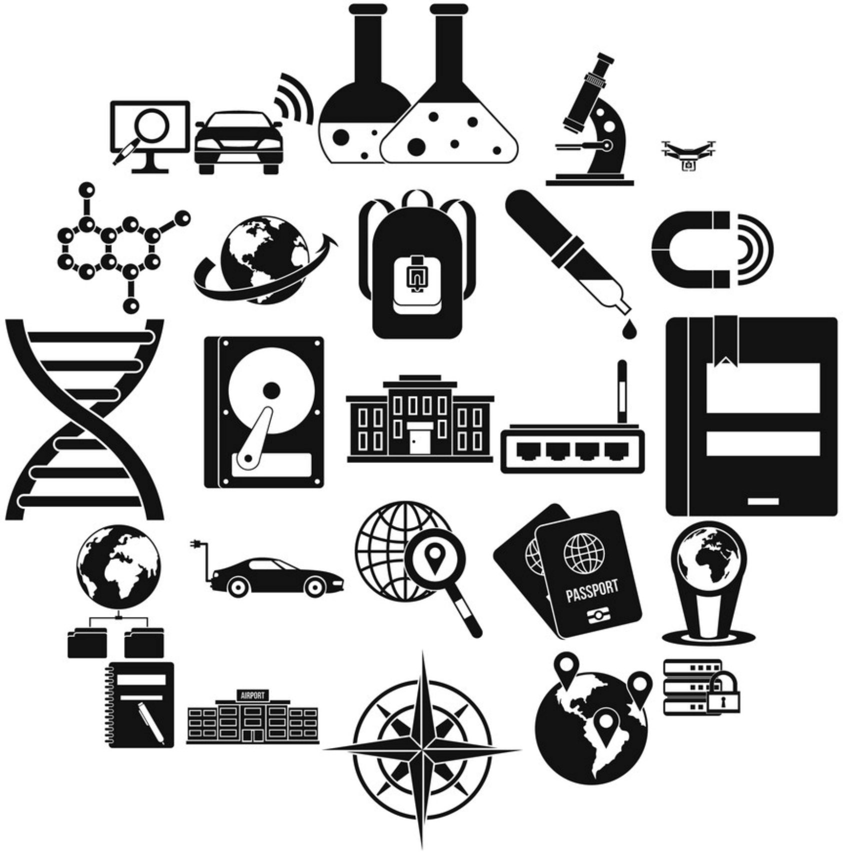
사람에서 장소로:
우리 모두가 공유하는 회복탄력성 레시피

글로벌융합학부
컬처앤테크놀로지
이창준

회복탄력성
(Resesilience)



회복탄력성
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Sustainability

Journal of Economic Geography (2022) **22**, 27–51
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Technological knowledge spaces and the resilience of European regions

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Abstract

Regional knowledge spaces are heterogeneous, and the structure of these knowledge spaces can play a significant role in shaping regional economic performances during economic downturns. This article explores the relationship between a region's technological profile and its resilience to exogenous shocks. To identify the determinants of regional economic resilience, we perform panel analyses of EU 15 NUTS II level data covering the years before and after the 2008 financial crisis. The most significant results are that, beyond pure diversification effects, regions endowed with technologically coherent capabilities adapted better in times of economic downturn, and that resilience is influenced by a region's capacity to generate new growth paths. These findings deepen our understanding of the evolution of regional economies and have relevant implications for the design of appropriate regional development policy instruments.

Keywords: Resilience, innovation, technological capabilities, knowledge space, diversification, financial crisis
JEL classifications: O30, R11, O33
Date submitted: 18 October 2018 **Editorial decision:** 21 December 2020 **Date Accepted:** 18 January 2021

Technology Network Structure Conditions the Economic Resilience of Regions

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This article assesses the network robustness of the technological capability base of 269 European metropolitan areas against the potential elimination of some of their capabilities. By doing so, it provides systematic evidence on how network robustness conditioned the economic resilience of these regions in the context of the 2008 economic crisis. The analysis concerns calls in the relevant literature for more in-depth analysis on the link between regional economic network structures and the resilience of regions to economic shocks. By adopting a network science approach that is novel to economic geographic inquiry, the objective is to stress test the technological resilience of regions by utilizing information on the coclassification of CPC (Cooperative Patent Classification) classes listed on European Patent Office patent documents. We find that European metropolitan areas show heterogeneous levels of technology network robustness. Further findings from regression analysis indicate that metropolitan regions with a more robust technological knowledge network structure exhibit higher levels of resilience with respect to changes in employment rates. This finding is robust to various random and targeted elimination strategies concerning the most frequently combined technological capabilities. Regions with high levels of employment in industry but with a vulnerable technological capacity base are particularly challenged by this aspect of regional economic resilience.

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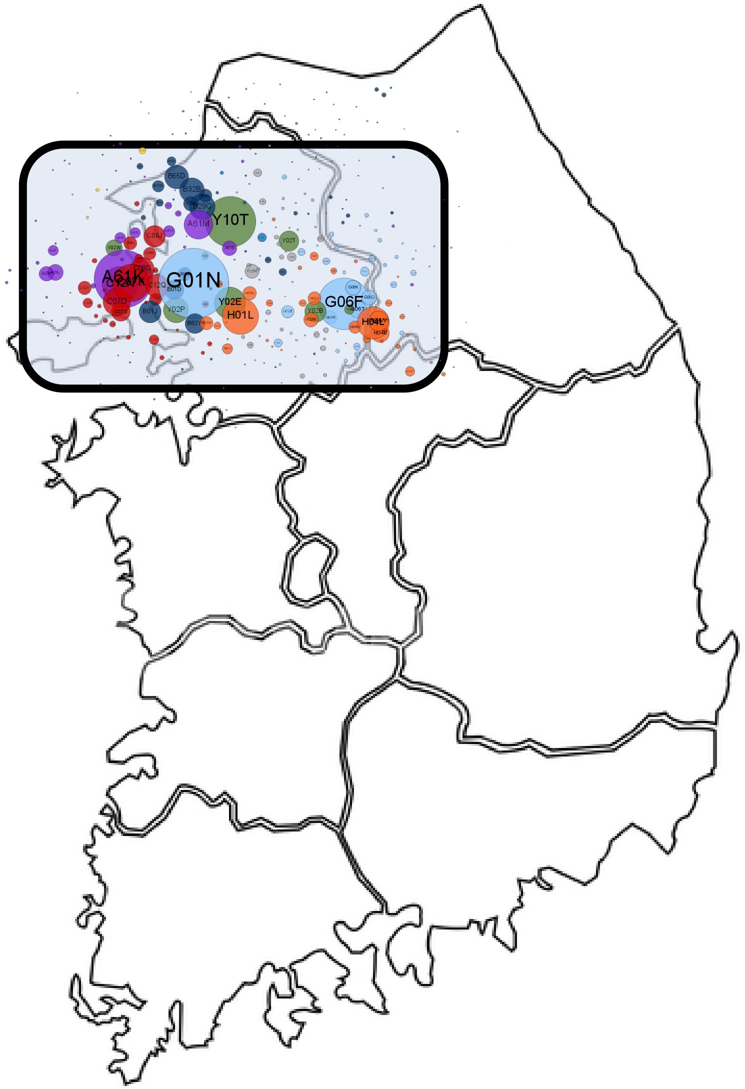
1. 모든 지역은 고유한 기술 구조를 가진다.



Technology Space

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X-ray image of
regional knowledge

2. 회복탄력성은 일관성에서 온다

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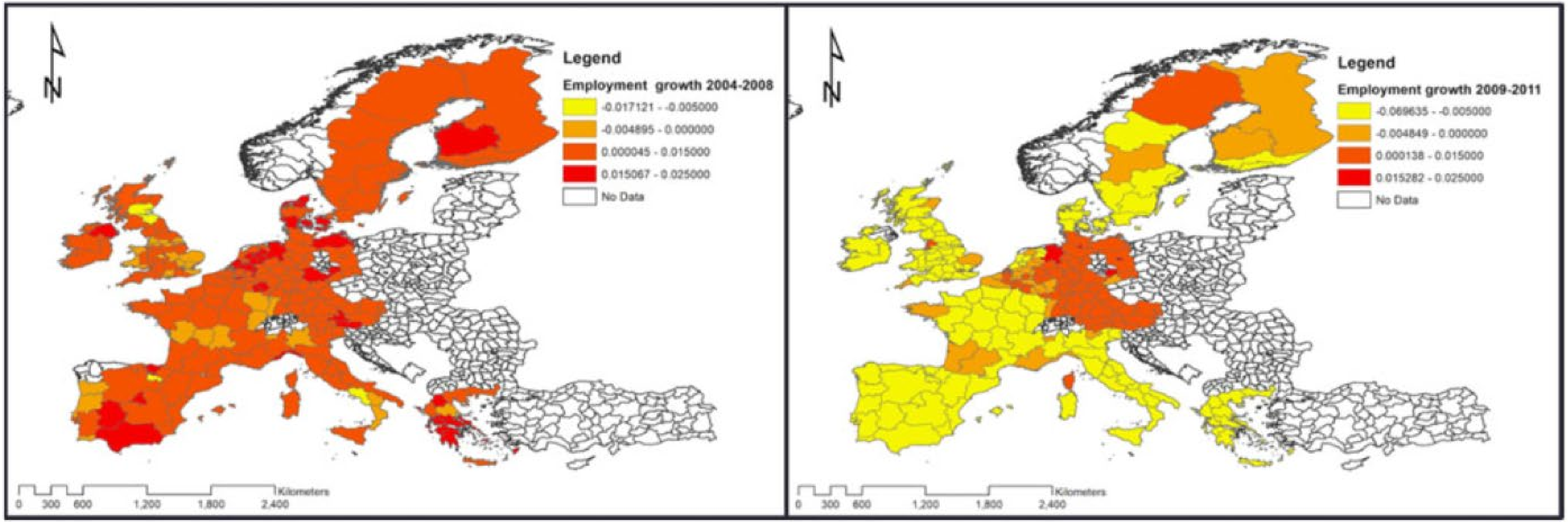


Figure 2. Evolution of EU15 NUTS II employment growth before and after the Great Recession.

2. 회복탄력성은 일관성에서 온다

Technological Coherence

vs.

Technological Diversity

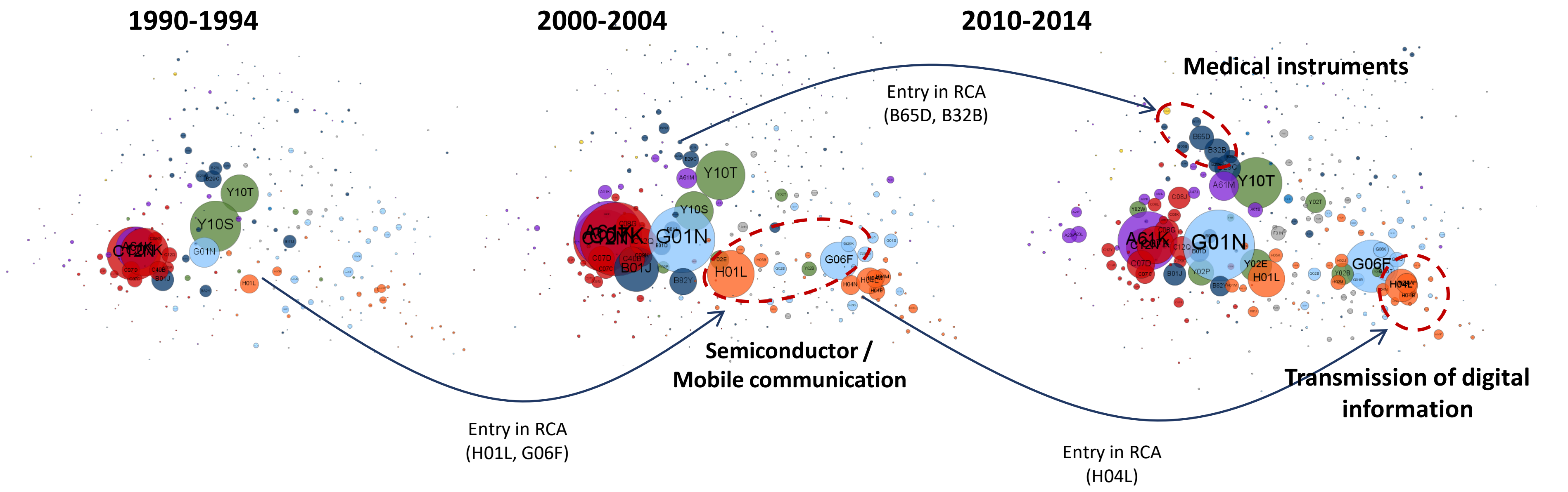
Table 3. Results of the multilevel estimations

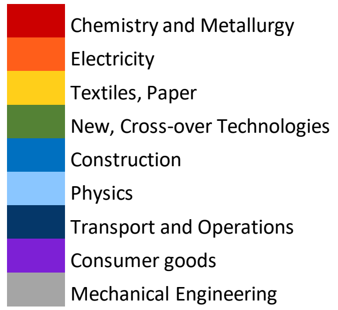
	(1) gEmp	(2) gEmp	(3) gEmp	(4) gEmp	(5) gEmp	(6) gEmp
Entropy	0.00119			0.00170*		
	(0.000721)			(0.000732)		
RV		0.00117			0.00148*	
		(0.000751)			(0.000743)	
UV			0.000801			0.00178
			(0.000935)			(0.000922)
C	0.00271***	0.00271***	0.00260***	0.00128*	0.00143*	0.00117
	(0.000665)	(0.000665)	(0.000740)	(0.000617)	(0.000608)	(0.000704)
Entry	0.00233**	0.00234**	0.00248**	−0.000582	−0.000532	−0.000137
	(0.000837)	(0.000837)	(0.000877)	(0.000834)	(0.000835)	(0.000910)
Education	0.00632**	0.00626**	0.00546**	−0.0000723	−0.000220	−0.000462
	(0.00194)	(0.00194)	(0.00192)	(0.00176)	(0.00176)	(0.00181)
Patents	0.000752	0.000712	−0.00200	−0.00165	−0.00174	−0.00440
	(0.00355)	(0.00355)	(0.00384)	(0.00314)	(0.00314)	(0.00352)
Serv_Emp	0.0456***	0.0456***	0.0844***	0.0312**	0.0313**	0.0673***
	(0.0110)	(0.0110)	(0.0115)	(0.00983)	(0.00985)	(0.0106)
Pop	−0.120***	−0.119***	−0.110***	−0.159***	−0.158***	−0.151***
	(0.0201)	(0.0201)	(0.0222)	(0.0181)	(0.0182)	(0.0206)
GDP	0.00225***	0.00225***	0.00253***	0.00363***	0.00363***	0.00356***
	(0.000538)	(0.000538)	(0.000573)	(0.000491)	(0.000492)	(0.000539)
Crisis	−0.0164***	−0.0164***	−0.0150***	−0.0259***	−0.0260***	−0.0245***
	(0.00122)	(0.00122)	(0.00131)	(0.00123)	(0.00123)	(0.00137)
Entropy × Crisis				−0.00329*		
				(0.00154)		
RV × Crisis					−0.00185	
					(0.00117)	
UV × Crisis						−0.00248*
						(0.00118)
C × Crisis				0.00706***	0.00576***	0.00603***
				(0.00180)	(0.00156)	(0.00175)
Entry × Crisis				0.00636***	0.00622***	0.00607***
				(0.00134)	(0.00134)	(0.00144
Constant	0.0285***	0.0284***	0.0518***	0.0134	0.0134	0.0349***
	(2.93)	(2.92)	(4.94)	(1.55)	(1.55)	(3.60)

2. 회복탄력성은 일관성에서 온다

Evolution of the Cambridge Knowledge Space

How does the KS evolve? Entry of the new ‘related’ technologies…





Path-dependency

Related diversification

3. 회복탄력성은 뼈대의 견고함에서 온다

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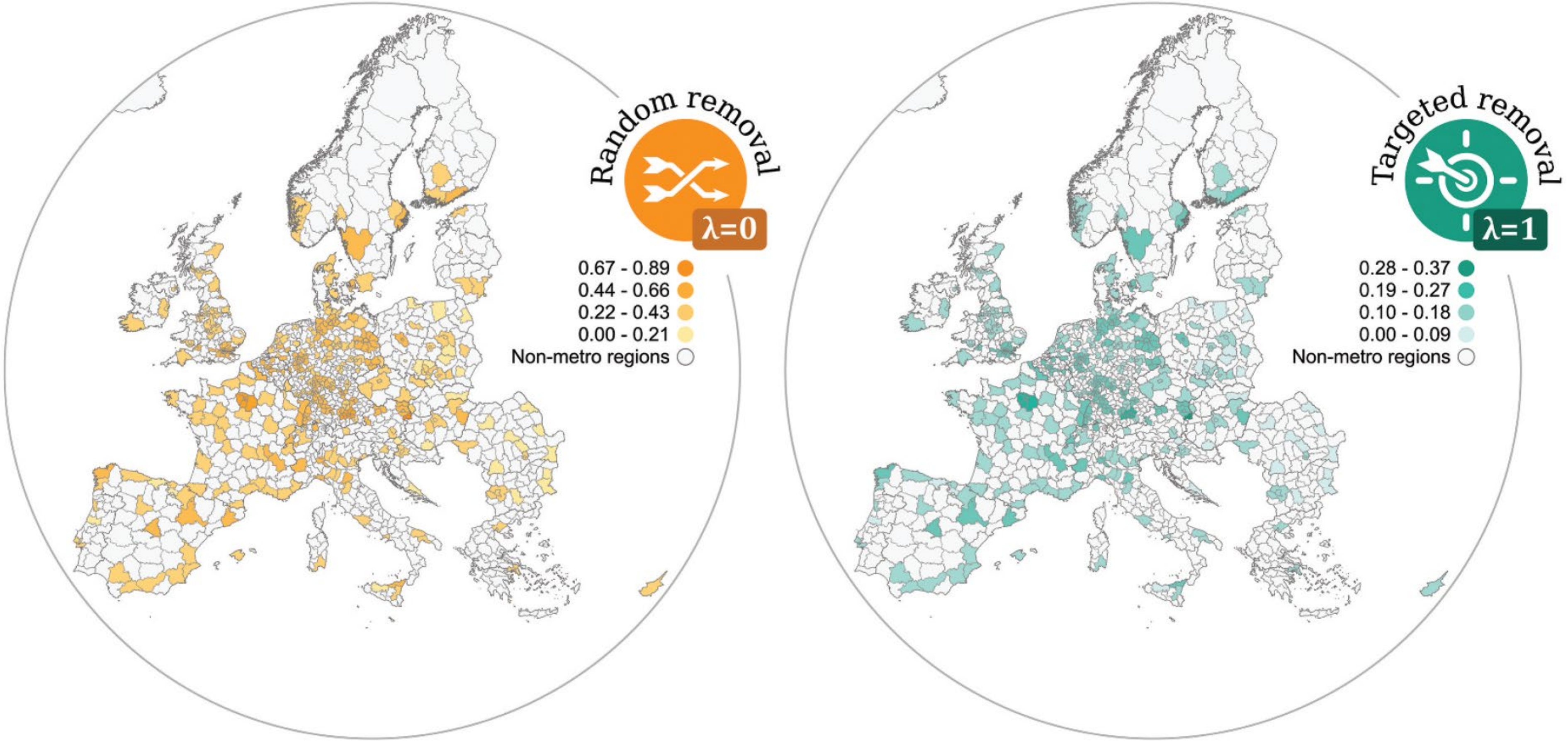
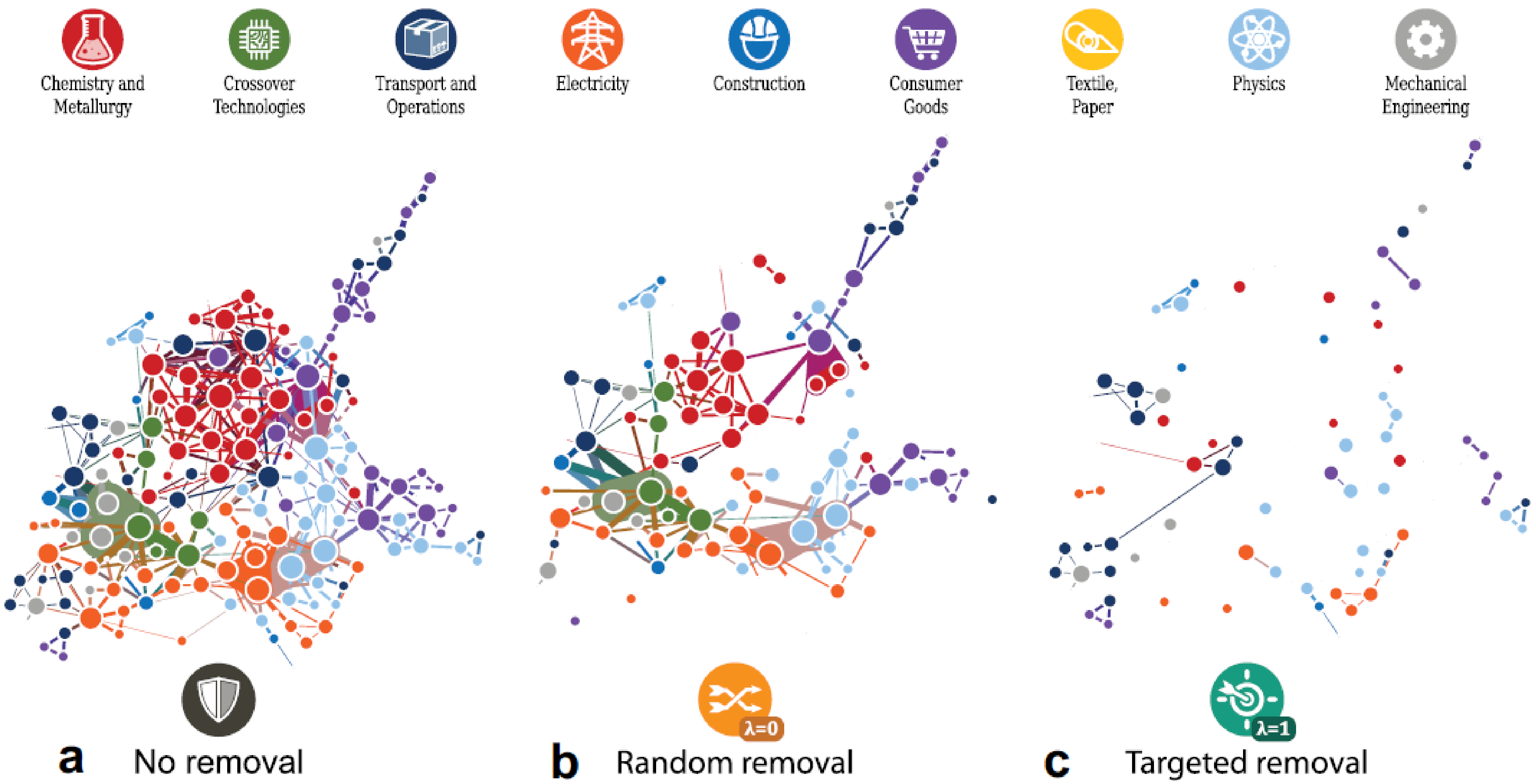


Figure 4. Mapping the geography of technology network robustness across European metropolitan regions.

3. 회복탄력성은 뼈대의 견고함에서 온다



Network Robustness

Figure 2. Random and targeted elimination of technological capabilities from Dublin's technology space (40 percent of node removal).

3. 회복탄력성은 뼈대의 견고함에서 온다

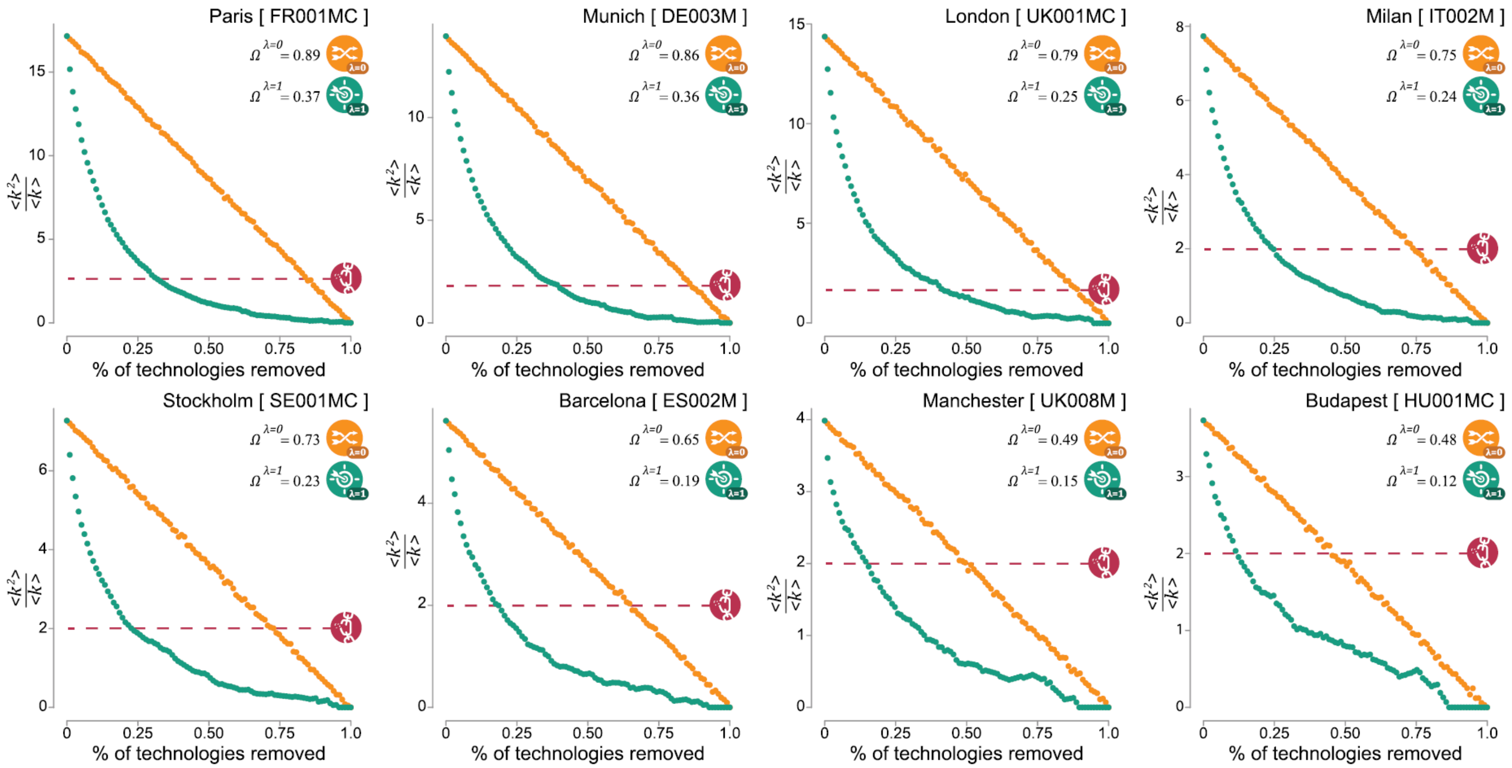


Figure 3. Random and targeted removal curves for selected metropolitan areas across Europe. Note: The figure shows the tolerance of metropolitan regions against targeted and random elimination based on their technological network (2006–08). The green series of dots refers to targeted, the yellow series of dots refers to random elimination of technologies, while the red dashed line indicates the threshold for the collapse of the giant component. Using the Molloy–Reed criterion, a giant component exists if k^2/k is higher than 2. $\Omega^{\lambda=0}$, and $\Omega^{\lambda=1}$ denotes the amount of eliminations the city can tolerate with a functioning network.

3. 회복탄력성은 뼈대의 견고함에서 온다

Table 1

Main Regression Results

	(1) All Sectors	(2) Industry	(3) All Sectors	(4) Industry	(5) All Sectors	(6) Industry
$\Omega^{\lambda=0}$			0.0594	0.1046***		
			(0.038)	(0.036)		
$\Omega^{\lambda=1}$					0.1618**	0.2487***
					(0.076)	(0.079)
UV	0.0216	0.0023	0.0403*	0.0161	0.0436**	0.0212
	(0.02)	(0.023)	(0.021)	(0.026)	(0.02)	(0.025)
RV	0.0545***	0.0758**	0.0208	0.0372	0.0205	0.0388
	(0.018)	(0.03)	(0.015)	(0.027)	(0.015)	(0.027)
C'	−0.0035***	−0.0035*	−0.0755**	−0.0385	−0.0855**	−0.0561
	(0.001)	(0.002)	(0.034)	(0.048)	(0.034)	(0.052)
B'	0.6184	0.2647	0.5024	0.069	0.4798	0.0583
	(0.444)	(0.537)	(0.480)	(0.620)	(0.467)	(0.633)
$\log(GVA)$	−0.0569**	−0.0656	−0.0504*	−0.0607	−0.0469	−0.0562
	(0.027)	(0.039)	(0.028)	(0.041)	(0.028)	(0.042)
$\log(POP)$	0.0159	−0.0139	0.0494	−0.019	0.0508	−0.0224
	(0.048)	(0.033)	(0.056)	(0.035)	(0.055)	(0.035)
$\log(EMPRATE)$	0.0019	0.0065	−0.0371	0.0071	−0.0425	0.0053
	(0.038)	(0.016)	(0.046)	(0.017)	(0.043)	(0.017)
Constant	1.2406***	1.4044***	1.2078***	1.4034***	1.1993***	1.3947***
	(0.122)	(0.160)	(0.140)	(0.174)	(0.139)	(0.176)
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes
Mean VIF	3.51	3.51	3.38	3.38	3.12	3.12
R^2	0.192	0.165	0.209	0.191	0.216	0.195
Adj. R^2	0.173	0.146	0.184	0.166	0.192	0.170
Observations	269	269	269	269	269	269

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

3. 회복탄력성은 뼈대의 견고함에서 온다

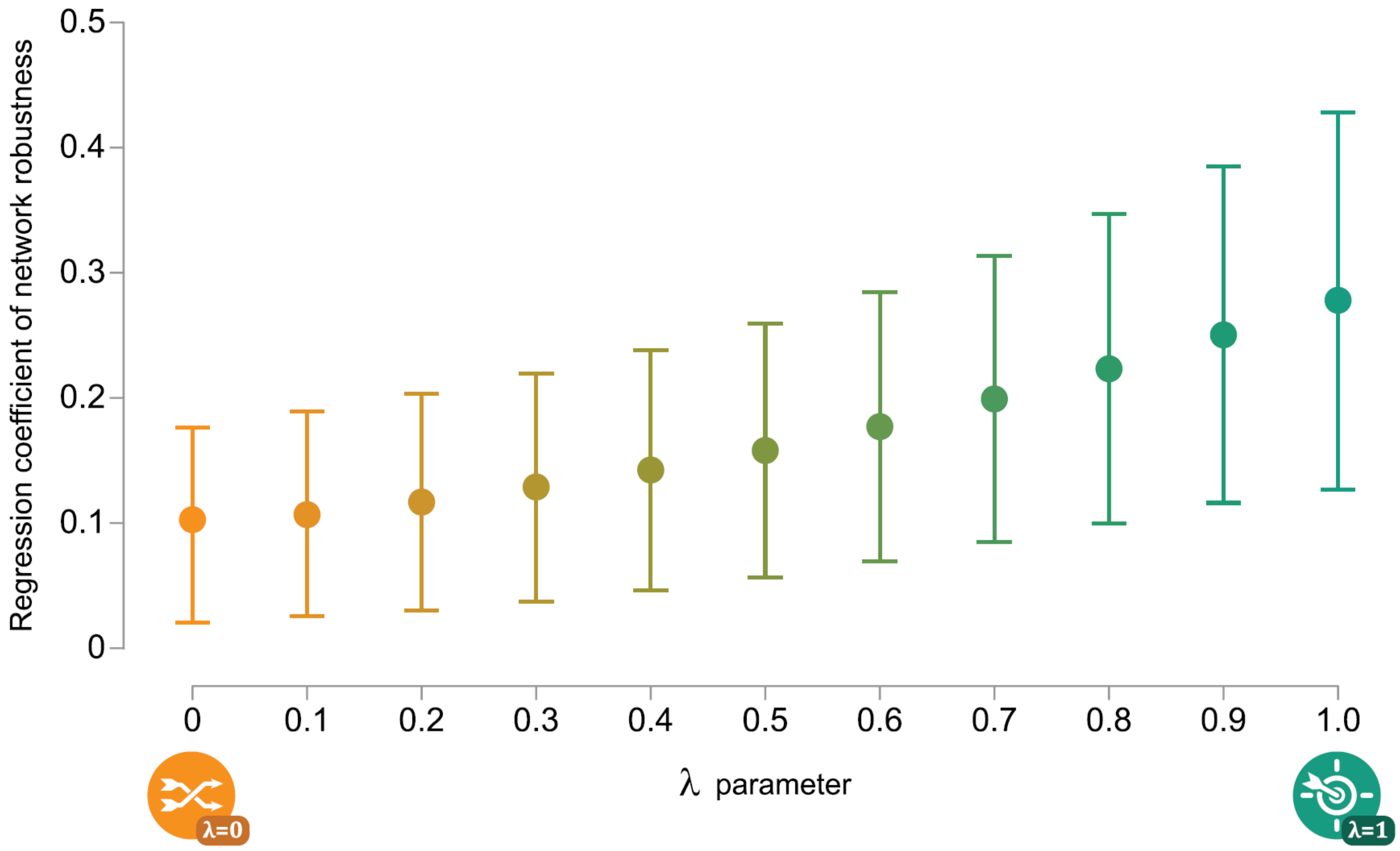


Figure 5. Regression coefficients of technology network robustness for different levels of λ.

요약 정리

- 지역은 고유한 기술 구조를 가진다.
- 지역의 회복탄력성을 높이려면

1. **일관성**: 기술 구조 안에서 기술들이 얼마나 일관성을 가지고 고도화 되어야 위기 상황에서 회복탄력성이 높다
2. **뼈대의 견고함:** 기술 구조 네트워크가 견고하게 엮이면서 진화한 지역이 회복탄력성이 높다

결론

결론은 자막으로만