Impact of innovation and globalization on polarization of the labor markets in Europe

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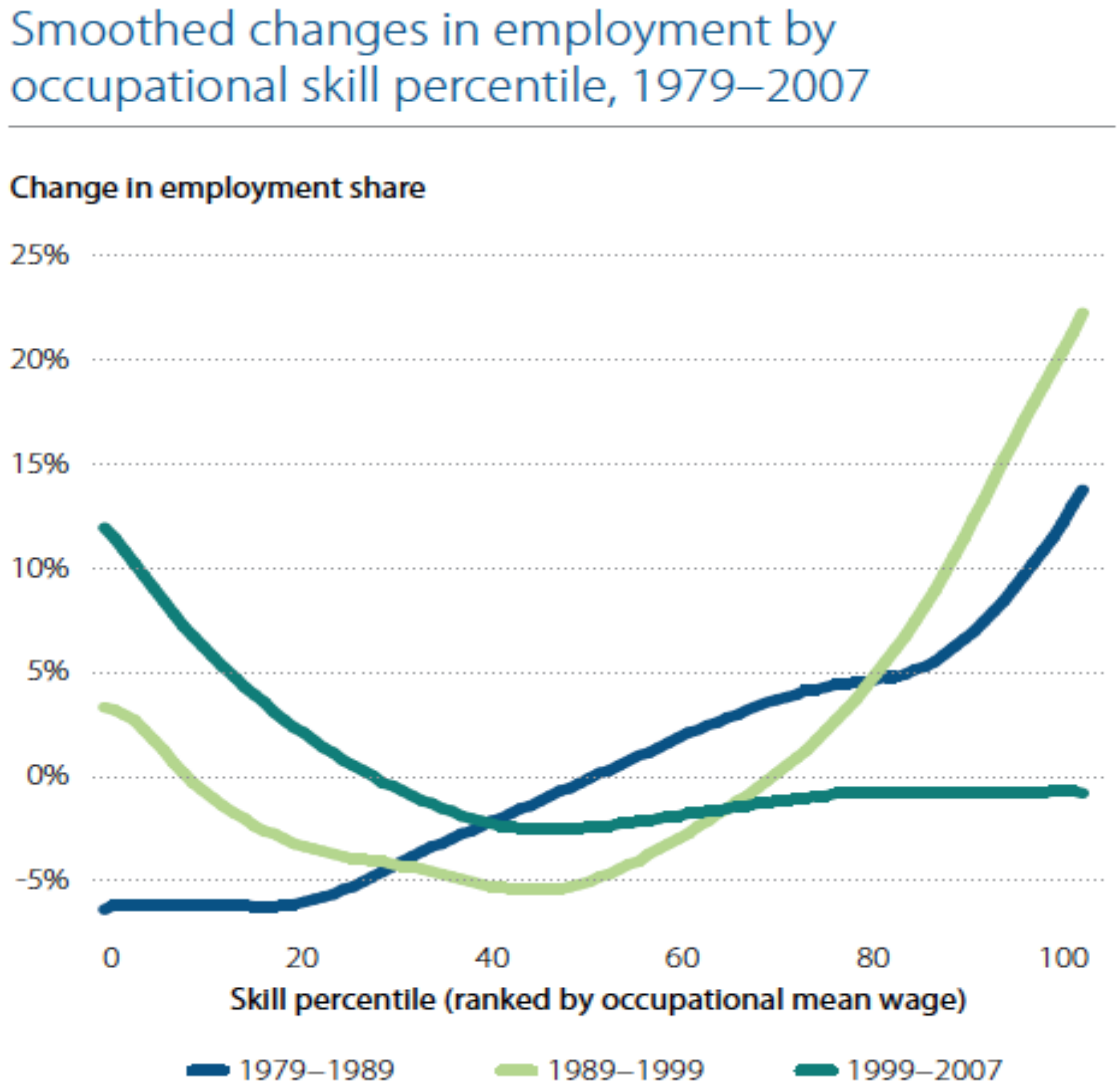
Motivation

- Developments in the labor markets in advanced countries since 1970s:
  - a shift in demand toward more educated workers
- Broadly accepted explanation for this shift in the 1990s:
  - skill-biased technological change (SBTC), Autor and Katz (1999)
- However…
  - this would predict a uniform shift of employment from low-skilled to high-skilled labor

However...

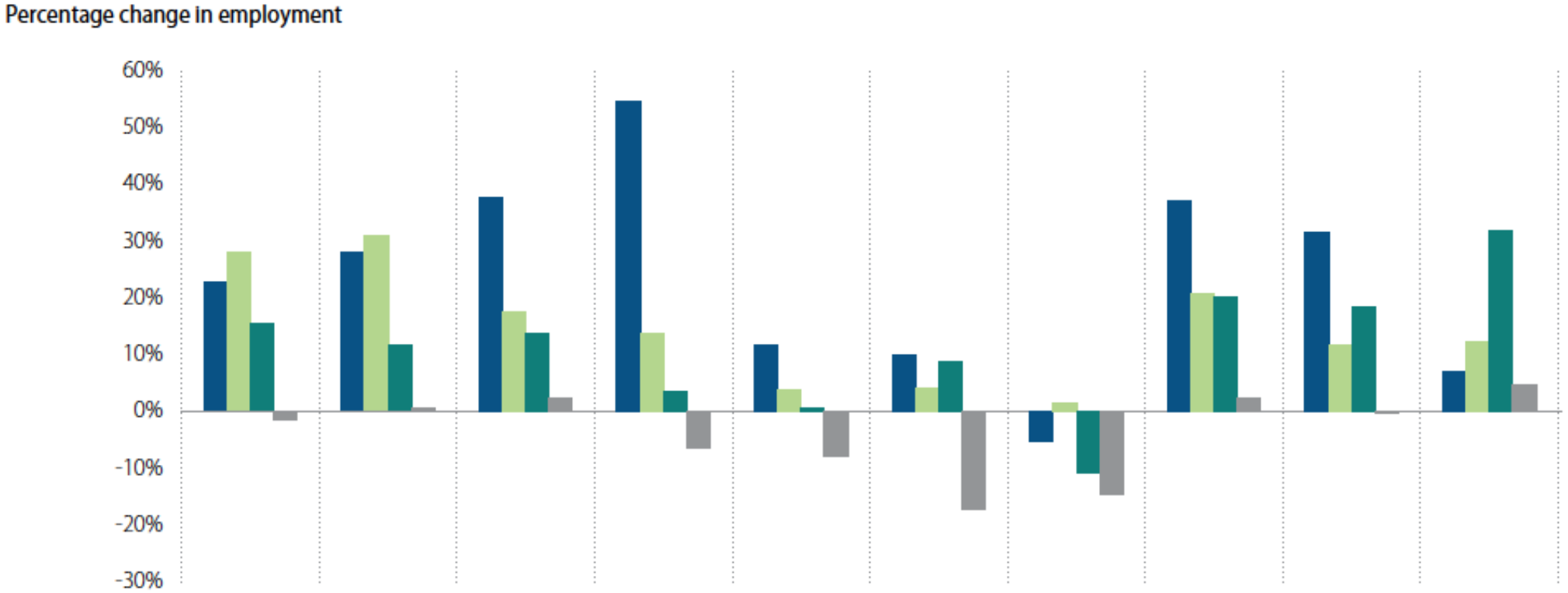
- Evidence of polarization in the labor markets:
  - an U-shaped evolution of employment wrt occupational wage in U.S.



Autor, Katz and Kearney (2006), Autor (2010)

U-shaped polarization

- By occupation: U.S., 1979-2009 (Autor, 2010)

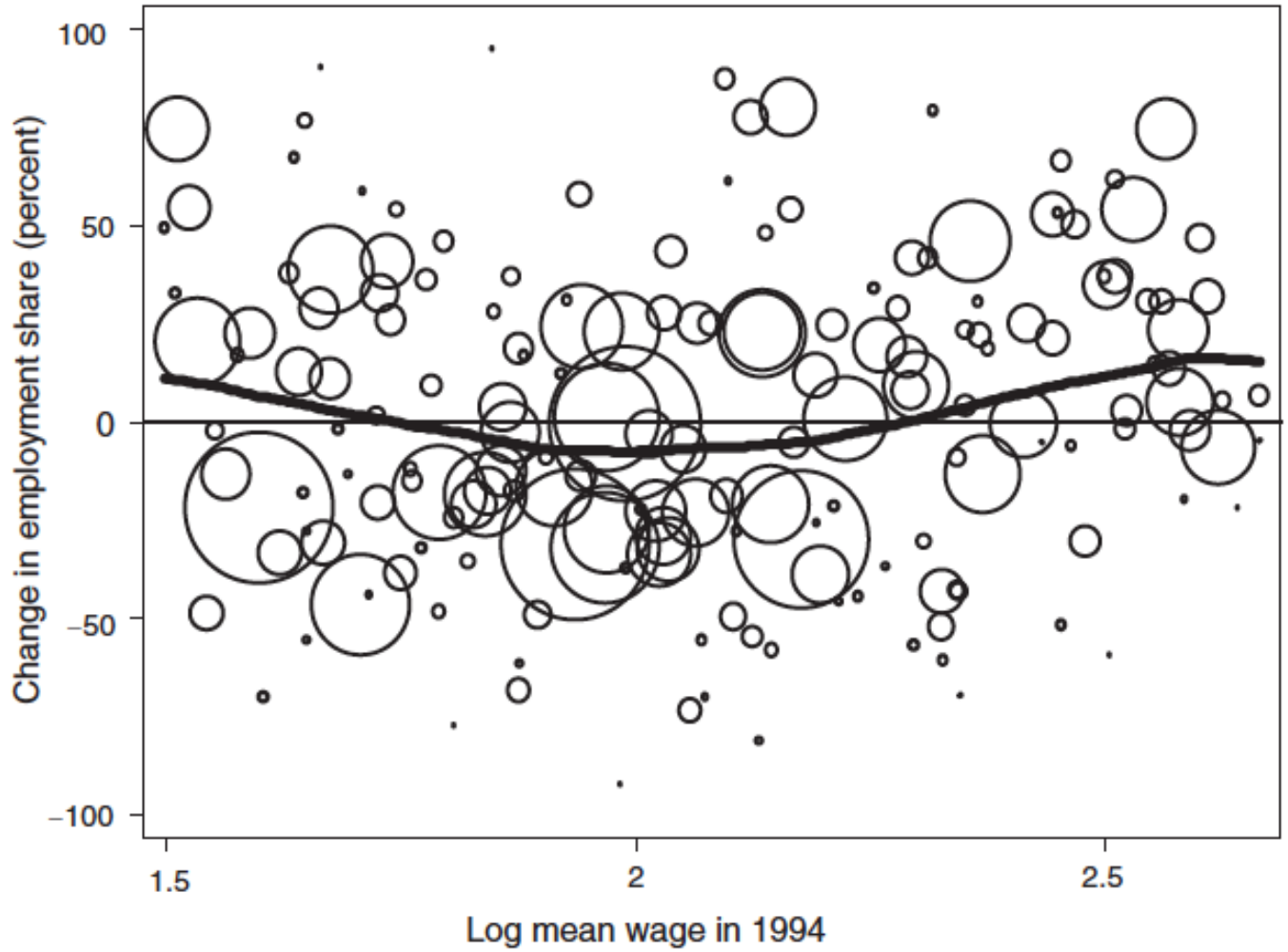


	Managers	Professionals	Technicians	Sales	Office and admin	Production, craft, and repair	Operators, fabricators, and laborers	Protective services	Food prep, building and grounds cleaning	Personal care and personal services
1979–1989	22%	28%	37%	54%	11%	10%	-5%	36%	31%	7%
1989–1999	27%	30%	17%	14%	3%	4%	1%	20%	11%	12%
1999–2007	15%	11%	14%	4%	1%	8%	-11%	20%	18%	31%
2007–2009	-1%	0%	2%	-7%	-8%	-17%	-15%	2%	0%	5%

A similar trend in Europe

- 16 EU countries, LFS data, 1993-2006 (Goos, Manning and Salomons, 2009)

FIGURE 1. PERCENTAGE CHANGES IN EMPLOYMENT SHARES OVER 1993–2006 FOR JOBS RANKED BY THEIR 1994 LOG WAGE



Explanations

- "Routinization hypothesis" (Autor, Levy & Murnane, 2003)
  - the effect of technological progress is to replace "routine" labor, which is in the middle of the wage distribution
- Globalization and offshoring (Blinder, 2009)
  - "Routine jobs" (assembly lines) are being progressively offshored to lower-wage countries,
  - Import competition in low tech & middle-low tech industries
- Polarization and wage inequality (Manning (2004), Mazzolari & Ragusa (2013)
  - A surge in the share of income going to the rich may have contributed to the shift in demand for low-skill labor to provide "services to the rich"
  - U.S. & UK only?

This paper

- Non-competing theories, but rather complementary forces at work
- Focus on two forces
- A: Routinization vs. innovation:
  - some tasks can be codified as routines, computerized and carried out by machines (automation)
  - some either *abstract* tasks or *simple* tasks cannot
  - abstract tasks are usually concentrated in high-paid service jobs (management, R&D and innovation, IT, etc.)
- B: Globalization and offshoring of routine jobs:
  - competition: imports in general and imports from China by tech groups
  - relocation of production (inward FDI, outward FDI) by tech groups

Expected relationships

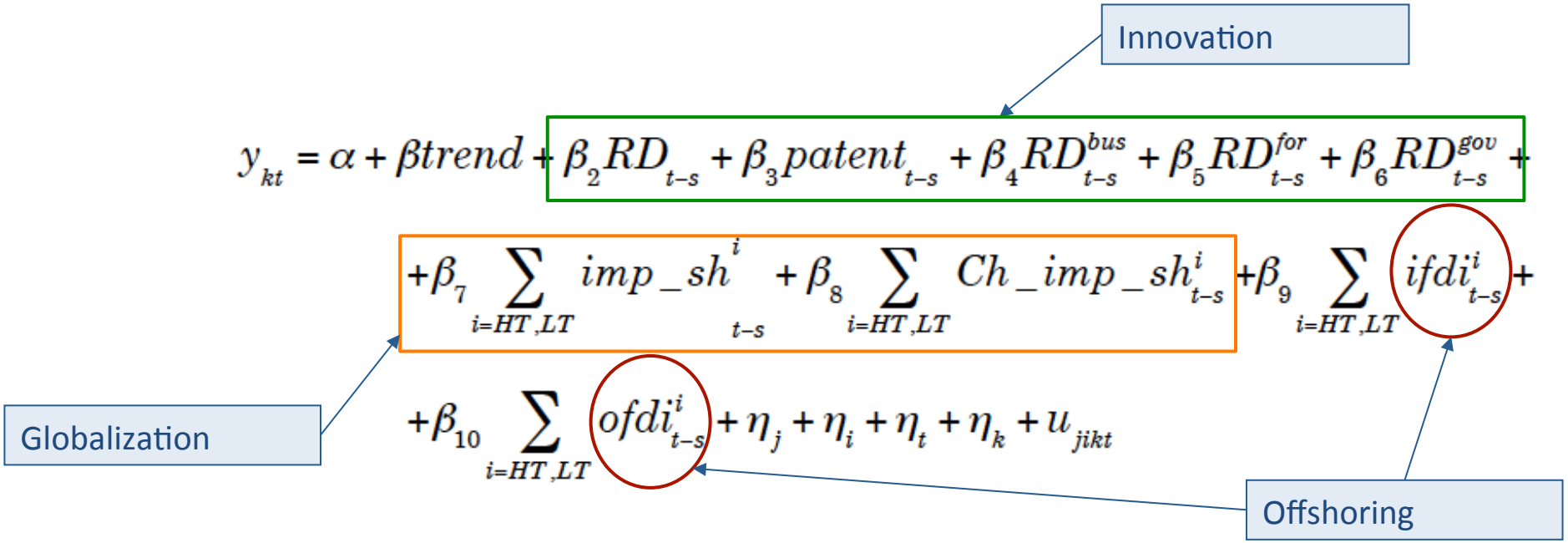
- Innovation
  - focus on innovation, associated with greater share of R&D exp., will also result in increasing employment shares of high-paid service jobs
  - i.e. increasing polarization in the higher end of the wage distribution
- Globalization
  - imports of low-tech goods will put in danger low-skill routine-based jobs
    - increasing polarization in the lower end of the wage distribution
  - imports of high-tech goods (production technology) may lead to more demand for high-skill workers
    - opposite effects in the higher end of the wage distribution
  - Similar but larger effects of imports from China in LT and MLT ind.

Expected relationships

- Offshoring

  - Heterogeneity across EU wrt development levels
  - SE & CEE countries attracting more FDI in LT and MLT industries
    - decreasing demand for middle-wage routine jobs in high-income countries and increasing demand for these jobs in SE and CEE
  - countries engaged in relocation of manufacturing production abroad (via outward FDI) will experience a polarizing effect in the labor markets, while in the FDI receiving countries this effect will be dampened (or aggravated)
  - Different effects in case of IFDI and OFDI in HT and MHT industries

Empirical model



- Dependent variable in two forms:

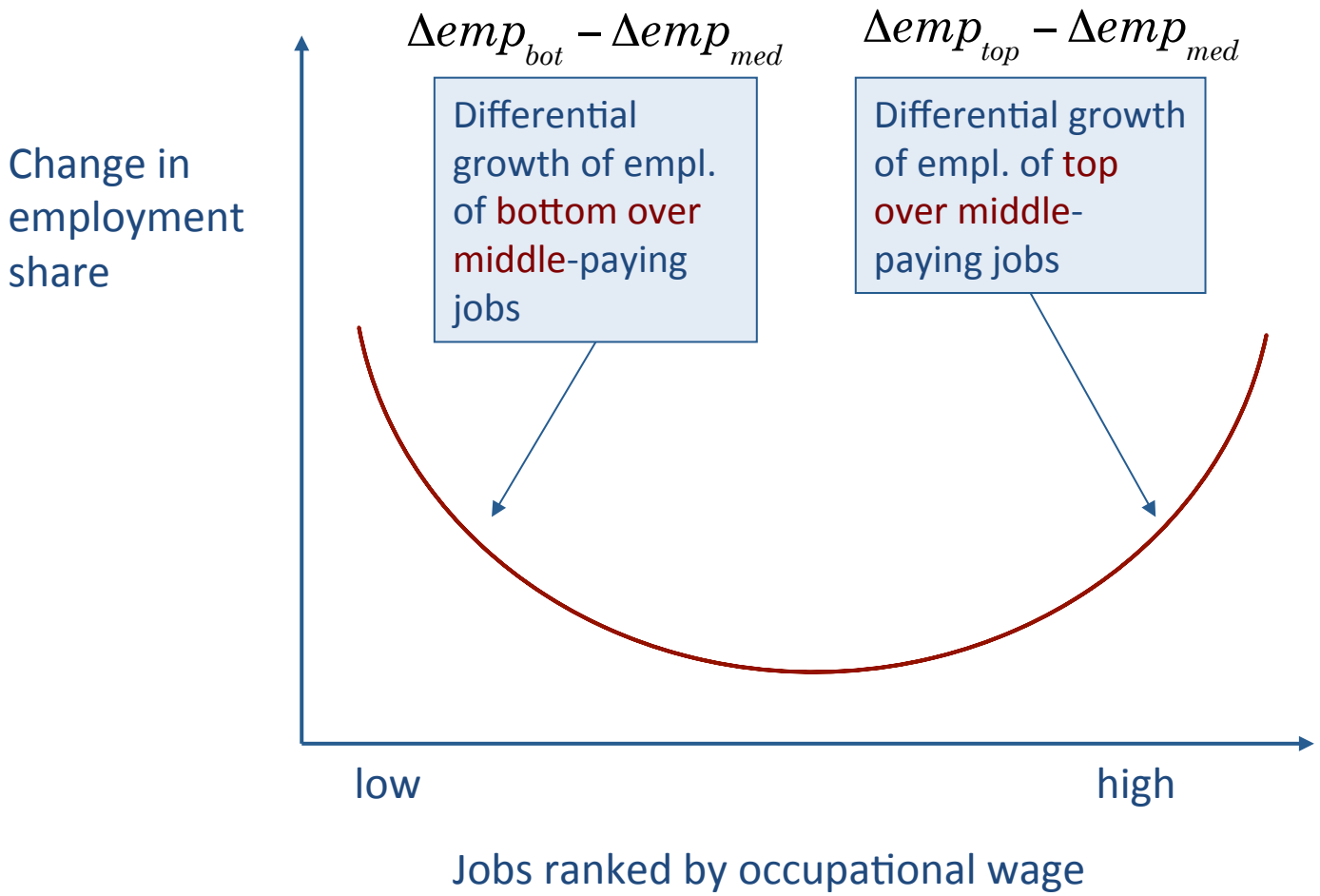
$$y = \Delta emp_{bot} - \Delta emp_{med}$$

$$y = \Delta emp_{top} - \Delta emp_{med}$$

Differential growth of employment:

- Lowest-paying over middle-paying jobs
- Highest-paying over middle-paying jobs

Capturing the polarization effects



Data

Employment

- Labor Force Survey, 1992-2013 (Eurostat)
- 33 European countries (EU-28 + CH, NO, IC, TR, MK)
- At aggregate level (no industry level until 2008)
- But info on sex, education, ISCO 2008 1-digit occupation

Innovation

- EPO patent data
- Eurostat GERD data by type of expenditure

Trade

- Eurostat-Comext by technology groups (LT, MLT, MHT, HT)
- China only for 2002-2013

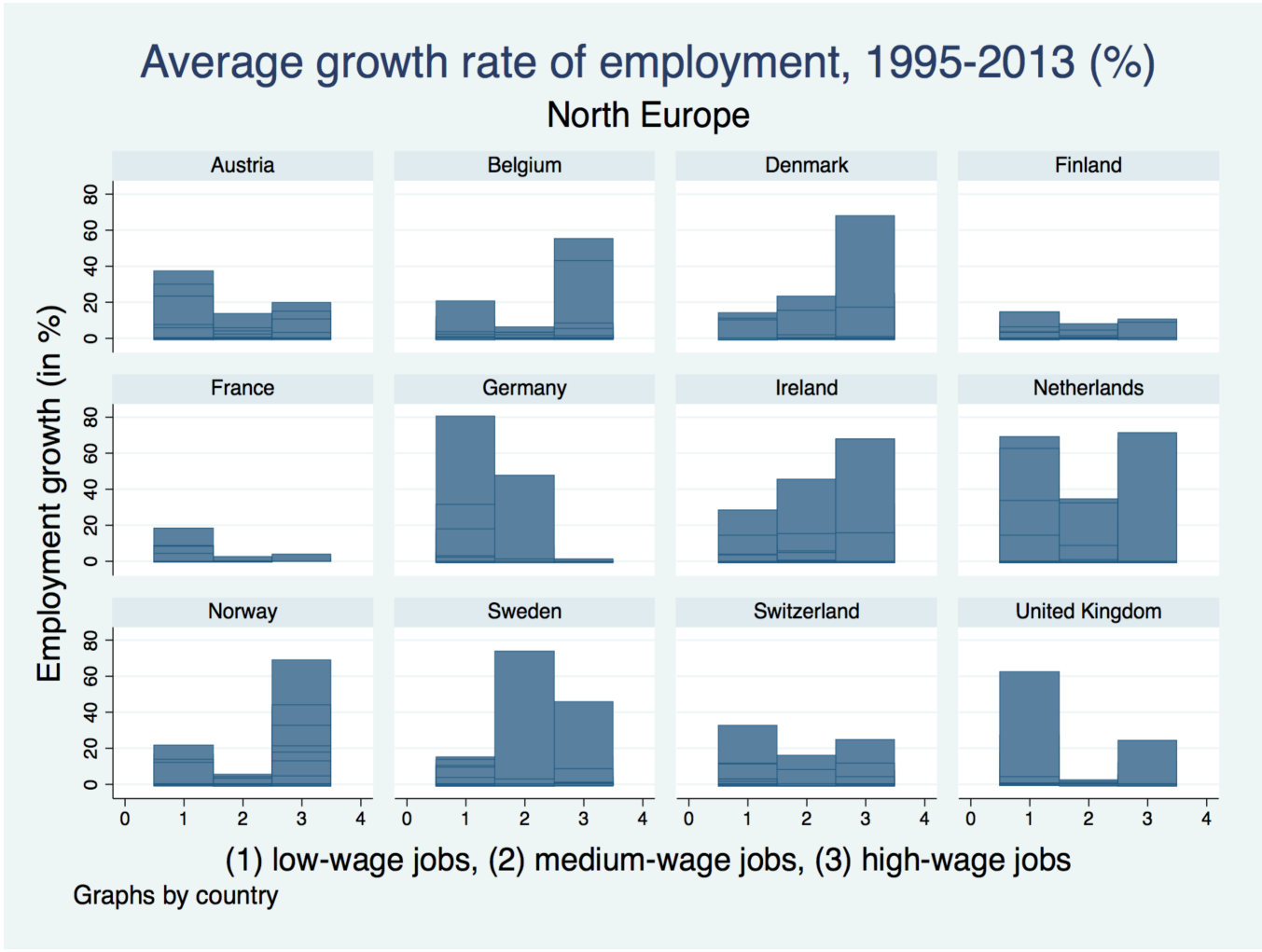
FDI

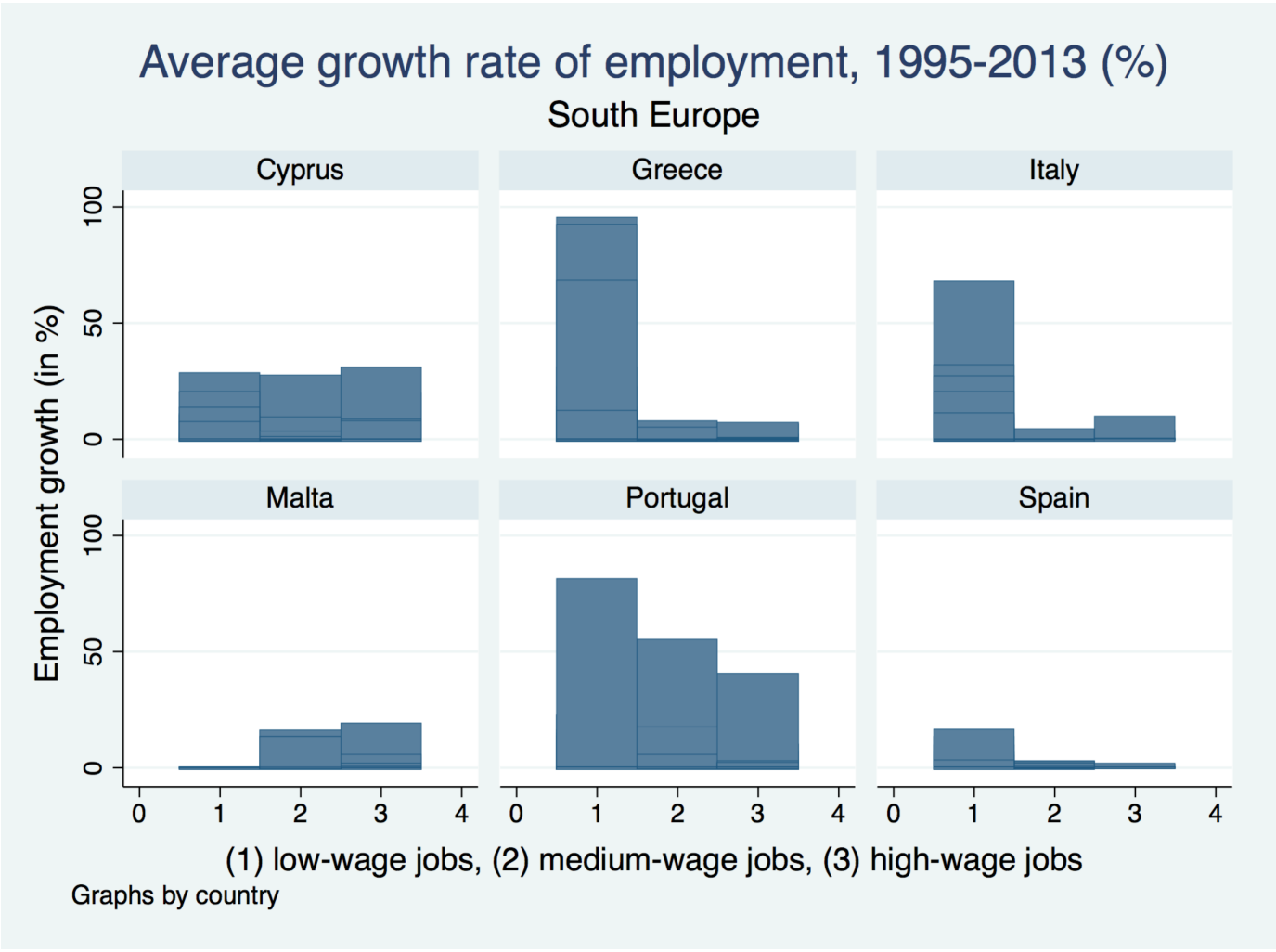
- UNCTAD
- 1995-2013

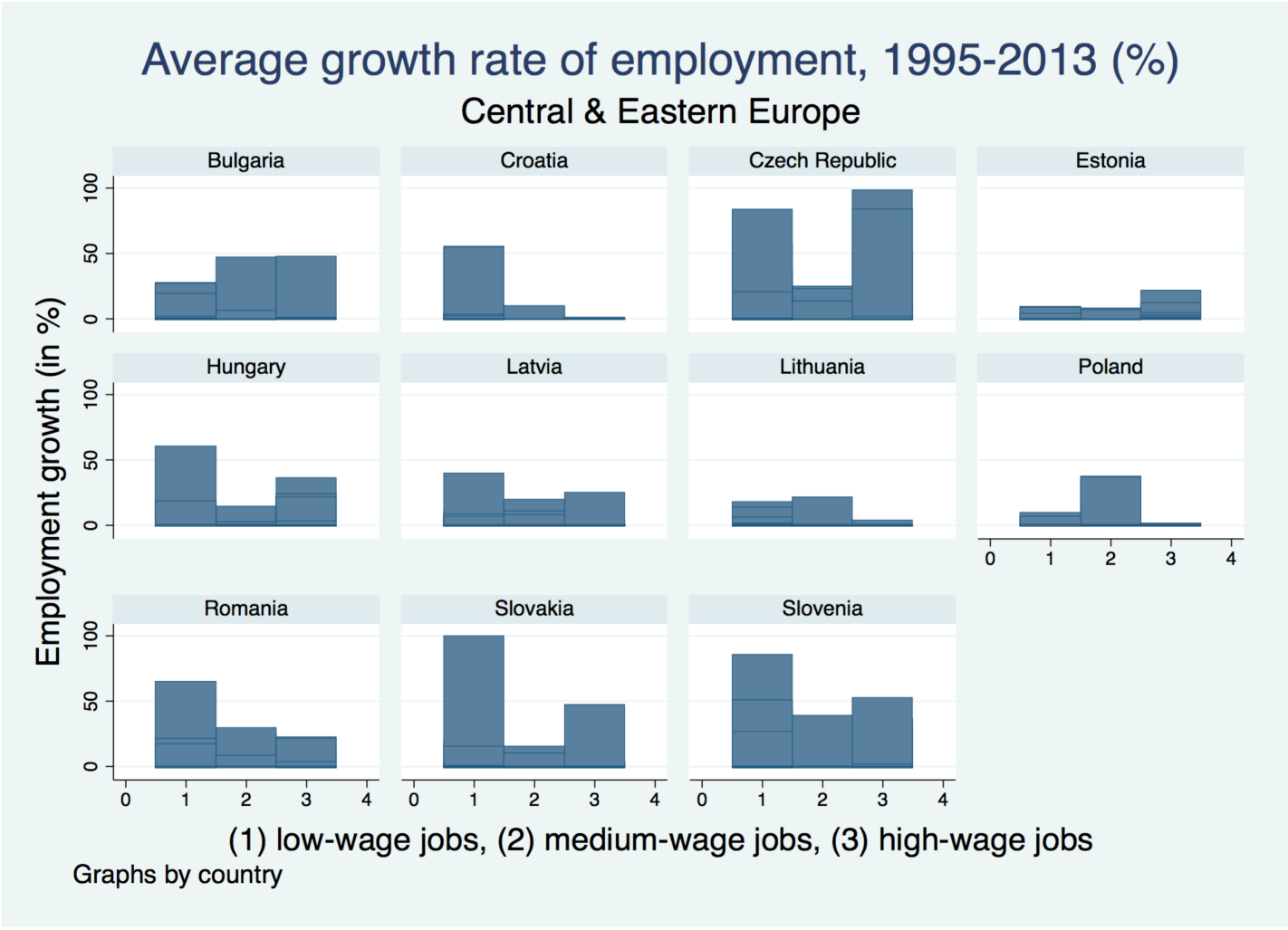
Changes in employment shares over 1995-2013 by three broad groups*
(weighted average across all countries, in %)

Three highest-paying occupations	Share of emp. in 1995	Percentage point change 1995-2013	Average growth rate 1995-2013#
Managers	12.0	-2.2	3.4
Professionals	10.4	1.7	5.4
Technicians	10.9	0.7	4.9
subtotal	***33.3***	***0.3***	***4.6***
Three middle-paying occupations			
Armed forces	3.4	2.2	7.4
Clerical support workers	12.8	-2.6	3.2
Craft and related service workers	12.6	-2.6	3.2
subtotal	***28.9***	***-3.0***	***3.9***
Four lowest-paying occupations			
Elementary occupations	9.7	2.7	9.7
Machine operators and assembly workers	7.3	1.5	7.3
Skilled agric., forest. and fisheries work.	9.5	1.8	9.5
Service and sales workers	11.9	-3.5	11.9
subtotal	***37.8***	***2.8***	***4.9***

* Wage ordering of occupations is based on Goos et al (2009)


Average growth rate of employment, 1995-2013 (%)
North Europe
Austria
Belgium
Denmark
Finland
France
Germany
Ireland
Netherlands
Norway
Sweden
Switzerland
United Kingdom
Employment growth (in %)
0
20
40
60
80
0
1
2
3
4
(1) low-wage jobs, (2) medium-wage jobs, (3) high-wage jobs
Graphs by country


Average growth rate of employment, 1995-2013 (%)
South Europe
Cyprus
Greece
Italy
Malta
Portugal
Spain
Employment growth (in %)
0
50
100
0
1
2
3
4
(1) low-wage jobs, (2) medium-wage jobs, (3) high-wage jobs
Graphs by country


Average growth rate of employment, 1995-2013 (%)
Central & Eastern Europe
Bulgaria
Croatia
Czech Republic
Estonia
Hungary
Latvia
Lithuania
Poland
Romania
Slovakia
Slovenia
Employment growth (in %)
0
50
100
0
1
2
3
4
(1) low-wage jobs, (2) medium-wage jobs, (3) high-wage jobs
Graphs by country

Partial correlation coefficients with dependent variable: Δ empl bottom / med.

	Yt	Yt-1	Yt-2	Yt-3
Patents per number of population	-0.0660*	-0.0159*	-0.0155*	-0.0131*
R&D expenditure per person	0.0015	0.0022	0.0034	-0.0081
Share of business RD in total RD expenses	-0.0048	-0.0087	0.0198*	0.0097
Share of foreign RD in total RD expenses	-0.0535*	-0.0331*	-0.0264*	-0.0574*
Share of government RD expenditure in total RD expenses	0.0370*	0.0273*	-0.0099	0.0064
Share of high tech industries in total imports	0.0620*	0.0139*	0.0173*	0.0179*
Share of low and medium-low tech ind. in imports	0.0316*	0.0011	0.0171*	-0.0091
Chinese share in imports of high tech industries	0.0652*	0.0399*	0.0457*	0.0502*
Chinese share in imports of low and medium-low tech ind.	0.0270*	0.0158*	0.0301*	0.0282*
Share of high tech industries in inward FDI	-0.0105	-0.0099	-0.0005	-0.0123*
Share of low and medium-low tech industries in inward FDI	-0.0114*	-0.0134*	-0.0144*	-0.0133*
Share of high tech industries in outward FDI	-0.0101	-0.0125*	-0.0149*	-0.0131*
Share of low and medium-low tech industries in outward FDI	-0.0168*	-0.0182*	-0.0196*	-0.0177*

* $P < 0.05$

Partial correlation coefficients with dependent variable: Δ empl top / med.

	Yt	Yt-1	Yt-2	Yt-3
Patents per number of population	0.0269*	0.0206*	0.0246*	0.0281*
R&D expenditure per person	0.0382*	0.0494*	0.0379*	0.0441*
Share of business RD in total RD expenses	-0.0167*	0.0002	0.0015	0.0221*
Share of foreign RD in total RD expenses	0.1185*	0.1073*	0.1080*	0.0686*
Share of government RD expenditure in total RD expenses	-0.0506*	-0.0531*	-0.0556*	-0.0546*
Share of high tech industries in total imports	0.0431*	0.0655*	0.0728*	0.0798*
Share of low and medium-low tech ind. in imports	-0.0249*	-0.0225*	0.001	-0.0037
Chinese share in imports of high tech industries	0.0340*	0.0434*	0.0421*	0.0639*
Chinese share in imports of low and medium-low tech ind.	0.0347*	0.0431*	0.0450*	0.0649*
Share of high tech industries in inward FDI	-0.0136*	0.0131*	-0.0099	-0.0146*
Share of low and medium-low tech industries in inward FDI	-0.0176*	0.0045	-0.0212*	-0.0133*
Share of high tech industries in outward FDI	-0.0173*	0.0036	-0.0219*	-0.0125*
Share of low and medium-low tech industries in outward FDI	-0.0190*	0.0024	-0.0224*	-0.0141*

* $P < 0.05$

Estimations

- OLS with:
  - Country FE
  - Sex FE
  - Technology group FE
  - Time FE
- RHS variables lagged by 1 year
- Robustness check with 2 lags
- Splitting the sample:
  - Pre-crisis & Post-crisis
  - By country groups

Results: Pooled

Dependent variable:	(1) bottom over median-paid jobs	(2) top over median-paid jobs
Time trend	-0.396	-0.666
Patents per capita	0.037	0.019
R&D expenditure per capita	-0.010	0.002
Share of business R&D (in total R&D exp.)	0.343	1.446*
Share of foreign R&D (in total R&D exp.)	0.096	1.904
Share of government R&D (in total R&D exp.)	0.069	1.505
Share of HT ind. in total imports	0.095*	-0.067
Share of LT and MLT ind. in imports	0.150*	-0.034
Chinese share in imports of HT ind.	3.304**	-0.734
Chinese share in imports of LT and MLT ind.	-1.423**	-0.176
Share of HT ind. in total inward FDI	-0.004	0.185
Share of LT and MLT ind. in total inward FDI	0.490**	-0.076
Share of HT ind. in total outward FDI	0.083	-0.119*
Share of LT and MLT ind. in total outward FDI	-0.293**	0.087
Constant	-29.279	-155.197*
Country fixed effects	YES	YES
Sex fixed effects	YES	YES
Technology group fixed effects	YES	YES
Time fixed effects	YES	YES
Observations	30,120	26,640
R-squared	0.165	0.168

Results: Pre- & post-crisis

Dependent variable:	(1)	(2)	(3)	(4)
	bottom over median-paid jobs		top over median-paid jobs	
	1995 to 2008	2009 to 2013	1995 to 2008	2009 to 2013
Patents per capita	0.079**	0.075	0.089**	0.354
R&D expenditure per capita	-0.002	-0.079*	0.010	-0.030
Share of business R&D	-0.163	3.870*	0.669	-0.082
Share of foreign R&D	-0.469	3.465*	0.406	0.641
Share of government R&D	-0.372	3.718*	0.667	-0.650
Share of HT imports	0.168**	0.306*	-0.015	0.435
Share of LT imports	0.172*	0.250	-0.018	-2.201
Share of Chinese HT imports	4.848*	-4.363	-0.613	-11.982
Share of Chinese LT imports	-1.656**	-0.612	0.078	-0.363
Share of HT ind. in inward FDI	-0.130	0.061	0.223	-0.815
Share of LT and MLT in IFDI	0.322	0.381	-0.065	3.444
Share of HT ind. in outward FDI	0.448	-1.204	-0.477	7.693
Share of LT and MLT ind. in OFDI	-0.364*	-0.205	0.332	1.645
Constant	7.765	-3.606	-82.860	-64.332
Observations	19,800	9,720	18,960	6,420
R-squared	0.243	0.295	0.144	0.529

Results: Δ empl bottom / med.

	(1) North 1995-08	(2) North 2009-13	(3) South 1995-08	(4) South 2009-13	(5) CEE 1995-08	(6) CEE 2009-13
Patents per capita	0.045*	0.086	-0.221	-0.074**	0.524	-0.168
R&D expenditure per capita	0.001	-0.040	-0.131***	6.111**	-0.213**	-0.123
Share of business R&D	-0.684	6.664**	-5.103***	0.933***	2.118*	6.790**
Share of foreign R&D	-0.828	3.338	-4.302***	1.073**	1.726	7.018**
Share of government R&D	-0.574	4.676*	-4.958***	0.969**	1.965	8.307*
Share of HT imports	-0.007	0.017	0.139***	-0.090*	0.212**	0.139
Share of LT imports	-0.146**	0.155	0.115	-0.405**	0.533**	0.719
Share of Chinese HT imports	0.940	14.563**	2.281	-8.074**	2.406	-1.143
Share of Chinese LT imports	0.426	10.075	-2.593***	5.539**	-2.233	4.992
Share of HT ind. in inward FDI	-0.138	-0.240	0.595	0.122	-0.585	7.500*
Share of LT and MLT in IFDI	0.037	0.066	-0.169*	-0.788	2.659	2.419
Share of HT ind. in outward FDI	0.189	-1.045	-2.739*	0.954	1.179	-6.167
Share of LT & MLT ind. in OFDI	-0.126	0.015	1.211**	-0.565**	-0.670	-0.882
Observations	9,240	4,080	3,600	2,160	6,960	3,480
R-squared	0.109	0.333	0.627	0.722	0.304	0.516

Results: Δ empl top / med.

	(1) North 1995-08	(2) North 2009-13	(3) South 1995-08	(4) South 2009-13	(5) CEE 1995-08	(6) CEE 2009-13
Patents per capita	0.092	1.402***	0.008	2.264***	0.485	3.206***
R&D expenditure per capita	-0.001	0.014	0.099***	-0.208*	0.004	2.178***
Share of business R&D	13.036	7.236*	0.872	-4.628	0.787	-0.110***
Share of foreign R&D	11.641	5.425*	1.304	-8.525**	1.169	0.733
Share of government R&D	12.992	1.531	1.024	-7.563**	0.603	6.956***
Share of HT imports	0.071	4.529***	-0.028	-0.070	0.069	-6.240**
Share of LT imports	0.112	0.673	0.062	-1.628	-0.195**	-0.497**
Share of Chinese HT imports	-7.597	2.074	2.731	-0.515	0.212	0.251*
Share of Chinese LT imports	1.289	-3.15***	-1.066**	-1.79*	0.030	-1.247**
Share of HT ind. in inward FDI	0.010	1.425***	-0.326	9.148***	0.779	-0.593**
Share of LT and MLT in IFDI	0.172	10.634***	-0.337	1.541	-0.166	0.157*
Share of HT ind. in outward FDI	0.252	2.559**	-1.441**	-4.35***	-0.635	-8.875*
Share of LT & MLT ind. in OFDI	1.139	3.409**	0.066	4.089*	0.146	-7.592**
Observations	9,000	2,940	3,660	1,500	6,300	1,980
R-squared	0.219	0.572	0.394	0.834	0.192	0.159

Conclusions

- First, innovation and R&D expenditures contribute to polarization in the higher end of the wage spectrum,
  - but less so at the lower end.
  - However, both became more important during the recent crisis period
- Second, general imports seem to accelerate polarization at the lower end of the wage spectrum,
  - while imports of Chinese low-tech products dampen these effects by reducing employment of the lowest-paying occupations.
- Finally, inward FDI seem to foster polarization by increasing demand for labor at both sides of the wage spectrum,
  - while relocation of production abroad via outward FDI moderates these polarization effects by reducing the demand for labor.
  - These effects are aggravated during the crisis.