Working in an immaterial world: intangible assets and the demand and supply for skilled labour

Mary O'Mahony, Catherine Robinson, Michela Vecchi

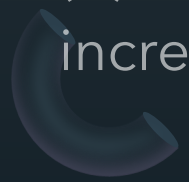
Worldklem conference, Manchester, 12-13 October 2022

Overview

- Up to the year 2000: evidence of skill biased technical change (O'Mahony, Robinson and Vecchi, 2008) (despite the increase in the supply of skilled labour, the skill wage premium carried on increasing)
- Job polarization (Autor, Levy and Murnane 2003, Goos and Manning 2007, Autor and Dorn 2013) versus technology reaching maturity (Chun 2003)
- After the year 2000: the premium in the US economy starts to slowdown (Autor and Acemoglu, 2011, Beaudry et al. 2016)
- Similar evidence for Europe (Crivellaro 2013)

Reasons for the decline in the skill wage premium

- (1) Slow down in the demand for cognitive skills – new technologies are no longer skill biased (Chun 2003, O'Mahony, Robinson and Vecchi 2008)
- (2) Technology and skill complement each other but investments in technological assets (IT and intangibles) have dropped after the year 2000. (Beaudry et al 2016, Haskel and Westlake 2020).
- (3) Long term negative effect of graduating during a recession (Liu et al. 2016)
- (4) Increasing supply of tertiary educated workers with heterogeneous skills, with increasing downward pressure on wages (also linked to the skill mismatch)



Main objectives

- Revisit the skill biased technical change in Europe over a longer time period (1995-2018)
- Account for different types of technological assets
- Recognize the importance of intangible assets – like the key to unlock the potentials of technological changes

Main questions

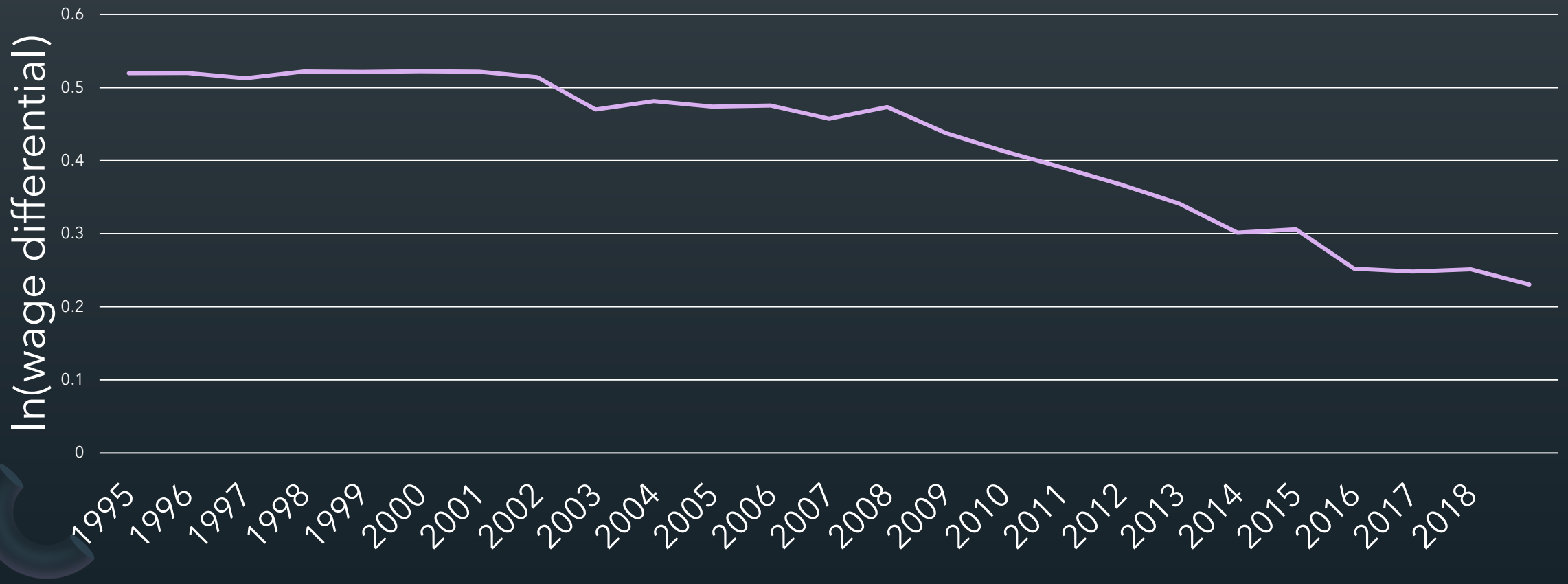
1. What is happening to the skill wage premium in Europe?
2. What is the relationship between ICT, intangibles and the demand for skills?
3. Can intangibles explain the wage premium in the race between technology and the supply of skills?
4. Is the technology still skill biased?

Data

- Latest release of the EUKLEMS database, with labour composition backdated from 2008 using previous EUKLEMS releases
- Covering the period 1995-2018
- 7 EU countries + the UK
- Information on output and different types of assets (tangible an intangible)
- Labour is classified according to the skill level (High, Intermediate and low skilled)
- In our analysis we combine intermediate and low skilled (problems with comparing intermediates skills across countries)

Main aggregate trend in Europe - EUKLEMS

Figure 1: Mean wage premium of high skilled workers, 1995-2018



From Acemoglu and Autor 2011

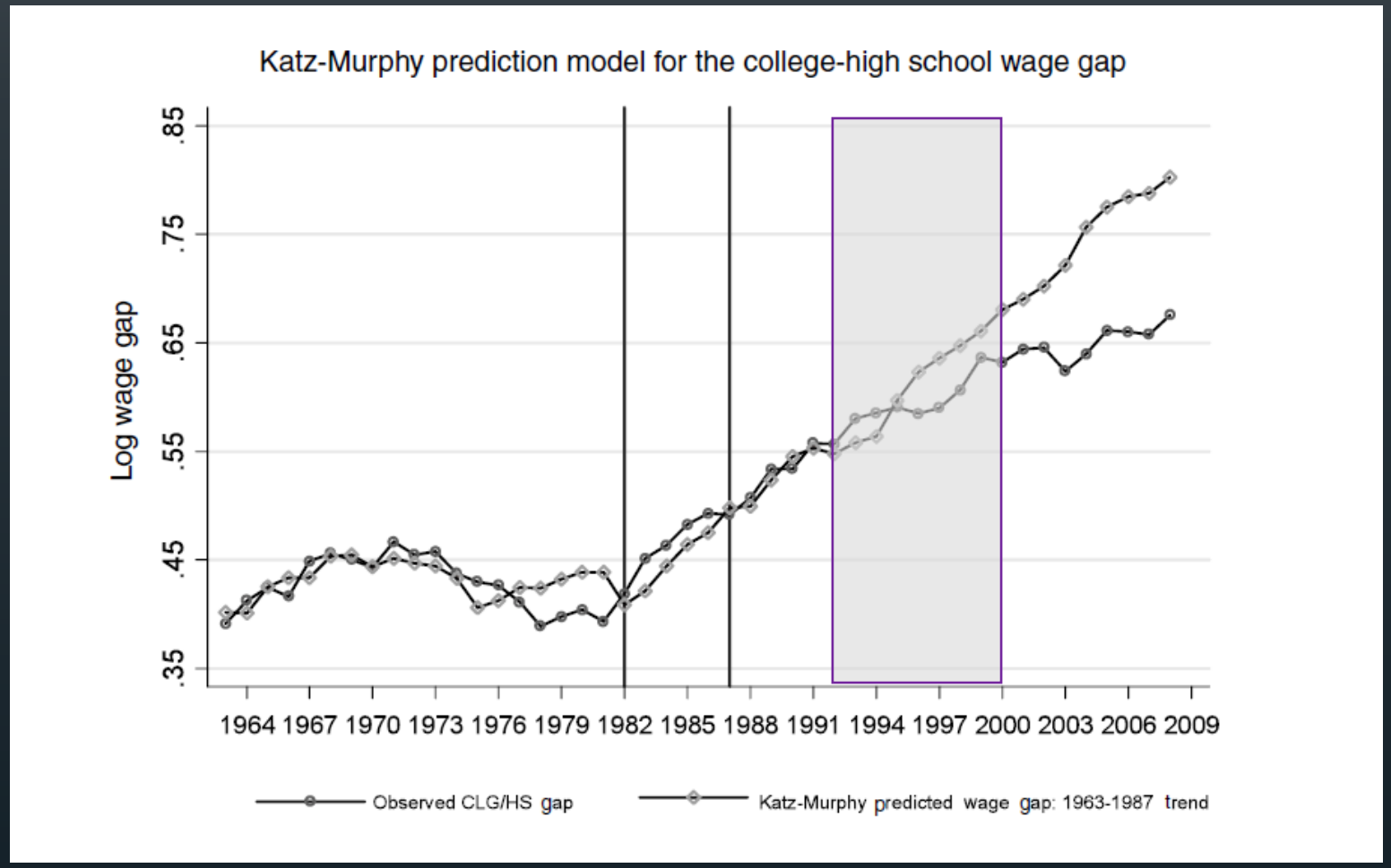


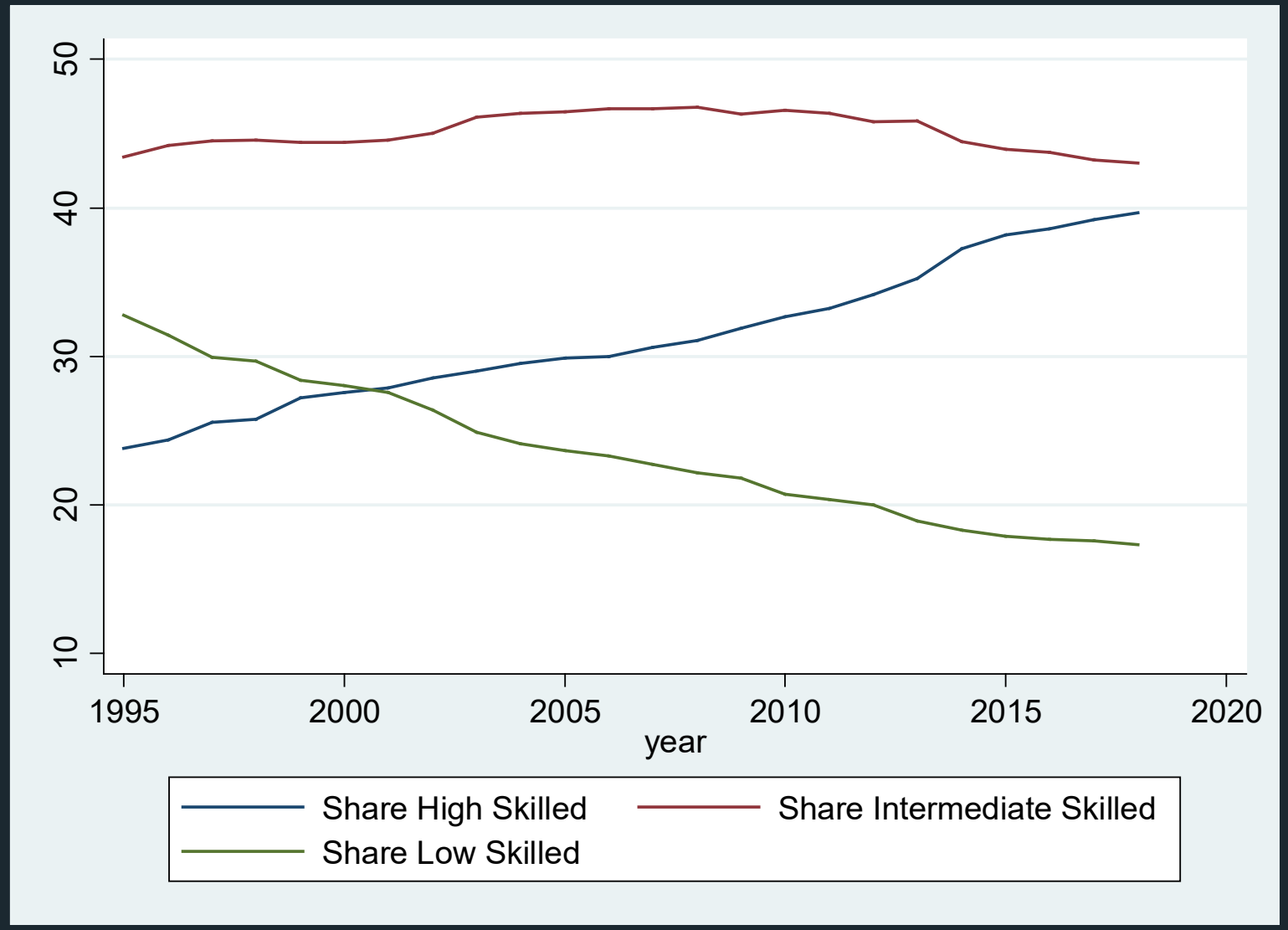
Table 1: Average wage premium for high skills in each EU-8 country

	1995 - 2018	1995-2007	2008-2019
Austria	0.308	0.528	0.048
Germany	0.570	0.585	0.552
Spain	0.412	0.422	0.401
Finland	0.367	0.385	0.346
France	0.409	0.450	0.361
Italy	0.500	0.609	0.371
Netherlands	0.595	0.734	0.431
UK	0.270	0.298	0.238

Table 2: Average wage premium for high skills by industry

	1995-2018	1995-2007	2008-2018
Agriculture, Forestry and Fishing	0.54	0.61	0.20
Mining and Quarrying	0.56	0.62	0.46
Manufacturing	0.57	0.61	0.45
Electricity, Gas, Steam and Air Conditioning Supply	0.38	0.45	0.29
Water Supply; Sewerage, Waste Management and Remediation Activities	0.38	0.42	0.28
Construction	0.48	0.57	0.40
Wholesale and Retail Trade; Repair of Motor Vehicles	0.56	0.57	0.44
Transportation and Storage	0.37	0.48	0.29
Accommodation and Food Service Activities	0.45	0.41	0.26
Information and Communication	0.26	0.32	0.23
Financial and Insurance Activities	0.26	0.39	0.24
Real Estate Activities	0.69	0.58	0.39
Professional, Scientific and Technical Activities	0.37	0.46	0.32
Administrative and Support Service Activities	0.55	0.64	0.52
Public Administration and Defense	0.38	0.41	0.22
Education	0.36	0.37	0.36
Human Health and Social Work Activities	0.48	0.61	0.46
Arts, Entertainment and Recreation	0.39	0.48	0.27
Other Service Activities	0.47	0.53	0.42

Figure 2: Average employment shares for different types of workers (EU-8 average)



Analytical models and results

Specifications: Model 1

- The race between technology and skills: distinguishes between demand and supply factors:
- (1) $$Y = \left[(A_l L)^{\frac{\sigma-1}{\sigma}} + (A_H H)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$
- (2) $$\omega = \frac{w_H}{w_L} = \left(\frac{A_H}{A_L} \right)^{\frac{\sigma-1}{\sigma}} \left(\frac{H}{L} \right)^{-\frac{1}{\rho}}$$
- (3) $$ln(\omega_{it}) = \frac{\sigma - 1}{\sigma} \gamma_0 + \frac{\sigma - 1}{\sigma} \gamma_1 time - \frac{1}{\sigma} ln \left(\frac{H_{it}}{L_{it}} \right)$$

Extension: defining technology

- $ln\left(\frac{A_{H,t}}{A_{L,t}}\right) = \gamma_0 + \sum \gamma_i tech_{it}$
- $ln(\omega_{it}) = \theta_1 + \theta_{2i} \sum tech_{it} - \theta_3 ln\left(\frac{H_{it}}{L_{it}}\right)$
- where $\theta_1 = \frac{\sigma-1}{\sigma}\gamma_0$, $\theta_{2i} = \frac{\sigma-1}{\sigma}\gamma_i$, and $\theta_3 = \frac{1}{\sigma}$.

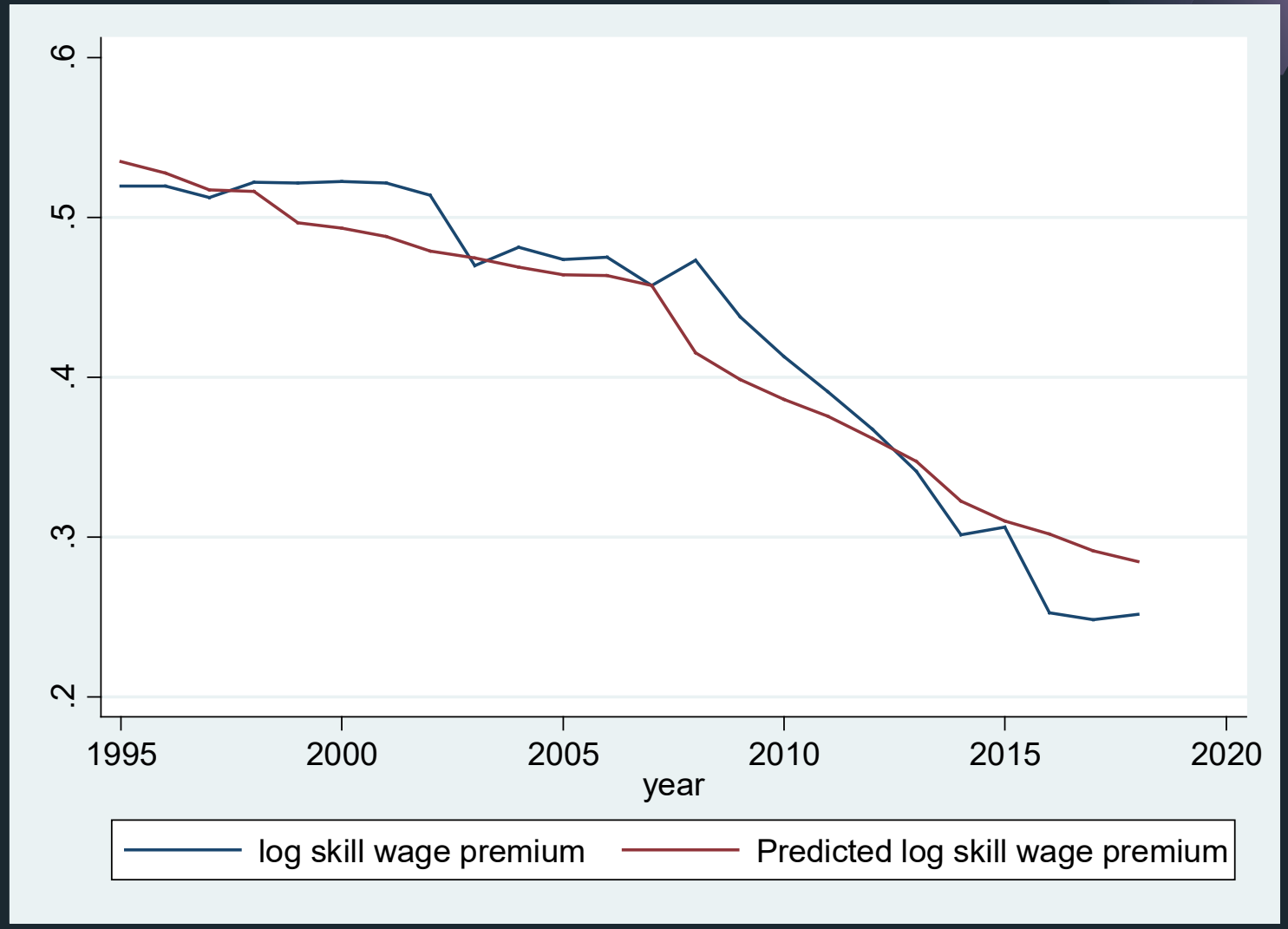
Table 3: The race between technology and skills 1995-2018

	(1)	(2)	(3)	(4)
VARIABLES				
ln(H/L)	-0.272***	-0.275***	-0.285***	-0.286***
Trend	0.0000			
lnTFP		-0.003	0.0003	-0.001
lnICT/TOT K			0.031***	0.027***
ln(Intangibles)/TOTK			-0.050**	
ln(Econ.Comp./TOTL)				-0.023
ln(Innov.Propert./TOTL)				-0.028**
Constant	0.169***	0.175	0.151	0.156
Elasticity of substitution $\hat{\sigma}$	-3.7	-3.64	-3.51	-3.50
Observations	3,400	3,254	3,193	3,193
R-squared	0.2774	0.2835	0.2871	0.2879
Number of id	143	140	136	136
FE	YES	YES	YES	YES

Table 4: testing for structural change

	(1)	(2)	(3)	(4)
VARIABLES	lwage_prem	lwage_prem	lwage_prem	lwage_prem
$ln\left(\frac{H_{it}}{L_{it}}\right)$	**-0.241*** **	**-0.252*** **	**-0.250*** **	**-0.247*** **
$ln\left(\frac{H_{it}}{L_{it}}\right) * D2008$	**0.029*** **	**0.029*** **	**0.030*** **	**0.031*** **
Trend	-0.0001			
*Ttrend*D2008*	0.0002			
ln(TFP)		-0.007	-0.028	-0.034
Ln(TFP)*D2008		**-0.091***	-0.069	**-0.008*** **
Ln(ICT/TK)			**0.054*** **	**0.053*** **
Ln(ICT/TK)*D2008			**-0.108*** **	**-0.138*** **
ln(Int/TK)			-0.005	
ln(Int/TK)*D2008			**-0.153*** **	
Ln(EC_comp/TK)				-0.020
Ln(EC_comp/TK)*D2008				0.009
lCAPInnovaP				0.0002
lCAPInnovaP*D2008				**-0.113*** **
D2008	-0.0193	0.4135*	0.2802	
Test structural change (P value)	<0.001	<0.001	<0.001	<0.001
Observations	3,400	3,254	3,193	3,193
R-squared	0.2901	0.2952	0.3082	0.3096
Number of id	143	140	136	136
FE	YES	YES	YES	YES

Figure 5: actual and predicted skill wage premium



Specifications: Model 2

- Skill biased technical change model – confound demand and supply factors (O'Mahony, Robinson and Vecchi 2008) :

1. $$LC_{it} = f(ps_{jit}, \dots, ps, K_{it}, Y_{it}$$

2. $$\frac{ws_{ji}}{WT_i} = \beta_i + \beta_w ln\left(\frac{ps_{ji}}{punsk_i}\right) + \beta_k ln\left(\frac{K_i}{Y_i}\right) + \varepsilon_i$$

- Simplification (Machin and Van Reenen 1998, Chun 2003):

3. $$\frac{ws_{ji}}{WT_i} = \beta_i + \beta_k ln\left(\frac{K_i}{Y_i}\right) + \beta_{it} ln\left(\frac{IT}{K_i}\right) + \delta_t D_t + \varepsilon_i$$

Figure 6: high-skilled wage bill share

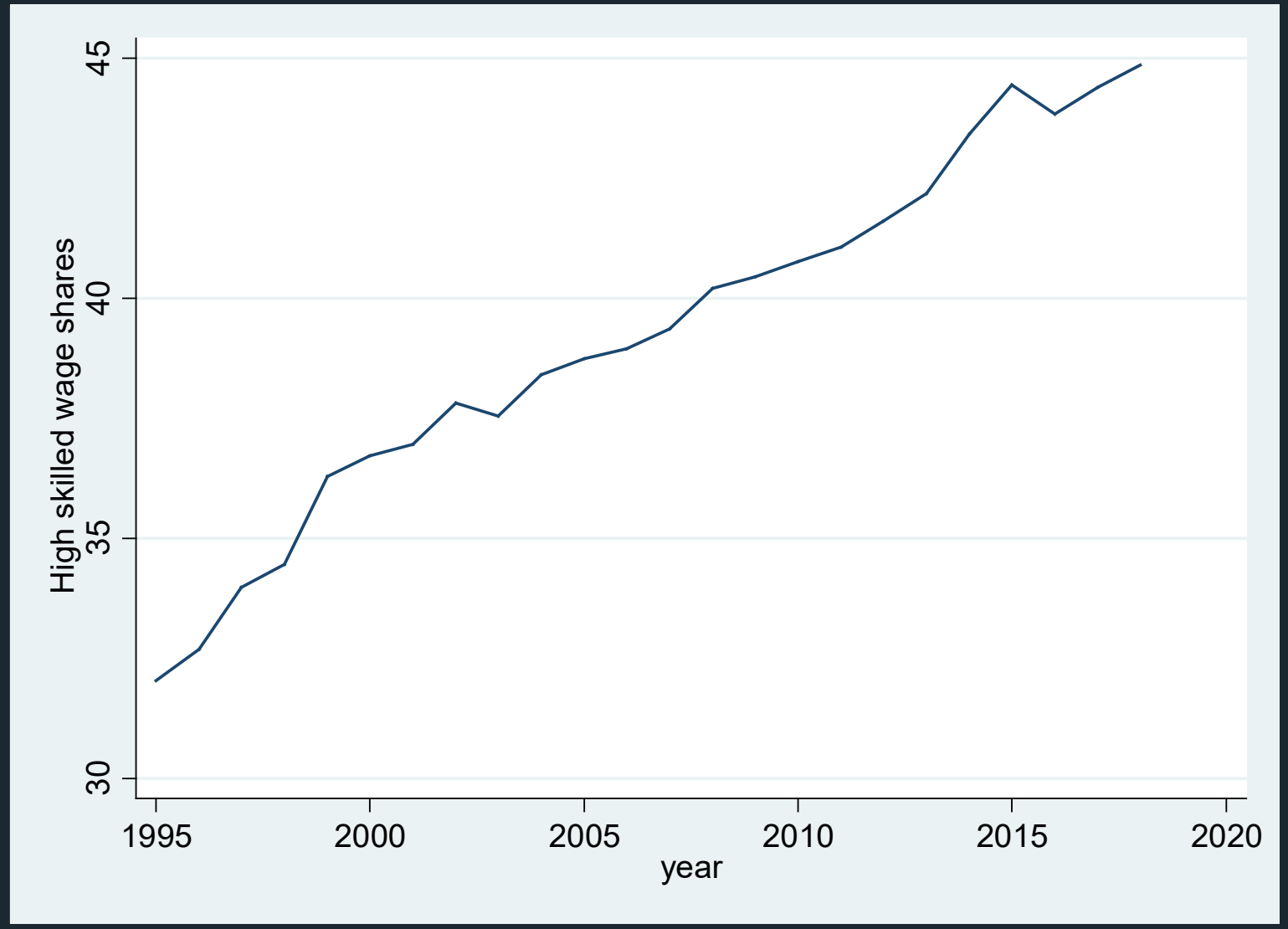


Table 5: analysis of the wage bill share

VARIABLES	(1) 1995-2018	(2) 1995-2018
lCAP_Y	0.128	-1.313
	(0.879)	(0.992)
ltfp	3.433***	2.737**
	(1.050)	(1.173)
lCAP_IT		0.503
		(0.359)
lCAPEC		-2.340***
		(0.626)
lCAPInnovaP		-0.0828
		(0.373)
Constant	16.10***	11.58***
	(3.397)	(3.815)
Observations	3,377	3,193
R-squared	0.414	0.419
Number of id	147	136
FE	YES	YES
TD	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Discussion and conclusions

- Wage premiums for high skilled in EU countries have been declining since the financial crisis
- Our results suggest that since the financial crisis the link between technology and the demand for skilled labour has vanished
- Investments in intangible assets do not appear to be complementing high skilled workers
- This is consistent with the productivity slowdown

Discussion and conclusions

- From the supply side, we observe an increasing supply of graduate workers, which may be associated with higher skill heterogeneity
- Our results support the evidence of skill downgrading: highly skilled workers are replacing the low skilled
- This is consistent with the literature on the skill mismatch among graduates

Future work

- Develop the theorical approach to include capital in the race model
- Expand on the dynamic specification
- We are looking at correlation and not causation: employ an identification strategy to discern causal effects