

Heterogeneous Sectoral Wage Phillips Curves: A Matter of Skills?

Sectoral Evidence from the Euro Area

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European Economic Association
Barcelona, August 31, 2023

Motivation

- ▶ Standard New Keynesian Phillips curve models typically **do not incorporate heterogeneity** among sectors or workers. (Gali, 2011; Gali and Gambetti, 2019; Nickel et al, 2020)
- ▶ However, evidence shows that **labour markets are strongly heterogeneous** across sectors and workers.
- ▶ So far, sectoral heterogeneity has **only been explored for prices**. (Imbs et al., 2011; Byrne et al., 2013)
- ▶ This paper investigates whether **wage Phillips curves are heterogeneous** across sectors.
- ▶ If so, **what drives the heterogeneity?**

This paper

Using country-sector level data for euro area countries, we:

▷ **Construct a measure of unemployment rate at the sectoral level.**

- Use **individual-level** data from the EU Labour Force Survey.
- Document **heterogeneous labour market dynamics** across sectors.

▷ **Estimate a Wage Phillips Curve using country-sector level data.**

- Develop a Bartik instrument based on sectors' **exposure to age groups**.
- Find a relatively **steep Wage Phillips Curve**.

▷ **Estimate sectoral Wage Phillips Curves.**

- Document considerable **heterogeneity in the slope** across sectors.

▷ **Explore the drivers of the heterogeneity.**

- Find that the heterogeneity is related to **skills** rather than occupations.
- Significantly **flatter WPC in low-skilled sectors**.

Contributions to the literature

▷ Empirical literature on the Wage Phillips curve

- Main finding: the wage Phillips curve is in better health than its price counterpart.

(Gali, 2011; Coibion and Gorodnichenko, 2015; Gali and Gambetti, 2019; Nickel et al, 2020)

▷ Burgeoning literature using sub-national data to estimate Phillips curves

- Find a steeper WPC using regional-level data, both for the US and for the EA.

(Hazell et al., 2022; Kumar and Orrenius, 2016; McLeay and Tenyero, 2020; Levy, 2019)

- Price Phillips curve: find strong heterogeneity across sectors.

(Imbs et al., 2011; Byrne et al., 2013)

▷ Provides empirical evidence to the heterogeneous agents literature

- HANK models: Contractionary monetary shocks increase income inequality

(Kaplan et al., 2018; Ravn and Sterk, 2018)

- SAM frictions models: MP easing might rather benefit higher-skilled workers.

(Dolado et al., 2021; Chaudhuri, 2020)

▷ Use of Bartik instruments in the empirical macroeconomics literature

(Bartik, 1991; Blanchard and Katz, 1992; Autor et al., 2013; Borusyak et al., 2022 and Goldsmith-Pinkham et al., 2020)

Data

- ▷ Exploit country-sector level data from Eurostat.
- ▷ 17 EA countries and 18 sectors following NACE Rev.2 classification.
(AT, BE, DE, EE, EL, ES, FI, FR, IE, IT, LT, LU, LV, NL, PT, SI, SL) ▶ [Sectors](#)
- ▷ Time coverage: revision of NACE in 2008 ▶ [Revision](#)
 - 2000-2020 for 9 sectors, 2008-2020 for 18 sectors
 - Annual frequency
- ▷ Eurostat provides:
 - Country level: inflation, unemployment rate by age groups (10 age brackets).
 - Country-sector level:
 - Labour hourly cost index (wages and salaries)
 - Labour productivity (GVA per hour worked)
- ▷ Use Eurostat's Labour Force Survey to construct:
 - Unemployment at the sectoral level.
 - Share of low/medium/high-skilled workers by sector.

Creating two new measures at the sectoral level for the EA

Use individual-level data from the EU Labour Force Survey to construct:

▶ EU-LFS

▶ Share of workers by skill groups

For each sector i ,

$$\text{Share of workers in skill group } s = \frac{\text{Number workers in skill group } s}{\text{Total number of workers}}$$

▶ Unemployment

- Information on the economic activity in previous job.
- Follow the methodology of the BLS (US) and the ONS (UK).
- Define the unemployment at the sector level:

$$u_i = \frac{\text{Number of unemployed whose last job was in sector } i}{\text{Labour force in sector } i}$$

Large variation of unemployment across sectors

Summary statistics for sectoral unemployment

(average across countries, 2008-2020)

	Mean	Median	Std. Dev.	10th pct	90th pct
National unemp. rate	10.52	9.00	5.23	5.40	17.80
Mining	9.07	6.97	6.57	2.18	18.07
Manuf.	8.00	6.59	5.15	2.96	15.86
Elec.	4.76	3.34	4.08	1.21	10.05
Water.	7.80	6.16	6.57	2.12	14.59
Const.	12.68	9.07	10.77	3.70	30.04
Retail	8.16	7.31	4.33	3.36	14.53
Transp.	6.27	5.34	3.66	2.39	10.91
Acc./Food	12.35	11.29	6.28	5.63	21.22
IT	5.83	4.67	4.22	2.14	11.26
Fin./Ins.	4.02	3.30	2.50	1.55	7.11
Real Est.	6.69	5.25	5.92	1.72	14.20
Scien./Techn.	4.79	3.80	3.40	1.82	9.23
Support	10.72	10.03	5.71	4.65	18.91
Publ. Admin	4.50	3.06	4.28	1.08	11.62
Educ.	3.82	3.00	2.56	1.42	7.17
Health	4.09	3.51	2.47	1.62	7.17
Arts	8.73	8.05	5.96	2.97	15.87
Other	7.26	6.35	4.62	2.45	13.17
Observations (for each sector)	221				

► Considerable heterogeneity across sectors, both in levels and in volatility.

► Common dynamics

The baseline empirical specification

▷ We estimate a reduced form of the **New Keynesian WPC** (Galí, 2011) with adaptive inflation expectations and homogeneous coefficients:

$$\pi_{c,i,t}^w = \alpha + \psi u_{c,i,t} + \delta \pi_{c,t-1} + \zeta X_{c,i,t} + \nu_{c,i} + \eta_{i,t} + \varepsilon_{c,i,t}$$

where c denote country, i industry and t year, and

- $\pi_{c,i,t}^w$ nominal wage growth
- $u_{c,i,t}$ unemployment
- $\pi_{c,t-1}$ national past inflation
- $X_{c,i,t}$ labour productivity growth
- $\nu_{c,i}$ and $\eta_{i,t}$ are country-sector and sector-time fixed effects
- Standard errors are clustered at the country-sector level

▷ **Endogeneity concerns:** (e.g.) residuals still contain the sectoral labour supply shocks that are not captured by the control variables.

▷ Develop a **Shift-Share (Bartik) instrument**, exploiting the **sectoral workforce composition by age groups**.

The Bartik instrument

▶ Bartik instruments popularized by [Bartik \(1991\)](#) and [Blanchard & Katz \(1992\)](#).

▶ We construct a Bartik instrument: [▶ Details](#)

$$z_{c,i,t} = \sum_k \underbrace{\omega_{c,i,k,\tau}}_{\text{Share}} \underbrace{u_{c,k,t}}_{\text{Shift}}$$

where $u_{c,k,t}$ is the [country-level](#) unemployment rate for workers in age group k .

▶ Exploit the [age composition of the sectoral workforce](#).

(Ten age brackets: [15-19], [20-24], [25-29], [30-34], [35-39], [40-44], [45-49], [50-54], [55-59] and [60-64])

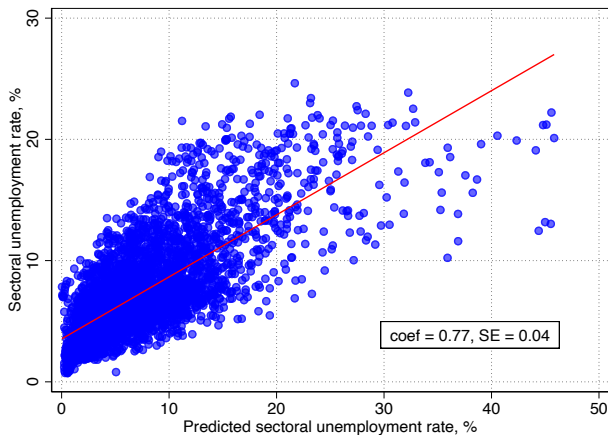
▶ [Large number](#) and [widespread distribution](#) of [shocks](#) validate the plausibility of our identifying assumption. ([Adao et al., 2019](#); [Borusyak et al., 2022](#) and [Goldsmith-Pinkham et al., 2020](#))

▶ [Summary statistics of the shares and shifts](#)

▶ [National](#) unemployment rates for a narrowly limited age group are [sufficiently random](#) not to be affected by unobserved [sectoral](#) labour supply shocks.

The Bartik is a relevant instrument

2SLS first stage regression



▷ First stage regression confirms relevance of the Bartik instrument.

▶ Results

The slope of the Wage Phillips Curve is steep

	I. Country-sector panel (2SLS)			II. Country panel (OLS)	
	2000-2020	2008-2020	2008-2020	2000-2020	2008-2020
	(1)	(2)	(3)	(4)	(5)
Unemployment	-0.55*** [0.075]	-0.68*** [0.091]	-0.69*** [0.067]	-0.45** [0.17]	-0.60*** [0.17]
Past inflation	0.00 [0.10]	-0.32** [0.13]	-0.19* [0.10]	0.25* [0.13]	-0.33 [0.22]
Labour productivity	0.041* [0.021]	0.015 [0.021]	0.032* [0.016]	0.22* [0.10]	0.036 [0.10]
Number of sectors	9	9	18	-	-
Sector-Time FE	✓	✓	✓	-	-
Country-Sector FE	✓	✓	✓	-	-
Country FE	-	-	-	✓	✓
Time FE	-	-	-	✓	✓
N	2233	1660	3369	327	218

- Steeper and more precisely estimated compared with country-level data.
- Steeper than previous studies using country-level or regional-level data. ▶ After 2008
(Bobeica, 2019; Levy, 2019)

Estimation of the WPC with heterogeneous coefficients

- ▶ We now explore the **heterogeneity across sectors**.
- ▶ Use the countries as the cross-sectional units.
- ▶ Estimate separately for each sector by 2SLS:

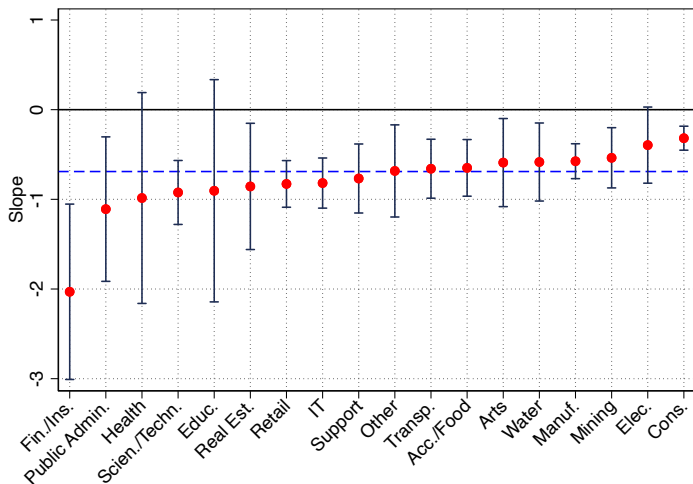
$$\pi_{c,i,t}^w = \alpha_i + \psi_i u_{c,i,t} + \delta_i \pi_{c,t-1} + \zeta_i X_{c,i,t} + \nu_c + \eta_t + \varepsilon_{c,i,t} \quad i \in \{1 \dots 18\}$$

where:

- ν_c and η_t are country and sector fixed effects
- Standard errors clustered at the country level

- ▶ We obtain **sector-specific** ψ , δ and ζ .

Strong heterogeneity of the WPC across sectors ▶ Results



- ▶ Strong heterogeneity in the sector-specific estimates (from -0.3 to -2).
- ▶ Visually, flat in low-skilled sectors and steeper in high-skilled sectors.

Skills heterogeneity in the Wage Phillips Curve

- ▷ **Hyp:** Responsiveness of π^w to u might be lower in low-skilled sectors.
- ▷ We augment our initial framework to test this assumption:

$$\pi_{c,i,t}^w = \alpha + \psi_1 u_{c,i,t} + \psi_2 u_{c,i,t} \times s_{c,i,t}^{low} + \delta \pi_{c,t-1} + \zeta \mathbf{X}_{c,i,t} + \varepsilon_{c,i,t}$$

where $s_{c,i,t}^{low}$ is the share of low-educated workers. Other controls include the share of part-time workers, share of female workers and trade union members (country-level).

- ▷ ψ_2 captures the variation of the slope for different levels of skills.
- ▷ Alternatively, the variation of the slope across sectors could also reflect the type of jobs workers occupy (Siena and Zago, 2021).

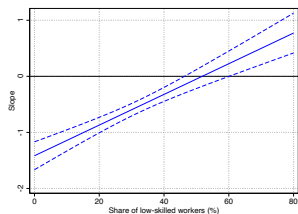
The slope of the Wage Phillips Curve depends on skills

	(1)	(2)	(3)	(4)	(5)	(6)
Unemployment	-0.70*** [0.084]	-0.74*** [0.081]	-1.42*** [0.15]	-0.44*** [0.13]	-0.72*** [0.11]	-0.54*** [0.089]
Unemployment × ShareLowSkills			0.027*** [0.0043]			
Unemployment × ShareHighSkills				-0.0092** [0.0045]		
Unemployment × ShareElementary					-0.0017 [0.0070]	
Unemployment × ShareProfessionals						-0.013* [0.0067]
ShareLowSkills		0.082 [0.064]	-0.23*** [0.070]	0.079 [0.060]	0.083 [0.064]	0.083 [0.060]
ShareHighSkills		0.068 [0.078]	0.052 [0.074]	0.13 [0.085]	0.068 [0.078]	0.070 [0.078]
ShareElementary		0.058 [0.065]	0.11* [0.064]	0.059 [0.063]	0.073 [0.096]	0.056 [0.063]
ShareProfessionals		-0.0079 [0.065]	-0.021 [0.062]	-0.017 [0.065]	-0.0078 [0.065]	0.047 [0.075]
Number of sectors	18	18	18	18	18	18
Controls	—	✓	✓	✓	✓	✓
Country-Sector FE	✓	✓	✓	✓	✓	✓
Sector-Time FE	✓	✓	✓	✓	✓	✓
N	1835	1835	1835	1835	1835	1835

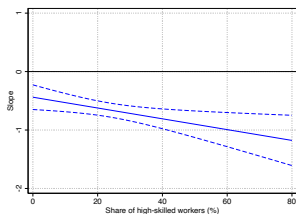
Note: coefficients for inflation and labour productivity growth not shown for readability.

The WPC is flatter in low-skilled sectors

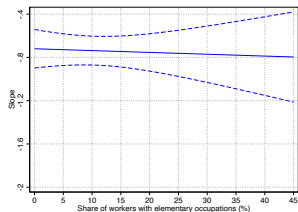
2SLS estimates conditional on the share of workers by skills and by occupations



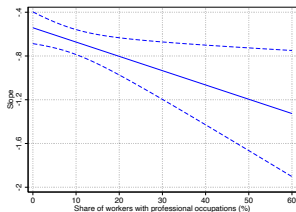
(a) Low-skilled



(b) High-skilled



(c) Elementary occupations



(d) Professionals

Additional analysis and robustness checks

Additional analysis:

- ▷ Wage Phillips curves are nonlinear. [▶ Results](#)

The results are robust to the following checks:

- ▷ Use of alternative sectoral wage measures, namely compensation per hour worked and the unit labour cost. [▶ Results](#)
- ▷ Use core inflation as an alternative measure of inflation. [▶ Results](#)
- ▷ Excluding public services. [▶ Results](#)
- ▷ Fix the education level in 2008. [▶ Results](#)
- ▷ Bartik instrument exploiting workforce composition by skill groups [▶ Results](#)
- ▷ Excluding public sectors [▶ Results](#)
- ▷ Use job vacancy rate as an alternative measure of labour market slack. [▶ Results](#)

Conclusion

Exploiting sector-level data for euro area countries, we document:

- ▷ A relatively **steep Wage Phillips Curve** using a **Bartik instrument** based on the age composition of the sectoral workforce.
- ▷ Document **considerable heterogeneity** in the slope across sectors.
- ▷ Show that the slope is **flatter in low-skilled** industries compared with most-skilled industries.
- ▷ **Policy implications:**
 - Wage inflation might be a better indicator of tightness in the high-skill labor market than in the low-skill labor market.
 - Monetary policy easing might benefit more high-skilled sectors. (Dolado et al., 2021)

International Standard Classification of Education (ISCED)

▷ ISCED is the reference international classification for organising education programmes and related qualifications by levels and fields.

Eurostat classification	Level	ISCED-11
Low	0	Early childhood education
	1	Primary education
	2	Lower secondary education
Medium	3	Upper secondary education
	4	Post-secondary non-tertiary education
High	5	Short-cycle tertiary education
	6	Bachelor's or equivalent level
	7	Master's or equivalent level
	8	Doctoral or equivalent level

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International Standard Classification of Education (ISCED)

Post-secondary non-tertiary level:

▷ Germany

- Fachoberschulen
- Berufsoberschulen/Technischen Oberschulen

▷ Italy

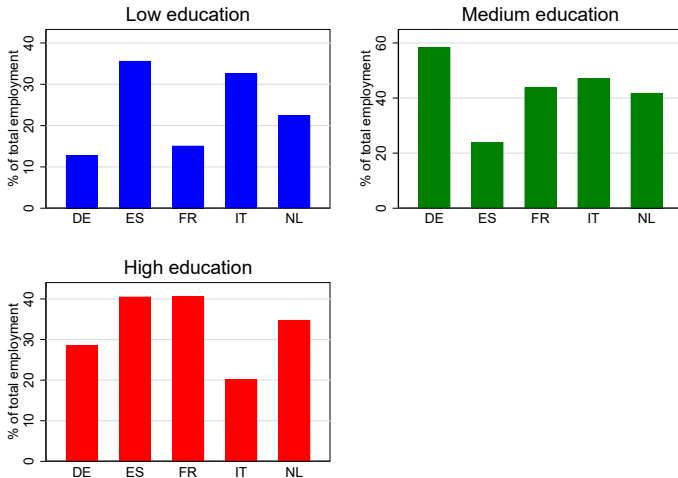
- Higher technical education and training system (Istruzione e formazione tecnica superiore - IFTS) managed by the State.
- Vocational training system managed by the Regions.

▷ France

- Does not exist in France

▶ [Back](#)

Figure: Employment by education level, % of total employment (2008-2020 average)



- ▶ NACE is the European statistical classification of economic activities. (*Nomenclature statistique des Activités économiques dans la Communauté Européenne*)
- ▶ A second revision (NACE Rev. 2) took place 2008 to better reflect changes in economic structures and organisations, as well as technological developments.
- ▶ NACE Rev. 2 classifies 21 sectors (vs. 17 sectors for NACE Rev 1.1).
- ▶ We exclude for data purposes (1) the agricultural sector, (2) the activities of households as employers and (3) the activities of extraterritorial organizations and bodies.

Code	Description	Short name
B	Mining and quarrying	Mining
C	Manufacturing	Manuf.
D	Electricity, gas, steam and air conditioning supply	Elec.
E	Water supply, sewerage, waste management and remediation activities	Water
F	Construction	Const.
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	Retail
I	Accommodation and food service activities	Acc./Food
H	Transportation and storage	Transp.
J	Information and communication	IT
K	Financial and insurance activities	Fin./Ins.
L	Real estate activities	Real Est.
M	Professional, scientific and technical activities	Scien./Techn.
N	Administrative and support service activities	Support
O	Public administration and defence; compulsory social security	Publ. Admin
P	Education	Educ.
Q	Human health and social work activities	Health
R	Arts, entertainment and recreation	Arts
S	Other service activities	Other

Corresponding table [▶ Back](#)

NACE Rev. 2		NACE Rev. 1.1	
Sector	Description	Sector	Description
B	Mining and quarrying	C	Mining and quarrying
C	Manufacturing	D	Manufacturing
D	Electricity, gas, steam and air conditioning supply	E	Electricity, gas and water supply
E	Water supply, sewerage, waste management and remediation activities		
F	Construction	F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
I	Accommodation and food service activities	I	Transport, storage and communications
H	Transportation and storage	J	Financial intermediation
J	Information and communication		
K	Financial and insurance activities	K	Real estate, renting and business activities
L	Real estate activities		
M	Professional, scientific and technical activities	L	Public Administration and defence; compulsory social security
N	Administrative and support service activities		
O	Public administration and defence; compulsory social security	M	Education
P	Education	N	Health and social work
Q	Human health and social work activities	O	Other community, social and personal services activities
R	Arts, entertainment and recreation		
S	Other service activities		

Eurostat's Labour Force Survey [▶ Back](#)

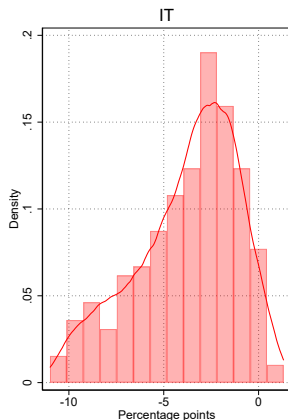
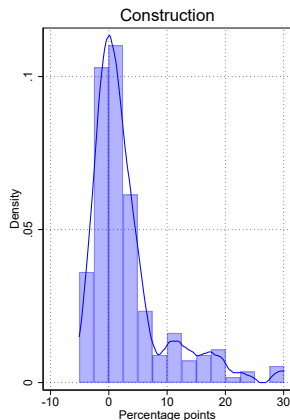
- ▶ The EU-LFS is a large cross-sectional household sample survey used by Eurostat to calculate various labour market indicators.

- ▶ For each (weighted) individual, the EU-LFS provides information on:
 - the labour market status (employed vs unemployed)
 - the level of education attained [▶ ISCED](#)
 - the sector of work [▶ NACE classification](#)

- ▶ We use this information to calculate at the sectoral level:
 1. Share of workers by skill groups
 2. Unemployment

Sectoral dynamics common across countries [▶ Back](#)

- ▶ Calculate the **deviation of sectoral unemployment from national unemployment rate**.
 - **Positive values**: sectoral unemployment $>$ national unemployment
 - **Negative values**: sectoral unemployment $<$ national unemployment



- ▶ Unemp in **construction** / **IT** tend to be relatively **higher** / **lower** in all EA countries.

Summary statistics for the shares and shifts

	2000-2020	2008-2020	2008-2020
	<i>Shares</i>		
Number of sectors	9	9	18
Exposure share (average)	0.10	0.10	0.10
Herfindahl index	0.13	0.13	0.13
	<i>Shifts</i>		
Age-specific unemployment (average)	11.3	12.1	12.1
Standard deviation	7.2	7.8	7.8
Interquartile range	5.0	5.4	5.4
Number of shocks (total)	3415	2171	2171
By country	201	128	128

Note: This table reports the summary statistics of the exposure shares and the shocks used in the shift-share instrument. The figures for the exposure shares correspond to their average across sectors within a given country for $\tau = 2000$ (Column 1) or $\tau = 2008$ (Columns 2 and 3). The Herfindahl index is defined as $\sum_k \omega_{c,i,k,\tau}^2$ and is reported on average across countries, sectors and years. The figure for the national unemployment by age group correspond to the average across countries and sectors over the different time samples. The standard deviations and the interquartile ranges are averages within countries.

A Bartik based on the workforce's age composition ▶ Bartik

▶ Start with accounting identity for sectoral unemployment $u_{c,i,t}$:

$$u_{c,i,t} = \sum_k \omega_{c,i,k,t} u_{c,i,k,t}$$

- k : subscript for age groups (10 age brackets)
- $\omega_{c,i,k,t}$: share of workers in age group k in the labour force in sector i .
- $u_{c,i,k,t}$: unemployment rate for given age group k in sector i .

We construct a Bartik instrument:

$$z_{c,i,t} = \sum_k \underbrace{\omega_{c,i,k,\tau}}_{\text{Share}} \underbrace{u_{c,k,t}}_{\text{Shift}}$$

where $u_{c,k,t}$ is the **country-level** unemployment rate for workers in age group k .

▶ Fix $\omega_{c,i,k,\tau}$ start-of-period ($\tau = 2000$ or 2008) to ensure exogeneity of the shares.
(Goldsmith-Pinkham et al., 2020)

▶ $z_{c,i,t}$ captures variation in sectoral labour demand but are orthogonal to industry-level unobservables. (Borusyak et al., 2022)

Dependent variable: sectoral unemployment rate

	2SLS first-stage estimates		
	2000-2020 (1)	2008-2020 (2)	2008-2020 (3)
Bartik instrument	0.80*** [0.066]	0.82*** [0.073]	0.77*** [0.042]
F-stat > 10	✓	✓	✓
Number of sectors	9	9	18
Country-Sector FE	✓	✓	✓
Sector-Time FE	✓	✓	✓
N	2317	1700	3409
R^2	0.86	0.90	0.89

Note: This table reports the first stage estimates. All regressions include past inflation and labour productivity growth as control variables. Standard errors (in brackets) are clustered at the country-sector level.

* / ** / *** indicate 10% / 5% / 1% significance level.

Flattening of the WPC after the 2008 crisis [▶ Back](#)

	I. Country-sector panel (2SLS)	II. Country panel (OLS)
	2000-2020 (1)	2000-2020 (2)
Unemployment	-0.79*** [0.17]	-0.42 [0.25]
Unemployment \times PostCrisis	0.25* [0.15]	-0.038 [0.23]
Past inflation	-0.0059 [0.10]	0.24** [0.11]
Labour productivity	0.041* [0.021]	0.21* [0.11]
Number of sectors	9	-
Sector-Time FE	✓	-
Country-Sector FE	✓	-
Country FE	-	✓
Time FE	-	✓
N	2233	327

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The slope of the WPC is flatter with OLS [▶ Back](#)

	(OLS)
Panel	Country-sector-time
$u_{c,i,t}$	-0.361*** [0.0414]
$\pi_{c,t-1}$	-0.620*** [0.0985]
$X_{c,i,t}$	0.0245* [0.0138]
Sector-Year FE	Y
Country-Sector FE	Y
N	2754
R ²	0.361

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Sector-specific estimates [▶ Back](#)

	Mining	Manuf.	Elec.	Water.	Cons.	Retail
Unemployment	-0.54** [0.20]	-0.57*** [0.12]	-0.40 [0.26]	-0.58** [0.27]	-0.32*** [0.082]	-0.83*** [0.16]
Past inflation	-0.33 [0.44]	-0.044 [0.22]	-0.40 [0.36]	-0.13 [0.25]	-0.17 [0.34]	-0.0026 [0.19]
Labour productivity	-0.0088 [0.038]	-0.0098 [0.033]	0.067 [0.053]	0.082* [0.044]	0.0029 [0.030]	0.19** [0.073]
<i>2SLS first stage estimates</i>						
Bartik instrument	0.89*** [0.139]	0.93*** [0.061]	0.55*** [0.047]	0.93*** [0.190]	2.09*** [0.196]	0.79*** [0.034]
F-stat > 10	✓	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓	✓
Sector FE	✓	✓	✓	✓	✓	✓
N	172	191	187	188	190	191

Sector-specific estimates [▶ Back](#)

	Transp.	Acc./Food	IT	Fin./Ins.	Real Est.	Scien./Techn.
Unemployment	-0.66*** [0.20]	-0.65*** [0.19]	-0.82*** [0.17]	-2.03*** [0.60]	-0.86* [0.43]	-0.92*** [0.22]
Past inflation	0.15 [0.52]	-0.011 [0.33]	0.21 [0.45]	-0.29 [0.23]	-0.45 [0.29]	0.37* [0.20]
Labour productivity	0.077 [0.046]	-0.051 [0.085]	0.040 [0.068]	0.016 [0.046]	0.013 [0.10]	0.098 [0.065]
<i>2SLS first stage estimates</i>						
Bartik instrument	0.71*** [0.033]	0.88*** [0.067]	0.67*** [0.100]	0.35*** [0.070]	0.68*** [0.129]	0.61*** [0.057]
F-stat > 10	✓	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓	✓
Sector FE	✓	✓	✓	✓	✓	✓
N	191	191	191	191	188	191

Sector-specific estimates [▶ Back](#)

	Support	Public Admin.	Educ.	Health	Arts	Other
Unemployment	-0.77*** [0.23]	-1.11** [0.49]	-0.90 [0.76]	-0.99 [0.72]	-0.59* [0.30]	-0.68** [0.31]
Past inflation	-0.64** [0.24]	-1.26*** [0.14]	-0.33** [0.15]	-0.55*** [0.12]	-0.46** [0.18]	0.56 [0.38]
Labour productivity	0.057 [0.068]	0.15 [0.16]	0.29* [0.15]	0.15 [0.15]	0.036 [0.064]	-0.12* [0.071]
<i>2SLS first stage estimates</i>						
Bartik instrument	0.78*** [0.087]	0.48*** [0.086]	0.42*** [0.054]	0.38*** [0.039]	0.72*** [0.078]	0.77*** [0.053]
F-stat > 10	✓	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓	✓
Sector FE	✓	✓	✓	✓	✓	✓
N	191	178	178	178	191	191

Wage Phillips curves are nonlinear [▶ Back](#)

$$\pi_{c,i,t}^w = \alpha + \psi_1 u_{c,i,t} + \psi_2 \max(u_{c,i,t} - \bar{u}, 0) + \delta \pi_{c,t-1} + \zeta \mathbf{X}_{c,i,t} + \varepsilon_{c,i,t}$$

	2000-2020			2008-2020		
	(1)	(2)	(3)	(4)	(5)	(6)
Unemployment	-1.59*** [0.27]	-1.65*** [0.29]	-0.53*** [0.078]	-1.63*** [0.22]	-1.63*** [0.24]	-0.66*** [0.093]
Linear spline term	1.23*** [0.30]			1.12*** [0.24]		
Cubic restricted spline term		0.64*** [0.16]			0.56*** [0.13]	
1 / Unemployment			2.52** [1.19]			2.74 [2.15]
Past inflation	-0.034 [0.099]	-0.032 [0.100]	-0.019 [0.11]	-0.19* [0.100]	-0.19* [0.10]	-0.33** [0.13]
Labour productivity	0.029 [0.019]	0.031 [0.019]	0.044** [0.021]	0.024 [0.017]	0.026 [0.017]	0.017 [0.022]
Number of sectors	9	9	9	18	18	18
Sector-Time FE	✓	✓	✓	✓	✓	✓
Country-Sector FE	✓	✓	✓	✓	✓	✓
N	2233	2233	2233	3369	3369	1660

Robustness check: alternative wage measures [▶ Back](#)

2SLS estimates of the wage Phillips curve with alternative wage measures

Dependent variable: nominal sectoral wage growth

<i>Wage growth measure:</i>	Labour cost index	Comp. per hour worked	ULC
Unemployment	-0.651*** [0.0663]	-0.575*** [0.0852]	-0.689*** [0.0967]
Past inflation	-0.0721 [0.109]	-0.360*** [0.120]	-0.184 [0.176]
Labour productivity	0.0288* [0.0162]	0.408*** [0.0602]	
Number of sectors	14	14	14
Sector-Year FE	✓	✓	✓
Country-Sector FE	✓	✓	✓
N	2647	2648	2648

Sectors not covered: Real Est. (L), Pub. admin (O), Educ. (P) and Health (Q).

2SLS estimates of the wage Phillips curve using core inflation

Dependent variable: nominal sectoral wage growth

	2000-2020 (1)	2008-2020 (2)	2008-2020 (3)
Unemployment	-0.59*** [0.077]	-0.73*** [0.093]	-0.72*** [0.069]
Core inflation	-0.030 [0.13]	-0.38** [0.17]	-0.21 [0.13]
Labour productivity	0.039* [0.021]	0.014 [0.022]	0.032** [0.016]
Number of sectors	9	9	18
Sector-Time FE	✓	✓	✓
Country-Sector FE	✓	✓	✓
N	2154	1660	3369

Table 4: 2SLS estimates of the wage Phillips curve excluding public services

Dependent variable: nominal sectoral wage growth

	2000-2020 (1)	2008-2020 (2)	2008-2020 (3)
Unemployment	-0.47*** [0.071]	-0.61*** [0.085]	-0.66*** [0.066]
Past inflation	0.14 [0.12]	-0.14 [0.14]	-0.096 [0.11]
Labour productivity	0.032 [0.020]	0.0019 [0.021]	0.027* [0.016]
Number of sectors	6	6	15
Sector-Time FE	✓	✓	✓
Country-Sector FE	✓	✓	✓
N	1528	1126	2835

Robustness check: education level in 2008 [▶ Back](#)

	(1)	(2)	(3)	(4)
$u_{c,i,t}$	-0.929*** [0.0850]	-0.0692 [0.152]	-0.520*** [0.0676]	-0.868*** [0.136]
$u_{c,i,t} \times ShareLowSkills_{c,i,2008}$	0.863*** [0.218]			0.799*** [0.249]
$u_{c,i,t} \times ShareMediumSkills_{c,i,2008}$		-0.799*** [0.249]		
$u_{c,i,t} \times ShareHighSkills_{c,i,2008}$		-0.985*** [0.289]	-0.727*** [0.268]	-0.186 [0.314]
$\pi_{c,t-1}$	-0.523*** [0.101]	-0.523*** [0.101]	-0.547*** [0.101]	-0.523*** [0.101]
$X_{c,i,t}$	0.0303** [0.0131]	0.0300** [0.0130]	0.0291** [0.0129]	0.0300** [0.0130]
Country-Sector FE	Y	Y	Y	Y
Sector-Year FE	Y	Y	Y	Y
N	2754	2754	2754	2754
R ²	0.407	0.407	0.402	0.407

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Robustness check: Bartik based on skill composition [▶ Back](#)

2SLS estimates of the wage Phillips curve using Bartik instrument based on skill groups

Dependent variable: nominal sectoral wage growth

	2000-2020	2008-2020	2008-2020
	(1)	(2)	(3)
Unemployment	-0.50*** [0.072]	-0.70*** [0.087]	-0.72*** [0.065]
Past inflation	0.21*** [0.079]	-0.37*** [0.13]	-0.27*** [0.10]
Labour productivity	0.048** [0.021]	0.022 [0.021]	0.034** [0.015]
Number of sectors	9	9	18
Sector-Time FE	✓	✓	✓
Country-Sector FE	✓	✓	✓
N	2988	1909	3858

Table 7: 2SLS estimates of the wage Phillips curve excluding public services

Dependent variable: nominal sectoral wage growth

	2000-2020 (1)	2008-2020 (2)	2008-2020 (3)
Unemployment	-0.47*** [0.071]	-0.61*** [0.085]	-0.66*** [0.066]
Past inflation	0.14 [0.12]	-0.14 [0.14]	-0.096 [0.11]
Labour productivity	0.032 [0.020]	0.0019 [0.021]	0.027* [0.016]
Number of sectors	6	6	15
Sector-Time FE	✓	✓	✓
Country-Sector FE	✓	✓	✓
N	1528	1126	2835

Robustness check: using the job vacancy rate [▶ Back](#)

	(1)	(2)	(3)	(4)	(5)
JVR	0.046 [0.35]	1.52*** [0.52]	-0.86 [0.61]	0.13 [0.45]	-0.20 [0.45]
JVR × ShareLowSkills		-0.078*** [0.021]			
JVR × ShareHighSkills			0.026* [0.014]		
JVR × ShareElementary				-0.0073 [0.020]	
JVR × ShareProfessionals					0.014 [0.015]
ShareLowSkills	-0.020 [0.056]	0.054 [0.065]	-0.021 [0.056]	-0.019 [0.057]	-0.019 [0.057]
ShareHighSkills	0.050 [0.061]	0.030 [0.060]	-0.000059 [0.063]	0.049 [0.061]	0.048 [0.060]
ShareElementary	0.19** [0.095]	0.20* [0.10]	0.18* [0.095]	0.20* [0.11]	0.19* [0.095]
ShareProfessionals	-0.060 [0.076]	-0.059 [0.077]	-0.060 [0.076]	-0.060 [0.076]	-0.081 [0.082]
Number of sectors	18	18	18	18	18
Controls	✓	✓	✓	✓	✓
Country-Sector FE	✓	✓	✓	✓	✓
Sector-Time FE	✓	✓	✓	✓	✓
N	1701	1701	1701	1701	1701