



The Impact of Labour Costs on Prices A Study of Bulgaria

17th South-Eastern European Economic Research Workshop
Tirana, Albania

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- 1 Motivation**
- 2 Literature Review: Price-Wage Link in Bulgaria**
- 3 Descriptive evidence on the relationship between inflation and wages**
- 4 Theoretical background**
- 5 Pass-through estimated on microdata**
- 6 Pass-through based on input-output analysis**
- 7 Reduced-form Phillips curve model**
- 8 Conclusion**

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- **Early Warning Signals:** Labour cost developments are an early indicator of sustained inflation pressures, according to the cost-push view of inflation
- **2017-2019 Wage Surge:** Substantial wage growth (9.0% per year) in 2017-2019 that resulted from cyclical, structural, and policy-driven factors
- **Tight Labour Market:** Robust post-COVID-19 recovery has led to unprecedented levels of labor shortages
- **Signs of Wage-Price Spiral in 2022-2023:** Tight labor market conditions and elevated inflation expectations triggered demands for wage increases. CPE increased by 11.3% in 2022 and 14.2% in 2023
- **Inflation Spread:** Following global commodity price shocks in 2021-2022, inflation spread across HICP components, with prices of services, the most labor-intensive sector, soaring by 13.9% in end-2022
- **Minimum Wage Increases:** The government raised the minimum wage by 33% between 2017-2019 and by further 39% between 2020-2023.

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- In 2009, the BNB conducted a survey among non-financial enterprises in Bulgaria (WDN 2 project)
 - pricing practices included following competitors' policies (40%) and setting prices based on predefined mark-ups (34%).
 - labor costs contributed less to price increases compared to raw materials prices and improved product quality
 - faced with an unexpected **permanent wage increase** affecting all corporations, only **43% of Bulgarian firms would opt to raise prices**, in contrast to the EU average of 60%
 - demonstrating flexibility, a notable majority of firms expressed intent to explore alternative strategies, such as cost reduction and adjusting profit margins (56.2% and 65.4%)
- In 2015 the BNB explored the drivers of low inflation over the period 2012-2014
 - low inflation was driven mostly by global commodity prices
 - no conclusive evidence of a significant change in the Phillips curve's slope, particularly related to labor costs or the output gap

Literature Review: Price-Wage Link in Bulgaria [2]



- In 2014, the BNB investigated firms' price- and cost-setting behavior in 2009 and 2010-2013 (WDN 3 project).
 - **state-dependent pricing** - the decision to change prices depended on the cost and demand conditions
 - the **wage-price link**, while relatively weak, showed signs of **strengthening** compared to the previous WDN2 round
 - in **2009** around **25.6% of firms applied inflation indexation rule**, similar to WDN2 results. During the low-inflation period of **2010–2013**, the practice became more widespread, with **29.2%** aligning wage growth with inflation
 - wage costs were not the primary factor driving price changes, with only around 23% of firms considering them 'very relevant.'
 - approximately 40% of companies followed competitors' prices, while **one-third used the 'mark-up over costs' policy for price setting**
 - results suggested spillover effects on wages of higher-paid employees due to changes in the minimum wage and social security thresholds
 - the survey found that around **37% of firms offset the effects of minimum wage and social security threshold increases on profits by raising prices**

- 2022 study on 'Inflation Dynamics in Bulgaria and Evidence on the Wage-Price Spiral.'
 - evidence of a gradual shift towards a **high-inflation regime**, accompanied by a strengthening **feedback loop between wages and prices**
 - the main factors for that were:
 - (1) a pronounced rise in inflation and inflation expectations
 - (2) labor market shortages, boosting workers' bargaining power and pressuring employers to meet higher wage demands
 - (3) the increased adoption of wage and social payment indexation practices
 - (4) resilient household demand propelled by substantial wage growth, expansionary fiscal policy measures and deeply negative real interest rates

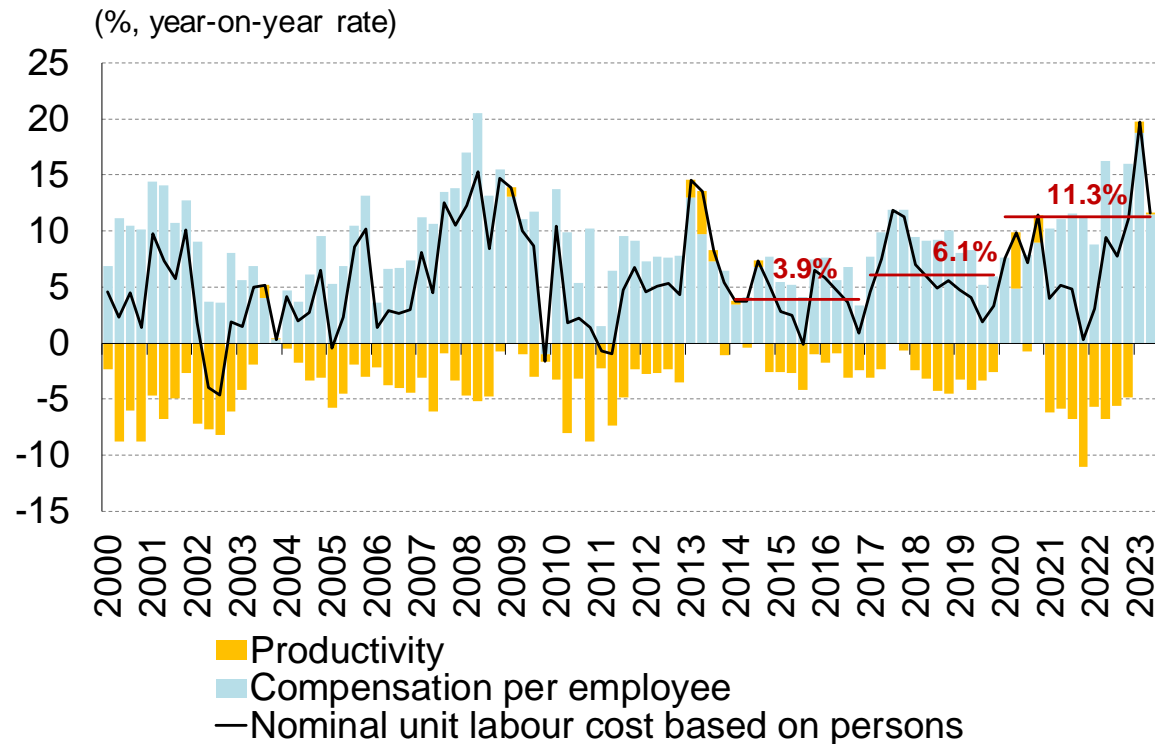
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Descriptive evidence [1]

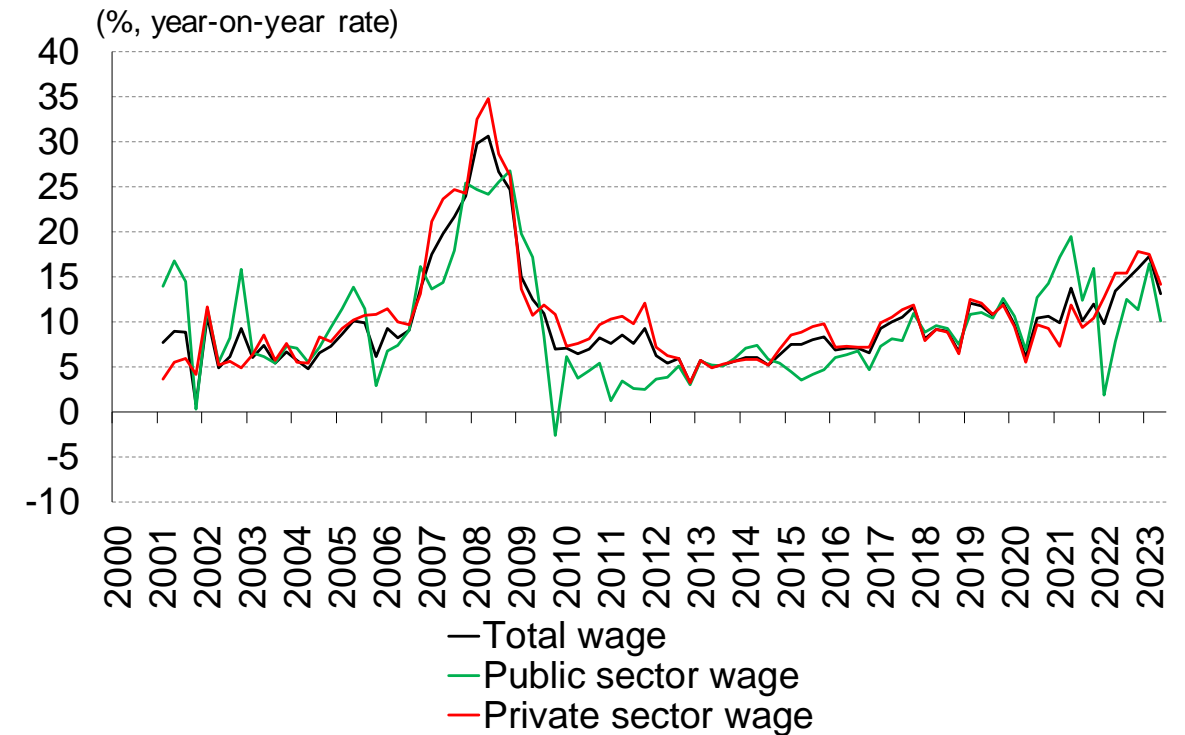


The surge in ULC from 2017 to Q2 2023 was driven by a more substantial rise in compensation per employee compared to productivity

Growth rate of ULC



Growth rate of private and public wages



Source: NSI, Eurostat, own calculations

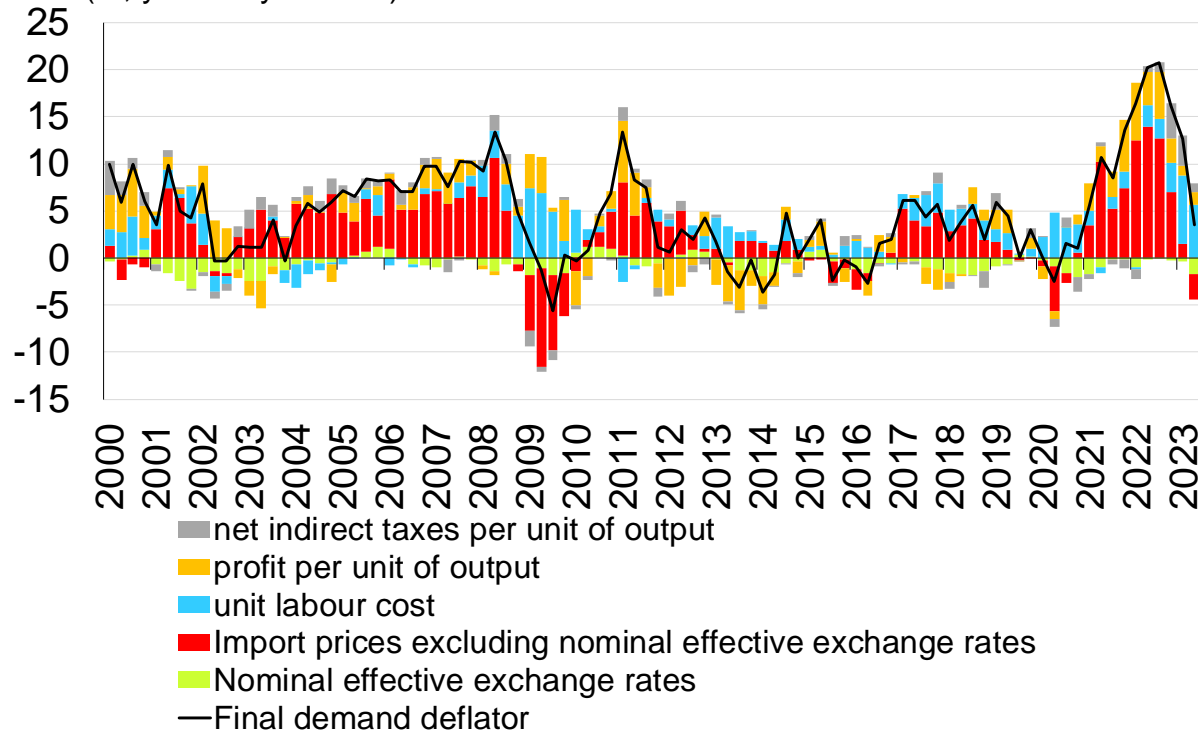
Descriptive evidence [2]



Although most of the price pressures in 2021 – 2022 emanated from the external environment, labour costs also contributed positively to domestic inflation

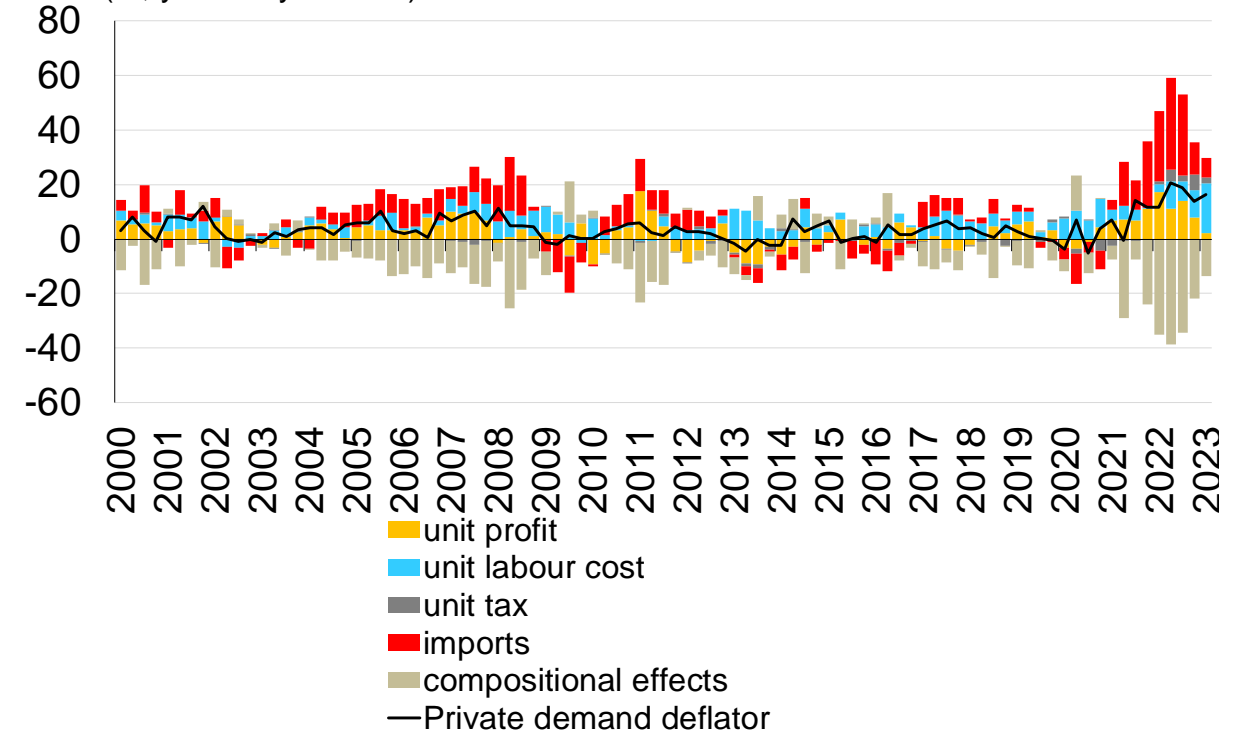
Breakdown of the final demand deflator

(%, year-on-year rate)



Breakdown of the private consumption deflator

(%, year-on-year rate)

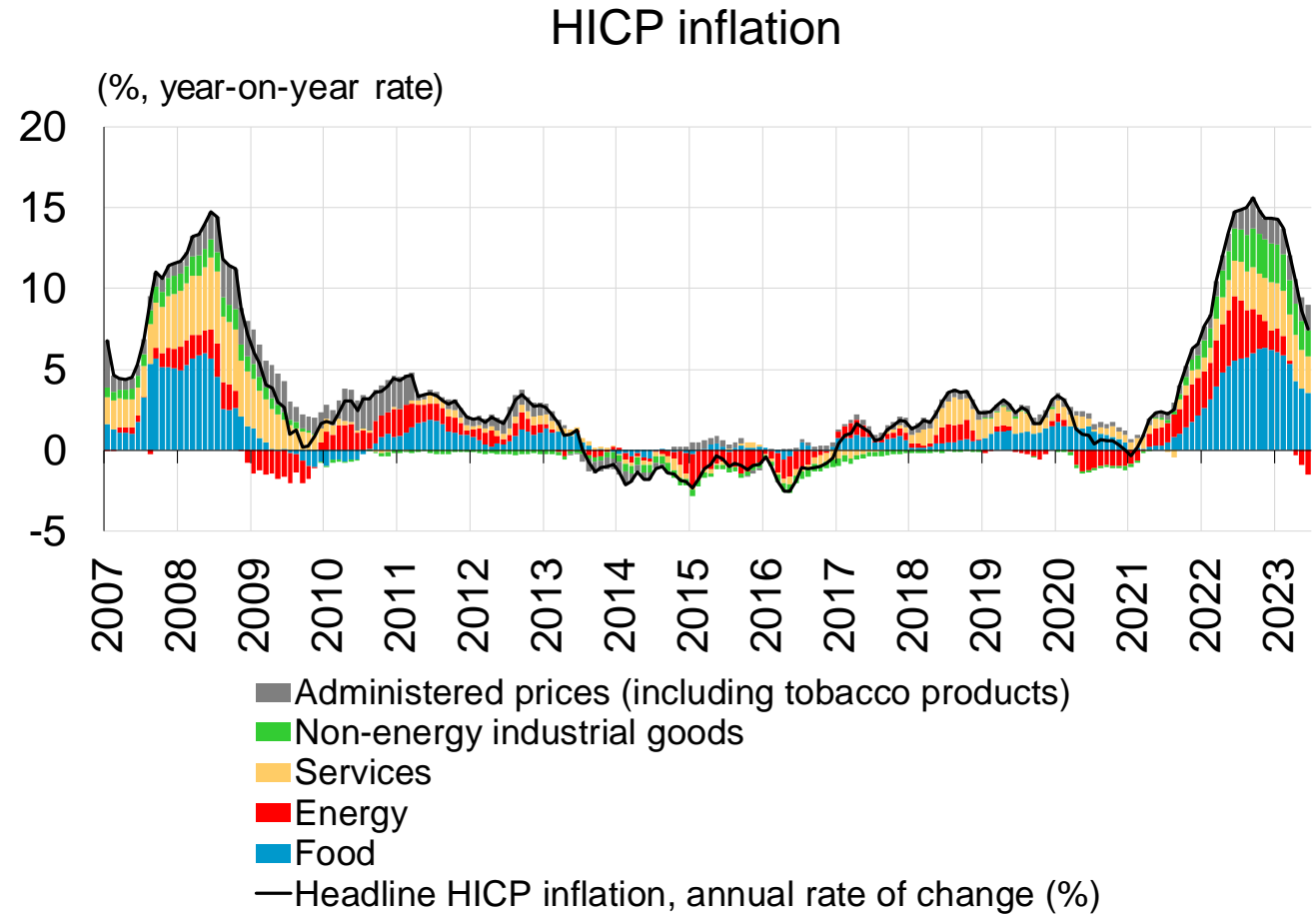


Source: NSI, Eurostat, own calculations

The broad based nature of inflation implies a high pass-through of labour costs

The paper aims to answer two major questions:

- First, what is the size of the pass-through of rising labour costs to consumer prices?
- Second, how has the sensitivity of prices to changes in labour costs changed over time?



Source: NSI, Eurostat, own calculations

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- The neoclassical theory postulates a long-term **relationship** between **changes in labour costs and prices**

➤ **Production function:** $Y_t = A_t L_t^\alpha Z_t^{1-\alpha}$, with $\alpha, 1 - \alpha \in (0,1)$

➤ Assuming perfect competition and rational behaviour, firms maximize profits:

Optimization problem: $\max_Y P_t Y_t - W_t L_t - R_t Z_t$

➤ Derive a relationship between **wages and prices**:

$$\pi_t = -\Delta \ln(A_t) + \alpha \Delta \ln(W_t) + (1 - \alpha) \Delta \ln Z_t$$

Assuming perfect competition and constant returns of scale, **α** can be shown to be **labor's share of output**

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- Propose a statistical method for calculating **labor cost shares** and build an aggregate metric for firms whose products are included in the HICP
- The analysis proceeds in 4 steps:
 - (1) Collect micro data from ORBIS and summarize the main characteristics of the firms in it
 - (2) Assign the products of the firms in the dataset to the HICP components at the COICOP 4-digit level
 - (3) Compute firms' labor costs for the different HICP components and weigh them based on the consumer basket's structure
 - (4) Account for the (indirect) impact of wage expenses that are contained in intermediate inputs, as well as the effects from domestic and international trade

Microdata – Step 1



- Data from the Bureau van Dijk's **Orbis database** as of 2021
- Information about 1 797 042 enterprises
- Reduced dataset of 265 110 enterprises – includes those with more than 1 employee and more than 1 000 EUR of annual turnover

Source: NSI, Orbis database

Economic Sectors	Code	Population of firms, NSI		Orbis dataset	
		2020		2021	
		Enterprises	% of Total	Enterprises	% of Total
Agriculture, forestry and fishing	A			12,527	4.7%
Mining and quarrying	B	310	0.1%	255	0.1%
Manufacturing	C	29,872	7.5%	25,762	9.7%
Electricity, gas, steam and air conditioning supply	D	1,926	0.5%	1,022	0.4%
Water supply; sewerage, waste management and remediation activities	E	782	0.2%	652	0.2%
Construction	F	21,297	5.3%	16,507	6.2%
Wholesale and retail trade; repair of motor vehicles and motorcycles	G	138,125	34.5%	79,890	30.1%
Transportation and storage	H	22,422	5.6%	18,940	7.1%
Accommodation and food service activities	I	25,352	6.3%	21,419	8.1%
Information and communication	J	15,336	3.8%	8,930	3.4%
Financial and insurance activities excluding activities of holding companies	K ¹	4,386	1.1%	2,437	0.9%
Real estate activities	L	24,315	6.1%	10,090	3.8%
Professional, scientific and technical activities	M	46,649	11.6%	26,807	10.1%
Administrative and support service activities	N	11,604	2.9%	7,370	2.8%
Public administration and defence; compulsory social security	O			1	0.0%
Education	P	4,089	1.0%	3,059	1.2%
Human health and social work activities	Q	14,204	3.5%	10,752	4.1%
Arts, entertainment and recreation	R	5,660	1.4%	4,110	1.6%
Other service activities	S	34,163	8.5%	14,563	5.5%
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	T				0.0%
Not allocated to a specific sector				17	0.0%
TOTAL		400,492	100%	265,110	100%

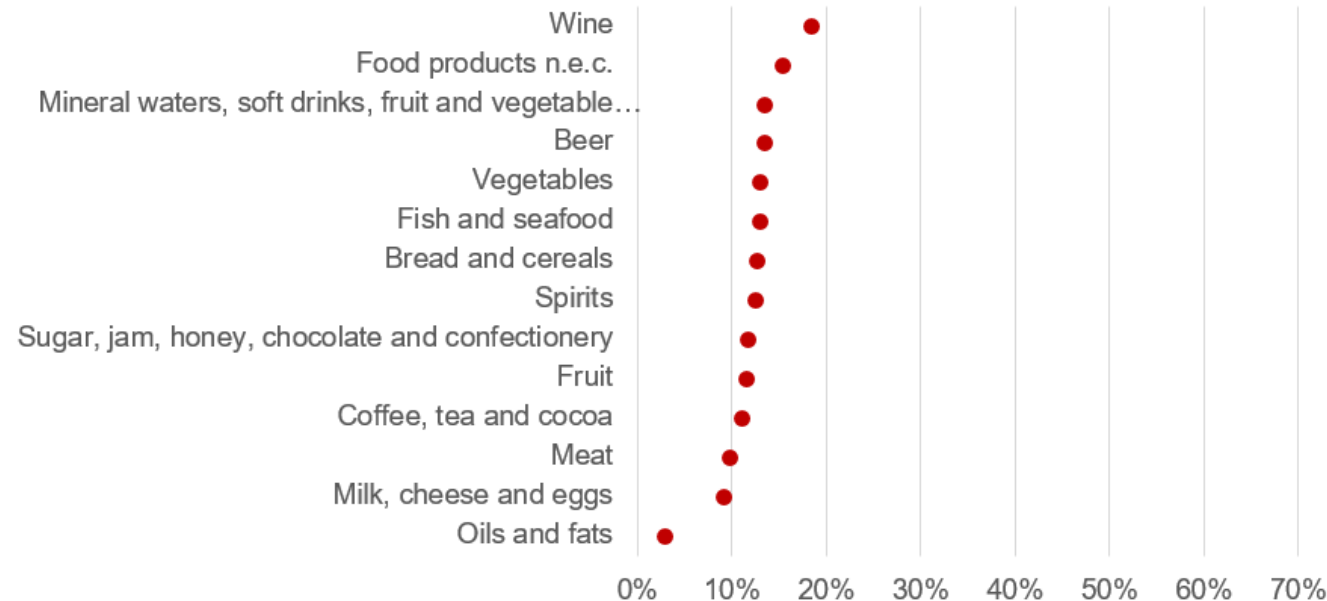
Microdata – Step 2 [1]



- Use Eurostat's **correspondence tables** to link a firm's NACE activity to a specific product (CPA classification) and HICP group (based on COICOP)

Distribution of labour cost shares as of 2021

Food products



Energy products

(excluding products with regulated prices)

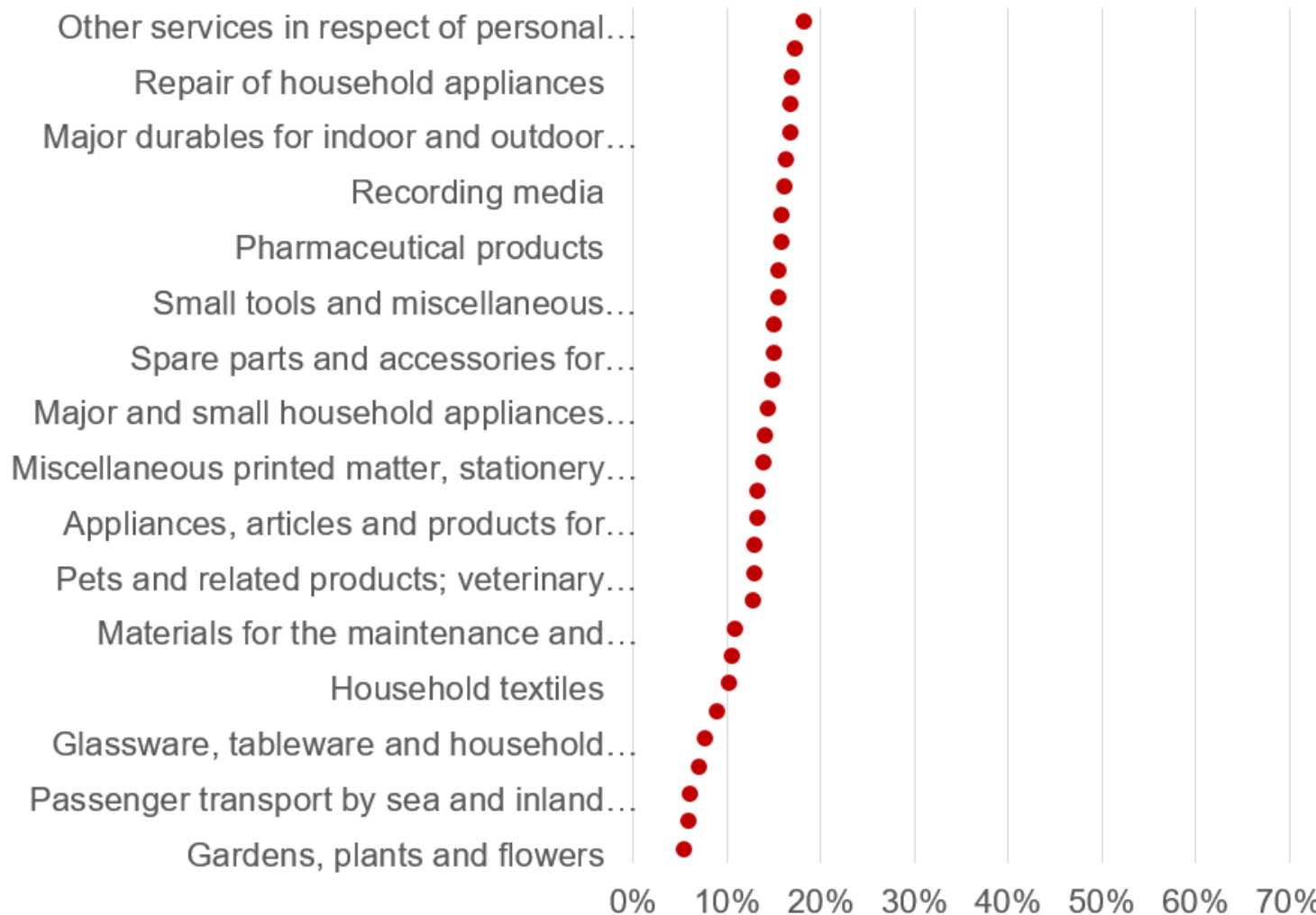
Fuels and lubricants for personal transport equipment

0% 10% 20% 30% 40% 50% 60% 70%

Orbis database, own calculations

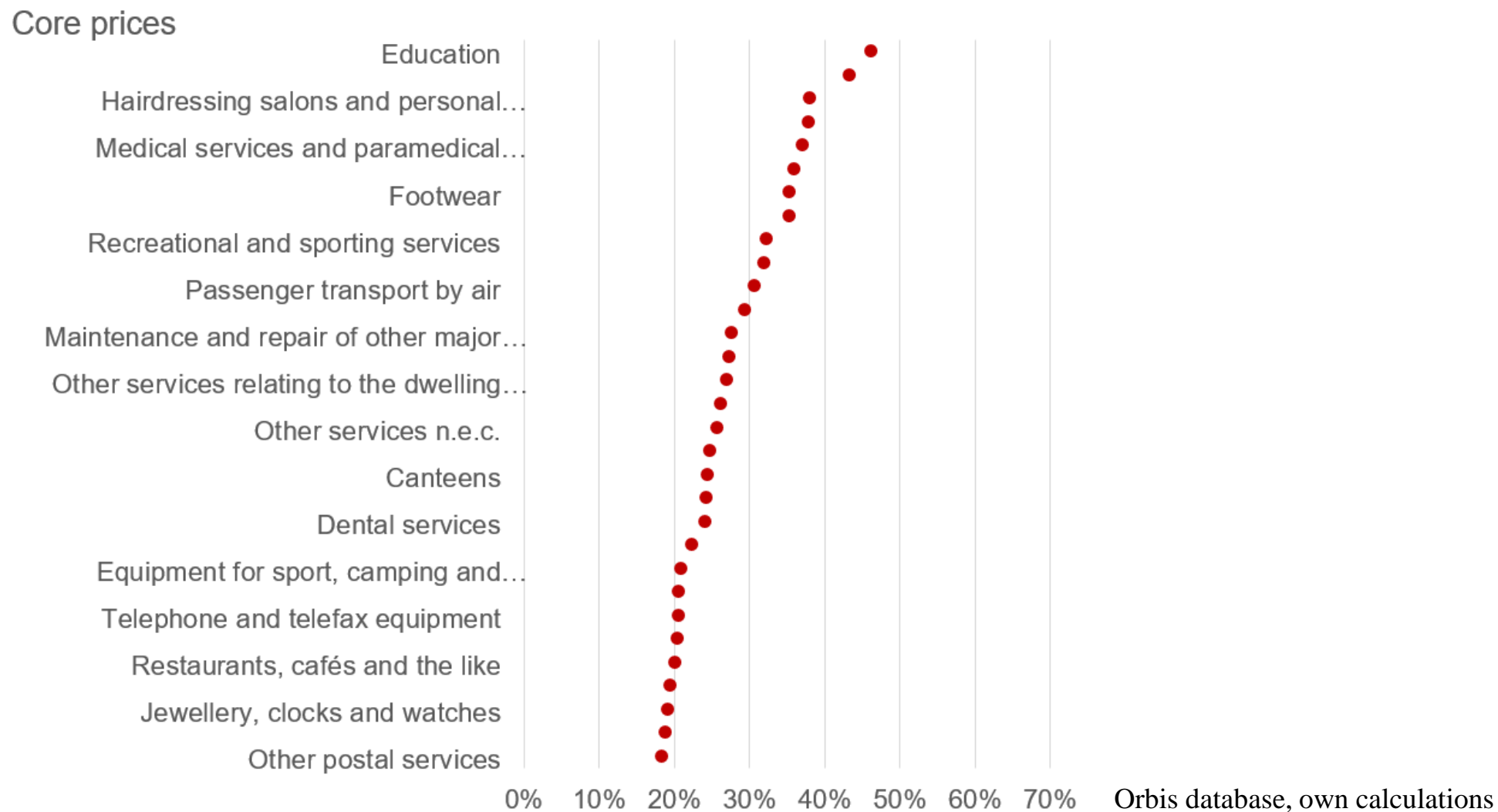
Distribution of labour cost shares as of 2021

Core prices (continue . . .)



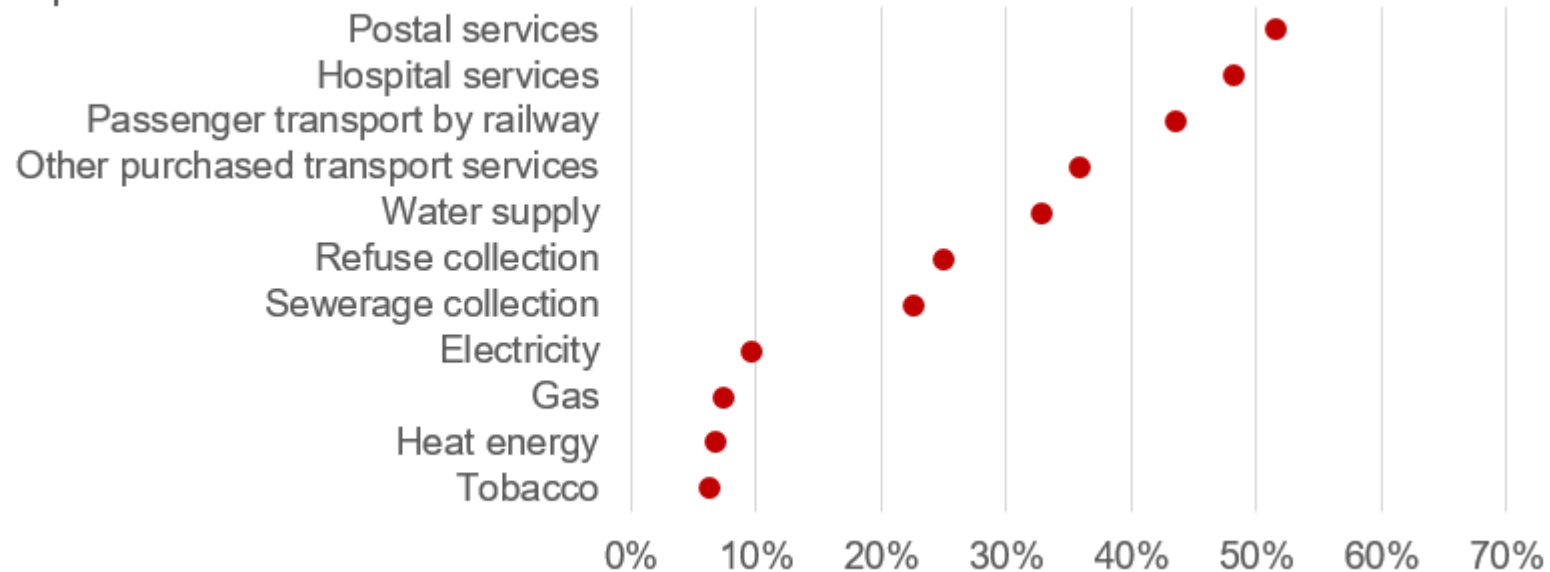
Orbis database, own calculations

Distribution of labour cost shares as of 2021



Distribution of labour cost shares as of 2021

Administered prices



- Derive a **single wage content measure** for domestically produced consumer goods and services

Wage content	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
HICP	14.1%	14.2%	14.4%	14.9%	15.7%	15.7%	16.0%	16.6%	17.8%	16.2%
Food	9.3%	8.8%	9.2%	9.3%	9.6%	9.7%	10.2%	11.0%	11.5%	11.9%
Energy (excl. products with administered prices)	0.9%	1.0%	1.2%	1.5%	1.5%	1.2%	1.1%	1.1%	1.8%	1.8%
Core prices	17.3%	17.6%	17.9%	18.3%	18.7%	19.1%	19.9%	20.5%	22.1%	20.0%
Administered prices	19.1%	19.6%	19.9%	19.3%	19.5%	19.0%	18.2%	17.9%	19.0%	15.1%

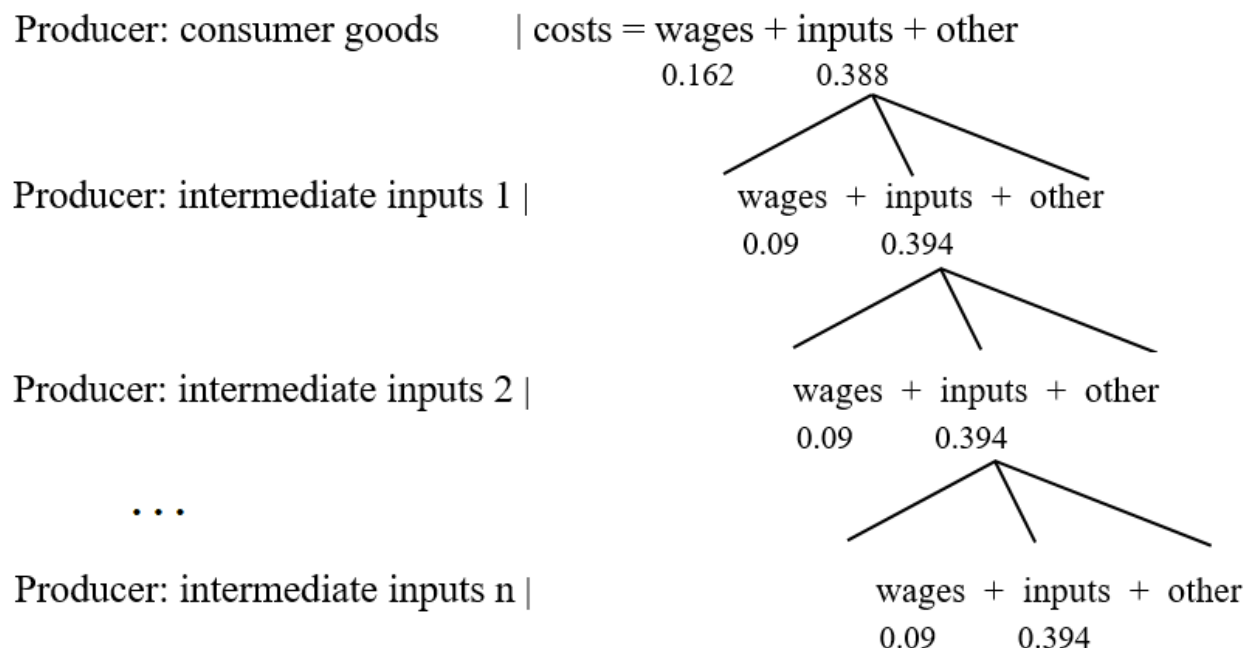
Source: Orbis database, own calculations

- The **labour cost pass-through** is 0.162
 - reflects only the direct labour cost shares of producers of consumer goods and services
 - it does not account for the labour costs of retail and wholesale firms or wages incorporated in intermediate inputs

Microdata – Step 4 [1]



- Calculate wage content of intermediate products
- Employ Eurostat's definition of intermediate producers
- Use Orbis data on the cost structure of intermediate producers
- Consider an infinite number of vertically integrated producers for intermediate inputs



Total labour cost share of domestic producers

$$= \underbrace{0.162}_{\text{direct labour costs}} + \underbrace{0.388}_{\text{share of inputs}} * \underbrace{0.118}_{\text{wage expenses embodied in inputs}} = 0.208$$

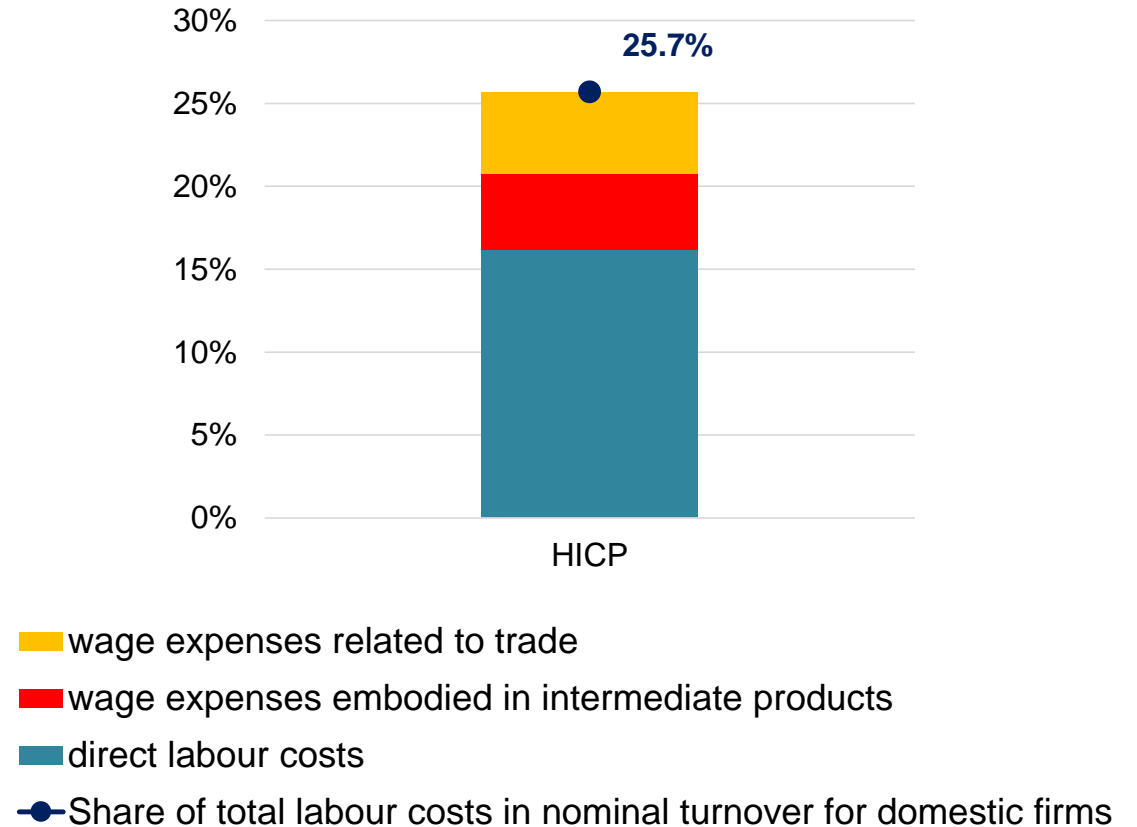
- Account for labour costs associated with trade
- Calculate the share of labour costs of firms in sector G ‘Trade and repair of motor vehicles’

Share of wage expenditure in nominal turnover for firms in trade	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Trade	3.9%	4.1%	4.2%	4.4%	4.7%	4.8%	5.0%	5.1%	5.3%	4.9%
Trade and repair of motor vehicles	6.0%	5.7%	5.7%	5.8%	6.4%	6.3%	6.0%	6.1%	6.5%	6.3%
Wholesale trade (except of motor	2.9%	3.1%	3.2%	3.3%	3.6%	3.7%	3.8%	3.9%	4.1%	3.8%
Retail trade (except of motor vehicles)	6.1%	6.4%	6.5%	6.9%	7.4%	7.4%	7.7%	7.8%	7.8%	7.6%

Source: Orbis database, own calculations

- Labour cost share of **domestically produced** goods and services = 0.257
- Approximately 22.8% of HICP-included products are directly imported, reducing the wage content of **domestically consumed** goods and services to 0.21
- Micro data suggests a 1% broad-based wage hike, fully passed on by firms, would result in a 0.21% increase in the HICP

Total labour cost shares of domestic producers of consumer goods at all downstream and upstream stages of production



Source: Orbis database, own calculations

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Input-output analysis [1]



- Input-output tables from OECD, 2021 ed., 45 branches
- Data refers to **2018** (in millions of USD)

INPUT-OUTPUT TABLE (Millions of USD)

		INPUT OF PRODUCTION ACTIVITIES						FINAL USES							Output
		Agri- culture	Industry	Construc- tion	Trade, hotel, transport	Business services	Other services	Private consump- tion (resident households)	Gov. consump- tion	Invest- ment	Changes in inven- tories	Direct purchases by non- residents (exports)	Exports (cross border)	Direct purchases abroad by residents (imports)	
		1	2	3	4	5	6	7	8	9	10	12	13	14	15
Agriculture	1	587	647	15	80	24	11	985	21	61	20	60	2 940	0	5 450
Industry	2	294	8 824	1 631	2 501	887	697	7 027	171	901	1 009	640	21 106	0	45 688
Construction	3	67	646	1 186	548	863	362	309	43	5 475	4	68	243	0	9 814
Trade,hotel,transport	4	585	5 101	953	3 140	864	445	6 326	371	871	- 107	2 447	7 603	0	28 600
Business services	5	427	1 700	1 275	3 524	5 727	1 272	9 085	598	857	115	645	2 843	0	28 065
Other services	6	20	149	74	537	394	1 687	2 780	8 672	59	5	447	396	0	15 219
Domestic products	7	1 978	17 067	5 135	10 329	8 759	4 474	26 512	9 876	8 225	1 045	4 306	35 131	0	132 836
Imported products	8	1 043	15 169	2 068	3 925	1 684	908	9 091	548	3 611	267	0	0	1 319	39 633
Taxes less subsidies on products	9	235	1 259	254	1 285	407	425	3 809	325	492	0	1 513	0	49	10 051
Intermediate consumption/ Final use at purchasers' prices	10	3 256	33 495	7 457	15 539	10 850	5 806	39 412	10 749	12 328	1 312	5 819	35 131	1 368	182 520
Compensation of employees	11	753	6 375	1 223	6 472	6 229	7 105								
Other taxes less subsidies on production	12														
Gross operating surplus and mixed income	13	1 441	5 819	1 135	6 589	10 986	2 307								
Value added at basic prices	14	2 194	12 194	2 358	13 061	17 215	9 413								
Output at basic prices	15	5 450	45 688	9 814	28 600	28 065	15 219								

Source: OECD

- Assume all sectors are producing with **Leontief production** functions
- Assume there are conditions for **perfect competition** (many suppliers, many purchasers, free access to markets, full information)
- In the production process all inputs (intermediates, labour, and capital) are used in fixed proportions in relation to output -> captured by “**technical**” **coefficients**
- The costs of production are reported for each sector in the corresponding column of the IO table:

$$(1) x_{11}p_1 + x_{21}p_2 + \dots + x_{n1}p_n + m_1p^M + z_1^Lw + z_1^Kq = x_1p_1$$

$$(2) x_{12}p_1 + x_{22}p_2 + \dots + x_{n2}p_n + m_2p^M + z_2^Lw + z_2^Kq = x_2p_2$$

...

$$(3) x_{1n}p_1 + x_{2n}p_2 + \dots + x_{nn}p_n + m_np^M + z_n^Lw + z_n^Kq = x_np_n$$

x_{ij} = domestic intermediate input of commodity i in sector j (quantity)

x_j = output of sector j (quantity)

p_i = price of commodity (product) i

m_j = imported intermediate inputs in sector j (quantity)

p^m = price of imported intermediate input

z_j^L = labour input to sector j (quantity)

w = factor price for primary input labour (wage rate)

z_j^K = capital input to sector j (quantity)

q = factor price for primary input capital

Input-output analysis [3]



In **matrix notation** the price model is defined as:

$$A'p + Mb + Wv^L + Qv^K = p$$

$$p - A'p = Mb + Wv^L + Qv^K$$

$$(I - A')p = Mb + Wv^L + Qv^K$$

The **solution** of the linear equation system is therefore:

$$p = (I - A')^{-1}(Mb + Wv^L + Qv^K)$$

A' = transposed matrix of input coefficients for domestic intermediates (technology matrix)

I = unit matrix

$(I - A')$ = transposed Leontief matrix

$(I - A')^{-1}$ = transposed Leontief inverse

b = column vector of input coefficients for imported intermediates

M = diagonal matrix with prices for imported intermediates

v^L = column vector of input coefficients for labour input

W = diagonal matrix with unit factor price for capital input

v^K = column vector of input coefficients for capital input

Q = diagonal matrix with unit factor price for capital input

p = vector of prices (price indices) for commodities/products

Input-output analysis [4]



The impact of a 10% wage increase in all sectors on the consumer price index (HICP)

Sector	Code		Initial price index	New price index	Initial HFCE-domestic concept (mln USD)	New HFCE-domestic concept (mln USD)	Growth rate (in %)
Agriculture	CPA_A	1	1.0000	1.0247	1045	1071	2.5
Industry	CPA_B-E	2	1.0000	1.0269	7667	7874	2.7
Construction	CPA_F	3	1.0000	1.0288	377	388	2.9
Trade,hotel,transport	CPA_G-I	4	1.0000	1.0375	8773	9102	3.8
Business services	CPA_J-N	5	1.0000	1.0224	9730	9947	2.2
Other services	CPA_O-T	6	1.0000	1.0510	3227	3391	5.1
Domestic products		7			30818	31773	3.1
Imported final goods		8			9091	9091	
Taxes less subsidies on products		9			5322	5449	
Household final consumption expenditures - domestic concept (HFCE)		10			45231	46313	2.4

Source: OECD, own calculations

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Phillips curve model [1]



- Construct a reduced-form **Phillips curve** model with ...
- **time-varying** coefficients and error variance

$$\pi_t = \mu_t + \rho_t \pi_{t-1} + \theta_t \pi_t^e + \beta_{1t} \Delta ulc_t + \beta_{2t} \pi_t^{imp} + \beta_{3t} x_t + e^{\frac{h_t}{2}} \varepsilon_t$$

$$\mu_t = \mu_{t-1} + \sigma_\mu v_t^\mu$$

$$\rho_t = \rho_{t-1} + \sigma_\rho v_t^\rho$$

$$\beta_{it} = \beta_{it-1} + \sigma_{\beta_i} v_t^{\beta_i} \text{ (for } i=1, 2, 3)$$

$$h_t = h_{t-1} + \sigma_h \eta_t$$

π_t - quarterly percent change of consumer prices (HICP)

π_t^e - survey-based price expectations of firms

Δulc_t - quarterly percent change of nominal unit labour costs

π_t^{imp} - quarterly percent change of import prices

x_t - a measure of slack (unemployment rate)

Estimation:

- Gibbs sampler in the spirit of Primiceri (2005)
- Inverted-Gamma priors

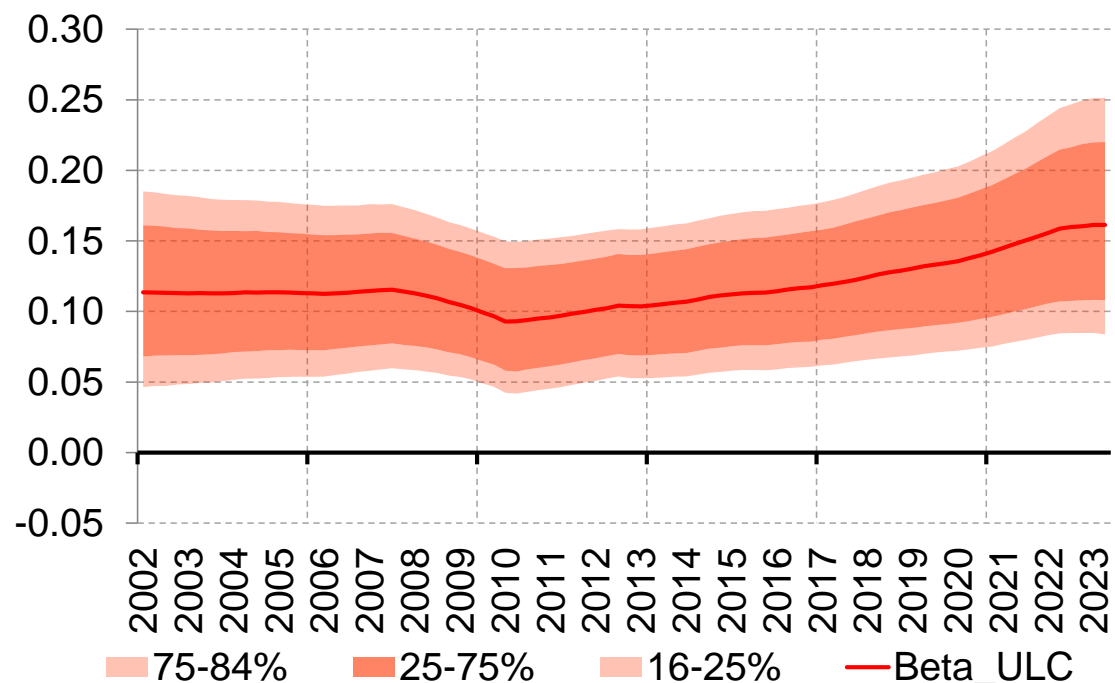
$$\sigma_\mu^2, \sigma_\rho^2, \sigma_{\beta_i}^2 \sim IG(6, 0.0005)$$

$$\sigma_h^2 \sim IG(6, 1.5)$$

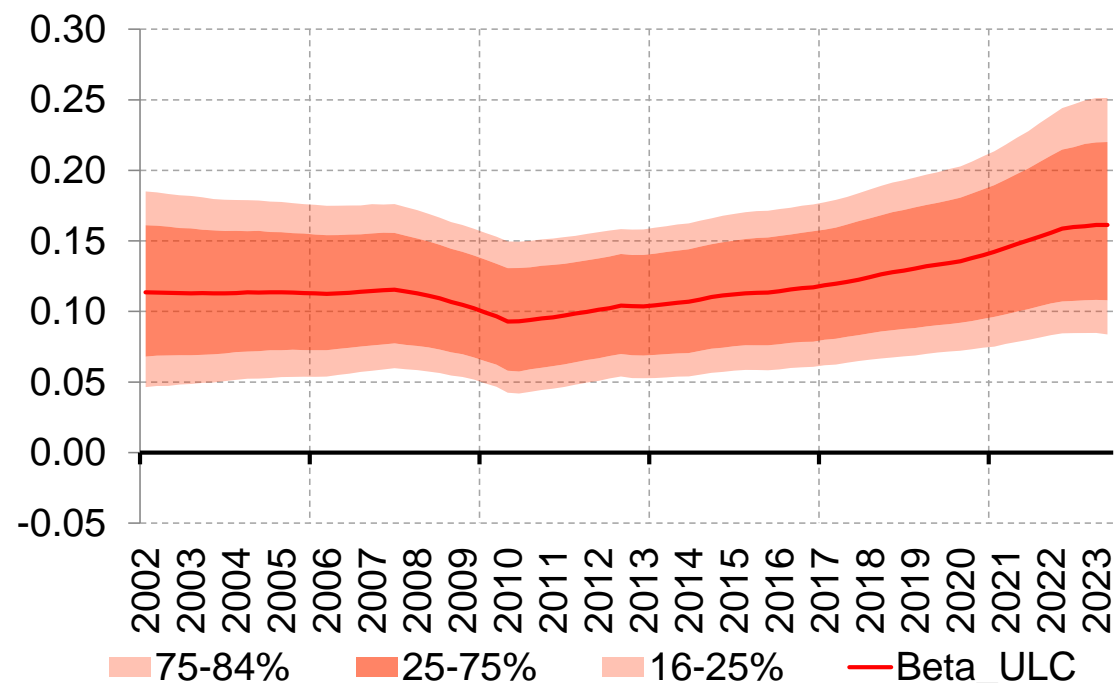
Phillips curve model [2]



Estimates of the Phillips curve coefficient on ULC, β_1



Estimates of the Phillips curve coefficient on lagged inflation, ρ_t

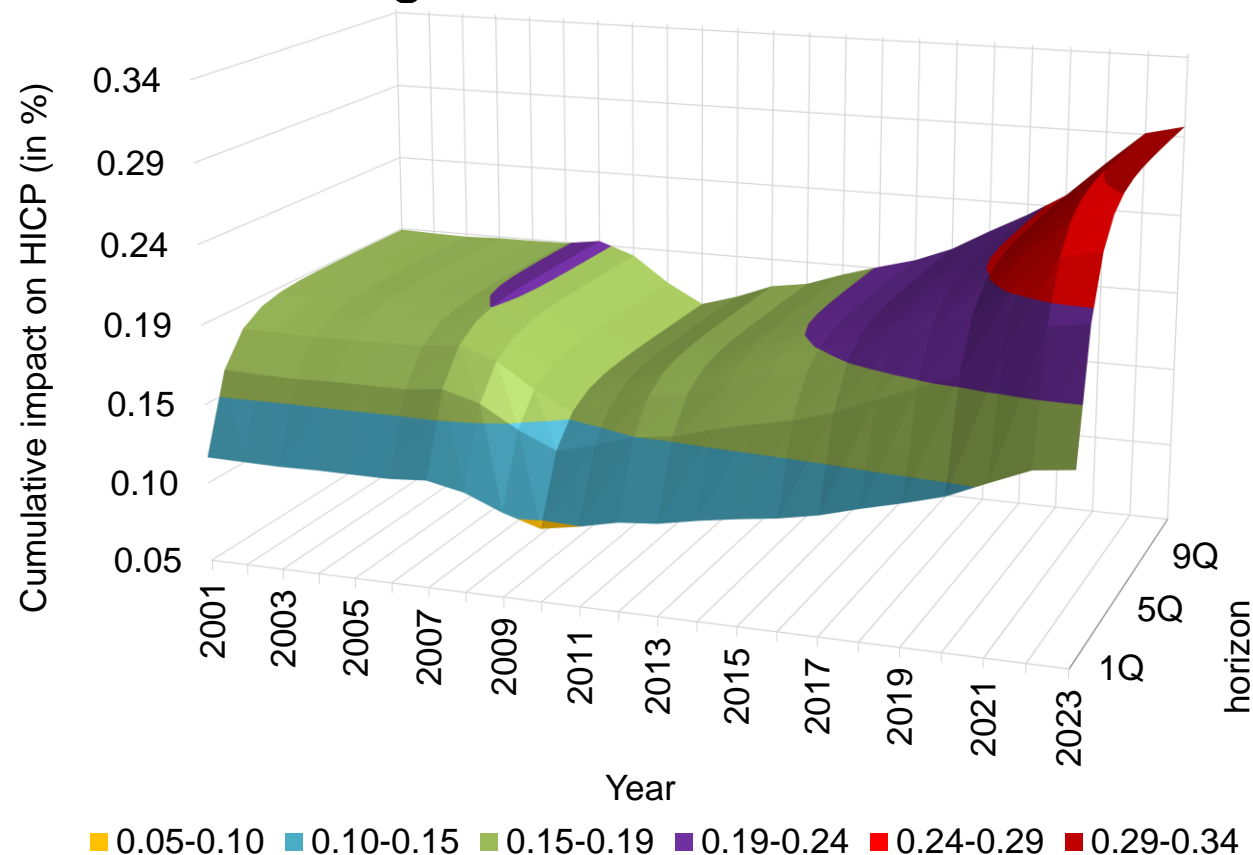


Source: NSI, Eurostat, own calculations

Phillips curve model [3]

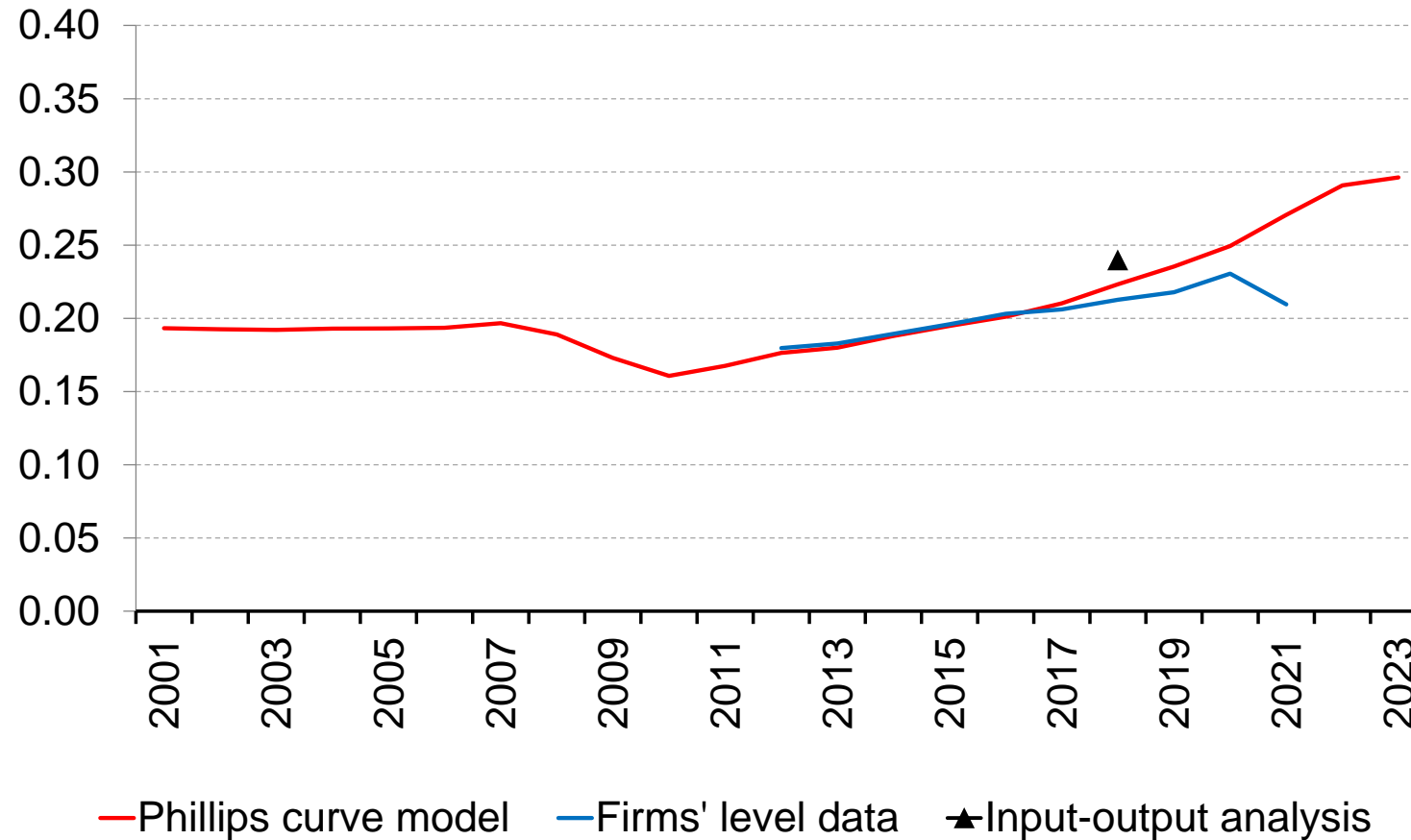


- The cumulative increase in consumer prices after n periods following a 1% increase in ULC can be estimated as $\beta_{1t} * (1 + \rho_t + \rho_t^2 + \dots + \rho_t^{n-1})$
- The majority of price adjustments following an increase in labor costs occur within 1 year
- On average, the pass-through is 0.21 over the period 2021-H1 2023
- Evidence of state dependent pass-through



Source: NSI, Eurostat, own calculations

Compare labour cost pass-through based on the 3 approaches



Source: NSI, Eurostat, own calculations

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- Compensation per employee increased on average by 10% per year during 2017-2022
- The study reveals that historically, on average, a 1% increase in nominal unit labor costs resulted in a 0.21-0.24% higher price level
- Since the COVID19 pandemic, there is evidence of a strengthening link between wages and prices, with the pass-through reaching 0.30 in H1 2023
- Future macroeconomic policies should prioritize the alignment of wage growth with that of productivity and the moderation of private consumption growth, which would curb any further increase in the labor cost pass-through.

Thank you very much for your attention!

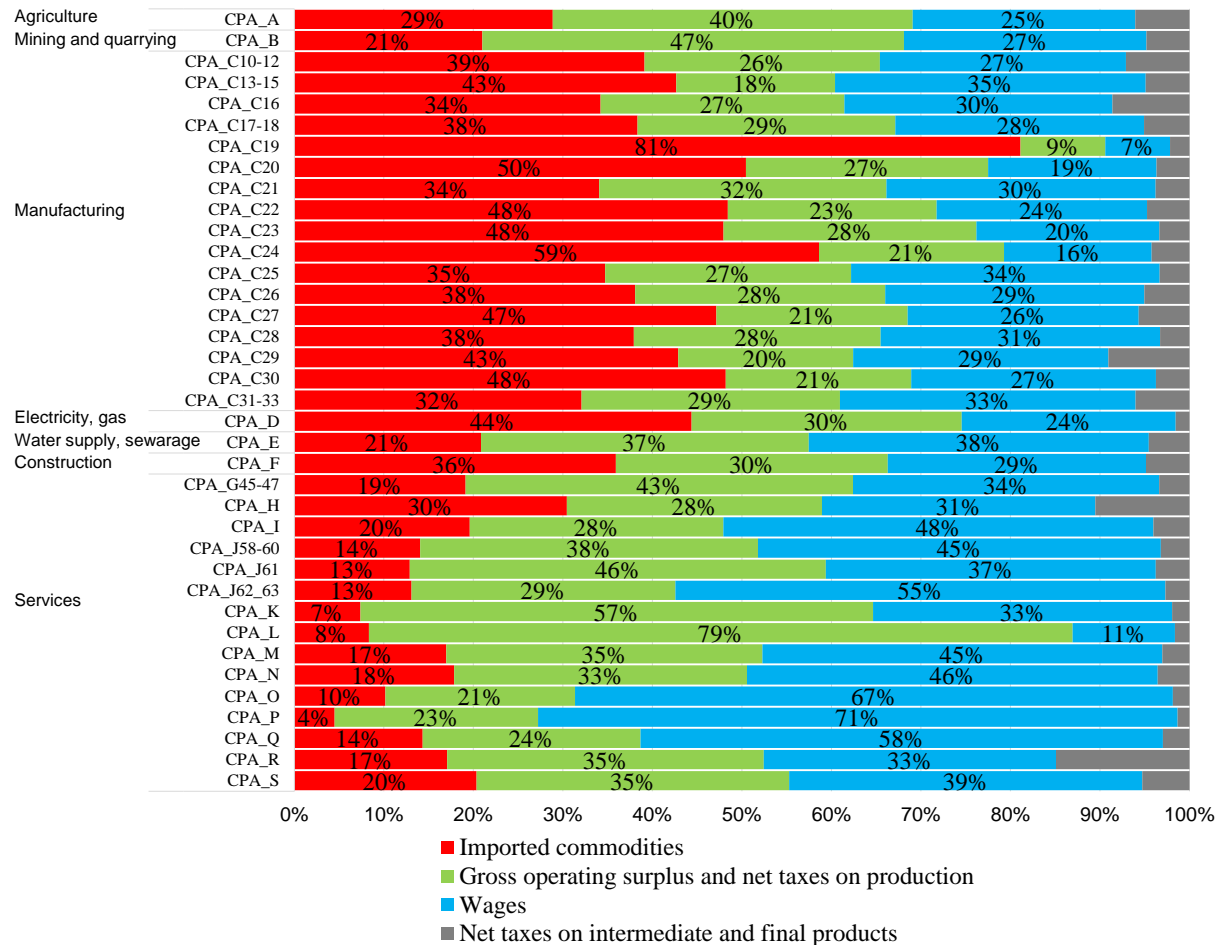
BACKGROUND SLIDES

Cost structure of firms based on input-output analysis

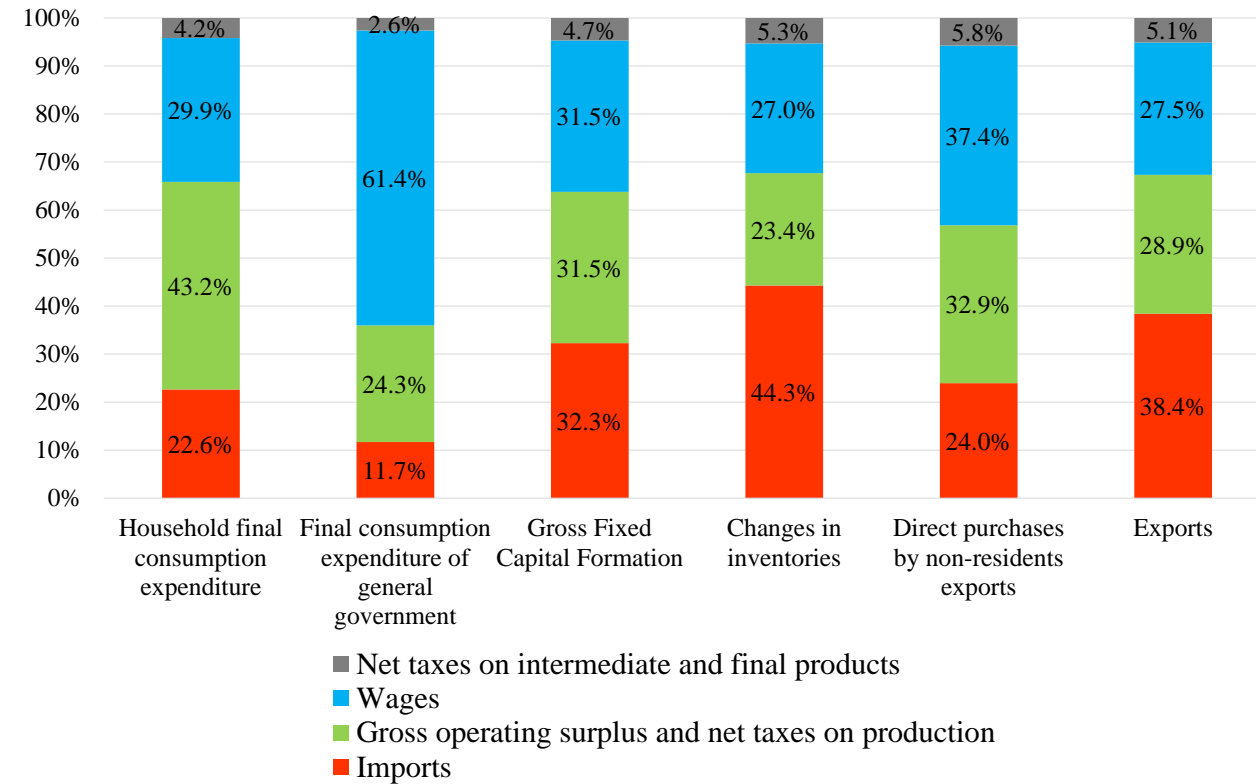


Structure of productions costs (direct and indirect requirements) of final demand ...

A) by product (in %)



B) by category (in %)



Source: OECD