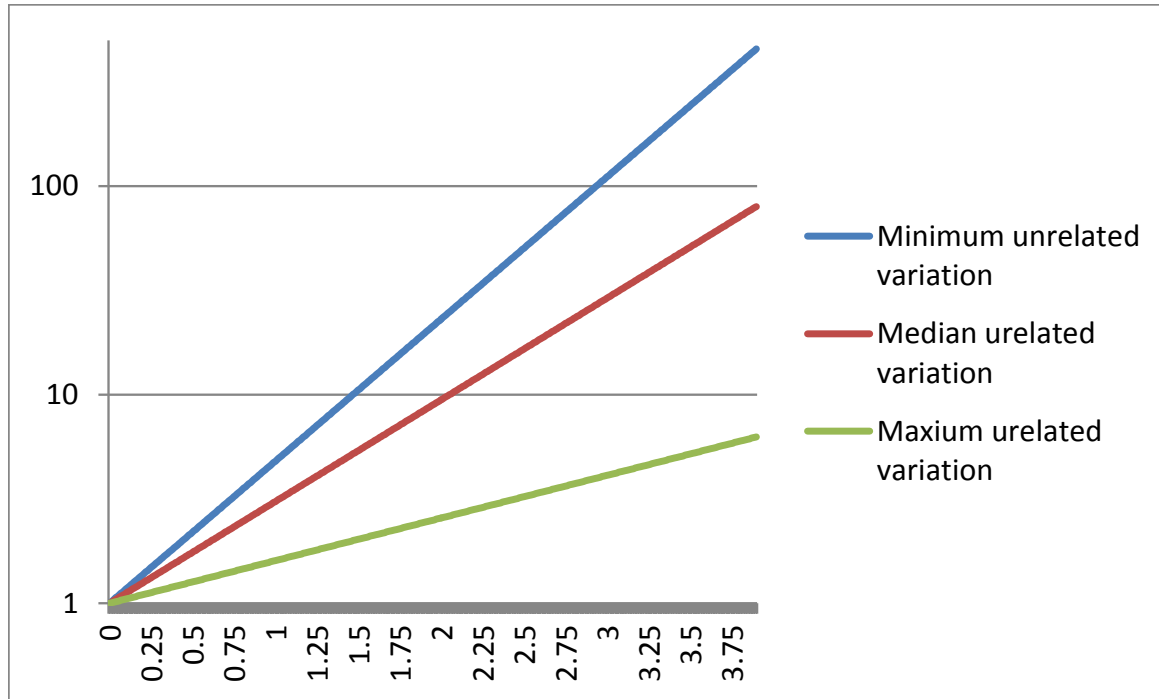


Figure 2. Odds ratio innovation as a function of related industrial variation at a regional level. Black line is based on Model 7, grey line based on the same model but which omits multidivisional enterprises from the sample.

Results, ctd.



Odds ratio innovation as a function of R&D per employee and regional unrelated variation