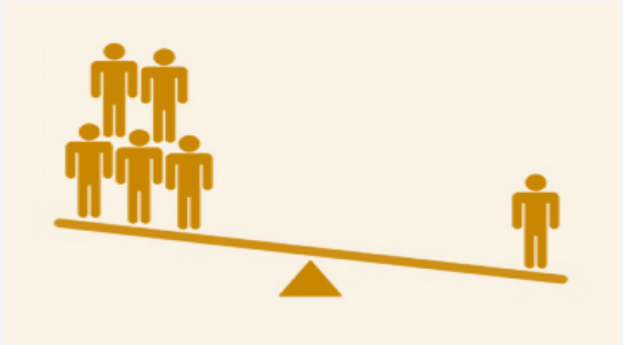
Technische Universiteit Eindhoven University of Technology

INNOVATION, TECHNOLOGICAL VARIETY AND INCOME INEQUALITY



EVIDENCE FROM EU REGIONS

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Income inequality on the rise

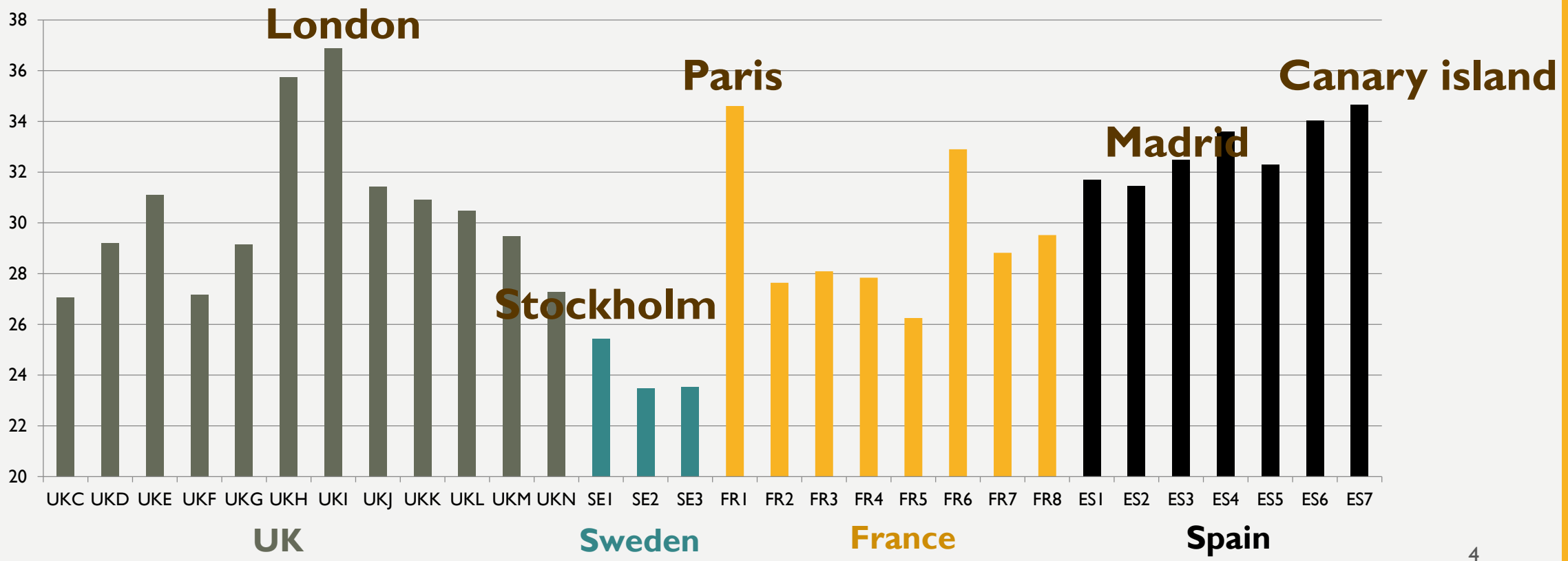
- Large debate on the role of innovation and new technology
- Most attention for the country level
- Regions are even more unequal given that economic and innovation activities tend to concentrate spatially
- Most studies focus on innovation intensity, we look at specialization patterns as well

RESEARCH QUESTION

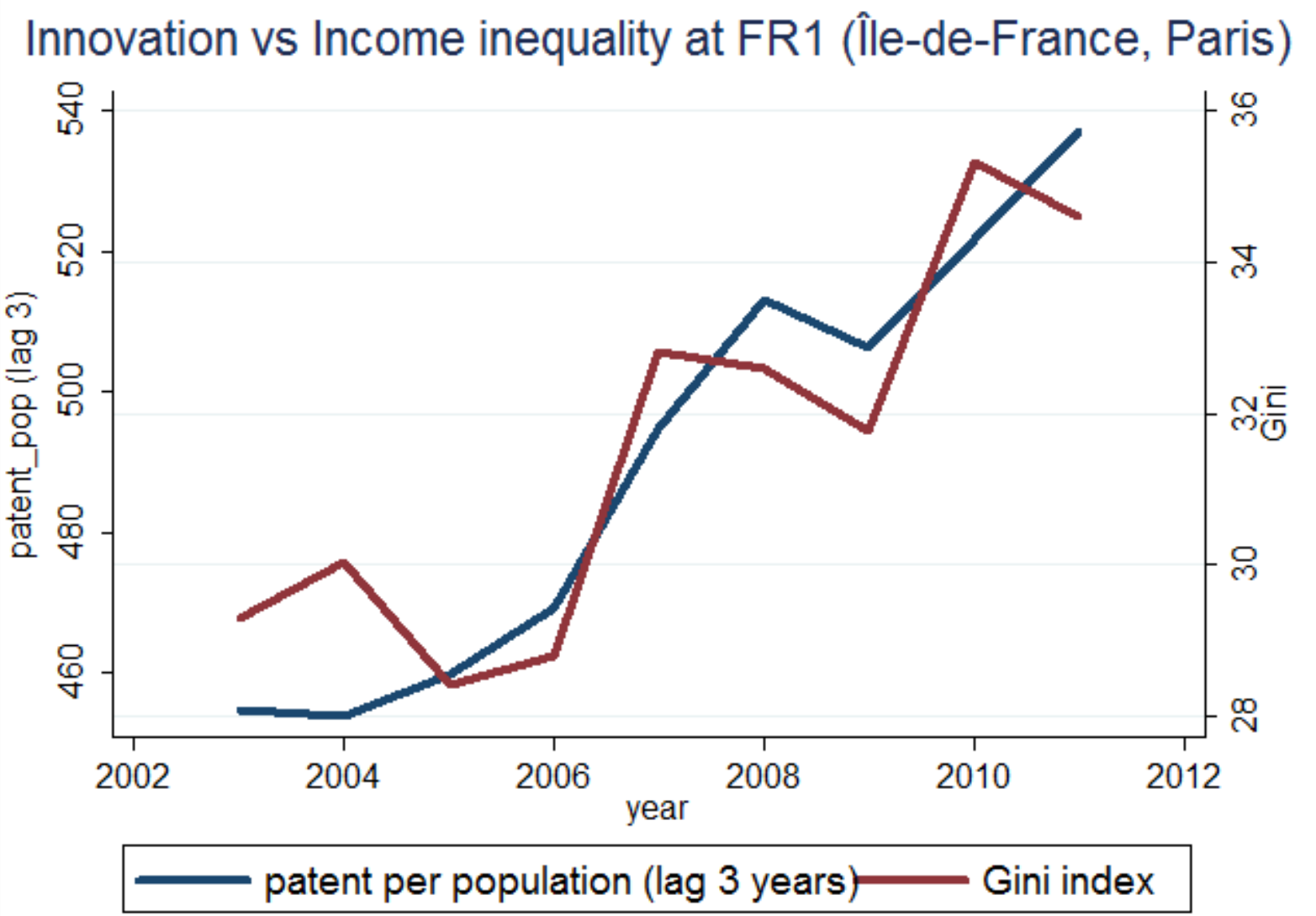
Do regions with higher technological variety experience lower income inequality?

EU AS CASE STUDY

Gini index in NUTS1 regions 2011
(UK, Sweden, France, Spain)



EU AS CASE STUDY



INNOVATION AND INEQUALITY

1. Innovation and rents
2. Innovation, productivity and wages
3. Skill-biased technical change

H1: Regional innovation is positively related to income inequality

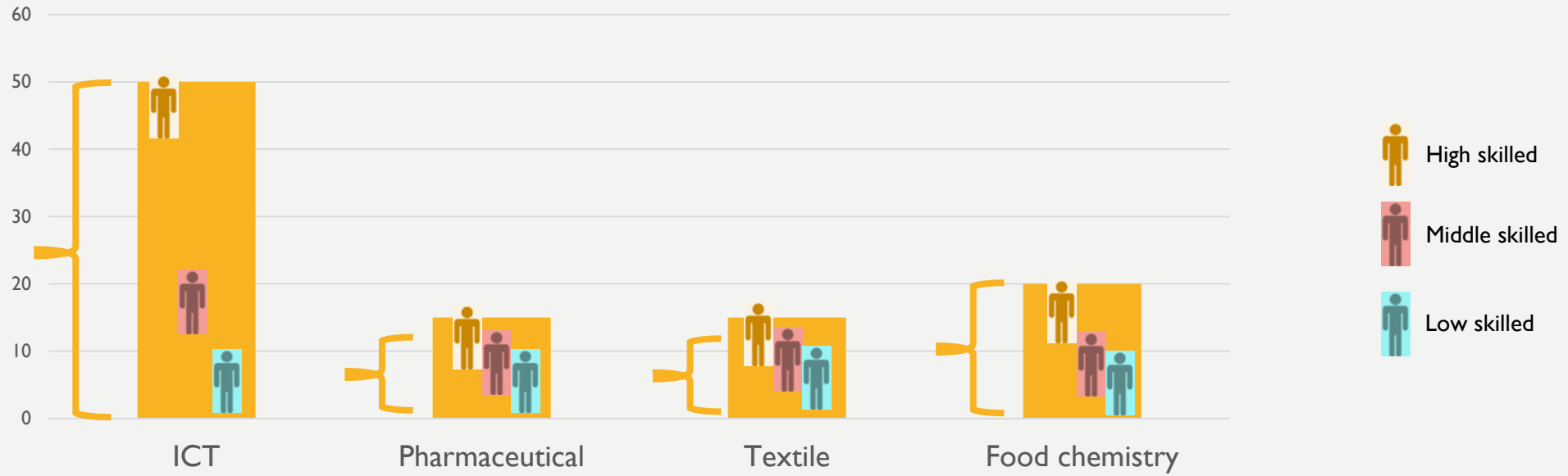
TECHNOLOGICAL SPECIALIZATION AND INEQUALITY

Between

Wage differences between sectors: same skill, different salary

TECHNOLOGICAL SPECIALIZATION AND INEQUALITY

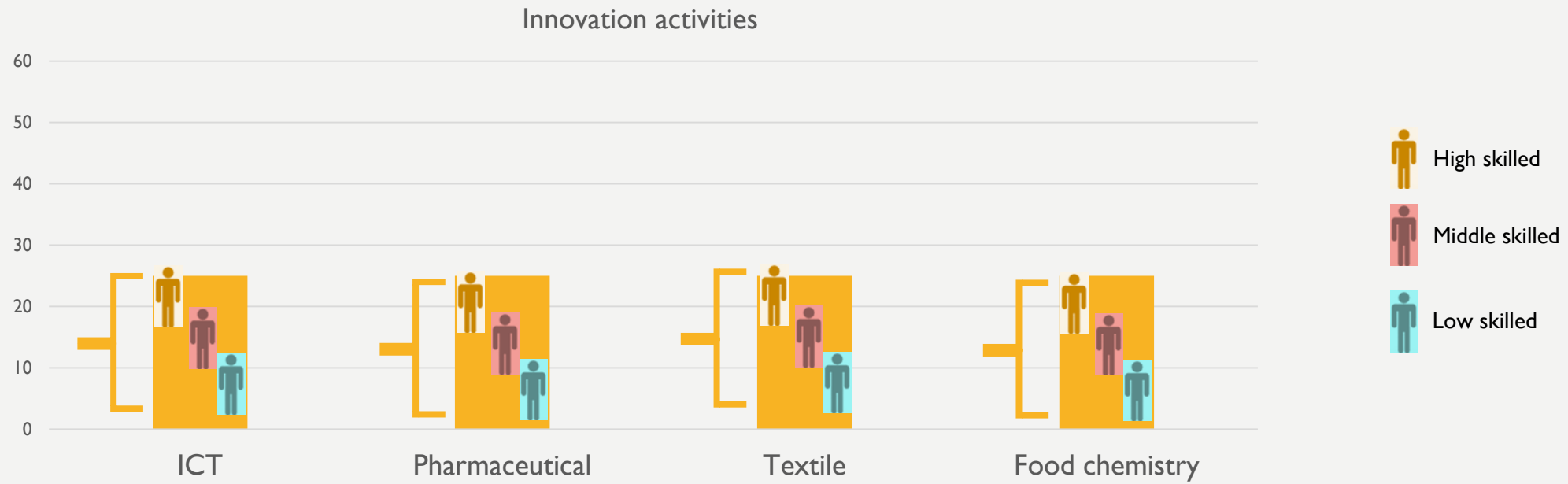
within



More innovative sectors have higher wage gap (SBTC)

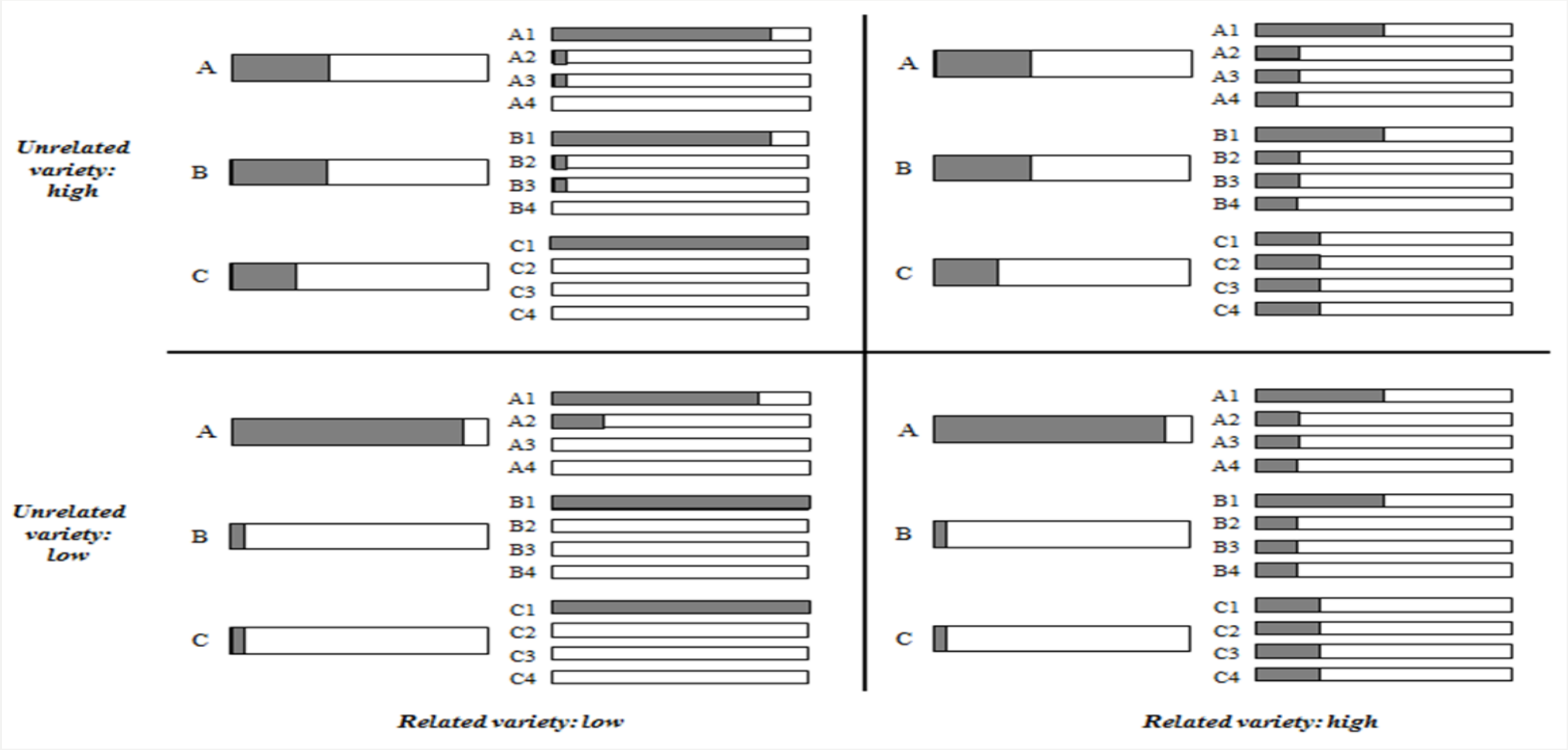
TECHNOLOGICAL VARIETY AND INEQUALITY

Instead, variety is expected to decrease inequality



H2: Regional technological variety is positively related to regional income inequality

RELATED AND UNRELATED VARIETY



Source: Janssen, 2015

RELATED AND UNRELATED VARIETY

1. **Related variety: localized knowledge spillovers (Gambardella and Giarratana, 2010, SEJ)**
2. **Unrelated variety: breakthroughs (Castaldi, Frenken and Los, 2015, RS; Castaldi and Los, 2017, RP)**

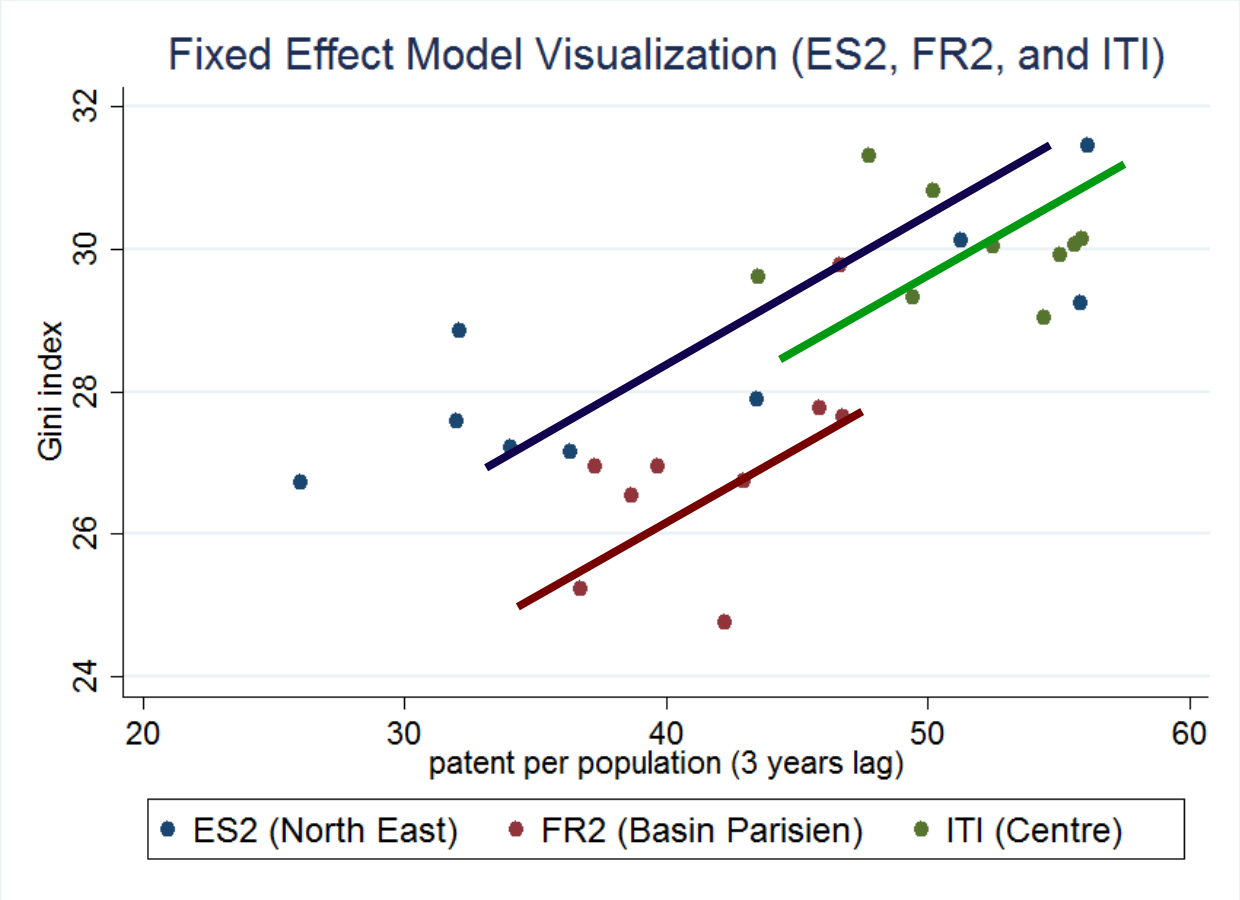
H3: Regional unrelated technological variety is more negatively related to income inequality than related variety

EMPIRICAL METHODS

- Fixed Effect Panel Regressions,

  (OLS with region dummies)

  - 84 NUTS 1 regions
- Panel data strength (Baltagi)
  - Control individual heterogeneity
  - Provide more informative data
  - Dynamics of adjustment
- FE model controls time-invariant differences between the regions; designed to study the causes of changes *within* a subject (Torres-Reyna, 2007)



EMPIRICAL METHODS

$$inequality_{it} = f\ (innovation_{it-h},\ control\ variables_{it},\ error_{it})$$

$$inequality_{it} = f\ (technological\ variety_{it-h},\ control\ variables_{it},\ error_{it})$$

Dependent variables:

- Gini Index,
- Percentile Ratio 90:50 (top half), 50:10 (bottom half), 90:10 (top bottom)

Independent variables:

- Innovation: Patent per inhabitants (from REGPAT, based on origin of applicant)
- Technological variety: Entropy measures

Control variables

education, GDP per capita, population growth (from EUROSTAT)

MEASURE OF TECHNOLOGICAL VARIETY

Entropy measure at different (nested) classification levels (from 1 digit to full digit)

$$TV = \sum_{j=1}^{N} Pj \ln\left(\frac{1}{Pj}\right)$$

$$UV = \sum_{i=1}^{M} Pi \ln\left(\frac{1}{Pi}\right)$$

$$RV = \sum_{j=1}^{N} Pj \ln\left(\frac{1}{Pj}\right) - \sum_{i=1}^{M} Pi \ln\left(\frac{1}{Pi}\right)$$

RESULTS

H1 confirmed

H2 confirmed

	(1) Gini Innovation	(2) Gini Entropy 1 digit	(3) Gini Entropy 3 digit	(4) Gini Entropy 4 digit	(5) Gini Entropy 8 digit	(3) Gini Entropy full digit
patent_pop	0.004**	0.004**	0.004**	0.004**	0.004**	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Entropy_1D		-0.705***				
		(0.265)				
Entropy_3D			-0.425**			
			(0.178)			
Entropy_4D				-0.432***		
				(0.166)		
Entropy_8D					-0.396**	
					(0.162)	
Entropy_fullD						-0.455***
						(0.149)
edu_low	-0.073	-0.061	-0.065	-0.063	-0.066	-0.061
	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)
edu_high	-0.171**	-0.144*	-0.145*	-0.137*	-0.146*	-0.143*
	(0.075)	(0.075)	(0.075)	(0.076)	(0.075)	(0.075)
gdp_cap	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
pop_growth	-0.107***	-0.109***	-0.106***	-0.107***	-0.108***	-0.110***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
R-square	0.0770	0.0927	0.0896	0.0920	0.0903	0.0975
N	481	481	481	481	481	481

Innovation (as measured by *patent_pop*) and entropy index are 3 years lagged.

RESULTS

H3 confirmed

	(1) Gini D3&DFull	(2) Gini D4&DFull	(3) Gini D3&D8	(4) Gini D4&D8	(5) Gini D1&D4
patent_pop	0.004**	0.004**	0.004**	0.004**	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
UV	-0.479***	-0.466***	-0.447**	-0.436***	-0.654**
	(0.180)	(0.167)	(0.180)	(0.168)	(0.271)
RV	-0.418*	-0.424	-0.243	-0.069	-0.225
	(0.219)	(0.267)	(0.287)	(0.400)	(0.259)
edu_low	-0.061	-0.061	-0.065	-0.063	-0.061
	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)
edu_high	-0.141*	-0.142*	-0.143*	-0.138*	-0.137*
	(0.075)	(0.075)	(0.075)	(0.076)	(0.076)
gdp_cap	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
pop_growth	-0.110***	-0.110***	-0.107***	-0.107***	-0.108***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
R-square	0.0976	0.0976	0.0912	0.0921	0.0944
N	481	481	481	481	481

SCIENTIFIC CONTRIBUTION

	Methods & case study	Result
Lee (2011)	Fixed effect panel data model EU regions 1996 – 2001 (6 years)	Innovation increases total income inequality
Antonelli and Gehringer (2013)	FGLS panel data model EU & OECD countries 1996 – 2011 (16 years)	Innovation decreases total income inequality
Aghion et al (2015)	OLS with country and time dummies U.S. state 1975 – 2010 (35 years)	Innovation increases top income inequality but not related to total income inequality
Hartmann et al (2017)	Pooled OLS and fixed effect panel data models Countries worldwide 1996 – 2008 (12 years) and 1963-2008 (45 years)	Economic variety (complexity) limits income inequality
This study (2017)	Fixed effect panel data model EU regions 2004-2011 (8 years)	Innovation increases income inequality Technological variety decreases, but mostly because of the effect of unrelated

POLICY IMPLICATIONS

- Awareness of distributional effects of innovation (policies)

- Strong specialization policies have an important downside