How can we operationalized the task approach?

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BACKGROUND

During 1990-2010 many OECD countries experienced **increases in wage and income inequality** (Atkinson, 2015; OECD,2017).

Three main explanations: 1) changes in labour market institutions; 2) increase in trade with countries where unskilled labour is cheaper; 3)Technology.

Skill Biased Technological Change (SBTC; demand driven) posits that technology (i.e. digitalization) complements high-skilled labour and substitutes for low-skilled labour.

Implications: employment should increase for high-skilled and decrease for low-skilled individuals. The implications for wages are theoretically less clear, as supply effects could be working as well. But in empirical work, SBTC has been used to explain increased wage inequality and, especially, increases in the skill premium.

BACKGROUND

However, some scholars (David Autor *in primis*) argued that changes in the wage and employment distribution in the US were **not consistent with the SBTC hypothesis**. In particular, together with other co-authors, Autor showed that **job polarization was happening in the US.**

Job polarization happens when jobs are growing at the extremes of the wage distribution and shrinking in the middle.

A new theory was proposed by Autor, Levy and Murnane (2003) and later developed and formalized by Autor and Acemoglu (2011), called **Routine Biased Technological Change** (RBTC).

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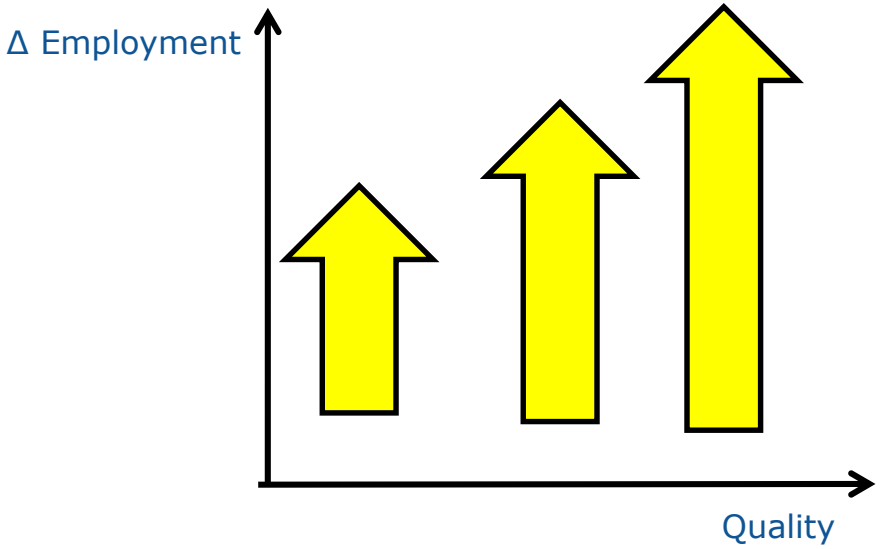
eduworks

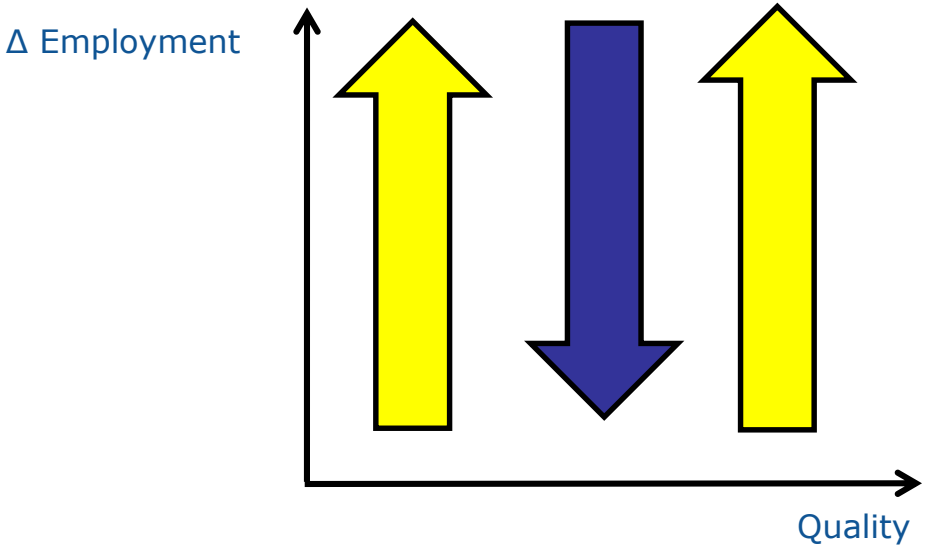
Upgrading



MAIN DRIVER: SBTC

Katz and Murphy, 1992;
Machin and Van Reenen, 1998

Job Polarization



MAIN DRIVER: RBTC

Autor, Levy and Murnane (2003)
Autor and Dorn (2013)

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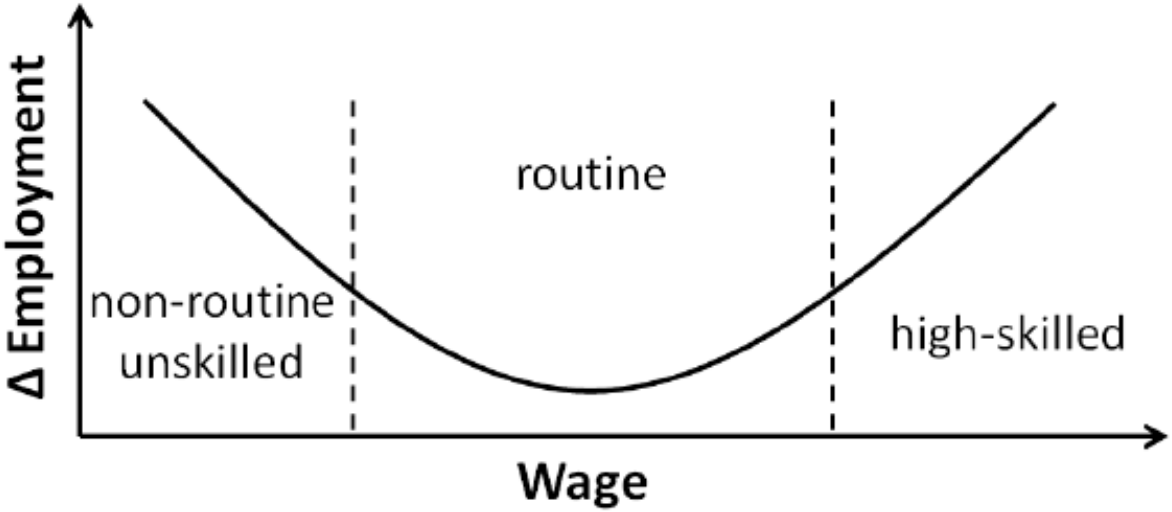
BACKGROUND

The RBTC hypothesis is based on the idea that:

1) **Jobs are seen as bundles of tasks**. Hence we should focus on the demand for tasks.

2) **Tasks can be categorised as either routine or non-routine, and either cognitive/abstract/interactive or manual in content**. Computers and advanced machinery can more easily replace workers employed in jobs that are very intensive in routine tasks. These are tasks that are repetitive and can be easily codified and programmed into some form of algorithm.

Previous research



At the EU: Good et al. (2014) find job polarization and routine as the main driver behind it using O*Net

BACKGROUND

Challenges for the RBTC:

1) How many types of tasks do we have? Researchers lack shared consistency concerning the typologies and definitions of tasks.

2) How can we capture these tasks in actual data (e.g. how to capture a routine job)? Information on tasks is not commonly collected by representative data sources.

3) Are results driven by the choice of data? This is something we explore here.

DATASETS

We work with **two types of data** sources:

A) **Occupational database** (Occupational Information Network database: **O*Net**): it is based on experts opinions for the US, with no variability within occupations. Only vary few upgrades and no direct measure for the EU.

B) **Workers surveys**: the Princeton Data Improvement Initiative Survey (**PDII**) for the US, the Programme for the International Assessment of Adult Competencies (**PIAAC**) and the European Working Condition Survey (**EWCS**). Allow for variation within occupations but prone to measurement error.

With the exception of the **EWCS (six waves from 1990)**, the other databases collect data do not have time variability.

We classify occupations according to the ISCO-88 nomenclature (2 digit).

METHODOLOGY

We choose to work with the simplest approach.

i) For each occupation we compute **an Abstract, a Routine and a Manual index** (as in Autor and Dorn, 2013).

ii) Then we use the LFS to compute the same three indexes **at the country level** (using occupational weights by 2015 LFS).

iii) Finally, for each country *c,* **we create an overall (relative) routine index** given by

$$RTI_c = \ln(T^R_{c,2015}) - \ln(T^A_{c,2015}) - \ln(T^M_{c,2015})$$

METHODOLOGY

Table 1. A comparison of task measures among the PDII, the EWCS, and the PIAAC

Autor and Dorn (2013) – O*net	Autor and Handel (2013) – PDII	EWCS	PIAAC
		Abstract	
	1) The length of the longest document typically read as part of the job		1) Read diagrams, maps, or schematics (g_q01h) 2) Write reports (g_q02c)
1) GED maths	2) The frequency of mathematical tasks involving high school or higher maths		3) Prepare charts, graphs, or tables (g_q03f) 4) Use simple algebra or formulas (g_q03g)
	3) The frequency of problem-solving tasks requiring at least 30 minutes to find a good solution	1) Does your main paid job involve: learning new things? (y10_q49f) 2) Does your main paid job involve: solving unforeseen problems on your own? (y10_49c)	5) Face complex problems (>30 minutes) (f_q05b)
2) Administration and management	4) The proportion of the day spent managing or supervising other workers	3) Does your main paid job involve: assessing yourself the quality of your own work? (y10_q49b)	6) Persuading/influencing people (f_q04a) 7) Negotiating with people (f_q04b)
		Routine	
1) Customer and personal services	1) Complete absence of face-to-face interactions with 1.1. Customers and clients 1.2. Suppliers or contractors 1.3. Students or trainees	1) (Not) dealing with people (y10_q11j) 2) Your pace of work depends on direct demands from people such as customers … (y10_q21b)	1) Learn work-related things from co-workers (d_q13a) 2) Learning by doing from tasks performed (d_q13b) 3) Keeping up to date with new products or services (d_q13c)
2) Finger dexterity	2) The proportion of the working day spent performing short and repetitive tasks	3) Short repetitive tasks (from 1 minute to 10 minutes) (1 minute: y10_q20a_a) (10 minutes: y10_q20a_b)	4) Change sequence of tasks (d_q11a) 5) Change how do you work (d_q11b) 6) Change speed of work (d_q11c) 4) Change working hours (d_q11d)
		Manual	
1) Arm-hand steadiness 2) Manual dexterity	1) The proportion of the working day spent performing physical tasks, such as standing or operating machines or vehicles	1) Does your job involve … 1.1. Tiring or painful positions? (y10_q11a) 1.2. Carrying or moving heavy loads? (y10_q11c) 1.3. Repetitive hand and/or finger movements? (y10_q11c)	1) Hand/finger skill accuracy (f_q06c) 2) Physical work (f_q06b)

Source: Author's analysis from the references quoted in the table.

Table 2. Distribution of abstract, manual, and routine tasks based on the EWCS, PIAAC, O*Net, and EWCS

		Abstract				Routine				Manual			
Country		EWCS (1)	PIAAC (2)	PDII (3)	O*Net (4)	EWCS (5)	PIAAC (6)	PDII (7)	O*Net (8)	EWCS (9)	PIAAC (10)	PDII (11)	O*Net (12)
Austria	AT	80.22	34.56	42.54	40.49	45.39	46.11	53.62	39.20	28.68	60.21	58.73	29.94
Belgium	BE	80.04	34.72	42.11	41.08	44.77	46.40	53.44	38.18	29.40	57.89	56.57	28.42
Bulgaria	BG	63.59	30.90	40.04	**37.29**	45.05	47.99	53.75	42.07	32.72	66.47	63.39	30.91
Cyprus	CY	69.20	32.14	40.75	39.42	53.64	47.41	53.79	38.23	44.55	59.27	58.55	28.26
Czech Republic	CZ	70.80	34.02	41.41	39.77	45.76	47.41	53.78	40.96	25.53	62.52	61.71	31.81
Germany	DE	75.20	35.67	42.41	41.32	44.94	45.98	53.68	38.69	24.28	58.22	56.58	29.72
Denmark	DK	89.65	35.74	43.11	41.59	46.59	45.86	53.41	37.43	25.68	57.02	55.47	27.86
Estonia	EE	84.83	33.49	41.39	39.65	50.18	47.42	53.87	40.45	35.04	61.95	61.49	30.47
Spain	ES	79.79	32.11	40.68	39.09	52.15	47.90	53.79	39.07	39.02	61.62	61.10	29.99
Finland	FI	83.88	36.39	43.89	41.74	49.19	45.29	53.59	38.52	30.96	58.44	56.42	28.89
France	FR	80.52	33.74	41.43	40.06	47.62	46.81	53.79	38.70	38.95	59.66	58.48	29.41
Greece	GR	66.09	31.89	42.00	39.01	61.15	46.47	54.29	41.05	42.98	63.45	62.29	30.26
Hungary	HU	**59.46**	32.54	40.59	38.91	41.55	48.07	54.27	41.37	28.78	63.22	62.79	31.28
Ireland	IE	79.12	34.18	42.35	40.59	44.72	46.04	54.01	39.15	27.06	59.64	58.13	29.37
Italy	IT	70.21	32.71	40.66	39.19	48.12	47.62	53.80	39.68	27.24	61.37	60.61	30.33
Lithuania	LT	72.85	33.26	42.13	39.42	57.27	**46.47**	54.09	**41.32**	34.08	62.56	61.91	30.33
Luxembourg	LU	86.81	40.21	45.72	44.06	48.57	42.35	53.93	35.77	32.61	**49.09**	**45.93**	**24.00**
Latvia	LV	62.86	32.26	41.16	38.95	48.38	47.66	54.11	40.44	30.38	62.61	62.65	30.48
Netherlands	NL	85.92	35.93	42.91	41.65	41.58	45.27	53.65	37.28	26.17	56.13	54.43	27.61
Norway	NO	88.21	37.68	44.75	42.58	43.83	44.71	**52.94**	37.55	**23.69**	56.89	54.38	28.34
Poland	PL	77.11	32.11	41.76	38.40	45.79	46.26	54.12	42.93	30.73	66.37	61.23	30.46
Portugal	PT	74.52	**30.57**	40.46	38.91	52.84	47.73	53.97	40.14	33.33	64.10	61.97	30.48
Sweden	SE	88.75	37.02	43.99	42.03	**41.48**	45.13	53.17	37.49	33.49	56.96	54.82	28.24
Slovenia	SI	81.92	33.11	41.79	38.49	44.62	46.29	54.51	42.61	34.53	64.38	58.48	29.62
Slovakia	SK	65.41	31.91	**39.72**	38.33	44.47	48.74	53.87	41.21	31.06	64.78	64.84	32.23
United Kingdom	UK	82.94	35.67	42.61	41.57	44.31	45.61	53.72	37.28	29.23	56.57	55.08	27.90

Notes: Countries are arranged in alphabetical order. The cells highlighted in grey are the highest value in the column; those in bold are the lowest value in the column. Columns (1) to (12) report normalized task measures in 2014, ranging [0,100].
Sources: Author's analysis from the EWCS (2015), PIAAC, O*Net, PDII, and EU-LFS (2014).

RESULTS: ABSTRACT

European

Table 3. The five countries with the highest and lowest abstract index

	EWCS	PIAAC	PDII	O*Net
Five countries with the lowest abstract index	Hungary Latvia Bulgaria Slovakia Greece	Portugal Bulgaria Greece Slovakia Spain	Slovakia Bulgaria Portugal Hungary Italy	Bulgaria Slovakia Poland Slovenia Hungary
Five countries with the highest abstract index	Denmark Sweden Norway Luxembourg Netherlands	Luxembourg Norway Sweden Finland Netherlands	Luxembourg Norway Sweden Finland Denmark	Luxembourg Norway Sweden Finland Netherlands

Sources: Author's analysis from the EWCS (2015), PIAAC, O*Net, PDII, and EU-LFS (2014).

Table 6. Correlation of the abstract index based on the different surveys at the country level (2014)

	EWCS	PIAAC	PDII	O*Net
EWCS	1			
PIAAC	0.723	1		
PDII	0.691	0.827	1	
O*Net	0.743	0.963	0.818	1

Source: Author's analysis from the EWCS, PIAAC, PDII, and O*Net.

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RESULTS: ROUTINE

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Table 4. The five countries with the highest and lowest routine index

	EWCS	PIAAC	PDII	O*Net
Five countries with the lowest routine index	Sweden Hungary Netherlands Norway United Kingdom	Luxembourg Norway Sweden Netherlands Finland	Norway Sweden Denmark Belgium Finland	Luxembourg United Kingdom Netherlands Denmark Sweden
Five countries with the highest routine index	Greece Latvia Cyprus Portugal Spain	Slovakia Hungary Bulgaria Spain Portugal	Slovenia Greece Hungary Poland Latvia	Poland Slovenia Bulgaria Hungary Latvia

Sources: Author's analysis from the EWCS (2015), PIAAC, O*Net, PDII, and EU-LFS (2014).

Table 7. Correlation of the routine index based on the different surveys at the country level (2014)

	EWCS	PIAAC	PDII	O*Net
EWCS	1			
PIAAC	0.149	1		
PDII	0.362	0.537	1	
O*Net	0.174	0.642	0.662	1

Source: Author's analysis from the EWCS, PIAAC, PDII, and O*Net.

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RESULTS:MANUAL

European

Table 5. The five countries with the highest and lowest manual index

	EWCS	PIAAC	PDII	O*Net
Five countries with the lowest manual index	Norway Germany Czech Republic Denmark Netherlands	Luxembourg Netherlands United Kingdom Norway Sweden	Luxembourg Norway Netherlands Sweden United Kingdom	Luxembourg Netherlands Denmark United Kingdom Sweden
Five countries with the highest manual index	Cyprus Greece Spain France Estonia	Bulgaria Poland Slovakia Slovenia Portugal	Slovakia Bulgaria Hungary Latvia Greece	Slovakia Czech Republic Hungary Bulgaria Latvia

Sources: Author's analysis from the EWCS (2015), PIAAC, O*Net, PDII, and EU-LFS (2014).

Table 8. Correlation of the manual index based on the different surveys at the country level (2014)

	EWCS	PIAAC	PDII	O*Net
EWCS	1			
PIAAC	0.217	1		
PDII	0.226	0.937	1	
O*Net	0.175	0.903	0.952	1

Source: Author's analysis from the EWCS, PIAAC, PDII, and O*Net.

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RESULTS: RTI INDEX

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Table 10. The five countries with the highest and lowest RTI index

	EWCS	PIAAC	PDII	O*Net
Five countries with the lowest RTI index	Norway Netherlands Denmark Germany Ireland	Luxembourg Norway Sweden Netherlands United Kingdom	Luxembourg Norway Sweden Netherlands Denmark	Luxembourg Netherlands Norway United Kingdom Denmark
Five countries with the highest RTI index	Greece Cyprus Latvia Spain Portugal	Bulgaria Portugal Slovakia Poland Hungary	Slovakia Bulgaria Hungary Portugal Latvia	Bulgaria Slovakia Poland Hungary Slovenia

Sources: Author's analysis from the EWCS (2015), PIAAC, O*Net, PDII, and EU-LFS (2014).

CONCLUSIONS

A) **PIAAC, O*NET and PDII give similar results, while results from the EWCS appear to differ, in terms of both value and range of the indexes. This is especially true for the Routine Index.**

Confirmed when we look at the correlation between indexes, which is lowest for the EWCS.
Unclear whether this is due to sampling or to the actual choice of the variables used to construct the indexes.

CONCLUSIONS

B) Countries with **high values for the Abstract index and low values for Routine and Manual indexes are concentrated in the North**.
Countries with **high values for Routine and Manual indexes and low values for the Abstract index are concentrated in the South and East**.

Does this imply that digitalization is increasing inequalities in the EU?

An extension: measuring the routine at the local labour market in Spain

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in-house science service

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Job Polarization or Job Upgrading?

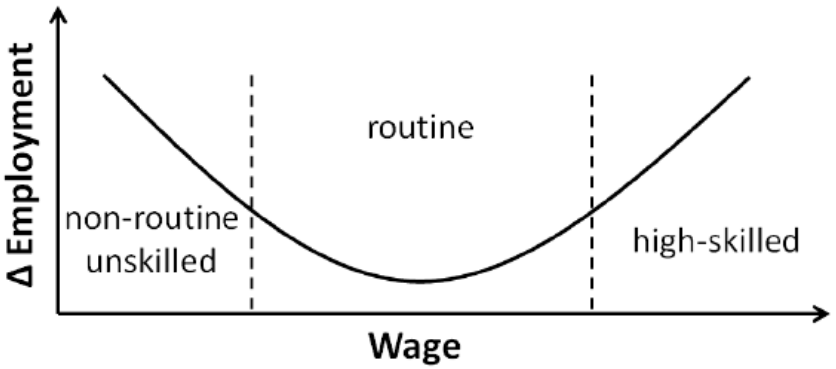
	U.S.A	U.K.	Germany	Spain	European Countries
Job polarisation Polarization	Wright and Dwyer (2003) Autor et al. (2006) Autor and Dorn (2009) Acemoglu and Autor (2011)	Goos and Manning (2003), (2007) Bisello (2013) Salvatori (2015)	Spitz-Oener (2006) Dustmann et al. (2009) Kampelmann and Rycx (2011)	Anghel et al. (2014)	Goos et al. (2009), (2014)
Upgrading			Oesch and Menés (2010), Oesch (2013)	Bustillo and Anton (2015)	Fernández-Macías (2012) Oesch and Menés (2010)

Polarization

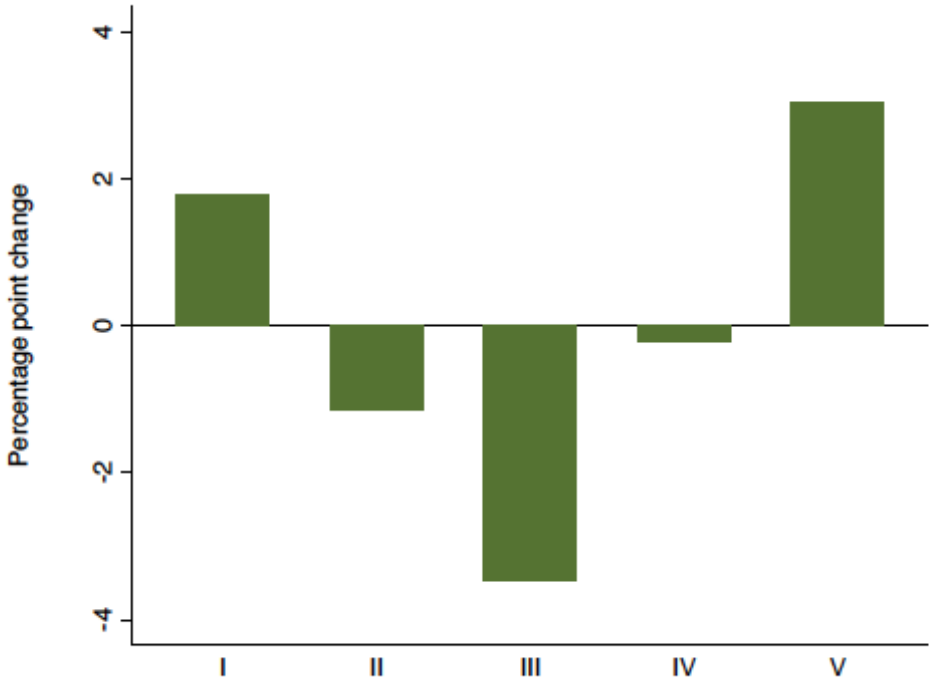
Results are controversial

MOTIVATION

1) Understand the **evolution of the structure labour market** in Spain using PIAAC
2) Using the previous framework: **understand if the technology is the main determinant behind it**. To do so:
   - Calculate the **Routine Share per region** in Spain
   - Divide the employment structure in three groups: **low, middle, upper**



JOB POLARIZATION



PIAAC:

1) Occupation at 3-digit level
2) Salary
3) Time: 1995-2010

By groups

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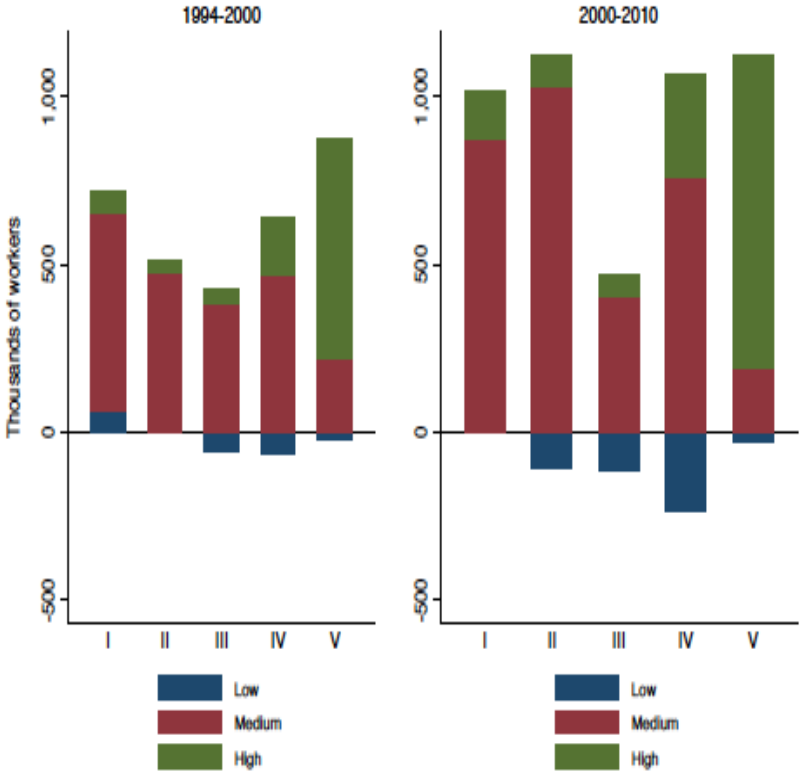
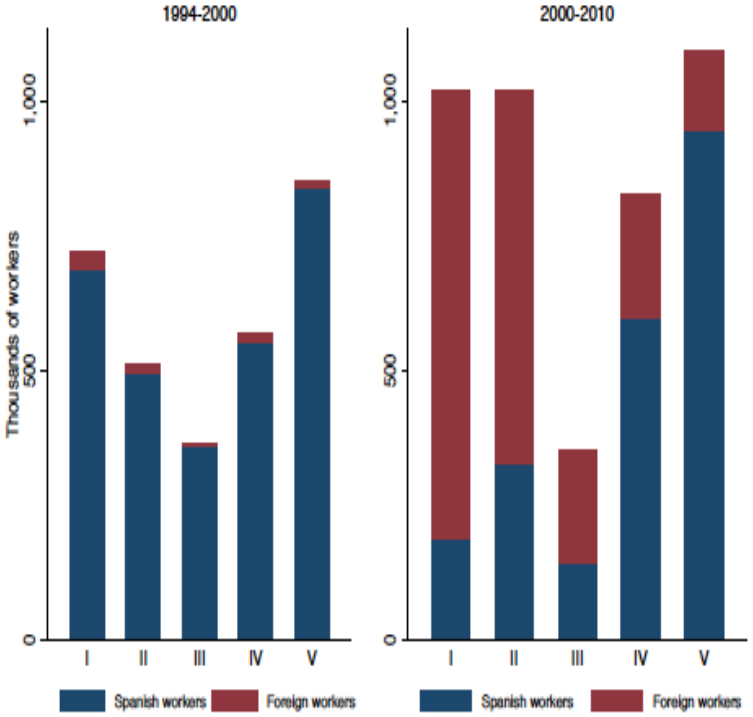
Education



Nationality



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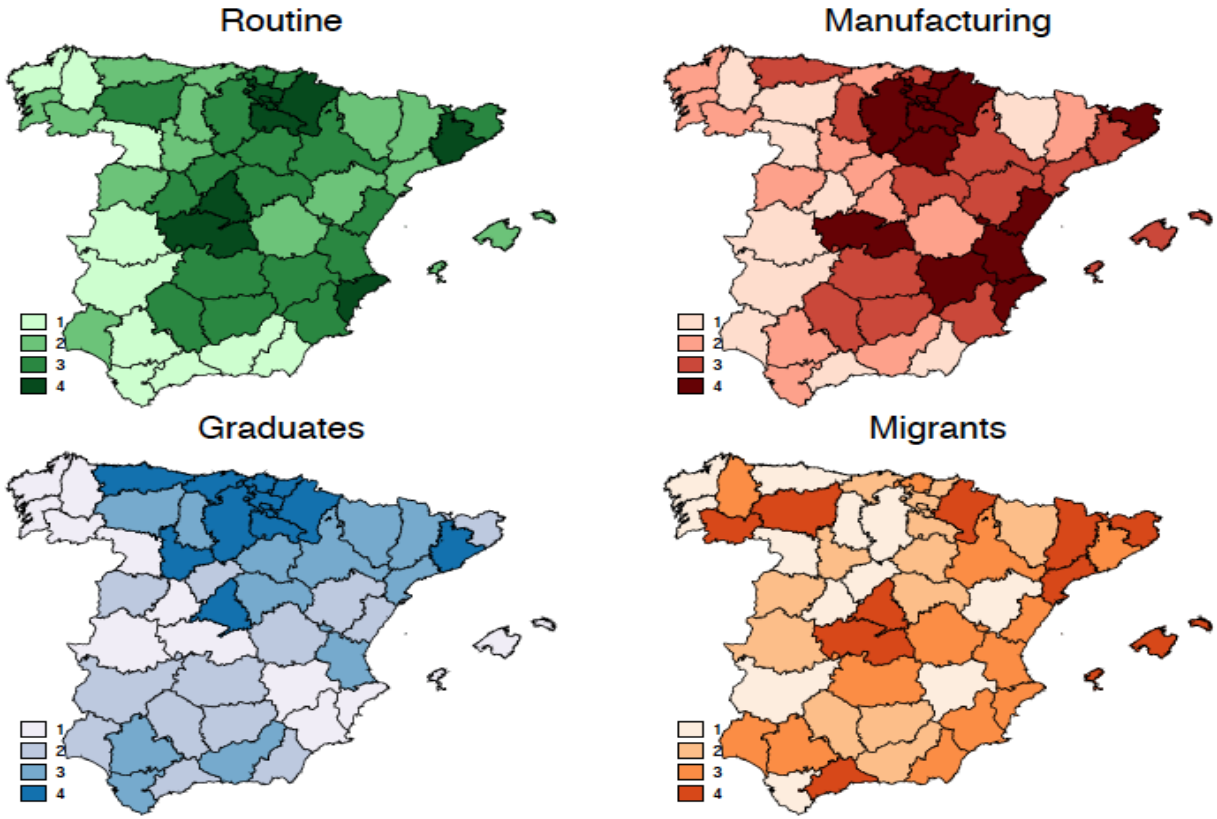
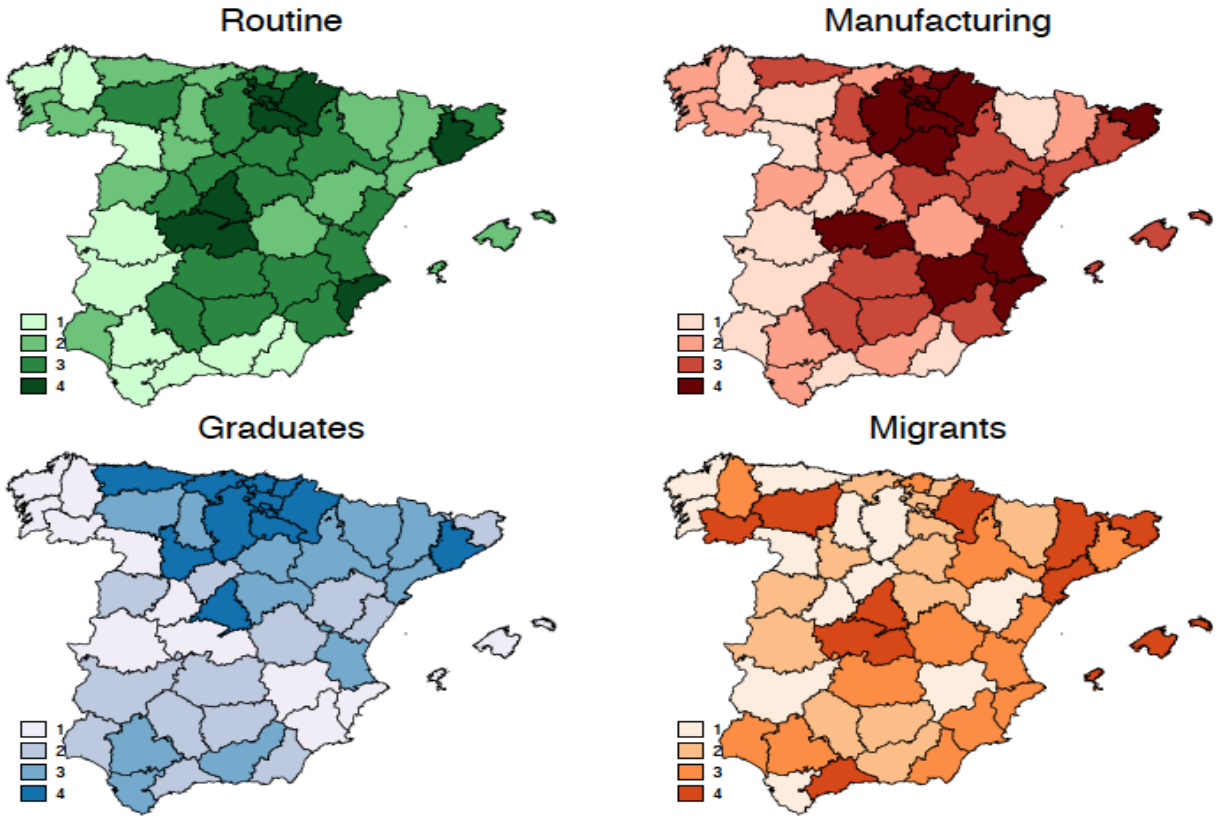
By region



Notes: We include the same number of provinces inside each group. As we have 50 provinces, our groups are uneven: the first group includes 12 provinces, the second group 13 provinces, the third group 13 provinces, and the fourth group 12 provinces.
Sources: Author's analysis from the EPA (1994, 2008).

By region



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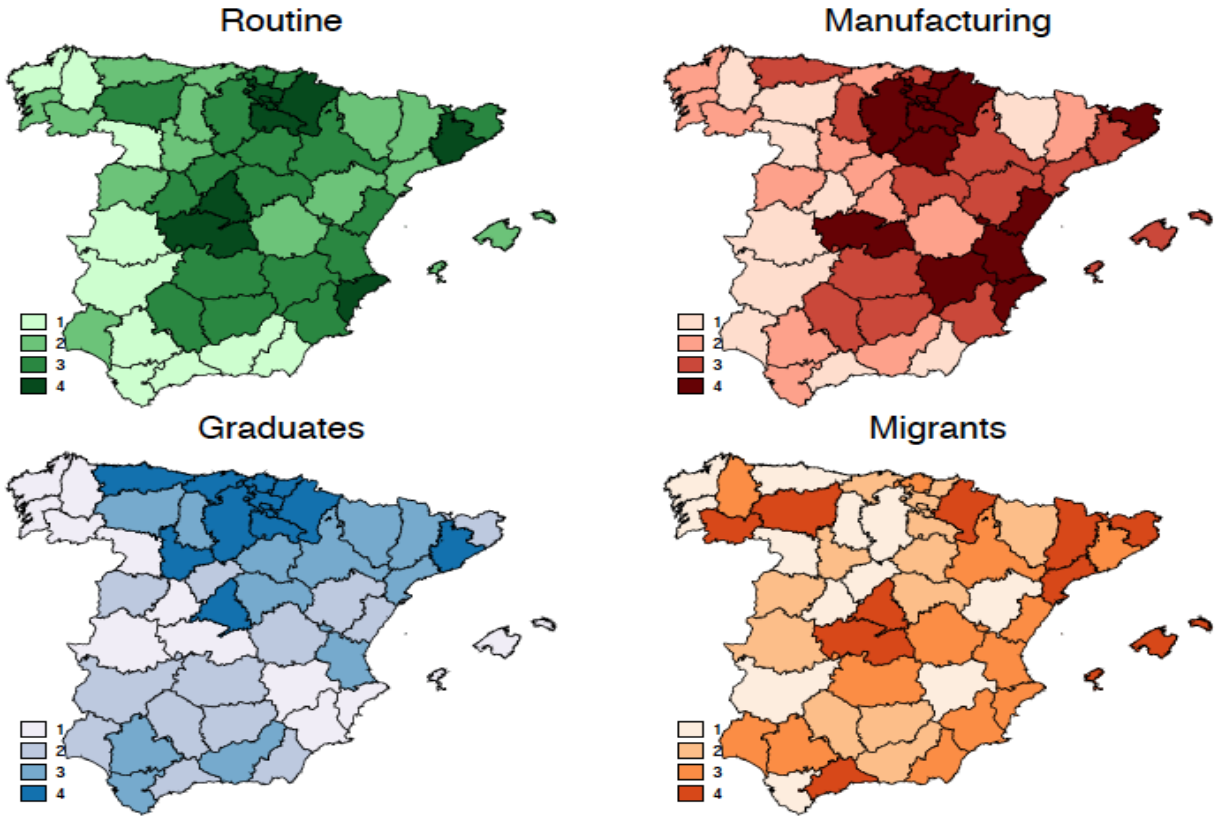
By region



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Sources: Author's analysis from the EPA (1994, 2008).

RESULTS

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Changes in routine occupations

	1994 2000	2000 2008	1994 2008	1994 2000	2000 2008	1994 2008
	(1)	(2)	(3)	(4)	(5)	(6)
RSH_{pt-1}	-0.301**	-0.314*	-0.616***	-0.196*	-0.841**	-1.225***
	(0.131)	(1.165)	(0.045)	(0.099)	(0.391)	(2.02)
$GradSh_{pt-1}$	-0.134**	-0.176*	-0.306**	-0.034	0.053	0.026
	(0.060)	(.103)	(.142)	(0.083)	(.075)	(0.129)
$MigSh_{pt-1}$	0.063	0.244**	0.248	-0.189	0.189*	0.165
	(0.677)	(0.116)	(0.157)	(0.571)	(0.098)	(0.126)
$ManufSh_{pt-1}$				-0.370	-0.852***	-1.030
				(0.333)	(0.290)	(0.747)
R^2	0.185	0.233	0.237	0.297	0.555	0.529
N	50	50	100	50	50	100

Notes: All models include an intercept and region dummies. The stacked regression includes a time period dummy. Standard errors clustered at the province level are showed in parentheses in the stacked regression. Robust standard errors are used for single-period regressions. Observations are weighted by the initial share of national population. Significance levels ***p<0.01; **p<0.05; *p<0.10.
Sources: Author's analysis from the EPA (1994, 2000, 2008) and O*Net.

RESULTS

European Commission

Changes in manual occupations

	1994 2000	2000 2008	1994 2008	1994 2000	2000 2008	1994 2008
	(1)	(2)	(3)	(4)	(5)	(6)
RSH_{pt-1}	0.102*	0.212**	0.208**	0.283**	0.131**	0.179**
	(0.118)	(0.095)	(0.099)	(0.109)	(0.057)	(0.068)
$GradSh_{pt-1}$	-0.211**	-0.167***	-0.372***	-0.153	-0.232***	-0.378***
	(0.094)	(0.044)	(0.113)	(0.105)	(0.052)	(0.132)
$MigSh_{pt-1}$	-1.227	0.128	-1.159	-1.319	0.235	-1.150
	-1.104	(0.592)	-1.501	-1.092	(0.582)	-1.533
$ManufSh_{p,t-1}$				-0.207	0.229*	0.0206
				(0.141)	(0.120)	(0.114)
R^2	0.456	0.388	0.567	0.488	0.449	0.567

Notes: All models include an intercept and region dummies. The stacked regression includes a time period dummy. Standard errors clustered at the province level are showed in parentheses in the stacked regression. Robust standard errors are used for single-period regressions. Observations are weighted by the initial share of national population. Significance levels ***p<0.01; **p<0.05; *p<0.10.
Sources: Author's analysis from the EPA (1994, 2000, 2008) and O*Net.

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RESULTS

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Changes in abstract occupations

	1994 2000	2000 2008	1994 2008	1994 2000	2000 2008	1994 2008
	(1)	(2)	(3)	(4)	(5)	(6)
RSH_{pt-1}	0.114	0.127	0.240	0.668	0.074	0.663
	(0.315)	(0.179)	(0.393)	(0.720)	(0.380)	-1.022
$GradSh_{pt-1}$	-0.317**	0.205**	-0.112	-0.193**	0.233**	0.0315
	(0.124)	(0.101)	(0.214)	(0.093)	(0.112)	(0.302)
$MigSh_{pt-1}$	0.407**	0.609***	1.017***	0.401**	0.637***	1.010***
	(0.172)	(0.176)	(0.318)	(0.190)	(0.173)	(0.341)
$ManufSh_{pt-1}$				-0.558	-0.107	-0.645
				(0.590)	(0.231)	(0.798)
R^2	0.226	0.367	0.489	0.293	0.427	0.519

Notes: All models include an intercept and region dummies. The stacked regression ncludes a time period dummy. Standard errors clustered at the province level are showed in parentheses in the stacked regression. Robust standard errors are used for single-period regressions. Observations are weighted by the initial share of national population. Significance levels ***p<0.01; **p<0.05; *p<0.10.
Sources: Author's analysis from the EPA(1994, 2000, 2008) and O*Net.

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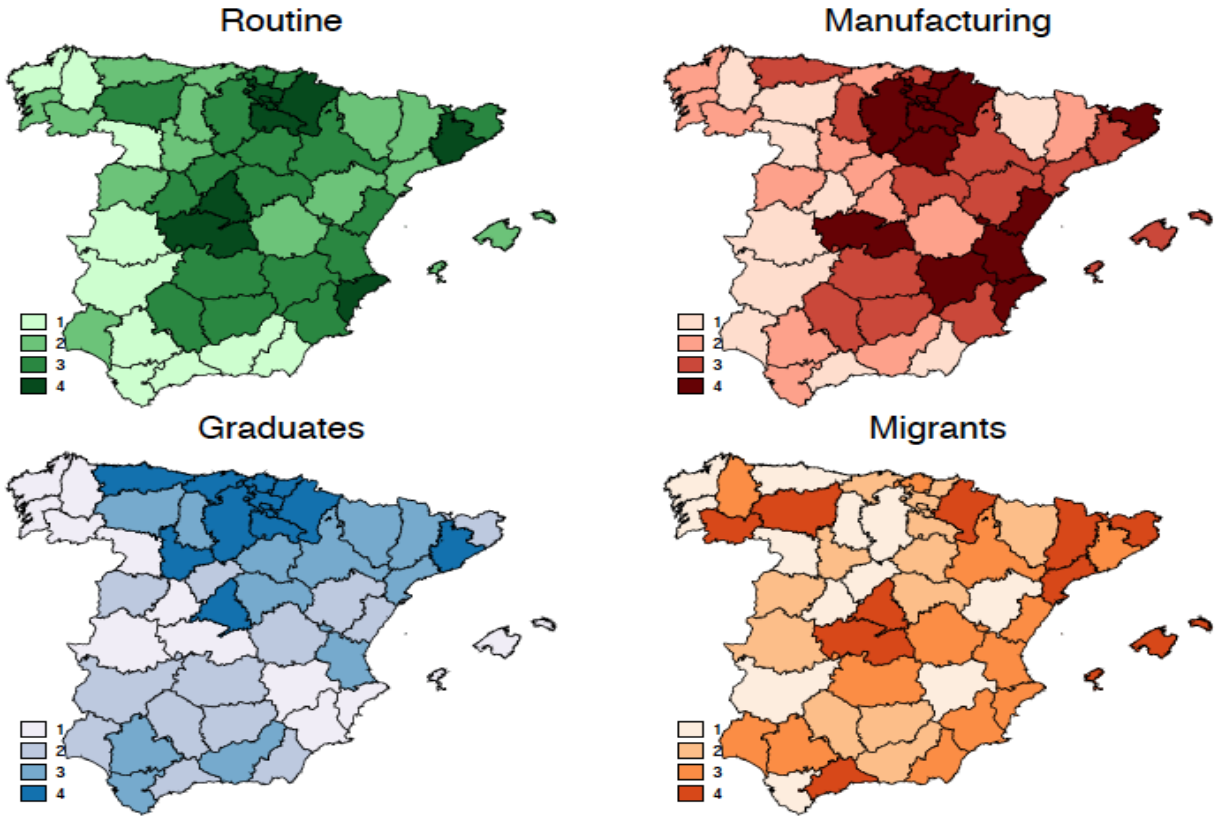
Conclusions

1) **PIAAC** is a good database to analyse the RBTC hypothesis
2) Spain is under a process of **job polarization** for the period under study
3) **RBTC**: able to explain the decrease at the middle part of the employment distribution and its subsequent reallocation at the bottom part while it is not convincing at the upper part of the employment distribution
4) Other factors such an **education play an important role**
5) Much remains to be understand when **making predictions** about the **future of jobs**


ThankYou
Merci
Salamat
Hvala
Kop
Tack
kun
Gra
Xie
Dhanyavad
Khopjai
Kruthagnathalu
Arigatou
Dhonnobaad
Gomapsupnida
Terima
Enkosi
Danke
dank
Euxaristo
Kun
Shukriya
Shokriya
Ngiyabonga
Dziękuję
Dekuju/Dekujeme
Te ekkür
Takk
Dank
Gamsahapnida
Diolch
Kiitos
Sheun
umesc
Shnorhakalutiun
Kasih
Mamnoon
Todah
Spaas
Mul
Ačі
Cam
or
al
Dankie
Go
Grazie
Falemínderit
Dhanyavaad
Dhanyavaadaalu
Waad
Daw
Dakujem
krap
Grazzi
raibh
Gracias
Nandree
Blagodariya
Fyrir
ederim
Hain
Dhan
Asante
daa
Or

By region



Notes: We include the same number of provinces inside each group. As we have 50 provinces, our groups are uneven: the first group includes 12 provinces, the second group 13 provinces, the third group 13 provinces, and the fourth group 12 provinces.
Sources: Author's analysis from the EPA (1994, 2008).

TIME EVOLUTION: EXTENSIVE VS INTENSIVE MARGIN

Using the PIAAC we will have different pictures of the indexes

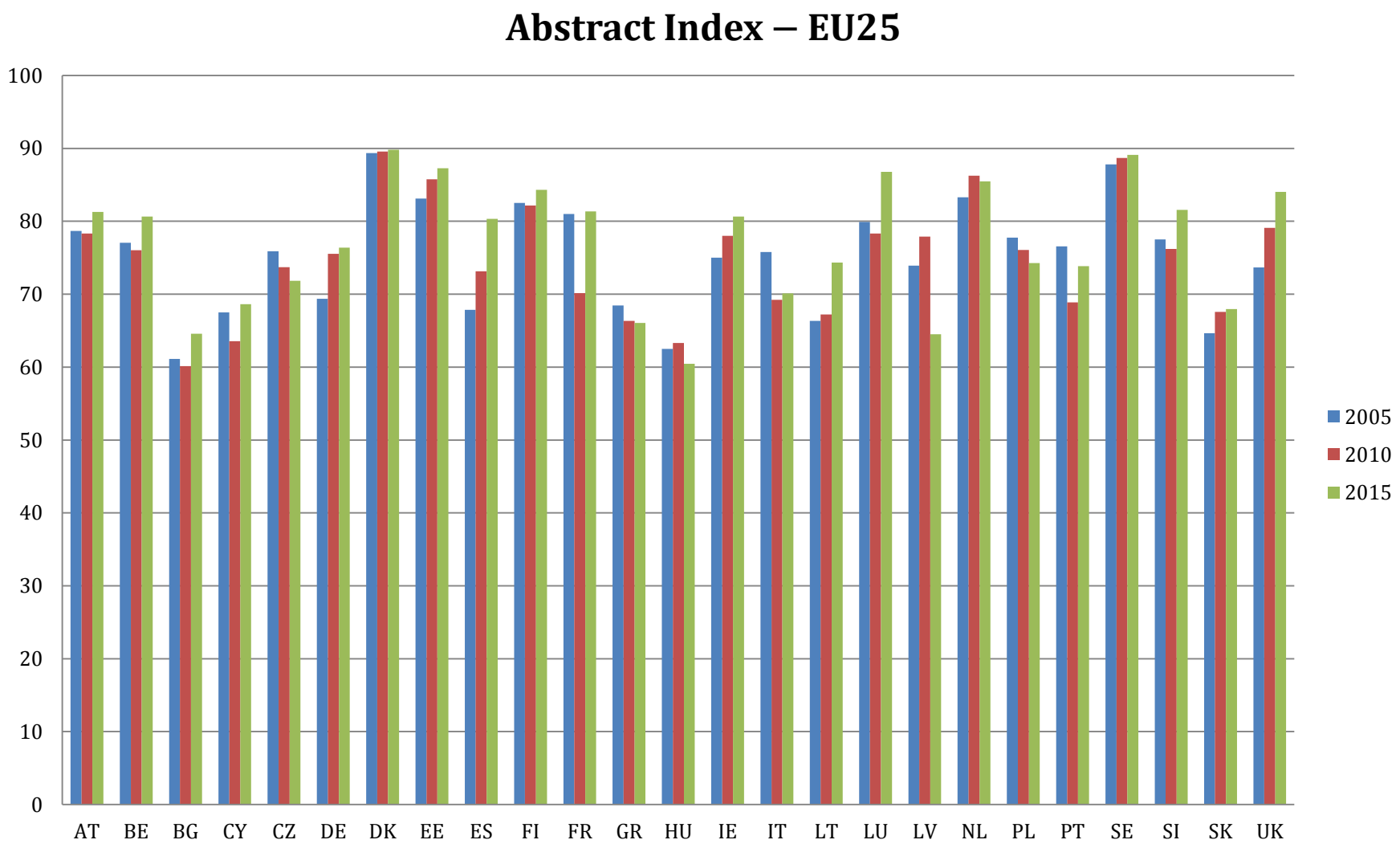
We work with the **2005, 2010 and 2015 waves**.

First, we look at the **evolution of each task index and its change between 2005 and 2015.**

Overall, the **change for Abstract intensity is positive** (in all but 7 countries) while the one for **Manual intensity is negative** (in all but 4 countries).
For Routine intensity the picture is less clear: increasing in 16 and decreasing in 9.

RESULTS: EVOLUTION OF ABSTRACT INTENSITY

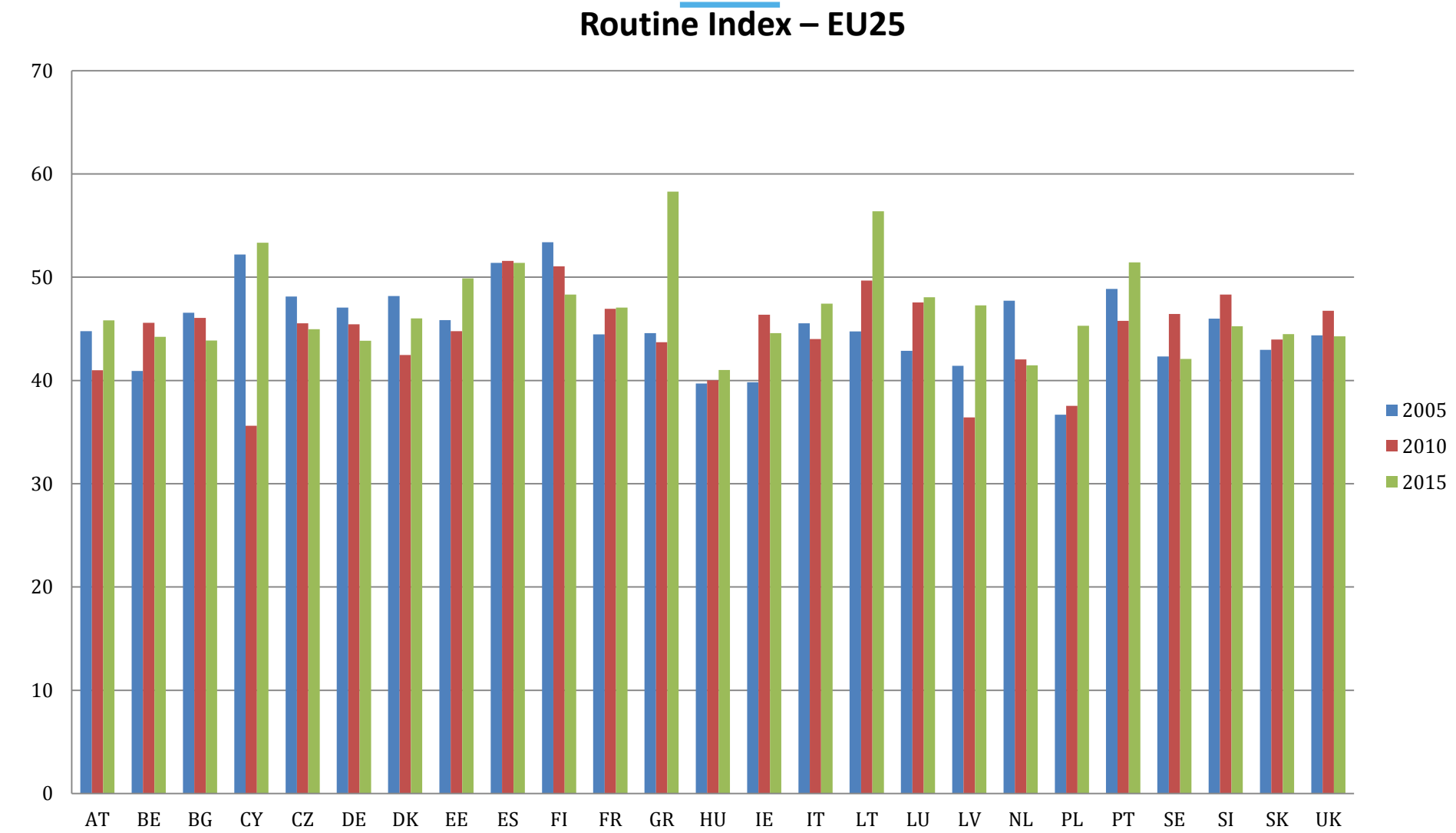
European Commission



Joint Research Centre

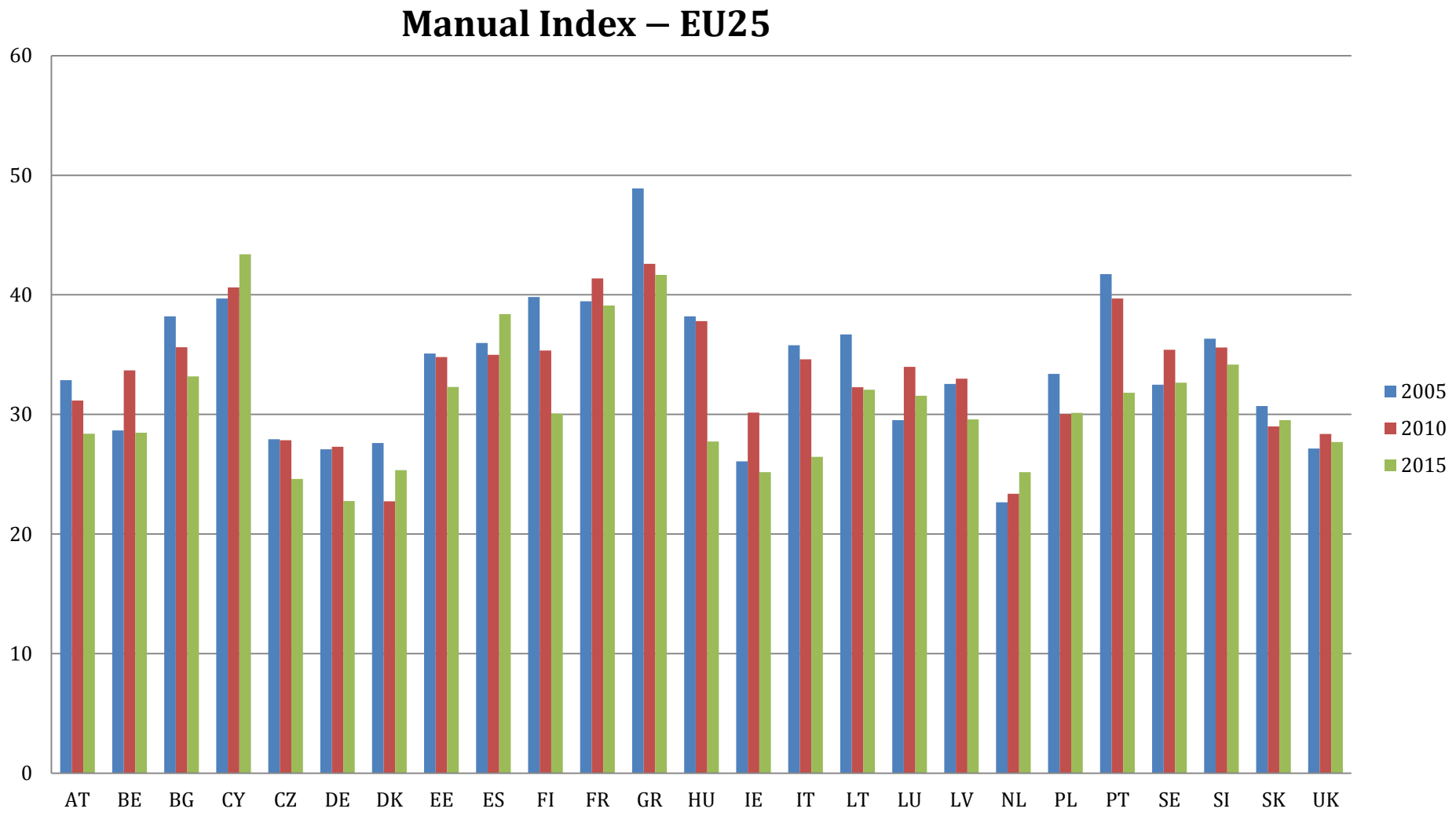
RESULTS: EVOLUTION OF ROUTINE INTENSITY

European Commission



Joint Research Centre

RESULTS: EVOLUTION OF MANUAL INTENSITY



CONCLUSIONS

***C)* We have used PIAAC to decompose the time evolution of the indexes into a between and a within component.**

For the **Routine Index, in the vast majority of cases the within component dominates**: this implies that even if employment in "routine occupations" is declining, all occupations are becoming more routine intensive.

Is this increasing the chances of labour substitution by digitalization?