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Explaining wage developments in Croatia – the role of firm composition effect

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Introduction - motivation

- The existing literature often overlooks the impact of worker allocation on aggregate wage developments.
- During recessions, the destruction of below-average paying jobs, which are then excluded from average wage calculations, leads to a lower decrease in the average wage than would otherwise occur.
- Conversely, during economic upturns, the re-entry of these workers into the labour market exerts a downward pressure on aggregate wages.
- As a result, changes in aggregate wages may differ from changes in the actual labor costs.

Introduction - motivation

- Shifts in worker composition from low paying to high paying firms can lead to changes in aggregate wages, even if wages within individual firms remain unchanged.
- As a result, aggregate wages can increase not only because individual firms raise their wages, but also because workers reallocate to more productive firms.
- For example, in a simple economy with only two firms, each with the same number of employees, one firm might pay twice as much as the other.
- In this scenario, aggregate wages can increase through:
    - wage increases at one or both firms
    - reallocation of workers from the lower-paying firm to the higher-paying firm.

Introduction – OP decomposition

- In estimating the firms' composition effect on aggregate wage, we apply the Olley and Pakes (hence OP) decomposition.
- The OP decomposition was introduced in the realm of aggregate productivity (Olley and Pakes, 1996) and is standard method of measuring allocative efficiency.
- Adamopoulou et al. (2019) utilized this method on Italian firms and interpreted changes in aggregate wages due to firm composition within the framework of allocative efficiency.
- We extend our analysis by applying the same decomposition method to productivity, using gross value added per worker as a proxy.

Methodology - OP decomposition

- We can decompose the average wage $\bar{w}_t$ as:
- $\bar{w}_t = \tilde{\omega}_{jt} + \sum_{j \epsilon J}(w_{jt} - \tilde{\omega}_{jt})(s_{jt} - \frac{1}{|J|})$

  where:

  - $\tilde{\omega}_{jt} = \frac{1}{|J|}\sum_{j \epsilon J} \omega_{jt}$ is unweighted average of the wages across firms,
  - $\sum_{j \epsilon J}(w_{jt} - \tilde{\omega}_{jt})(s_{jt} - \frac{1}{|J|})$ is the covariance between firm wage and firm size (OP term),
  - J being a set of active firms in an economy,
  - $s_{jt} \equiv \frac{e_{jt}}{E_T} = \frac{e_{jt}}{|J| e_t}$ is the employment share of firm j at time t, with E_t aggregate employment and e_t average firm size.

Methodology - Allocation efficiency

- The ratio between average wage $\bar{w}_t$ and unweighted wage $\tilde{\omega}_t$ can be defined as:
  - $\varepsilon = \bar{w}_t \,/\, \tilde{\omega}_t$
- When ε=1, aggregate wages are equal to unweighted wages. The covariance between the firm wage and its size is equal to zero. This would be the case in the scenario with purely random distribution of workers among firms (or when all firms are of equal size).
- When ε>1, aggregate wages are greater than unweighted wages. This suggests a shift from random distribution, so that more workers are allocated to higher paying firms.
- We can interpret ε as allocation premium, which reflects how much higher the aggregate wage is compared to the scenario with random worker allocation.

Methodology - Counterfactual wage

- To estimate the effect of changes in allocation premium on aggregate wage, we construct 'counterfactual wage' $\bar{w}^{c}_{b+s}$, which represents what the aggregate wage would be in year *b*+*s*, if the allocation premium stayed as in the base year *b*:

- $$\bar{w}^{c}_{b+s} = \frac{\tilde{\omega}_{b+s}}{1-OP_b/\bar{w}_b} = \frac{\tilde{\omega}_{b+s}}{\frac{1}{\varepsilon_b}} = \tilde{\omega}_{b+s}\varepsilon_b$$

  where:

  - $\bar{w}^{c}_{b+s}$ is average wage in year b+s
  - $\tilde{\omega}_{b+s}$ is unweighted average wage in year b+s
  - $1 - OP_b/\bar{w}_b$ is inverse of allocation premium ε_b in base year b
  - ε_b is allocation premium in base year b

Methodology – Dynamic OP decomposition

- The dynamic OP decomposition, proposed by Melitz and Polanec (2015), extends the static version by separating the impact of surviving firms on aggregate wage changes from the effects of firms entering and exiting the market.
- The decomposition accounts for differences among firms entering and exiting the market, compared to the surviving firms:
- $\triangle \bar{w}_t = \triangle \tilde{\omega}_t^S + \triangle OP_t^S + \sum_{j \epsilon E} s_{jt}(\bar{w}_t^E - \bar{w}_t^S) - \sum_{j \epsilon X} s_{jt-1}(\bar{w}_{t-1}^X - \bar{w}_{t-1}^S)$

  where:

  - subscript S refers to surviving firms, E for entering and X for exiting firms.

Data overview

- Fina database, period 2002-2023
- We calculated GVA as a sum of total cost of personnel, amortization, financial costs and profit or loss before taxes.
- First, companies with zero employees were removed from the sample.
- Next, we excluded firms with a GVA per worker below the 0.5th percentile and those above the 99.5th percentile.

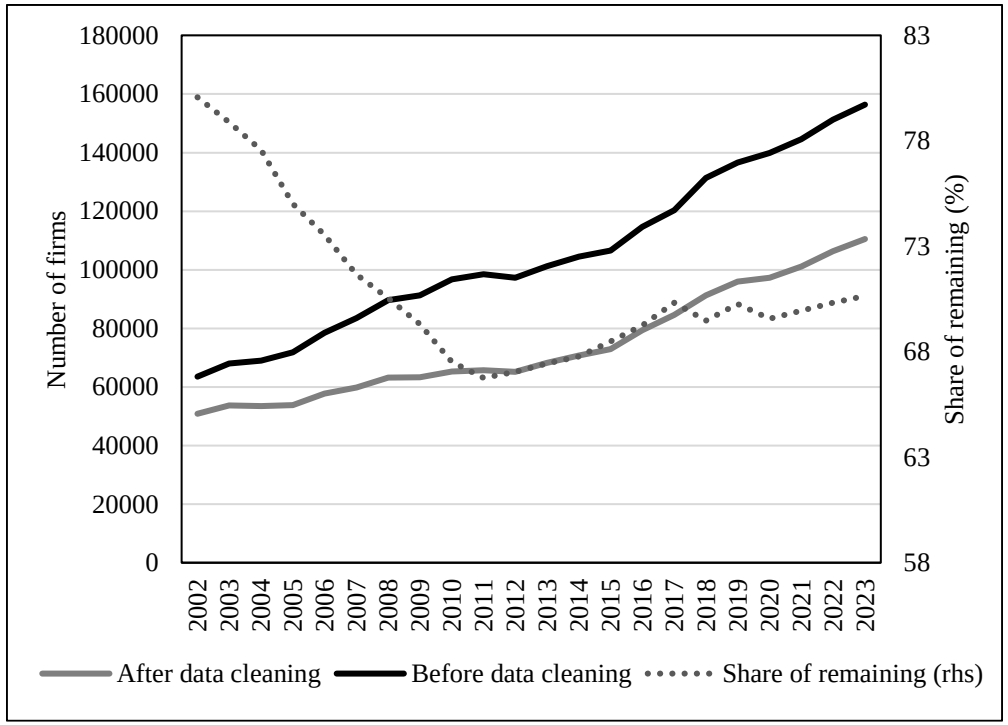
Fina database overview

Year	Number of firms	Total employees	Average firm size	Average gross monthly wage (€)	GVA per employee, annual (€)
2002	50.891	768.424	15	579	15.947
2007	59.866	914.647	15	773	20.474
2012	65.216	848.701	13	854	21.324
2017	84.621	931.200	11	924	23.435
2022	106.331	1.059.715	10	1155	29.864
2023	110.524	1.100.504	10	1302	33.549

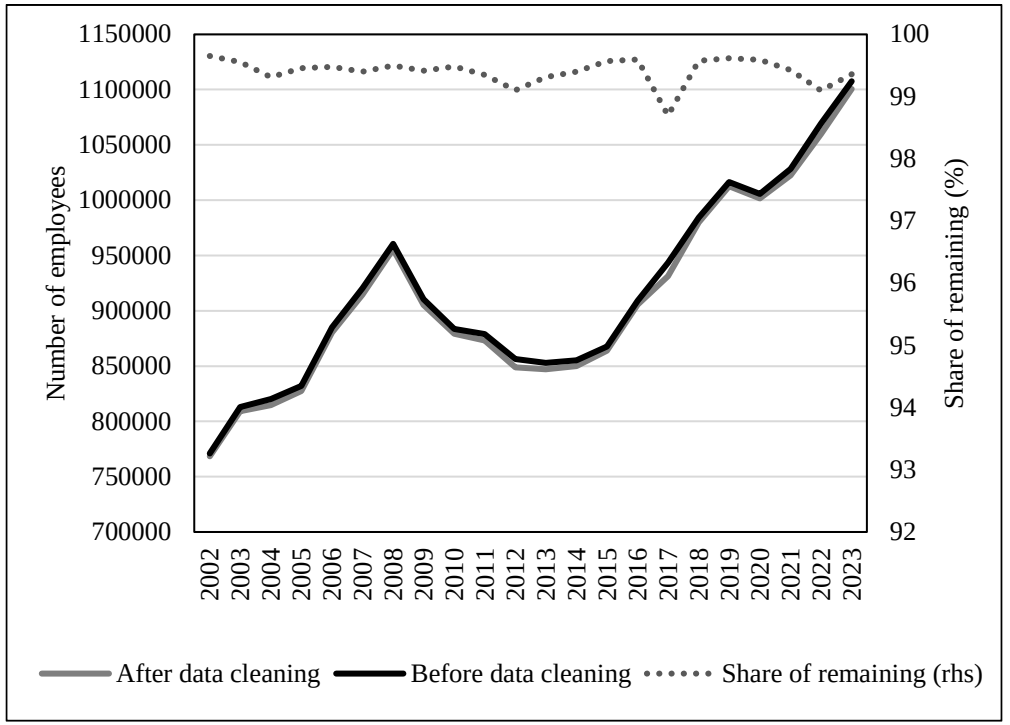
Source: Fina and authors' calculations

Cleaning the data removed about 30% of all firms, but only about 1% of total employees

Number of firms, before and after data cleaning

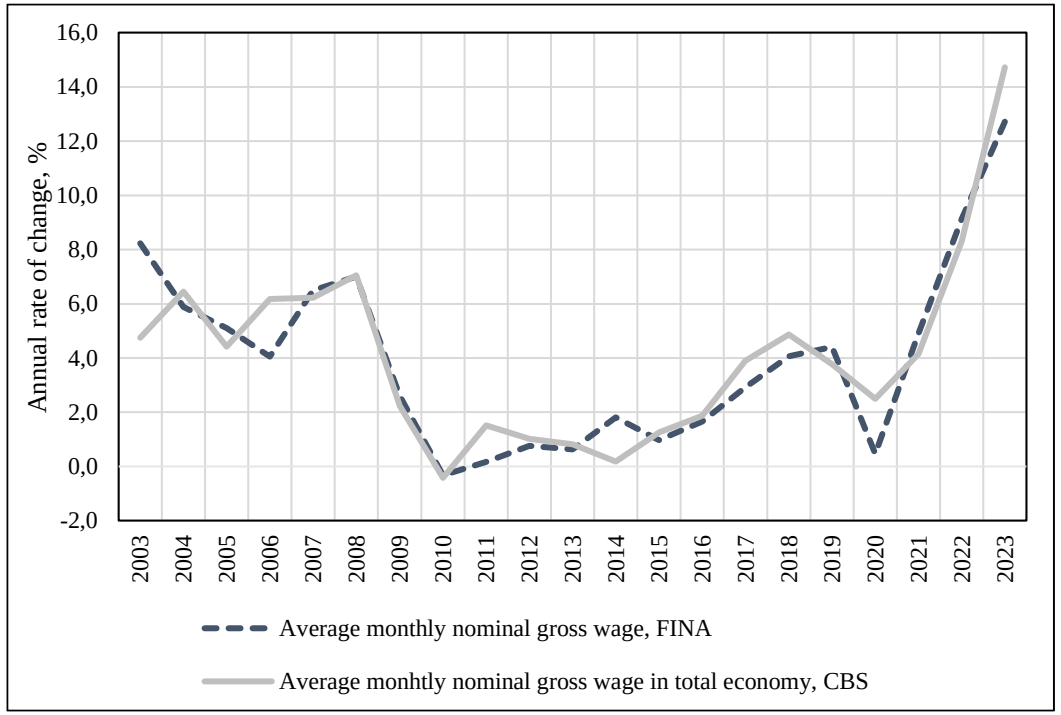


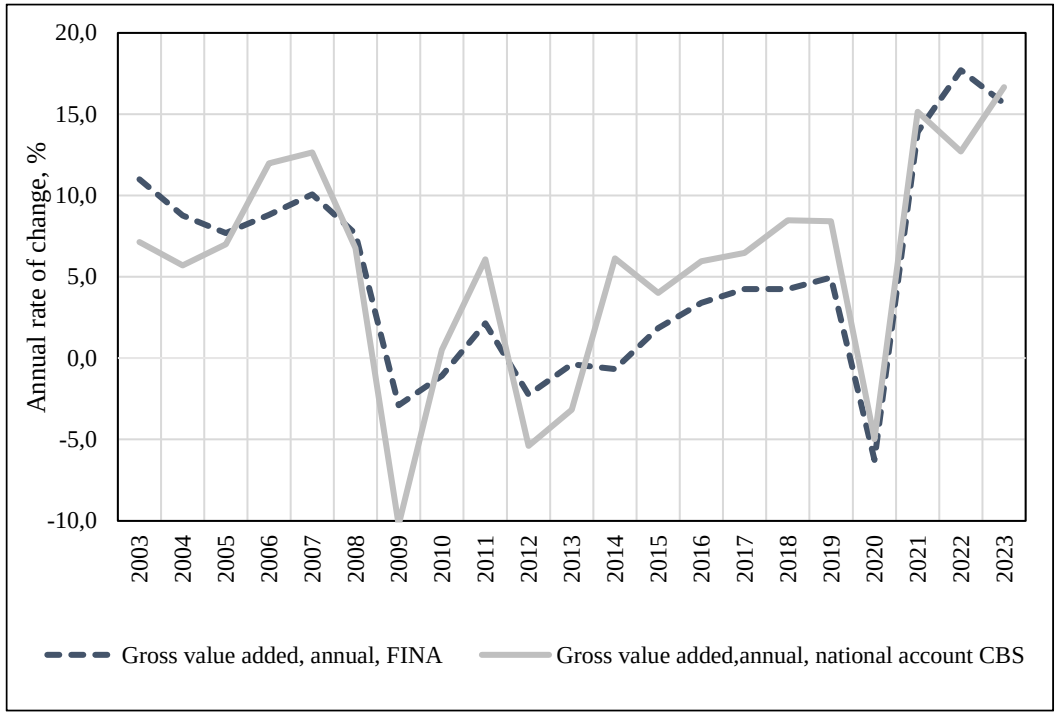
Number of employees, before and after data cleaning



Source: Fina and authors' calculations

Growth of annual wages and GVA in cleaned database closely tracks official CBS data

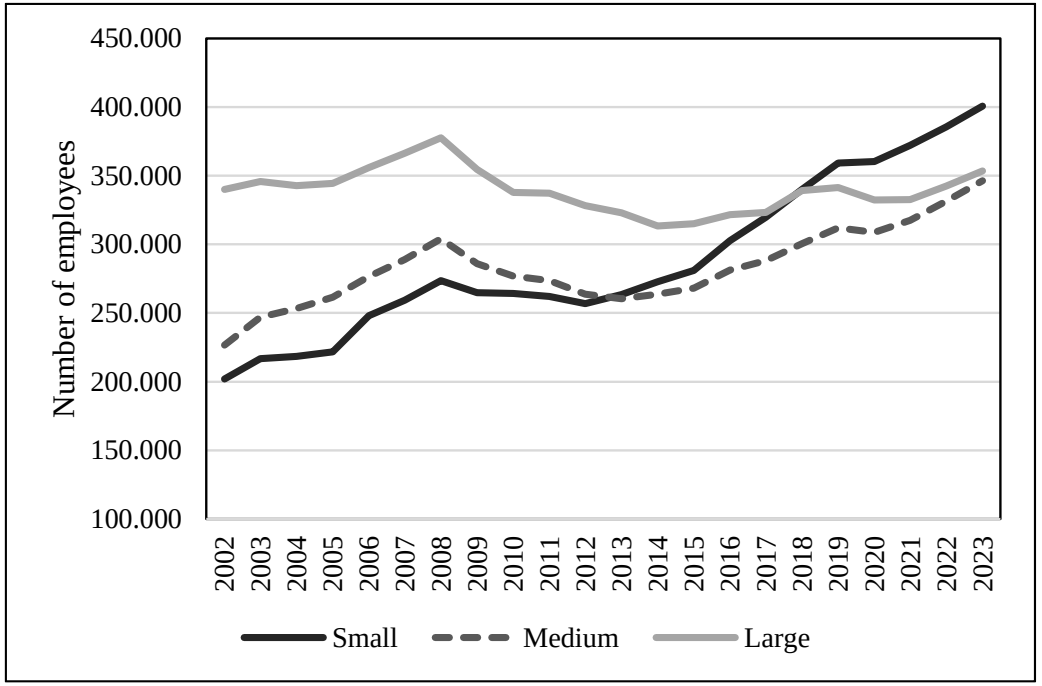




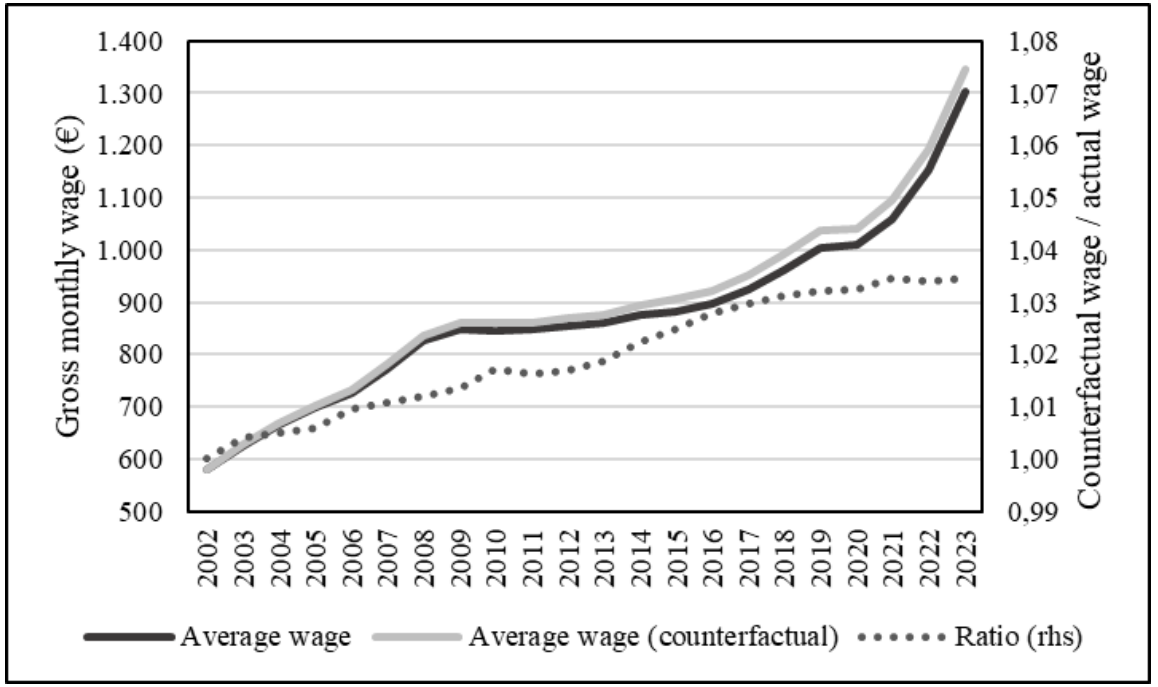
Source: Fina, CBS and authors' calculations

The increased share of small, lower paying firms had a negative effect (~3.4%) on aggregate wages...

Number of employees in small, medium and large firms



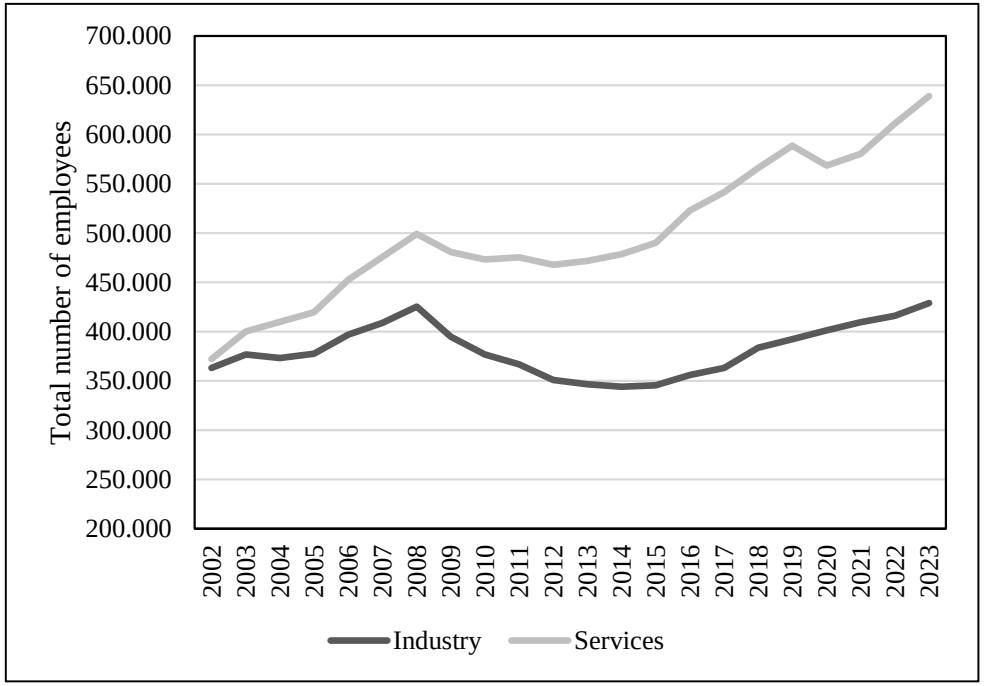
Effect of firm size composition shift on aggregate wages



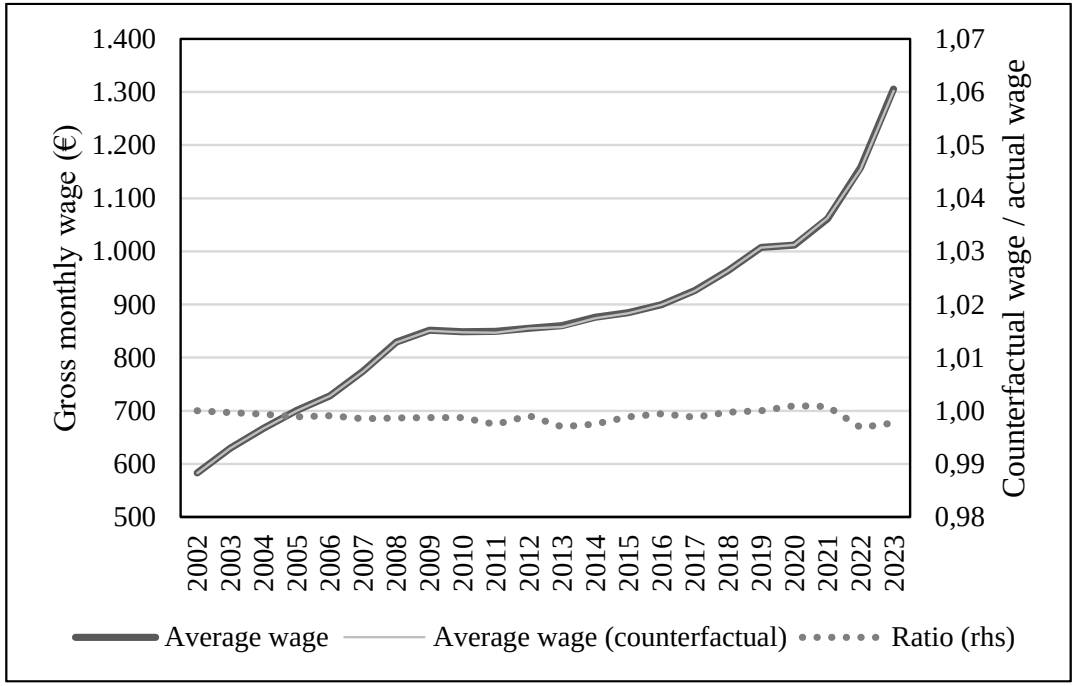
Note: Counterfactual wage is average wage with firm size weights fixed to 2002 as a base year
Source: Fina and authors' calculations

...while the shift from industry to services had a minimal effect on aggregate wages (<0.1%)

Number of employees in industry and services



Effect of sector composition shift on aggregate wages

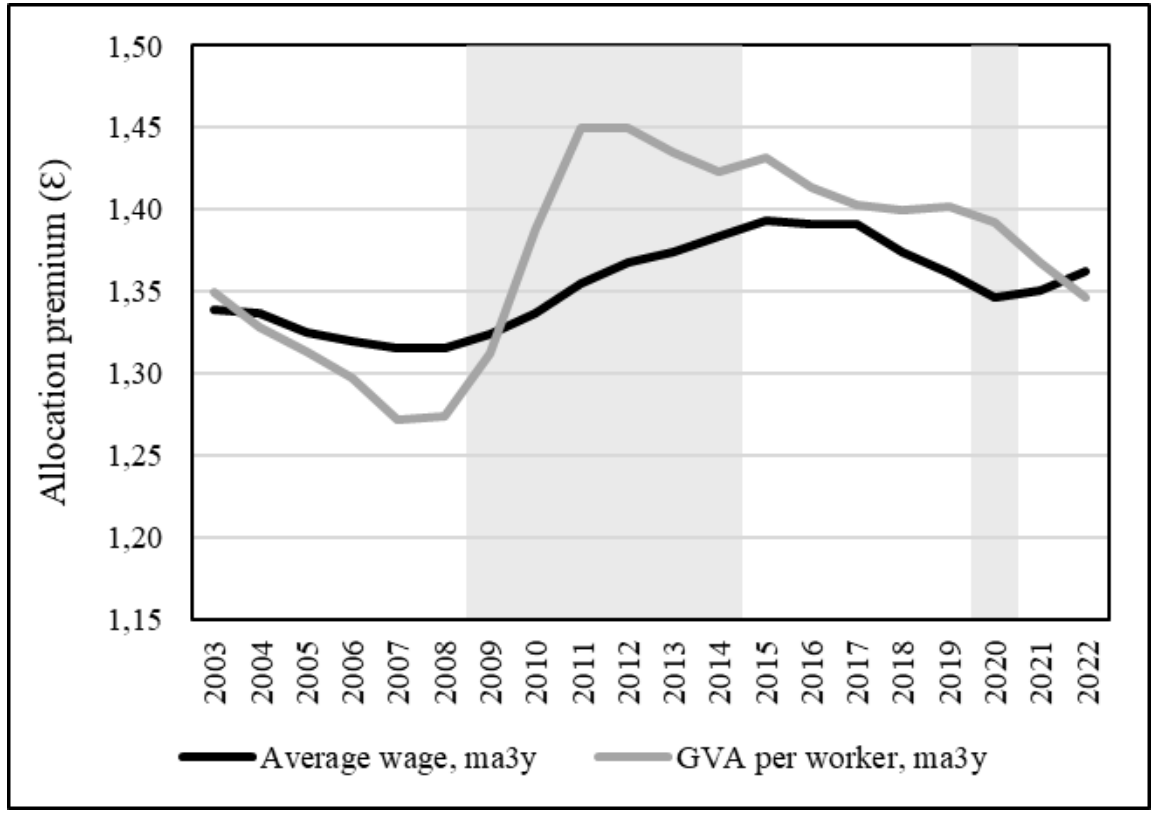


Note: Counterfactual wage is average wage with sector weights fixed to 2002 as a base year
Source: Fina and authors' calculations

Static OP decomposition - allocation premium is countercyclical

- Allocation premium increases in recessions, and decreases during periods of growth.
- Less paying and less productive firms were more likely to reduce workforce during recession
- In periods of growth, less paying and less productive firms increase their employment faster than more paying, more productive firms
- Effect of the reallocation is more pronounced for GVA per worker, than for wages.
- Post-pandemic, the wage allocation premium turned procyclical.

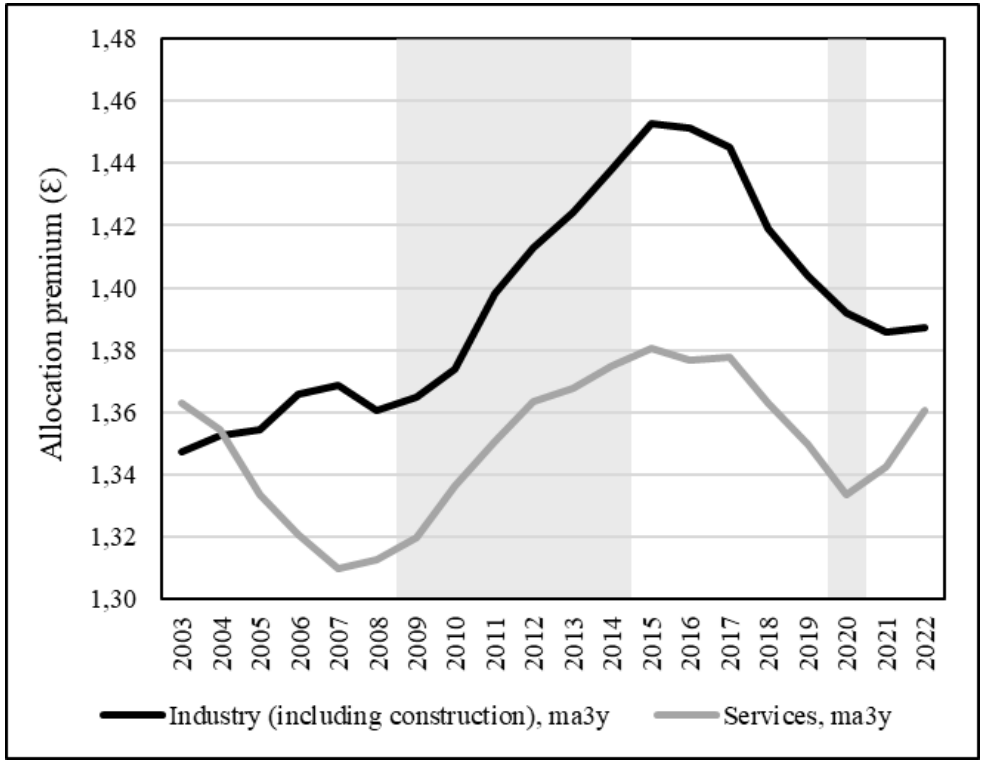
Allocation premium, wages and GVA, 2002-2023



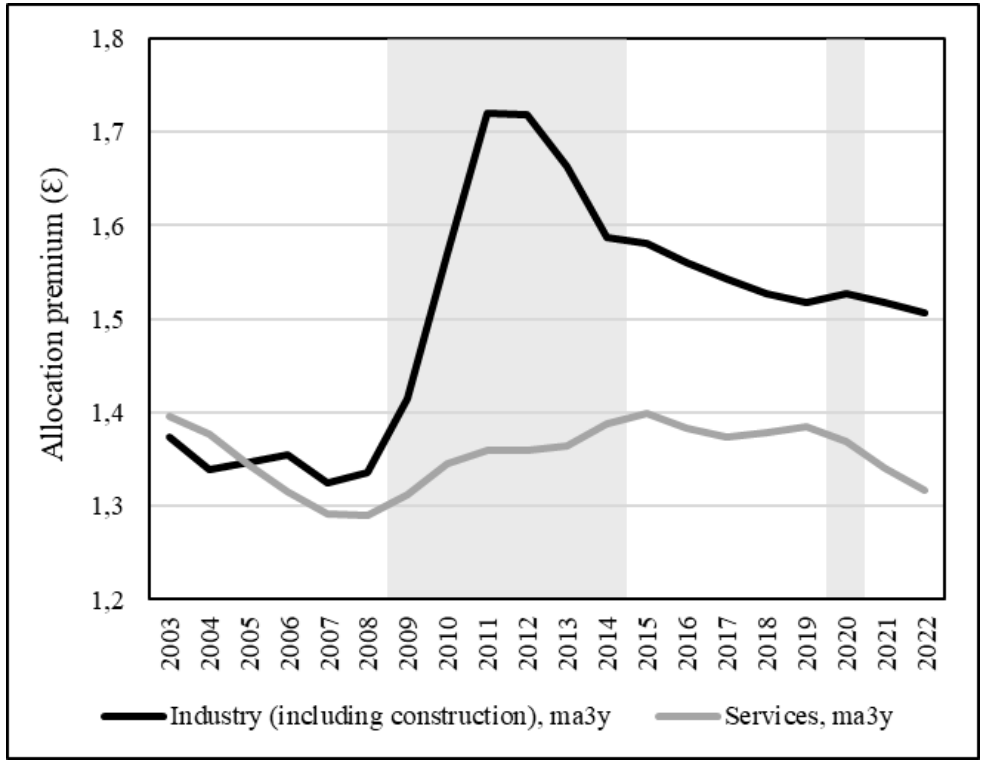
Notes: Shaded areas indicate period of negative real GDP growth in Croatia.
Source: Fina and authors' calculations

The effect of reallocation is more pronounced in industry than in services

Wage allocation premium by sector, 2002-2023



GVA allocation premium by sector, 2002-2023



Notes: Shaded areas indicate period of negative real GDP growth in Croatia.
Industry refers to NACE 2007 sections B-F (Industry including construction), while 'Services' include sections G-U.
Source: Fina and authors' calculations

The impact of allocation premium on wages from 2002 to 2023 is small, but larger in shorter periods

- From 2002 to 2008, wages grew by 42.8%. This increase would have been even greater (by 1.9 percentage points) had the allocation premium remained at its 2002 level.
- In 2008-2014 period, 80% of wage growth can be attributed to the reallocation of workers (unweighted wage component rose by only 1.0%).
- Similar pattern in both the services and manufacturing sectors.

Contribution of the OP term to aggregate wage growth in different periods

		2002-2008	2008-2014	2014-2019	2019-2020	2020-2023	2002-2023
Total economy	WG (%)	42,8	5,7	14,8	0,5	29,1	124,7
	CWG (%)	44,7	1,0	17,0	1,6	25,8	118,6
	CAP (p. p.)	-1,9	4,7	-2,2	-1,1	3,3	6,1
Industry (including construction)	WG (%)	44,5	5,9	17,2	1,1	26,3	128,9
	CWG (%)	41,9	1,3	19,9	2,2	26,0	122,0
	CAP (p. p.)	2,6	4,6	-2,7	-1,2	0,3	6,8
Services	WG (%)	40,0	5,2	13,4	-0,1	31,0	118,5
	CWG (%)	46,3	0,4	16,0	1,4	25,8	117,4
	CAP (p. p.)	-6,3	4,7	-2,6	-1,4	5,1	1,1

Notes: Counterfactual wage growth is one which would be realised if the wage allocation premium was the same as in the base year. Industry (including construction) refers to B-F, while services are residual. WG refers to wage growth, CWG to counterfactual wage growth, CAP to contribution of allocation premium
Source: Fina and authors' calculations

The impact of changes in the allocation premium is more pronounced on GVA per employee than on wages.

- From 2002 to 2008, GVA per employee increased by 31.2%. Had the allocation premium remained unchanged, the growth would be even greater (45.8%).
- This negative effect of reallocation is especially pronounced in industry.
- During the recession (2008-2014), GVA per worker increased (4.6%), but had the allocation remained as in 2008, it would have decreased (8.4%).
- Post pandemic - decrease of GVA allocation premium, combined with increased wage allocation premium.

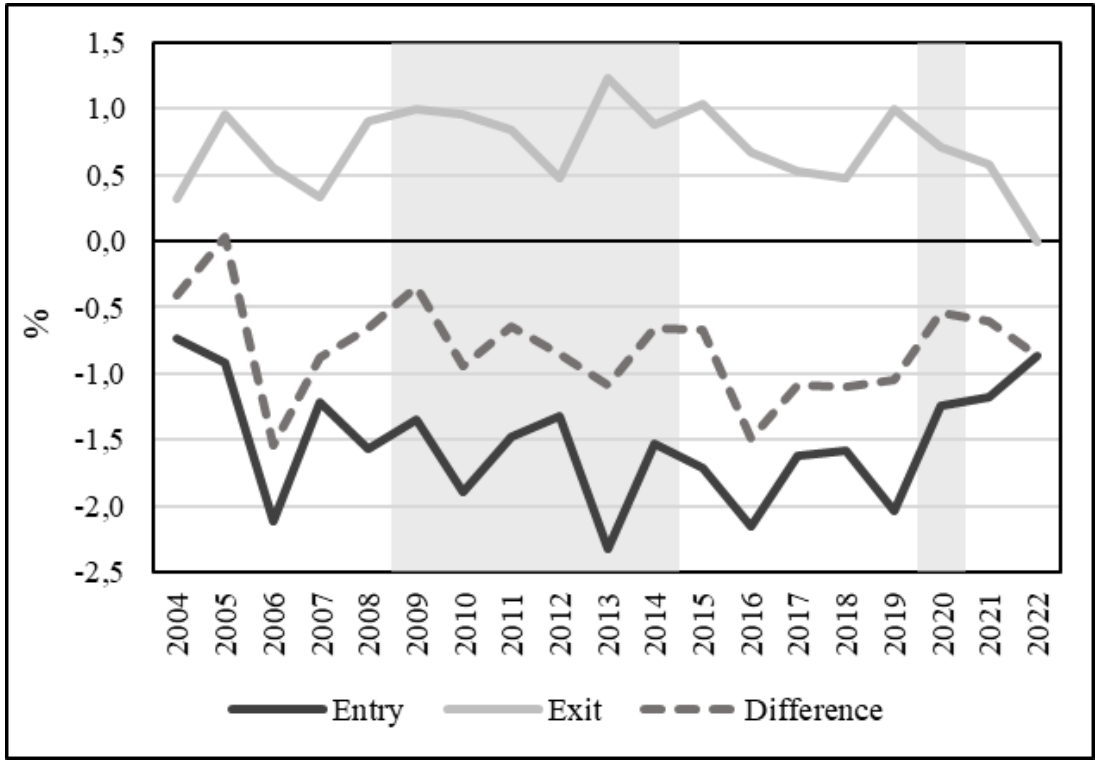
Contribution of the OP term to aggregate productivity growth in different periods

		2002-2008	2008-2014	2014-2019	2019-2020	2020-2023	2002-2023
Total economy	GVA growth (%)	31,2	4,6	15,8	-3,9	37,8	110,4
	CGVA growth (%)	45,8	-8,4	18,0	-2,6	44,2	121,4
	CAP (p. p.)	-14,6	13,0	-2,2	-1,3	-6,4	-11,1
Industry (including construction)	GVA growth (%)	24,3	10,9	14,0	-0,9	33,1	107,1
	CGVA growth (%)	42,4	-9,7	20,5	-0,5	35,9	109,7
	CAP (p. p.)	-18,1	20,6	-6,6	-0,4	-2,9	-2,5
Services	GVA growth (%)	33,6	-1,2	17,4	-6,3	41,6	105,7
	CGVA growth (%)	46,3	-9,3	16,7	-3,7	49,2	122,6
	CAP (p. p.)	-12,7	8,1	0,7	-2,6	-7,6	-16,9

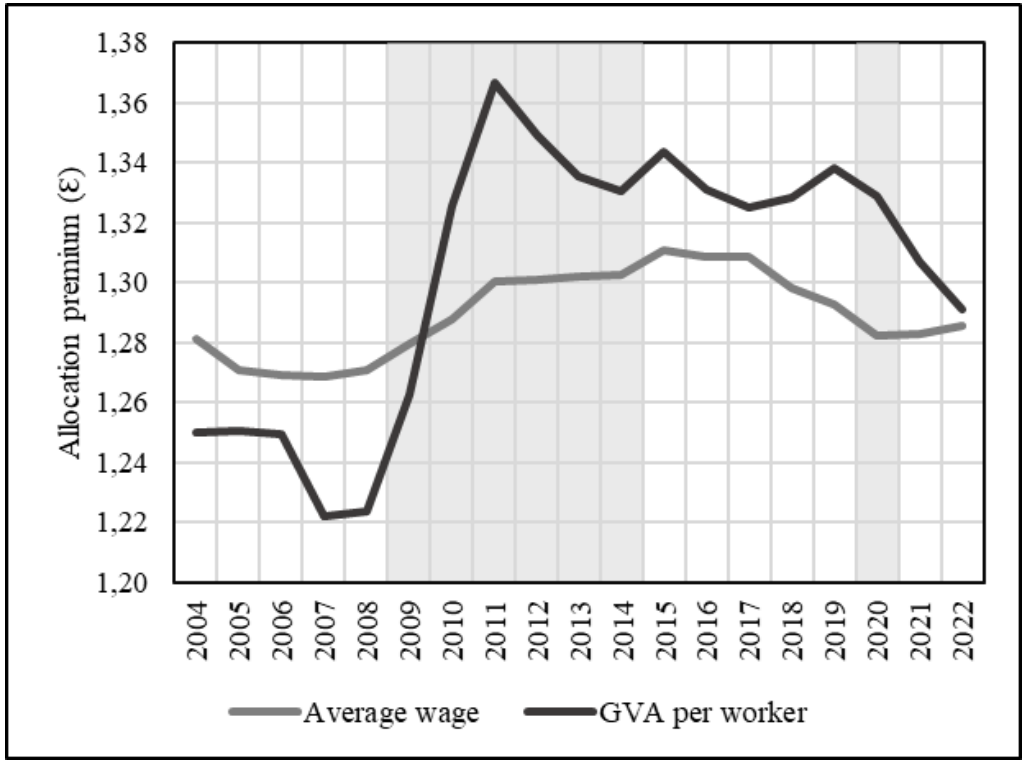
Notes: Counterfactual GVA growth is one which would be realised if the allocation premium was the same as in the base year. Industry (including construction) refers to B-F, while services are residual. CGVA growth refers to counterfactual GVA growth, CAP to contribution of allocation premium
Source: Fina and authors' calculations

Dynamic OP decomposition - entering firms exert downward pressure on wages, while exiting firms have a positive effect

Contributions of entering and exiting firm to wage change, %



Dynamic OP decomposition (three year moving average)



Source: Fina and authors' calculations

Conclusion (I)

- Wage developments depend not only on firm-level wage setting policies, but also on the firm composition, which is often overlooked and not evident in aggregate data.
- Our application of the OP decomposition revealed that allocation premium behaved countercyclically before the COVID-19 pandemic.
- During economic downturns, the allocation premium increases, which decreases the severity of the negative impact on wages, as lower-paying firms were disproportionately affected by the recession.
- During the periods of growth, the allocation premium decreases, moderating the wage growth.
- The results are in line with Adamopoulou et al. (2019) who reported that allocation of employees can explain 32% of the increase in the aggregate wage in Italy in the period 2004-2015.
- However, in the post-pandemic period (2020-2023), the wage allocation premium exhibits a procyclical behaviour, increasing the aggregate wages.

Conclusion (II)

- The effect of changes in allocation premium has been much more pronounced for productivity (GVA per worker) than for wages.
- This reallocation effect has remained countercyclical through the entire examined period, including after the COVID-19 pandemic.
- After the pandemic, the employees were reallocated toward higher-paying firms, but without a corresponding increase in productivity. This disconnect may have contributed in putting upward pressure on prices.
- One possible explanation for this unexpected behaviour can be found in the extensive government support measures implemented during the COVID-19 pandemic, which may have allowed firms to retain employees and maintain wage levels even when output declined.

Conclusion (III)

- Finally, the dynamic OP decomposition showed that firms entering the market tend to exert downward pressure on aggregate wages.
- This suggests that new firms typically pay lower wages, which is consistent with the literature indicating that startups usually offer lower initial wages that rise over time as they stabilize.
- At the same time, exiting firms have an upward impact on aggregate wages (as exiting firms typically pay lower wages compared to surviving firms), but this effect is weaker than the effect of new entrants.
- OP decomposition on sample of continuing firms yields similar results as on the entire sample, though with slightly weaker effect.

HNB

Thank you for your attention!

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Appendix

Contribution of the change in OP term to aggregate wage growth in different periods, by sector (NACE 2007)

		2002-2008	2008-2014	2014-2019	2019-2020	2020-2023	2002-2023
Industry (excluding construction)	WG (%)	46.2	7.0	16.5	1.2	26.8	133.7
	CWG (%)	42.6	2.8	20.8	1.0	25.8	125.1
	CAP (p. p.)	3.5	4.2	-4.4	0.2	1.0	8.7
Construction	WG (%)	44.0	-3.4	25.5	1.2	26.9	124.3
	CWG (%)	43.9	-2.3	21.4	4.3	27.6	127.0
	CAP (p. p.)	0.0	-1.1	4.2	-3.1	-0.7	-2.7
Retail	WG (%)	45.2	6.9	19.6	1.5	30.3	145.5
	CWG (%)	45.7	3.6	21.3	1.7	25.0	132.8
	CAP (p. p.)	-0.6	3.3	-1.7	-0.3	5.3	12.6
Transportation	WG (%)	37.3	5.1	5.7	-0.9	20.3	81.7
	CWG (%)	44.7	2.2	11.6	2.2	24.0	109.2
	CAP (p. p.)	-7.4	2.9	-5.9	-3.1	-3.8	-27.5
Accommodation and food services	WG (%)	43.6	9.2	9.4	-13.7	53.3	126.8
	CWG (%)	46.7	14.4	7.1	-2.1	36.7	140.6
	CAP (p. p.)	-3.0	-5.2	2.3	-11.6	16.6	-13.7
ICT	WG (%)	36.7	7.2	12.4	4.5	34.2	131.0
	CWG (%)	45.8	-4.9	26.2	3.5	26.1	128.3
	CAP (p. p.)	-9.1	12.1	-13.8	1.0	8.1	2.7
Financial sector	WG (%)	24.8	-4.2	19.2	7.3	4.9	60.3
	CWG (%)	31.4	-10.7	10.8	4.7	20.8	64.4
	CAP (p. p.)	-6.6	6.4	8.4	2.6	-15.9	-4.1
Real estate	WG (%)	53.2	5.6	-1.6	-16.9	19.1	57.5
	CWG (%)	28.5	9.5	16.8	-0.7	19.3	94.9
	CAP (p. p.)	24.7	-3.9	-18.4	-16.3	-0.2	-37.3
Professional and administrative services	WG (%)	41.1	-1.9	14.1	1.0	27.3	103.0
	CWG (%)	49.5	-5.9	13.6	0.7	22.6	97.4
	CAP (p. p.)	-8.4	3.9	0.5	0.3	4.7	5.6
Non-government public sector activities	WG (%)	48.1	3.2	13.7	0.7	30.1	127.7
	CWG (%)	48.2	2.5	11.1	0.9	23.5	110.3
	CAP (p. p.)	-0.1	0.7	2.6	-0.2	6.6	17.3
Art and other	WG (%)	26.2	7.4	16.0	0.2	29.7	104.5
	CWG (%)	28.1	-2.8	26.1	4.7	26.5	108.0
	CAP (p. p.)	-1.9	10.2	-10.1	-4.5	3.2	-3.5

Note: WG refers to wage growth, CWG to counterfactual wage growth, CAP to contribution of allocation premium
Source: Fina and authors' calculations

Contribution of the change in OP term to aggregate GVA per worker growth in different periods, by sector (NACE 2007)

		2002-2008	2008-2014	2014-2019	2019-2020	2020-2023	2002-2023
Industry (excluding construction)	GVA growth (%)	22.8	14.1	12.8	-0.6	33.3	109.4
	CGVA growth (%)	38.6	-5.2	22.8	-1.2	37.9	119.9
	CAP (p. p.)	-15.8	19.3	-10.0	0.6	-4.6	-10.5
Construction	GVA growth (%)	38.7	-7.9	27.1	-1.2	35.8	118.0
	CGVA growth (%)	51.4	-17.1	20.7	1.1	36.2	108.8
	CAP (p. p.)	-12.7	9.2	6.4	-2.3	-0.4	9.2
Retail	GVA growth (%)	40.9	-6.2	31.3	1.6	38.4	143.8
	CGVA growth (%)	42.1	-8.3	28.4	0.2	40.5	135.3
	CAP (p. p.)	-1.2	2.1	2.9	1.4	-2.1	8.5
Transportation	GVA growth (%)	32.6	12.7	7.6	-9.3	34.7	96.2
	CGVA growth (%)	51.9	-4.0	0.7	-9.4	51.4	101.3
	CAP (p. p.)	-19.3	16.6	6.9	0.1	-16.8	-5.2
Accommodation and food services	GVA growth (%)	38.2	22.1	7.2	-46.1	147.0	140.6
	CGVA growth (%)	54.8	20.6	-9.0	-27.7	122.5	173.5
	CAP (p. p.)	-16.5	1.4	16.1	-18.5	24.5	-32.9
ICT	GVA growth (%)	16.3	-8.5	6.9	3.1	20.7	41.6
	CGVA growth (%)	34.8	-9.9	40.3	8.8	47.1	172.9
	CAP (p. p.)	-18.5	1.3	-33.4	-5.7	-26.4	-131.4
Financial sector	GVA growth (%)	54.0	9.7	45.9	-21.0	-8.9	77.3
	CGVA growth (%)	12.0	-14.3	17.5	-20.3	34.0	20.5
	CAP (p. p.)	42.0	24.1	28.4	-0.7	-42.9	56.9
Real estate	GVA growth (%)	44.6	15.4	-2.1	-6.8	19.9	82.4
	CGVA growth (%)	40.3	15.6	19.9	-3.0	25.9	137.7
	CAP (p. p.)	4.3	-0.3	-22.1	-3.8	-6.0	-55.3
Professional and administrative services	GVA growth (%)	43.2	-13.7	15.3	-2.7	38.0	91.4
	CGVA growth (%)	61.4	-17.1	14.5	-2.9	42.1	111.3
	CAP (p. p.)	-18.2	3.4	0.8	0.2	-4.1	-19.8
Non-government public sector activities	GVA growth (%)	58.6	-2.6	18.5	-3.2	36.5	142.0
	CGVA growth (%)	60.9	-2.7	8.6	-0.9	37.1	130.7
	CAP (p. p.)	-2.2	0.1	9.9	-2.2	-0.6	11.2
Art and other	GVA growth (%)	19.3	19.7	27.0	-10.3	54.6	151.2
	CGVA growth (%)	18.1	-11.5	22.7	-10.6	58.2	81.4
	CAP (p. p.)	1.2	31.1	4.3	0.2	-3.6	69.8

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Note: CGVA growth refers to counterfactual GVA growth, CAP to contribution of allocation premium
Source: Fina and authors' calculations