Regional diversification, relatedness and smart specialisation

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structure

1. relatedness and diversification

2. knowledge complexity and diversification

3. diversification of European regions

4. implications for smart specialisation policy

5. role of regional institutions

2 recent publications

Balland, P., R. Boschma, J. Crespo and D. Rigby (2017), Relatedness, knowledge complexity and technological opportunities of EU regions, A framework for smart specialisation, Papers in Evolutionary Economic Geography, 17.17, Utrecht University

Cortinovis, N., J. Xiao, R. Boschma and F.G. van Oort (2017), Quality of government and social capital as drivers of regional diversification in Europe, *Journal of Economic Geography*, online available

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1. relatedness and diversification

- **smart specialisation** is part of EU regional and innovation policy

- objective of **smart specialisation** is to develop **new activities** in regions, rather than to strengthen existing specializations in regions

- **some features** of smart specialisation policy:

- no 'one-size-fits all' policy: bottom-up strategy

- no duplication of policy: not 'more of the same'

- policy targeting potential new activities based on regional capabilities, rather than just being 'hot'

1. relatedness and diversification

- some **critiques** on smart specialisation:

- perfect example of policy running ahead of theory

- lacking evidence-base

- building on anecdotal evidence, rather than the application of theoretically grounded methodologies

1. relatedness and diversification

- smart specialisation policy requires a basic understanding of **how regions diversify**, and **why their capacity** to diversify **differs** between regions

- new specialisations are no random events: they are often strongly embedded in **territorial capabilities**

- **local capabilities** condition which new activities will be feasible to develop: they provide **opportunities** but also set **limits** to the diversification process in regions

- **new specialisations** grow out of **related activities**, in which new activities combine and exploit knowledge and skills from local related activities

related and unrelated regional diversification

region A

region B

1. relatedness and diversification

- Hidalgo, Klinger, Barabasi and Hausmann (2007): how **countries** build a CA in new export products

- countries develop new export products that are **closely related** to existing export products

- countries with **related variety**: more opportunities to diversify and higher economic growth

- Neffke, Henning and Boschma (2011*)*: **industrial diversification** in 70 Swedish **regions** 1969-2002

- industries that are technologically **related** to pre-existing sectors in a region had a higher probability to enter the region

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2. knowledge complexity and diversification

- but smart specialisation is **not only** about developing new specializations in regions that have growth potential due to local related capabilities

- smart specialisation is **also** about developing new specializations in regions that are unique in the world : **more complex** that **upgrade local economy** (Hidalgo and Hausmann 2009)

- **complexity of knowledge** refers to the degree of its sophistication and the number of capabilities required to develop such new technology
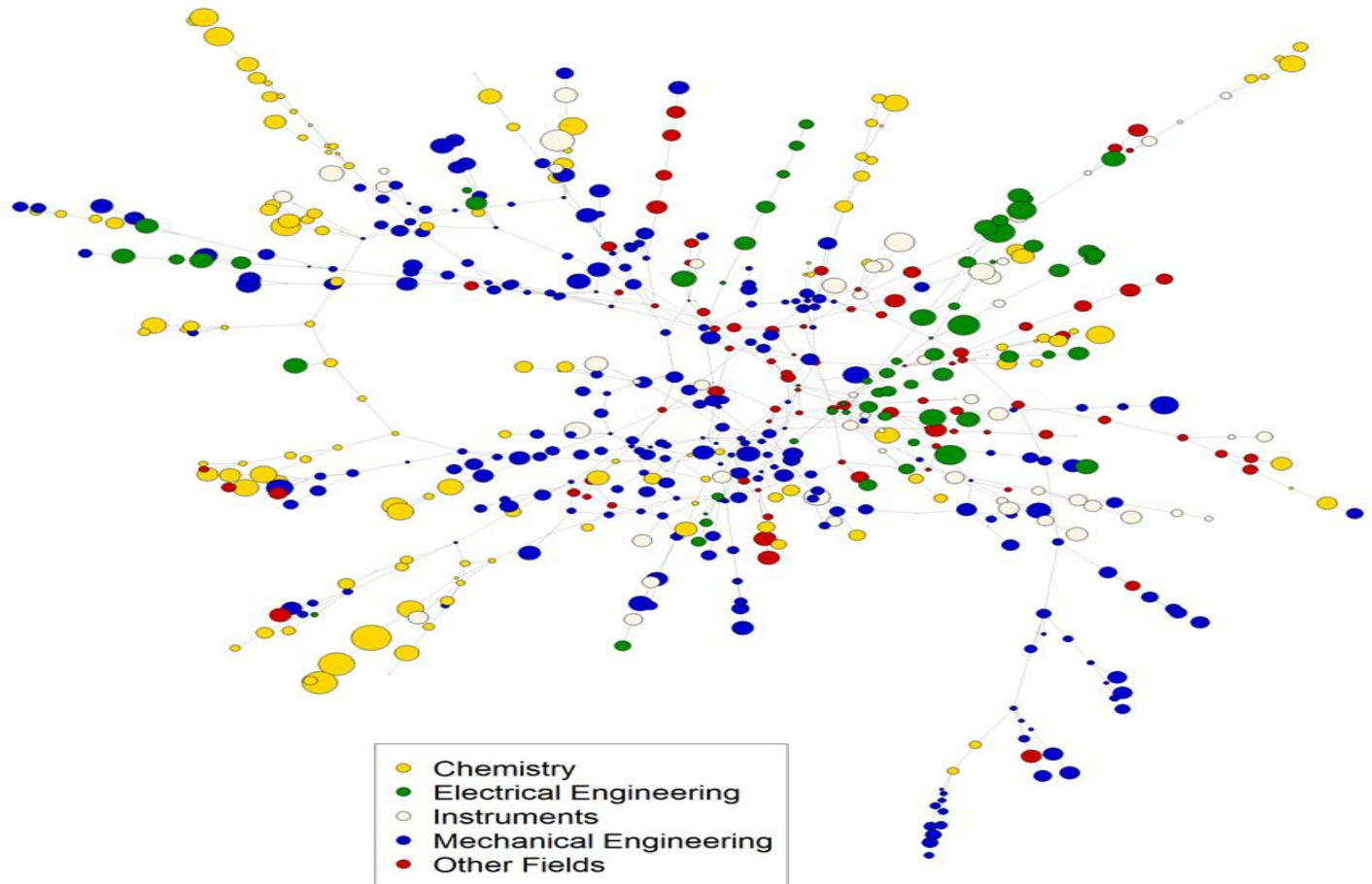
3. diversification of European regions

- technological diversification in 282 European NUTS 2 regions (EU 27, Norway, Switzerland) 1985-2009

- patent data from the European Patent Office (EPO): 617 technology classes (IPC)

- **entry-model**, where y=1 if a region r gains a RTA in technology i, otherwise y=0

- RTA= share technology i in region r > share technology i in Europe

- **growth-model**: growth in number of knowledge claims in technology i

- main variables: **relatedness** and **complexity**

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- **relatedness:** frequency of co-occurrence of technology classes on patent document

Figure 1. European Knowledge Space

- Chemistry
- Electrical Engineering
- Instruments
- Mechanical Engineering
- Other Fields

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3. diversification of European regions

- **density**: how close a potential new technology i is from the current set of technologies j in region c

$$density_{ic} = \frac{\sum\limits_{j} \varphi_{ij} x_{jc}}{\sum\limits_{j} \varphi_{ij}}$$

Region	Technology	Density (%)
Ile de France	Biotech	10
Ile de France	Nanotech	100
Rhone Alpes	Biotech	80
Rhone Alpes	Nanotech	0
…	…	…

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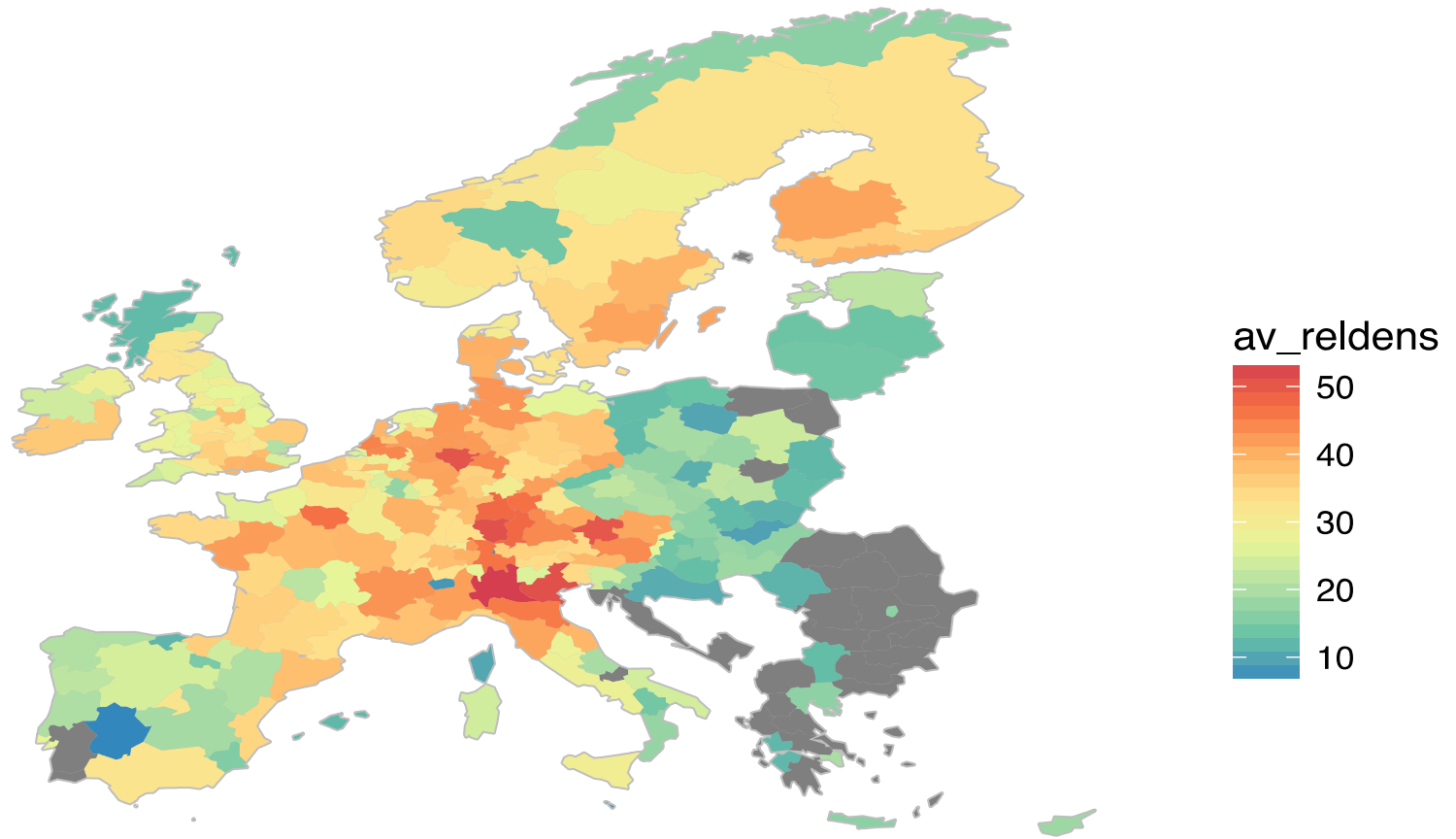
3. diversification of European regions

- average relatedness of European regions: **potential of regions to diversify into new technologies**

- **positive** effect of **density** on **entry** probability of a new technology in a region

- **positive** effect of **density** on **growth** of new technology in that region

average relatedness of European regions

3. diversification of European regions

- **knowledge complexity index** (KCI) based on method of reflection (Hidalgo & Hausmann 2009)

- **network-based indicator**: 2 mode network linking regions to technologies in which regions have RTA

- KCI combines information on:

- number of technologies in a region: **diversity of regions**

- number of regions producing a technology: **ubiquity of technologies**

- **technology complexity** (Balland and Rigby 2016): eigenvector method

top 15 technologies by complexity

rec.2d	label.2d	label.1d	eigen.2d
4	Digital communication	Electrical engineering	100
3	Telecommunications	Electrical engineering	96.97
6	Computer technology	Electrical engineering	93.94
5	Basic communication process	Electrical engineering	90.91
2	Audio-visual technology	Electrical engineering	87.88
7	IT methods for management	Electrical engineering	84.85
9	Optics	Instruments	81.82
8	Semiconductors	Electrical engineering	78.79
16	Pharmaceuticals	Chemistry	75.76
12	Control	Instruments	72.73
15	Biotechnology	Chemistry	69.7
14	Organic fine chemistry	Chemistry	66.67
10	Measurement	Instruments	63.64
22	Micro-structure and nano-technology	Chemistry	60.61
13	Medical technology	Instruments	57.58

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3. diversification of European regions

- **no** or **negative effect** of **complexity** of technology on **entry** probability of that technology in a region

- **positive effect** on **entry** when complex technology **related** to existing technologies in region

- **positive effect** on **growth** when complex technology related to existing technologies in region
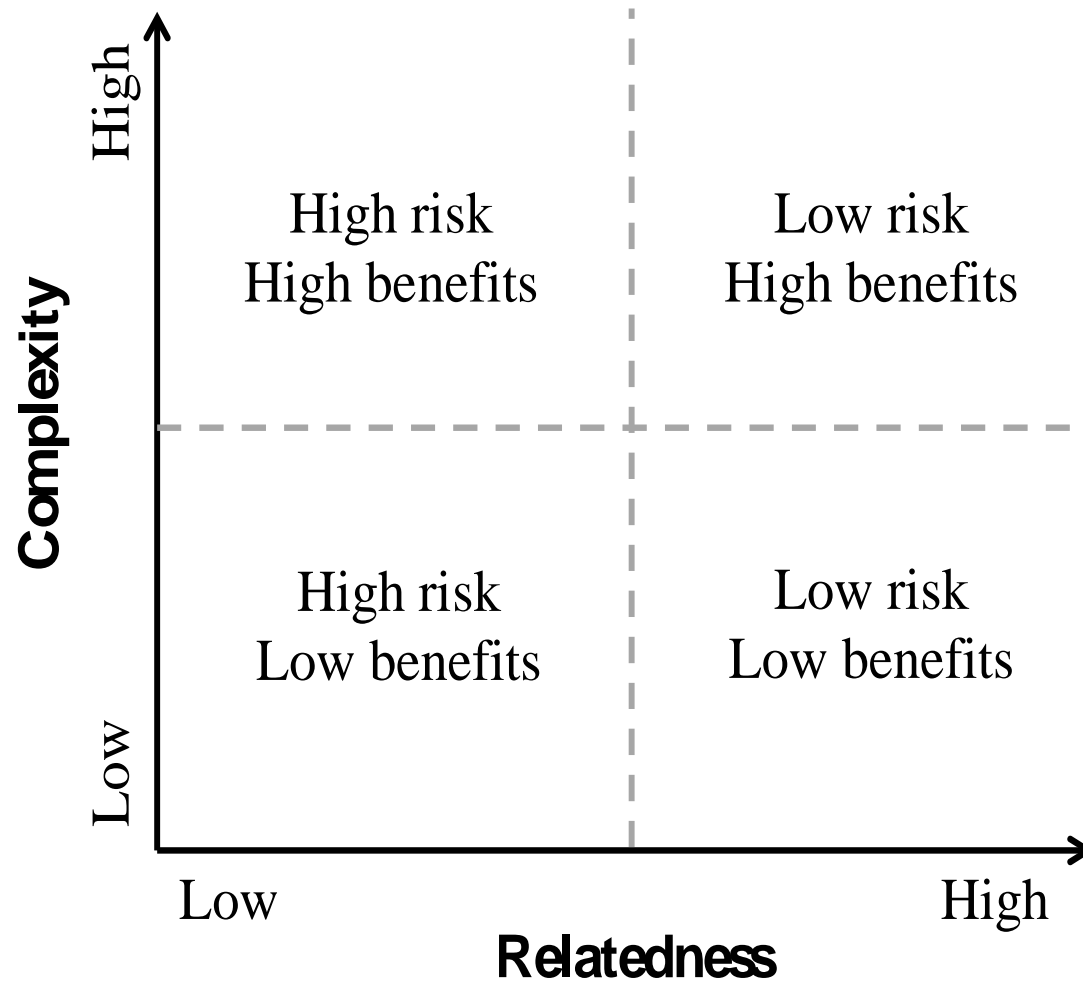
4. implications for smart specialization policy

- **objective**: develop a smart specialization policy framework that is **evidence-based,** and that can assist policy makers to **identify possible diversification strategies** for regions, depending on their existing capabilities

- **relatedness**: to assess **potential risks** of alternative diversification strategies for regions

- **complexity**: to assess **potential benefits** of policy

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4. implications for smart specialization policy

Complexity (vertical axis, from **Low** to **High**)

Relatedness (horizontal axis, from **Low** to **High**)

	Low Relatedness	High Relatedness
High Complexity	High risk High benefits	Low risk High benefits
Low Complexity	High risk Low benefits	Low risk Low benefits

Ile de France region

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Lancashire region

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Legend:
- Chemistry
- Electrical engineering
- Instruments
- Mechanical engineering
- Other fileds
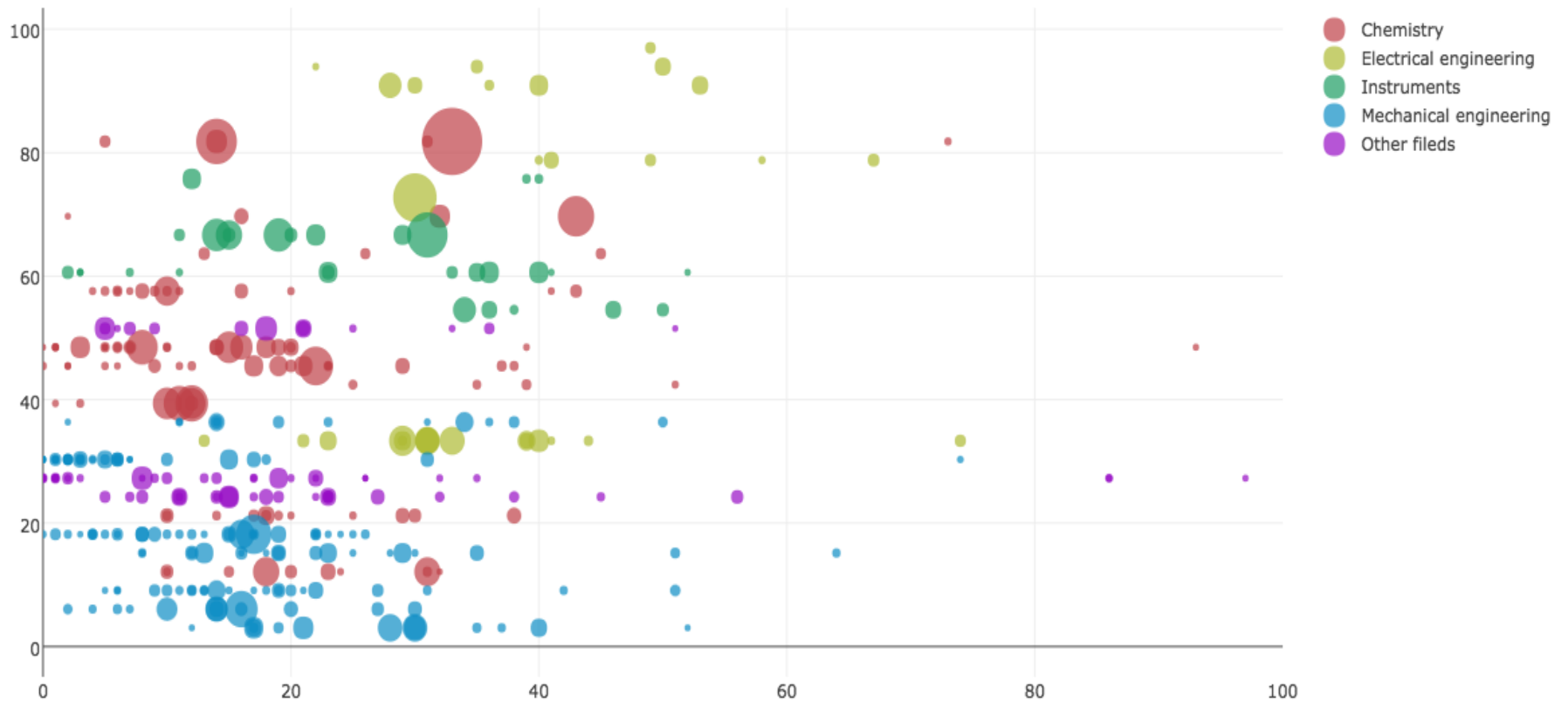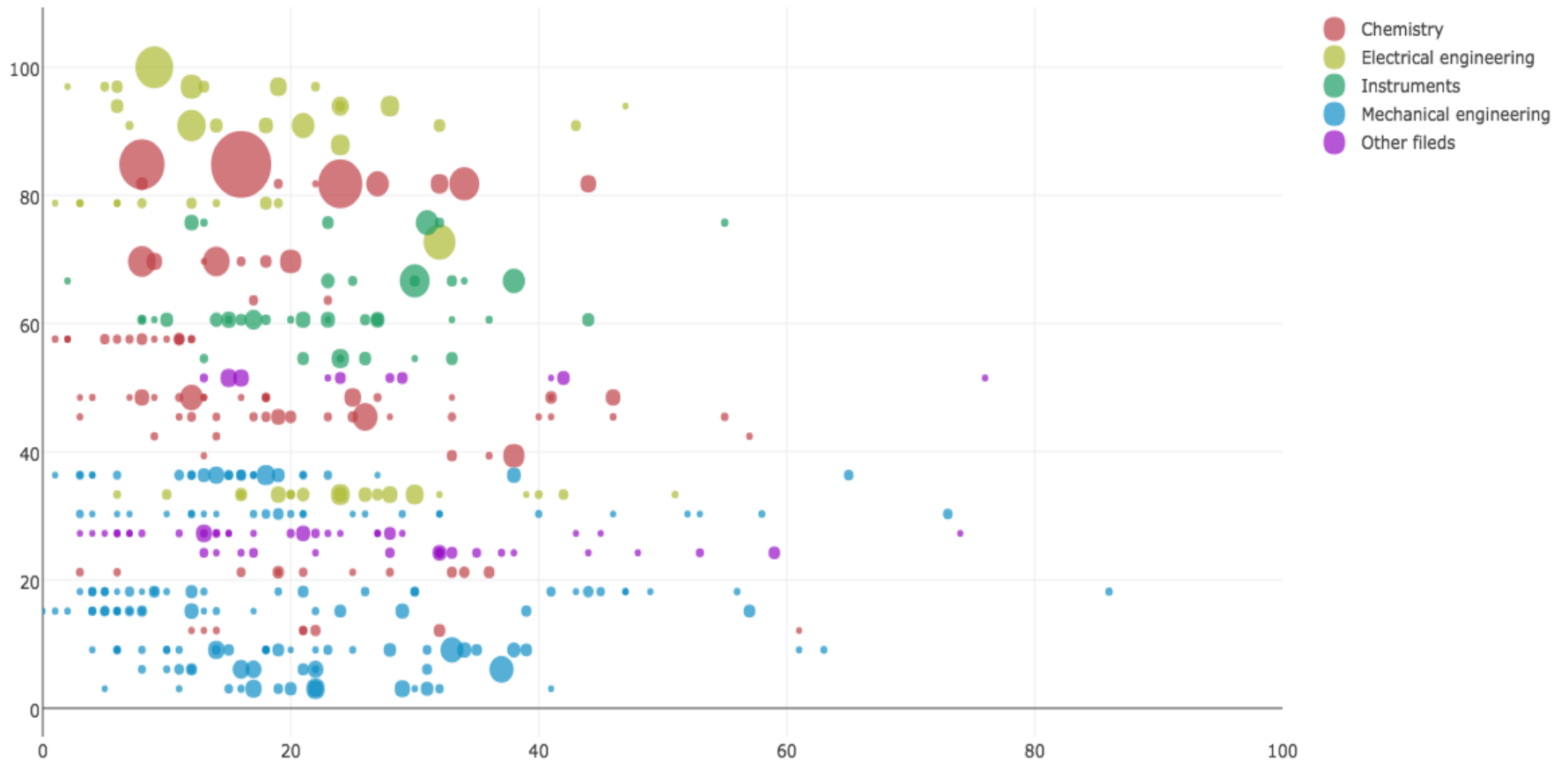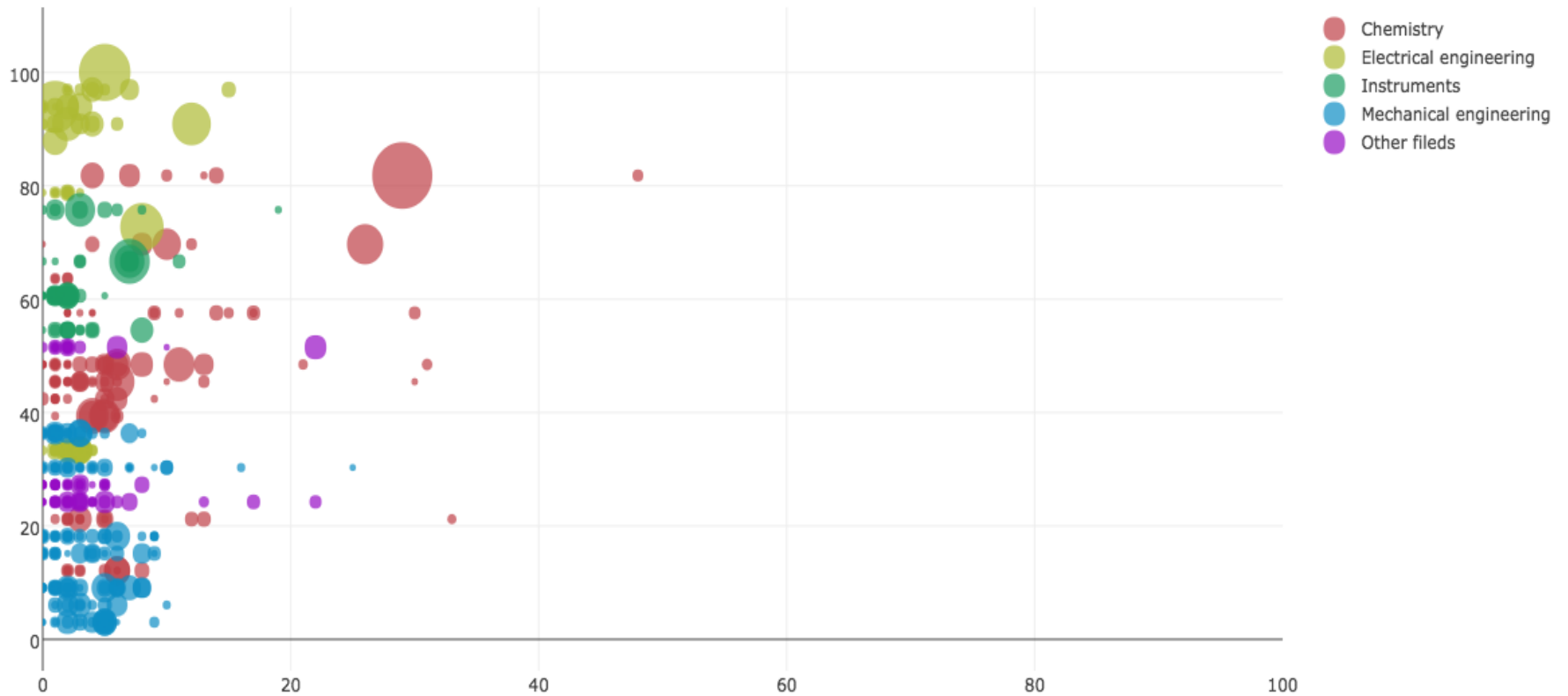
Extremadura region

5. role of regional institutions

- but how about regional institutions (Cortinovis et al. 2017, Journal of Economic Geography)?

- **formal institutions** (laws, regulations, policies, etc.) reduce uncertainty and enable new combinations and **diversification** in regions

- European **quality of government data** recently available at **regional** scale: significant within-country variations (Charron et al. 2014) in Europe based on survey data on quality of governance, impartiality and corruption

- **hypothesis**: positive effect of quality of government on the probability that a region becomes specialized in a new industry

5. role of regional institutions

- **informal institutions**: **social capital**: "features of social organizations, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions (Putnam et al. 1993, p. 167)

- social capital can have a **positive** effect (reducing uncertainty, mobilizing resources, promoting collective action) but also a **negative** effect (conformity and opportunistic behavior by established groups)

- distinction **bridging** and **bonding social capital** (Putnam 2001)

- **bridging social capital**: socio-economic heterogeneity: focus on inclusiveness and cross-cutting interactions in society: access to external capabilities

- **bonding social capital**: socio-economic homogeneity: internal cohesion helps mobilizing support and solidarity but only to the benefit of the group: leads to conformity and rent-seeking behavior

5. role of regional institutions

- social capital and **regional diversification**: provides potential to **make crossovers and combinations** across different and disconnected activities

- **hypothesis:** probability that a region specializes in a new industry is **positively** related to level of **bridging social capital** in region

- **bridging social capital**: share of respondents volunteering in bridging type of associations (Putnam groups)

- **hypothesis**: probability that a region specializes in a new industry is **negatively** related to level of **bonding social capital** in region

- **bonding social capital**: share of respondents volunteering in bonding type of associations (Olson groups)

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5. role of regional institutions

- **substitution effect** between formal and informal institutions?

- social capital being relevant **only** when formal institutions are weak (Ahlerup et al. 2009)

- **hypothesis**: **bridging social capital** has a stronger **positive** effect on the probability that a region specializes in a new industry when **quality of government is low**

- **hypothesis**: **bonding social capital** has a stronger **negative** effect on the probability that a region specializes in a new industry when **quality of government is low**

5. role of regional institutions

- study of **industrial diversification** on 118 (NUTS-2) European regions in 13 European countries 2004-2012

- to estimate effects of relatedness and institutions at *t* on developing **specialization in a new industry in region** at *t+5*

- ORBIS dataset Bureau Van Dijk: 323 tradable industries

- binary **dependent variable**: value 1 if country has acquired a new specialization in industry *i* at *t+5*, value of 0 otherwise

- specialization: computation of (standardized) location quotient on industrial employment

$$LQ_{ic} = \left(\frac{E_{ic} / E_{\bullet c}}{E_{i \bullet} / E_{\bullet \bullet}} \right)$$

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5. role of regional institutions

Hypotheses: direct effects of institutional variables

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
density	0.0208***	0.0205***	0.0203***	0.0206***	0.0204***
	(0.00129)	(0.00129)	(0.00129)	(0.00129)	(0.00130)
EQI	9.72e-06			-0.000570	-0.000341
	(0.000428)			(0.000442)	(0.000444)
Trust		0.00136***		0.00156***	
		(0.000444)		(0.000458)	
Brid. SK			0.00223***		0.00233***
			(0.000669)		(0.000681)
Bond. SK			-0.000332		-0.000415
			(0.000456)		(0.000474)
Observations	99,037	97,768	97,768	97,768	97,768
R-squared	0.025	0.025	0.026	0.025	0.026
Industry_year FE	YES	YES	YES	YES	YES

5. role of regional institutions

Hypothesis: substitution effects between quality of government and social capital

VARIABLES	Model 1 Low EQI	Model 2 Low EQI	Model 3 High EQI	Model 4 High EQI
density	0.0212***	0.0207***	0.0270***	0.0269***
	(0.00257)	(0.00257)	(0.00386)	(0.00387)
EQI	-0.000503	-0.000109	0.000490	-0.00571
	(0.00104)	(0.00101)	(0.00607)	(0.00671)
Trust	0.00137		0.000669	
	(0.000960)		(0.00135)	
Brid. SK		0.00469***		0.00224*
		(0.00136)		(0.00121)
Bond. SK		-0.00188**		0.00317
		(0.000835)		(0.00194)
Observations	28,419	28,419	15,954	15,954
R-squared	0.067	0.068	0.088	0.089
Industry_year FE	YES	YES	YES	YES

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5. role of regional institutions

- positive effect of **density** on regional diversification

- **institutions** matter for regional diversification

- positive effect of **social capital**
- positive effect of **bridging social capital**
- no effect of bonding social capital

- no general effect of **quality of government**
- but with **low quality of government**: bridging social capital stronger positive effect, while bonding social capital turns from no effect into a negative effect

- yet, we are **far from** a comprehensive policy framework:

- **design** and implementation of smart spec policy?

- relevant for **peripheral regions**: bring it in line with objectives of Cohesion Policy?

- inherent **tension** between prioritising based on relatedness in our policy framework and reliance on decentralized entrepreneurial discovery process

- besides regional capabilities, what is role of **extra-regional linkages** and **agents** (Neffke et al. 2017)?

- should smart spec policy enable **jumps** or not?

thank you for your attention!

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Cortinovis, N., J. Xiao, R. Boschma and F.G. van Oort (2017), Quality of government and social capital as drivers of regional diversification in Europe, *Journal of Economic Geography*, online available

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where to intervene in the industrial structure of a region?

Table 3. Entry Models - Full Sample

	Baseline (1)	Complexity (2)	Controls (3)	Full Model (4)	Full Model (F.E.) (5)
			Dependent variable: Entry (=1) | 1990 − 2009		
Constant	0.1632872*** (0.0005543)	0.1632945*** (0.0005543)	0.1498963*** (0.0005242)	0.1639320*** (0.0005722)	-0.0117608 (0.0255653)
Relatedness Density	0.0042477*** (0.0000388)	0.0042494*** (0.0000388)		0.0041635*** (0.0000419)	0.0037696*** (0.0000449)
Knowledge Complexity		0.0000459* (0.0000199)		0.0000354 (0.0000211)	-0.0000575** (0.0000215)
Population (log)			0.0322163*** (0.0008129)	0.0172538*** (0.0008150)	-0.1155466*** (0.0148724)
GDP per cap.			0.0000020*** (0.0000001)	0.0000005*** (0.0000001)	0.0000017*** (0.0000003)
Population Density			-0.0000090*** (0.0000007)	-0.0000030*** (0.0000007)	0.0000198 (0.0000122)
Tech. stock			-0.0000022*** (0.0000001)	-0.0000022*** (0.0000001)	-0.0000023*** (0.0000002)
Tech. size			0.0000004** (0.0000002)	0.00000005 (0.0000002)	0.0000013*** (0.0000002)
Region fixed effects	No	No	No	No	Yes
Time fixed effects	No	No	No	No	Yes
Observations	498,785	498,785	466,814	466,814	466,814
R^2	0.0303005	0.0303106	0.0040004	0.0306804	0.0371538

Table 4. Entry Models by Level of Relatedness

	Dependent variable: Entry (=1) | 1990 – 2009					
	High Relatedness (1)	Low Relatedness (2)	High Relatedness (3)	Low Relatedness (4)	High Relatedness (5)	Low Relatedness (6)
Constant	0.3669312*** (0.0023488)	0.0309562*** (0.0006430)	0.3614363*** (0.0026666)	0.0405249*** (0.0009141)	0.2306594 (0.1847726)	0.0903739** (0.0327663)
Knowledge Complexity	0.0004628*** (0.0001007)	-0.0000389 (0.0000272)	0.0002671* (0.0001127)	-0.0000062 (0.0000395)	0.0002526* (0.0001124)	-0.0000359 (0.0000419)
Population (log)			0.0433384*** (0.0044990)	0.0224518*** (0.0014247)	-0.0657516 (0.0934813)	0.0488210* (0.0200723)
GDP per cap.			0.0000004 (0.0000004)	0.0000015*** (0.0000001)	0.0000016 (0.0000016)	0.0000002 (0.0000005)
Population Density			0.0000016 (0.0000034)	-0.0000057*** (0.0000015)	0.0000252 (0.0000569)	-0.0000202 (0.0000281)
Tech. stock			-0.0000026*** (0.0000004)	0.0000002 (0.0000002)	-0.0000036*** (0.0000007)	0.0000003 (0.0000004)
Tech. size			0.0000088*** (0.0000012)	0.0000021** (0.0000007)	0.0000139*** (0.0000013)	0.0000018* (0.0000007)
Region fixed effects	No	No	No	No	Yes	Yes
Time fixed effects	No	No	No	No	Yes	Yes
Observations	42,164	72,557	34,309	47,029	34,309	47,029
R^2	0.0005119	0.0000281	0.0053447	0.0127176	0.0584039	0.0334063

Table 5. Growth Models - Full Sample

	Dependent variable: Technological growth | 1990 − 2009				
	Baseline (1)	Complexity (2)	Controls (3)	Full Model (4)	Full Model (F.E.) (5)
Constant	13.7038900*** (0.1707395)	13.7207500*** (0.1707130)	13.5505400*** (0.1773364)	13.5218000*** (0.1767446)	73.6810700*** (7.4333840)
Relatedness Density	0.4642356*** (0.0101046)	0.4650504*** (0.0101016)		0.3519811*** (0.0113171)	0.2038730*** (0.0119662)
Knowledge Complexity		0.2083142*** (0.0079042)		0.1811793*** (0.0082521)	0.1236107*** (0.0079222)
Population (log)			15.6830000*** (0.2933130)	13.9970400*** (0.2957986)	57.4033100*** (4.4582030)
GDP per cap.			0.0004739*** (0.0000201)	0.0003251*** (0.0000205)	0.0000061 (0.0000892)
Population Density			-0.0039671*** (0.0002246)	-0.0033924*** (0.0002242)	-0.0031405 (0.0032979)
Tech. stock			-0.0004838*** (0.0000325)	-0.0005061*** (0.0000326)	-0.0051211*** (0.0001068)
Tech. size			0.0010760*** (0.0000560)	0.0007250*** (0.0000565)	0.0016523*** (0.0000584)
Region fixed effects	No	No	No	No	Yes
Time fixed effects	No	No	No	No	Yes
Observations	556,721	556,721	521,175	521,175	521,175

Table 6. Growth Models by Level of Relatedness

	Dependent variable: Technological growth | 1990 − 2009					
	High Relatedness (1)	Low Relatedness (2)	High Relatedness (3)	Low Relatedness (4)	High Relatedness (5)	Low Relatedness (6)
Constant	53.7695700*** (0.7609844)	-6.0870230*** (0.1377738)	49.6868700*** (0.8003883)	-8.4233190*** (0.2020142)	-31.0214900 (60.1171500)	-10.3398200 (5.9970820)
Knowledge Complexity	0.3256727*** (0.0340018)	-0.0096395 (0.0069824)	0.2581051*** (0.0361123)	-0.0107926 (0.0104075)	0.2276855*** (0.0344880)	-0.0305587** (0.0101187)
Population (log)			28.4596000*** (1.4859160)	-3.3740520*** (0.3181761)	-26.7761900 (31.0434900)	-2.6496500 (4.0115730)
GDP per cap.			0.0001111 (0.0001073)	-0.0003621*** (0.0000220)	0.0037211*** (0.0005146)	0.0001280 (0.0000970)
Population Density			-0.0048569*** (0.0009146)	0.0006342* (0.0002874)	-0.0729367*** (0.0144477)	-0.0052360 (0.0046896)
Tech. stock			-0.0020091*** (0.0001021)	-0.0001944* (0.0000909)	-0.0080889*** (0.0003040)	-0.0015154*** (0.0002594)
Tech. size			-0.0012314*** (0.0001257)	-0.0013100*** (0.0002712)	0.0001989 (0.0001165)	-0.0011047*** (0.0002697)
Region fixed effects	No	No	No	No	Yes	Yes
Time fixed effects	No	No	No	No	Yes	Yes
Observations	63,797	74,199	54,992	48,659	54,992	48,659