Human Capital Spillovers Across Cities
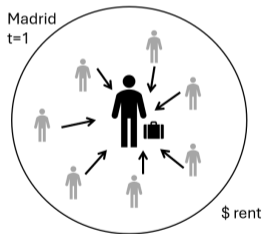
Giulia Lo Forte & Pablo Valenzuela-Casasempere

VSE-UBC
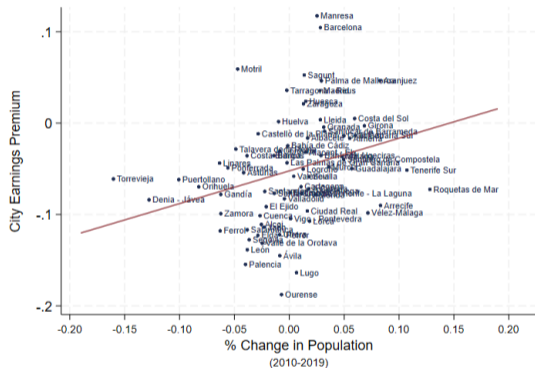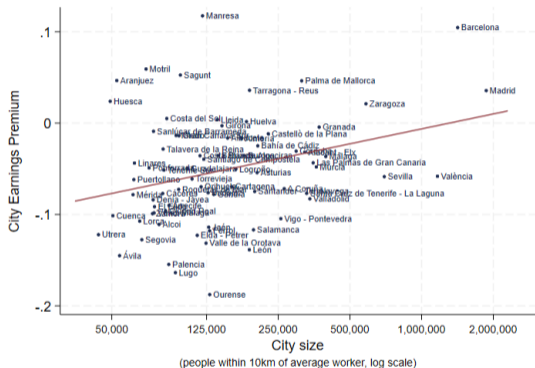
April 24, 2024

Motivation

Individuals get valuable experience from working in big cities.

Big cities offer higher wage premiums

▸ Size and Population growth

but do not adjust their zoning as they grow in size

▸ Size, Zoning, and Price

and zoning attenuates rent increase
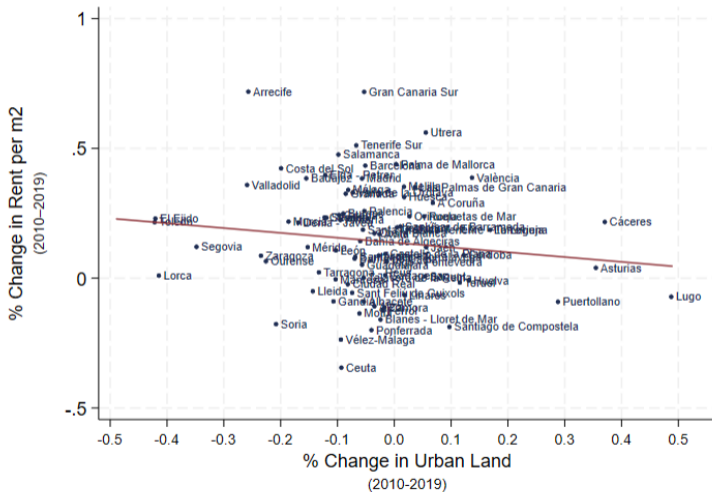
Motivation

Individuals get valuable experience from working in big cities.
Yet, as big cities get too expensive, workers move to smaller, cheaper cities.
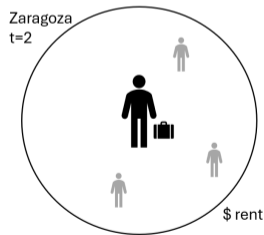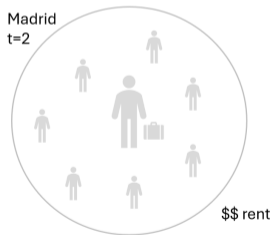
Motivation

Individuals get valuable experience from working in big cities.
Yet, as big cities get too expensive, workers move to smaller, cheaper cities.

Therefore, do individuals transfer their experience to new coworkers?
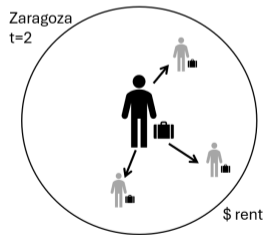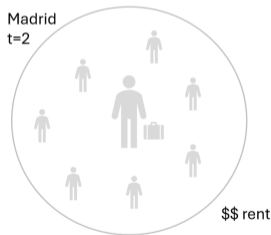
What we do

We study human capital spillovers between cities in Spain.

Aspiration:

We embed our findings in a Quantitative General Equilibrium model to quantify the effects of these spillovers on housing prices and aggregate output.

How we do it

We use administrative data on employment spells in Spain:

- We follow workers through their employment history **across locations**;

- We define **teams** of coworkers at the **establishment-occupation** level.

We track change in wage growth for teams receiving a worker from a bigger city.

What we find

Positive spillovers from coworkers' experience to wage growth.

Experience gained in bigger cities spills over to new coworkers in smaller cities.

Having coworkers with an extra year of experience in Madrid or Barcelona
$\Rightarrow$ +1.2% wage growth after three years in Valencia.

Why we care

Productive cities are "too small."

- Housing constraints in productive cities lowered US growth by 36%
  (Hsieh and Moretti, 2019)

Housing affordability is a key issue in many countries.

The spillover changes the GE effects of Place-Based Policies.

Contributions to the literature

Return to big city experience and earnings premium

(De La Roca and Puga, 2017; Eckert et al., 2022; Lhuillier, 2024)

→ Identify a new avenue in how the **return to big city experience** affects earnings.

Learning from coworkers

(Mas and Moretti, 2009; Akcigit et al., 2018; Jarosch et al., 2021)

→ We identify how learning from coworkers depends on **where** they gained experience.

Aggregate effects of zoning (aspirational)

(Hsieh and Moretti, 2019; Glaeser and Gyourko, 2018)

→ We identify a consequence of housing regulation: human capital flows.

Data and Empirical Strategy

Data

Employer-employee information between 2006-2021:
Spain's Continuous Sample of Employment Histories (MCVL).

- social security, income tax, and census records for 4% Spanish workers.

Housing prices between 2006-2020:
Idealista, an online real estate marketplace.

- average housing prices and characteristics by municipality.

Zoning information between 1995 and 2020:
Catastro Único, from INE (Spanish equivalent to StatsCan).

- urban, rural, and buildable land for each municipality.

Empirical strategy

Wage growth as a function of coworkers' experience:

$$w_{i,t+h} = \alpha + \beta_1 \overline{\text{ExpBig}}_{i,t} + \beta_2 \overline{\text{ExpMed}}_{i,t} + \beta_3 \overline{\text{ExpSmall}}_{i,t} + w_{i,t} + \boldsymbol{\delta} + \varepsilon_{i,t+h}$$

- $w_{i,t+h}$: (log) wage of individual i in year $t+h$;

- Coworker: workers in the same establishment **and** occupation;

- $\overline{\text{ExpBig}}_{i,t}$, $\overline{\text{ExpMed}}_{i,t}$, $\overline{\text{ExpSmall}}_{i,t}$: average experience of i's teammates/coworkers (years);
  Big: Madrid and Barcelona; Medium: Valencia, Sevilla, and Zaragoza; Small: rest of Spain

- $\boldsymbol{\delta}$: FE for age decile, tenure decile, gender, education, occupation, sector, year, and city;

- $\varepsilon_{i,t+h}$: errors clustered at the establishment level.

Experience of coworkers in bigger cities matters

	(1) Future wage h = 1	(2) Future wage h = 2	(3) Future wage h = 3	(4) Future wage h = 5
Average coworkers experience top 2	0.004***	0.004***	0.003***	0.004***
	(0.000)	(0.000)	(0.001)	(0.001)
Average coworkers experience 3rd-5th	0.005***	0.005***	0.006***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.004***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.001)
Current wage (ln)	0.690***	0.661***	0.653***	0.633***
	(0.004)	(0.005)	(0.006)	(0.007)
Observations	791,161	594,467	464,882	293,950
Adjusted R^2	0.719	0.696	0.685	0.663
Cluster level	Establishment	Establishment	Establishment	Establishment
N. clusters	43104	33630	27398	18822

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

It matters for workers in medium-sized cities

	(1) Future wage h = 1	(2) Future wage h = 2	(3) Future wage h = 3	(4) Future wage h = 5
Average coworkers experience top 2	0.011***	0.014***	0.012***	0.021***
	(0.002)	(0.003)	(0.004)	(0.006)
Average coworkers experience 3rd-5th	0.005***	0.005***	0.005***	0.007***
	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 6th+	0.004***	0.005***	0.005***	0.005**
	(0.001)	(0.001)	(0.002)	(0.002)
Current wage (ln)	0.647***	0.610***	0.593***	0.547***
	(0.010)	(0.012)	(0.014)	(0.021)
Observations	89,034	66,087	51,384	32,395
Adjusted R^2	0.673	0.648	0.639	0.614
Cluster level	Establishment	Establishment	Establishment	Establishment
N. clusters	5815	4403	3461	2325

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: medium-sized cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

It matters for workers in smaller cities

	(1) Future wage h = 1	(2) Future wage h = 2	(3) Future wage h = 3	(4) Future wage h = 5
Average coworkers experience top 2	0.006***	0.008***	0.008***	0.009***
	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 3rd-5th	0.004***	0.004***	0.005***	0.006***
	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 6th+	0.004***	0.005***	0.005***	0.006***
	(0.000)	(0.000)	(0.000)	(0.001)
Current wage (ln)	0.620***	0.581***	0.560***	0.522***
	(0.005)	(0.007)	(0.008)	(0.010)
Observations	306,742	228,955	179,339	114,049
Adjusted R^2	0.642	0.617	0.603	0.574
Cluster level	Establishment	Establishment	Establishment	Establishment
N. clusters	21379	16446	13338	9103

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: small cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Results are robust to

- Adding team size fixed effects ‣ All ‣ Medium ‣ Small

- Wage growth at the establishment level ‣ All ‣ Medium ‣ Small

- Stable across the distribution of:
  - age ‣ All ‣ Medium ‣ Small
  - tenure ‣ All ‣ Medium ‣ Small
  - establishment size ‣ All ‣ Medium ‣ Small
  - wage quintile ‣ All ‣ Medium ‣ Small

Theoretical framework

Objectives of the model

We need a model featuring

- Production with complementarities across human capital of workers
  $\longrightarrow$ w_i depends on the human capital of coworkers

- Free movement of workers across locations

- Housing restrictions through zoning

Model setup

Overlapping generations' model with two types of individuals: young and old.

There is an exogenous number of discrete cities indexed by $j = 1, \dots, J$.

Total population in the economy N_t evolves exogenously.

Each city has a population of $N_j = N_j^Y + N_j^O$ individuals.

Each period,
- the adult generation of the previous period passes away
- children of the previous generation become adults and have one offspring each

Each individual *i* lives two periods

Young
Individual *i* is born in city *j* and has human capital $h_i^Y = e_i$.
The individual cannot move when young.

Old
The human capital depends on the size and composition of the location at a young age.

$$h_i^O = e_i \left(N_{j(Y)} \right)^\gamma H_{j(Y)}^O \quad \text{with} \quad H_{j(Y)}^O = \left[\int_i \left(h_i^O \right)^\lambda di \right]^{\frac{1}{\lambda}}$$

No altruism: old individuals do not internalize their effect on others' human capital.
$N_{j(Y)}$: population where the individual grew up. Big city experience is "more valuable"
(De La Roca and Puga, 2017).

Production and housing supply

The representative firm of city *j* produces a homogeneous, freely traded good using the human capital of young and old individuals:

$$Y_j = A_j \left[\alpha_j^Y \left(H_j^Y \right)^{\frac{\sigma-1}{\sigma}} + \alpha_j^O \left(H_j^O \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

The implicit demand for human capital is:

$$H_j^a = \left(\frac{w_j^a}{\alpha_j^a W_j} \right)^{-\sigma} Y_j \quad \text{with} \quad W_j = \left((\alpha_j^Y)^\sigma (w_j^Y)^{1-\sigma} + (\alpha_j^O)^\sigma (w_j^O)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

Housing supply

Supplied elastically with Cobb-Douglas production function using available land T_j and capital M_j to produce housing L_j^S

(Combes et al., 2021; Epple et al., 2010)

The implied housing supply follows

$$L_j^S = T_j \left(\frac{1-\mu}{\mu} \right)^{\frac{1-\mu}{\mu}} r_j^{\frac{1-\mu}{\mu}}$$

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$$L_j^S = T_j \left(\frac{1-\mu}{\mu} \right)^{\frac{1-\mu}{\mu}} r_j^{\frac{1-\mu}{\mu}}$$

Zoning restrictions: T_j is endogenous and depends on the zoning restrictions. Not modeled so far.

Consumption side

Consumer *i* of age *a* living in city *j* maximizes their utility

$$U_{ij}^a = B_j \epsilon_j \frac{\left(C_{ij}^a\right)^\beta}{\beta} \frac{\left(L_{ij}^a\right)^{1-\beta}}{1-\beta}$$

subject to the budget constraint

$$h_i^a w_{ij}^a = C_{ij}^a p + L_{ij}^a r_j$$

where *C* is the freely traded good whose price is normalized: $p = 1$

B_j are amenities of city *j*

ϵ_j is a Type II EV shock: $F(\epsilon_j) = \exp\{\epsilon_j^{-\phi}\}$.

Optimal location choice

An old individual chooses to live in the city j^* such that

$$j^* = \text{argmax } B_j \epsilon_j r_j^{\beta-1} h_{ij(Y)}^O w_{ij}^O$$

Notice that $h_{ij(Y)}^O$ does not depend on the destination city, only on the origin city.

The number of old individuals moving from city j to city j' are

$$\pi_{j \rightarrow j'} = \frac{(B_{j'} r_{j'}^{-(1-\beta)} w_{j'}^O)^\phi}{\sum_k (B_k r_k^{-(1-\beta)} w_k^O)^\phi}$$

Knowledge flow

The model delivers an equation for the knowledge flow from city j to city j':

$$\eta_{j\rightarrow j'} = \left(\int\limits_{i \in N_{j'}^{O}} (h_i^O)^\lambda di \right)^{\frac{1}{\lambda}} - \left(\int\limits_{\substack{i \in N_{j'}^{O}, \\ i \notin N_{j'}^{O}(j(Y))}} (h_i^O)^\lambda di \right)^{\frac{1}{\lambda}}$$

Particular case: Perfect substitution ($\lambda = 1$)

The knowledge flow can be written as:

$$
\begin{aligned}
\eta_{j \to j'} &= \left(\int\limits_{i \in N_{j'}^O(j)} h_i^O \, di \right) \\
&= \underbrace{\pi_{j \to j'} N_j^Y}_{\text{Flow of individuals}} \quad \times \quad \underbrace{(\bar{e}(N_j)^\gamma H_j^O)}_{\text{Human capital stock}}
\end{aligned}
$$

Closing the model

Human capital supply:

$$
\begin{aligned}
H_j^Y &= \int\limits_{i \in N_j^Y} e_i di \\
H_j^O &= \int\limits_{i \in N_j^O} h_{ij}^O di
\end{aligned}
$$

Housing demand:

$$
L_j^D = (1-\beta)\frac{w_j^Y}{r_j}\bar{e}N_j^Y + (1-\beta)\frac{w_j^O}{r_j}\int\limits_{i \in N_j^O} h_{ij}^O di
$$

Conclusions

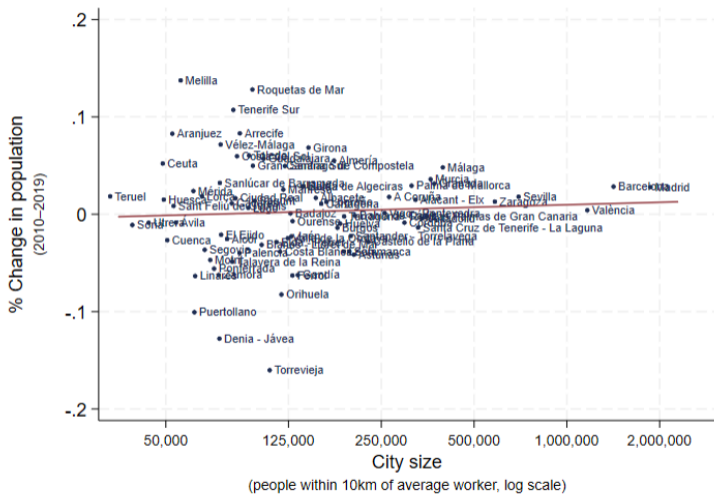# To sum up

- individuals gain from the experience coworkers got in bigger cities
  +1 year in Madrid $\Rightarrow$ +1.2% increase in wages in Valencia after 3 years

- potential GE effects

Thank you

Appendix

Larger cities grow faster

% Change in population (2010–2019) vs City size (people within 10km of average worker, log scale)

but do not adjust their zoning as they grow in size

All cities with team size fixed effects

	(1) Future wage h = 1	(2) Future wage h = 2	(3) Future wage h = 3	(4) Future wage h = 5
Average coworkers experience top 2	0.004***	0.004***	0.003***	0.004***
	(0.000)	(0.000)	(0.001)	(0.001)
Average coworkers experience 3rd-5th	0.005***	0.005***	0.006***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.004***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.001)
Current wage (ln)	0.690***	0.661***	0.652***	0.632***
	(0.004)	(0.005)	(0.006)	(0.007)
Observations	791,161	594,467	464,882	293,950
Adjusted R^2	0.719	0.696	0.686	0.663
Cluster level	Establishment	Establishment	Establishment	Establishment
N. clusters	43104	33630	27398	18822

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: all cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Medium cities with team size fixed effects

	(1) Future wage h = 1	(2) Future wage h = 2	(3) Future wage h = 3	(4) Future wage h = 5
Average coworkers experience top 2	0.011***	0.014***	0.013***	0.021***
	(0.002)	(0.003)	(0.004)	(0.006)
Average coworkers experience 3rd-5th	0.005***	0.005***	0.005***	0.007***
	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 6th+	0.004***	0.005***	0.005***	0.005**
	(0.001)	(0.001)	(0.002)	(0.002)
Current wage (ln)	0.647***	0.610***	0.593***	0.547***
	(0.010)	(0.012)	(0.014)	(0.021)
Observations	89,034	66,087	51,384	32,395
Adjusted R^2	0.673	0.648	0.639	0.614
Cluster level	Establishment	Establishment	Establishment	Establishment
N. clusters	5815	4403	3461	2325

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: medium-size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Small cities with team size fixed effects

	(1) Future wage h = 1	(2) Future wage h = 2	(3) Future wage h = 3	(4) Future wage h = 5
Average coworkers experience top 2	0.007***	0.008***	0.008***	0.009***
	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 3rd-5th	0.004***	0.004***	0.005***	0.007***
	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 6th+	0.004***	0.005***	0.005***	0.006***
	(0.000)	(0.000)	(0.000)	(0.001)
Current wage (ln)	0.619***	0.581***	0.559***	0.520***
	(0.005)	(0.007)	(0.008)	(0.009)
Observations	306,742	228,955	179,339	114,049
Adjusted R^2	0.642	0.618	0.603	0.575
Cluster level	Establishment	Establishment	Establishment	Establishment
N. clusters	21379	16446	13338	9103

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: small size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Establishment controls for all cities

	(1) Future wage h = 1	(2) Future wage h = 2	(3) Future wage h = 3	(4) Future wage h = 5
Average coworkers experience top 2	0.004***	0.003***	0.003***	0.004***
	(0.000)	(0.000)	(0.001)	(0.001)
Average coworkers experience 3rd-5th	0.005***	0.005***	0.006***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.003***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.001)
Current wage (ln)	0.709***	0.680***	0.672***	0.655***
	(0.004)	(0.005)	(0.006)	(0.008)
Observations	722,212	544,537	424,629	265,068
Adjusted R^2	0.726	0.702	0.692	0.668
Cluster level	Establishment	Establishment	Establishment	Establishment
N. clusters	37268	29819	24507	16898

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: all cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Establishment controls for medium size cities

	(1) Future wage h = 1	(2) Future wage h = 2	(3) Future wage h = 3	(4) Future wage h = 5
Average coworkers experience top 2	0.010***	0.013***	0.013***	0.022***
	(0.002)	(0.003)	(0.004)	(0.006)
Average coworkers experience 3rd-5th	0.005***	0.005***	0.005***	0.007***
	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 6th+	0.004***	0.004***	0.004***	0.005**
	(0.001)	(0.001)	(0.002)	(0.002)
Current wage (ln)	0.664***	0.626***	0.611***	0.563***
	(0.010)	(0.012)	(0.015)	(0.023)
Observations	80,860	60,364	46,794	29,216
Adjusted R^2	0.681	0.654	0.647	0.617
Cluster level	Establishment	Establishment	Establishment	Establishment
N. clusters	4934	3848	3067	2081

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: medium size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Establishment controls for small size cities

	(1) Future wage h = 1	(2) Future wage h = 2	(3) Future wage h = 3	(4) Future wage h = 5
Average coworkers experience top 2	0.006***	0.008***	0.008***	0.009***
	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 3rd-5th	0.004***	0.004***	0.005***	0.006***
	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 6th+	0.004***	0.005***	0.005***	0.006***
	(0.000)	(0.000)	(0.000)	(0.001)
Current wage (ln)	0.640***	0.600***	0.578***	0.541***
	(0.006)	(0.008)	(0.008)	(0.010)
Observations	277,369	207,919	162,597	101,963
Adjusted R^2	0.650	0.625	0.608	0.577
Cluster level	Establishment	Establishment	Establishment	Establishment
N. clusters	18287	14473	11836	8099

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: small size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Age quintile for all cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.005***	0.004***	0.003***	0.004***	0.003***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Average coworkers experience 3rd-5th	0.005***	0.004***	0.005***	0.005***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.004***	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Current wage (ln)	0.546***	0.628***	0.685***	0.743***	0.775***
	(0.006)	(0.007)	(0.006)	(0.005)	(0.006)
Observations	131,370	144,630	166,351	175,448	173,361
Adjusted R^2	0.553	0.639	0.703	0.763	0.800
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	19687	19677	19761	18861	17043

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: all cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at ◂ Back ablishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Age quintile for medium size cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.010**	0.004	0.012***	0.010**	0.012***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)
Average coworkers experience 3rd-5th	0.006***	0.003**	0.004***	0.007***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.005**	0.002	0.003**	0.005***	0.004***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Current wage (ln)	0.514***	0.597***	0.658***	0.664***	0.728***
	(0.015)	(0.021)	(0.017)	(0.015)	(0.015)
Observations	14,742	17,764	19,245	18,431	18,843
Adjusted R^2	0.473	0.580	0.670	0.717	0.764
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	2565	2638	2595	2464	2181

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Sample: medium size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and

Age quintile for small size cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.009***	0.005***	0.003*	0.005***	0.007***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Average coworkers experience 3rd-5th	0.003**	0.005***	0.007***	0.003***	0.004***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.004***	0.004***	0.003***	0.005***	0.005***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Current wage (ln)	0.497***	0.562***	0.600***	0.671***	0.706***
	(0.009)	(0.009)	(0.009)	(0.008)	(0.010)
Observations	52,404	57,121	63,600	66,992	66,623
Adjusted R^2	0.469	0.569	0.626	0.690	0.727
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	9461	9320	9259	8814	8141

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: small size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

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Tenure quintile for all cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.011***	0.006***	0.003***	0.002***	0.001***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Average coworkers experience 3rd-5th	0.010***	0.008***	0.004***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Average coworkers experience 6th+	0.009***	0.005***	0.002***	0.001***	0.001***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Current wage (ln)	0.399***	0.704***	0.809***	0.843***	0.880***
	(0.004)	(0.006)	(0.006)	(0.006)	(0.008)
Observations	114,782	130,897	164,779	184,309	196,394
Adjusted R^2	0.528	0.669	0.735	0.773	0.829
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	30622	26194	22325	16533	10676

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: all cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at ‹ Back ablishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Tenure quintile for medium size cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.017***	0.012***	-0.001	0.007***	0.004**
	(0.005)	(0.003)	(0.004)	(0.003)	(0.002)
Average coworkers experience 3rd-5th	0.012***	0.009***	0.004***	0.002**	0.001*
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.007***	0.006***	0.003**	0.002*	0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Current wage (ln)	0.376***	0.659***	0.759***	0.800***	0.860***
	(0.010)	(0.015)	(0.015)	(0.018)	(0.016)
Observations	13,780	15,342	18,512	21,167	20,230
Adjusted R^2	0.443	0.617	0.688	0.722	0.809
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	4127	3461	2876	2147	1267

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Sample: medium size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and

Tenure quintile for small size cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.010***	0.006***	0.005***	0.003**	0.004***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Average coworkers experience 3rd-5th	0.010***	0.006***	0.005***	0.003***	0.002***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.010***	0.006***	0.003***	0.002***	0.002***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Current wage (ln)	0.365***	0.626***	0.716***	0.767***	0.822***
	(0.006)	(0.010)	(0.009)	(0.010)	(0.017)
Observations	46,391	50,383	61,474	70,928	77,564
Adjusted R^2	0.423	0.566	0.657	0.695	0.760
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	14884	12465	10557	7826	5095

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: small size cities. Each column corresponds to a different time window, expressed in years. Standard errors clus- t the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

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Establishment size quintile for all cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.002***	0.003***	0.004***	0.005***	0.007***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)
Average coworkers experience 3rd-5th	0.002***	0.003***	0.004***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Average coworkers experience 6th+	0.002***	0.002***	0.004***	0.006***	0.006***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Current wage (ln)	0.651***	0.672***	0.672***	0.683***	0.674***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.013)
Observations	103,337	135,732	151,341	187,125	213,625
Adjusted R^2	0.617	0.666	0.704	0.740	0.760
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	28253	20818	9368	3540	680

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: all cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at ◂ Back ablishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Establishment size quintile for medium size cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.007**	0.005*	0.006*	0.022***	0.054***
	(0.004)	(0.003)	(0.003)	(0.005)	(0.011)
Average coworkers experience 3rd-5th	0.002**	0.004***	0.004***	0.006***	0.005
	(0.001)	(0.001)	(0.001)	(0.002)	(0.005)
Average coworkers experience 6th+	0.002	0.004***	0.003**	0.007***	0.000
	(0.001)	(0.001)	(0.002)	(0.002)	(0.006)
Current wage (ln)	0.621***	0.642***	0.614***	0.590***	0.618***
	(0.016)	(0.019)	(0.015)	(0.020)	(0.025)
Observations	13,276	16,960	18,549	18,549	21,699
Adjusted R^2	0.565	0.625	0.649	0.695	0.749
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	3819	2800	1260	410	83

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: medium size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and

Establishment size quintile for small size cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.005***	0.006***	0.008***	0.010***	0.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.007)
Average coworkers experience 3rd-5th	0.004***	0.004***	0.005***	0.005***	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
Average coworkers experience 6th+	0.002***	0.003***	0.006***	0.008***	0.003*
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)
Current wage (ln)	0.603***	0.610***	0.604***	0.595***	0.570***
	(0.008)	(0.009)	(0.009)	(0.010)	(0.022)
Observations	53,685	63,671	65,850	74,241	49,293
Adjusted R^2	0.531	0.582	0.658	0.705	0.670
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	14596	9935	4141	1473	217

Note: *** p $<$ 0.01, ** p $<$ 0.05, * p $<$ 0.1. Sample: small size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Wage quintile for all cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.007***	0.004***	0.002***	0.002***	0.001***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Average coworkers experience 3rd-5th	0.009***	0.005***	0.004***	0.003***	0.002***
	(0.002)	(0.001)	(0.001)	(0.000)	(0.000)
Average coworkers experience 6th+	0.009***	0.005***	0.003***	0.002***	0.001***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Current wage (ln)	0.334***	0.733***	0.947***	0.946***	0.955***
	(0.011)	(0.011)	(0.010)	(0.007)	(0.004)
Observations	86,987	152,147	174,900	185,905	191,220
Adjusted R^2	0.152	0.115	0.182	0.338	0.780
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	20765	23430	22449	17164	10376

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: all cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at ◂ Back ablishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

Wage quintile for medium size cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.004	0.000	0.003	0.000	0.004**
	(0.011)	(0.004)	(0.003)	(0.003)	(0.002)
Average coworkers experience 3rd-5th	0.008***	0.005***	0.002***	0.002***	0.001**
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.004	0.004***	0.001	0.001	0.002**
	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Current wage (ln)	0.328***	0.760***	1.007***	0.968***	0.930***
	(0.024)	(0.028)	(0.028)	(0.021)	(0.018)
Observations	12,759	20,987	21,322	17,835	16,122
Adjusted R^2	0.142	0.114	0.189	0.358	0.711
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	2975	3298	2970	1947	1078

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Sample: medium-size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and

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Wage quintile for small size cities, h = 1

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
Average coworkers experience top 2	0.009***	0.002	0.002	0.002	0.002***
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)
Average coworkers experience 3rd-5th	0.006**	0.002	0.004***	0.002***	0.002***
	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Average coworkers experience 6th+	0.008***	0.004***	0.002***	0.002***	0.001***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Current wage (ln)	0.318***	0.764***	0.944***	0.912***	0.891***
	(0.015)	(0.015)	(0.015)	(0.011)	(0.011)
Observations	44,858	76,976	77,139	63,816	43,948
Adjusted R^2	0.125	0.111	0.180	0.351	0.685
Cluster level	Establishment	Establishment	Establishment	Establishment	Establishment
N. clusters	11124	12352	10776	6925	3379

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: small size cities. Each column corresponds to a different time window, expressed in years. Standard errors clustered at the establishment level. The regressions include fixed effects for age decile, tenure decile, gender, education, occupation, sector (2 digits), year, and city.

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