Wages and agglomeration economies: A long-run perspective

Clémence Berson
ECB

Pierre-Philippe Combes
Science Po - CNRS

Laurent Gobillon
Paris School of Economics - CNRS and Banque de France

Aurélie Sotura
Banque de France

Motivations

Steady growth of cities over last decades (Duranton and Puga, 2014) with urban giants concentrating population and employment

Agglomeration economies increase local productivity, and **returns to agglomeration may depend on city size**. If returns are higher for small/medium cities, urban development towards large cities can reduce average productivity

$\Longrightarrow$ changes in city sizes may not maximize average productivity

Important for urban policies since some are designed to develop mainly large cities (Glaeser and Gottlieb, 2008)

In France, certain policies influence the size of cities (building constraints, transport development, spatially targeted housing policies)

Literature

Effects of agglomeration economies on productivity
(Combes and Gobillon, 2015; Ahlfeldt and Pietrostefani, 2019; Duranton and Puga, 2020)

Agglomeration economies in a historical perspective
(Combes, Lafourcade and Thisse, 2011)

City-size distribution (Zipf law)
(Gabaix and Ioannides, 2004; Dittmar, 2019)

Building constraints and misallocation of factors
(Hsieh and Moretti, 2019; Duranton and Puga, 2020)

Our paper

We **quantify agglomeration economies** in France over the 1976-2015 period using individual wage data (DADS)

We use a definition of **cities that evolves over time**

We assess the **effects of agglomeration economies and city-size distribution on average daily wages**

Preview of the results

- **Elasticity of wages/density**: 0.025 (OLS), 0.031 (IV)
  1% increase in density $\Longrightarrow$ 0.02% increase in wages (r. 0.03%)
  Increases over time (x4 between 1976 and 2015)
- **Elasticity of wages/market potential**: 0.065 (OLS), 0.050 (IV)
  1% increase in MP $\Longrightarrow$ 0.07% increase in wages (resp. 0.05%)
  Non-monotonic over time
- Negligible role for changes in values, **important for changes in returns**.
- **Local variables matter** to some extent for wage disparities and their importance increases over time
- Agglomeration variables play a minor role in the evolution of average wage but **a significant one for large cities**

Delineating cities

Methodology: de Bellefon, Combes, Duranton, Gobillon, and Gorin (2021, *Journal of Urban Economics*), using a dartboard approach

CEREMA-IGN data and BDTOPO: information on all buildings on the territory every year (exact location, footprint, height and construction year) at census years (1975, 1982, ..., 2016)

Urban area: a set of contiguous urban squares

City: urban area with core. In practice, a city is the set of included municipalities

A municipality belongs to a city if more than 50% of its census population is located in the city squares (allocating population to squares proportionally to building volume)

Cities may appear/disappear/change size at census years when they are redefined
City employment densities are constructed using administrative data

Wage data

Social security administrative data (DADS) matched employer-employee panel data 1976-2015

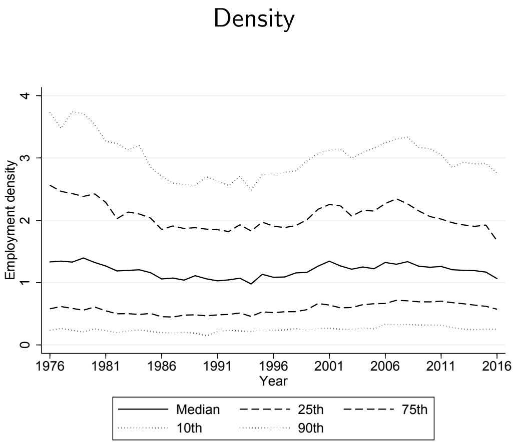
- Individual characteristics (age, sex)
- Match characteristics (Part-time/full-time status, number of working days, net wage, occupation, sector)
- Municipality identifiers

Our sample: 18,619,578 observations

- Individuals aged 18-65
- Only main full-time job (highest daily net wage) in the non-farm private sector
- Wages are trimmed (drop of wages in the 1^{st} and 99^{th} centiles each year)

City density and market potential computed using DADS

Moments of city wage and density distributions, 1976-2015 period



Overview

Two steps:

1/ **Estimation of returns to agglomeration variables on wages**, taking into account sorting of individuals across cities

2/ **Evolution of average daily wage** decomposed into

- effects of agglomeration economies
- individual characteristics/time

Wage equation: First step

$$\ln w_{i,t} = X_{i,t}\beta + \mathbb{1}_{\{(i,t)\in C\}}\left[\sum_{ag=1}^{C} \mathbb{1}_{\{ag(i,t)=ag\}}\gamma_{ag,t}\right] + \mathbb{1}_{\{(i,t)\in U\}}\gamma_t^U + \mathbb{1}_{\{(i,t)\in R\}}\gamma_t^R + \mu_{s(i,t),t} + u_i + \epsilon_{i,t}$$

with:

- i the individual, t the year, $s(i,t)$ the sector
- the location of the worker: C for cities, U urban areas without core and R rural areas, $ag(i,t)$ the city where the worker i works
- $w_{i,t}$ the daily wage
- $X_{i,t}$ time-varying individual characteristics (age squarred)
- u_i individual and $\mu_{s(i,t),t}$ sector fixed effects
- $\epsilon_{i,t}$ the residual

Wage equation: Second step

$$\gamma_{ag,t} = Z_{ag,t}\theta_t + \delta_t + \eta_{ag,t}$$

with:

- t the year, ag the city
- $\gamma_{ag,t}$ the location effect of the city ag of the previous equation
- $Z_{ag,t}$ time-varying city characteristics (employment density, area, market potential)
- δ_t time fixed effects
- $\eta_{ag,t}$ the residual

Second stage regression - constant agglomerations

	(1)	(2)	(3)	(4)	(5)	(6)
Density	0.051***		0.044***	0.033***		0.025***
	(0.002)		(0.002)	(0.002)		(0.001)
Area	0.024***	0.037***	0.024***	0.014***	0.021***	0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market potential		0.111***	0.062***		0.093***	0.065***
		(0.005)	(0.003)		(0.005)	(0.003)
Individual FE	No	No	No	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.859	0.810	0.872	0.934	0.931	0.945
N	10926	10922	10922	10921	10917	10917

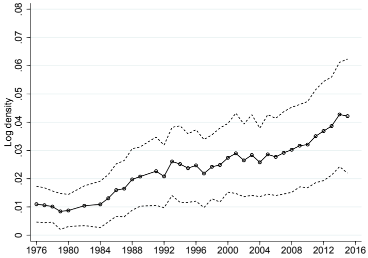
Standard errors in parentheses
The dependent and explanatory variables are all in logarithm.
* $p < 0.5$, ** $p < 0.02$, *** $p < 0.01$

IV 2nd stage regressions - constant agglomerations

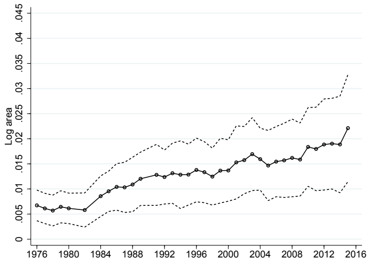
	(1)	(2)	(3)	(4)	(5)	(6)
Density	0.043***	0.049***	0.043***	0.027***	0.046***	0.031***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)
Area	0.012***	0.013***	0.012***	0.016***	0.013***	0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market potential				0.050***	0.015***	0.050***
				(0.003)	(0.005)	(0.003)
Historical IV	Yes	No	Yes	Yes	No	Yes
Soil IV	No	Yes	Yes	No	Yes	Yes
KP F-stat.	95.71	96.07	88.81	59.55	62.15	68.50
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	10679	10921	10679	10679	10917	10679

Standard errors in parentheses
The dependent and explanatory variables are all in logarithm
*: $p<0.5$, **: $p<0.02$, ***: $p<0.01$

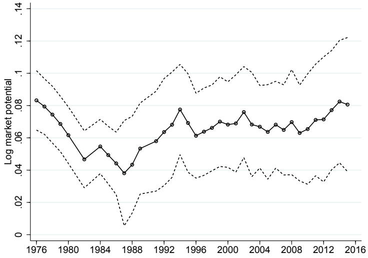
2nd stage regression - moving agglomerations



log-density



log-area



log MP

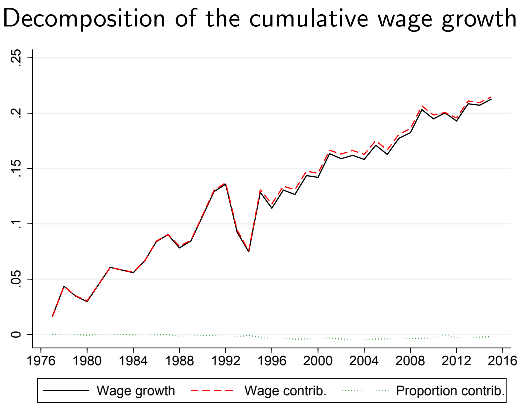
Wage growth decomposition

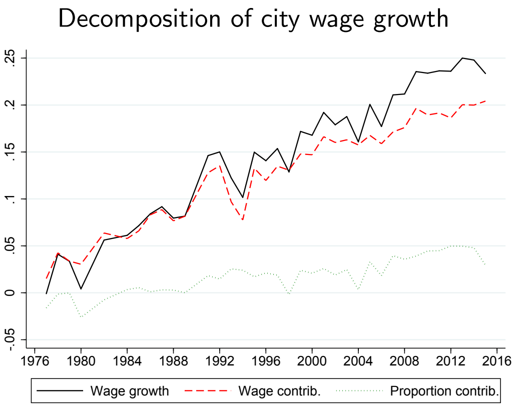
The evolution of average log-wages in a given city ag, $\overline{\log w}_{ag,1} - \overline{\log w}_{ag,0}$ can be decomposed into the effects of:

- A change in individual characteristics/time effects (labelled "composition effects")
- A change in the returns to agglomeration variables
- A change in the values of agglomeration variables
- A change in the unobservables

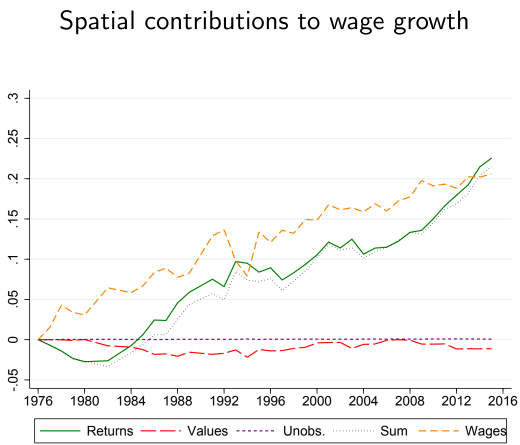
A similar decomposition can be made at the national level

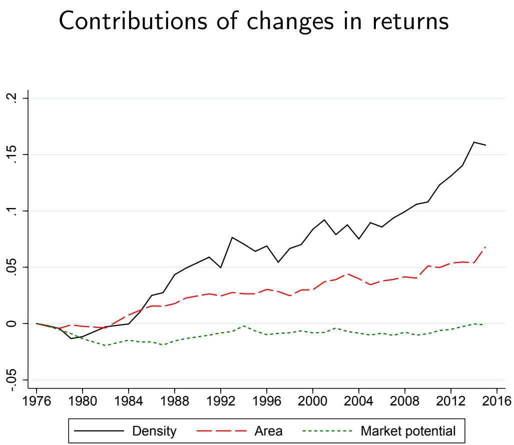
Decomposition of the cumulative wage growth





Spatial contributions to wage growth





Conclusion

- Elasticity of wages/**density**: 0.025 (OLS), 0.031 (IV), **increasing over time**
- Elasticity of wage/**market potential**: 0.065 (OLS), 0.050 (IV), **non-monotonic over time**
- **Positive sorting** of productive individuals into dense cities, it decreases over time
- Local variables matter to some extent for wage disparities, their importance increases over time
- **Agglomeration variables play a minor role** in the evolution of average wage but a significant one in large cities

Possible extensions

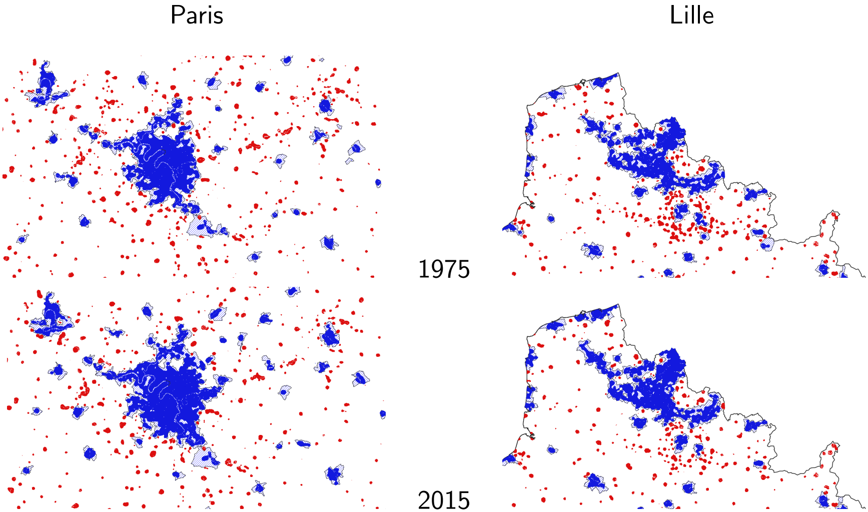
Going further:

Inclusion of industry-city variables (i.e., specialization)

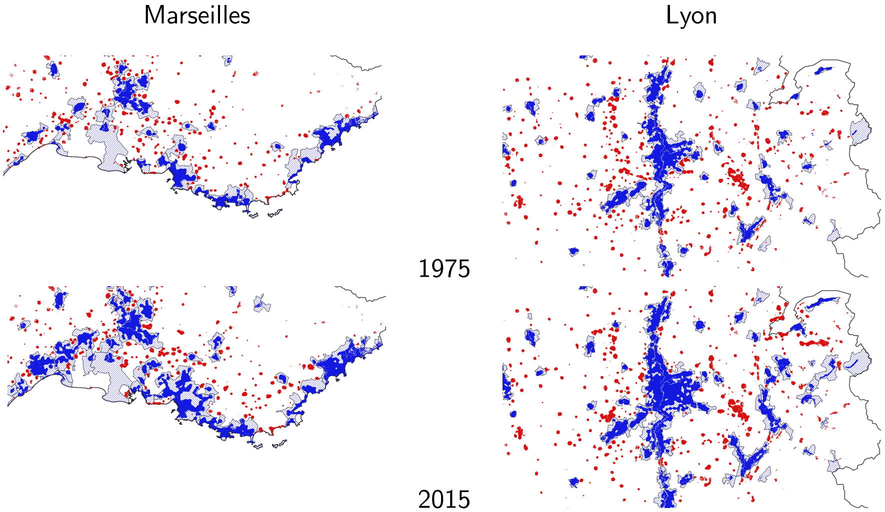
Decompose effects of changes in city population into effects of:

- Differential fertility rates
- Internal migrations
- International migrations
- Role of agglomeration economies in wage disparities and aggregate productivity

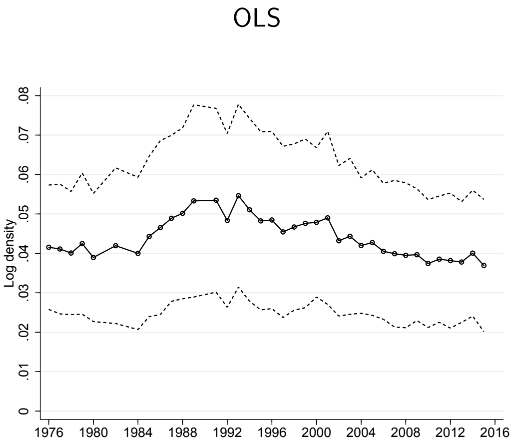
City delineations - Paris and Lille, 1975 and 2015

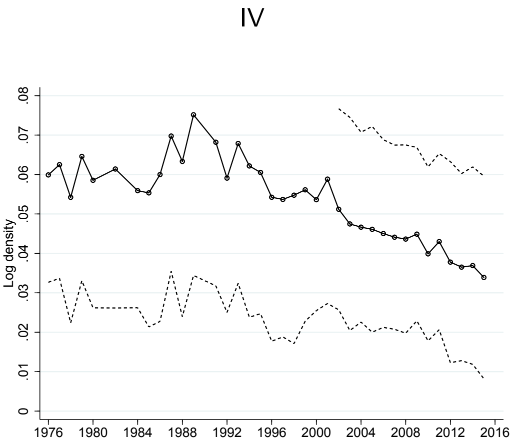


City delineations - Marseilles and Lyon, 1975 and 2015

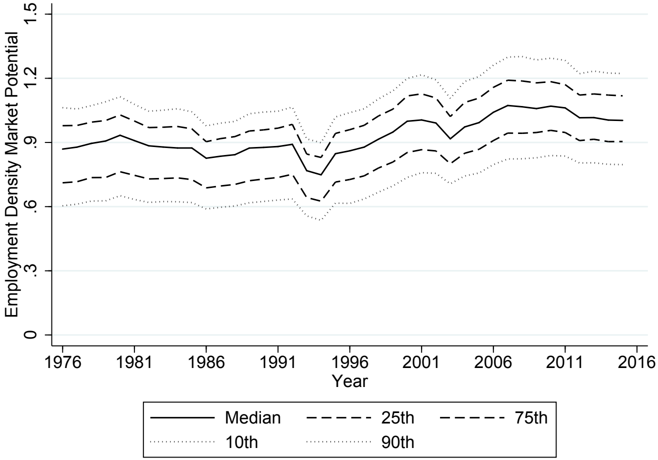


2nd stage regression - moving agg., log-density effects



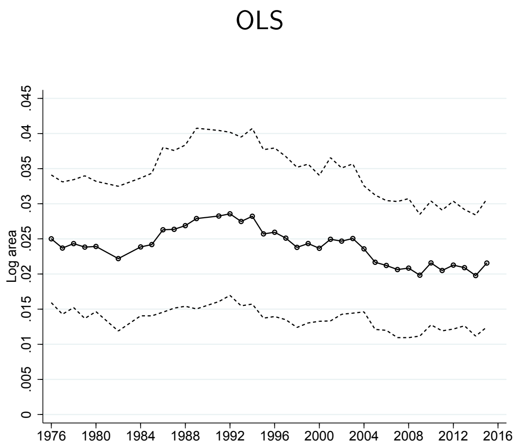


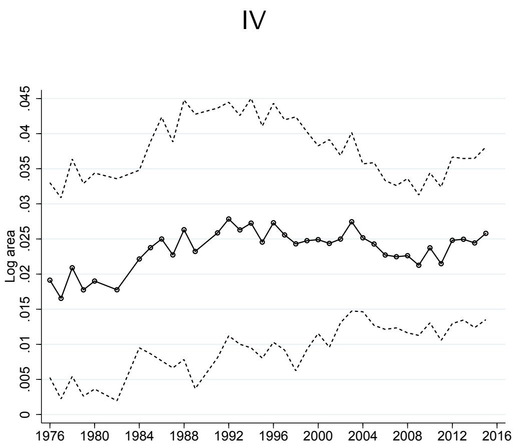
Moments of city MP distribution, 1976-2015 period



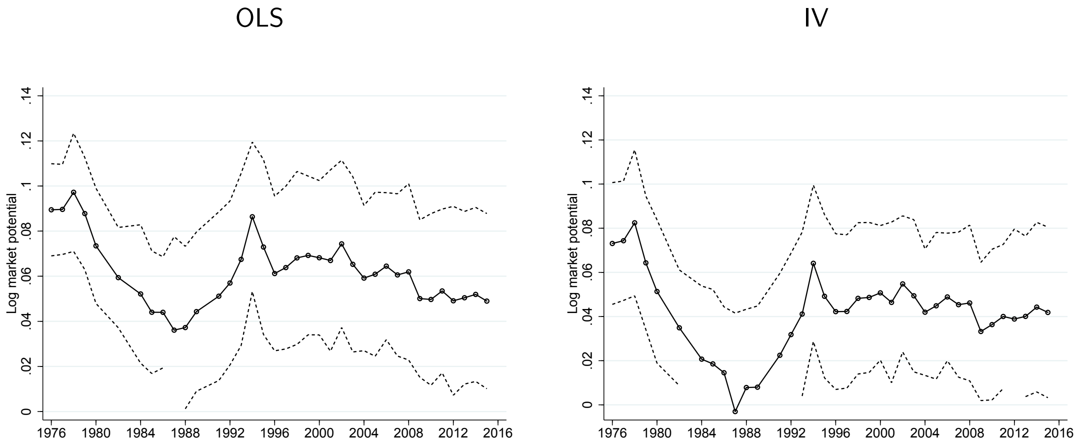
Market potential: $MP_{ag,t} = \sum_{z \neq ag} \frac{den_{z,t}}{dist_{z,ag}}$

2nd stage regression - moving agg., log-area effects

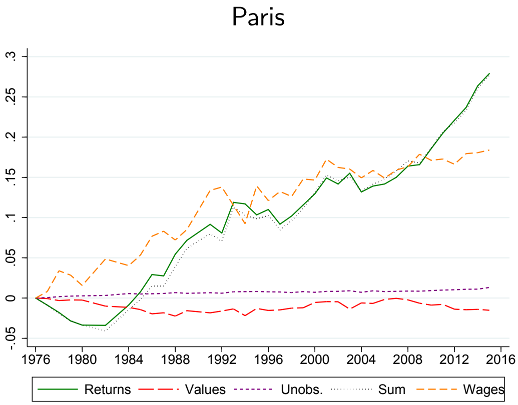


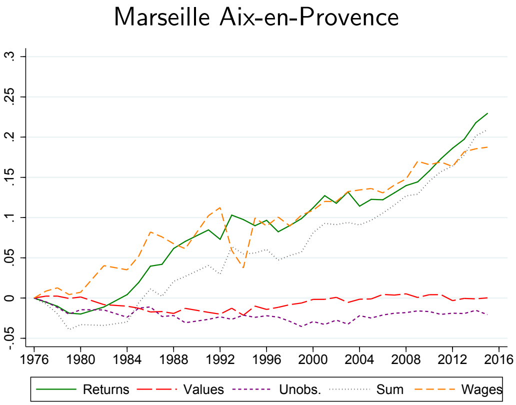


2nd stage regression - moving agg., log-MP effects

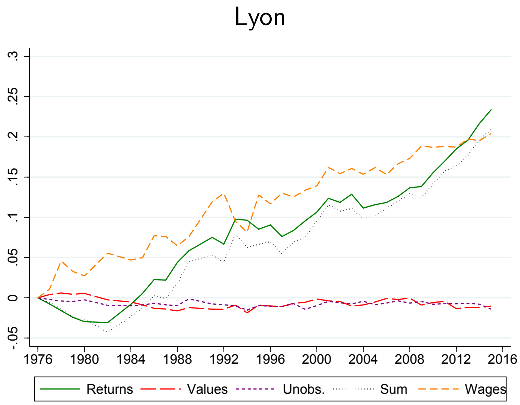


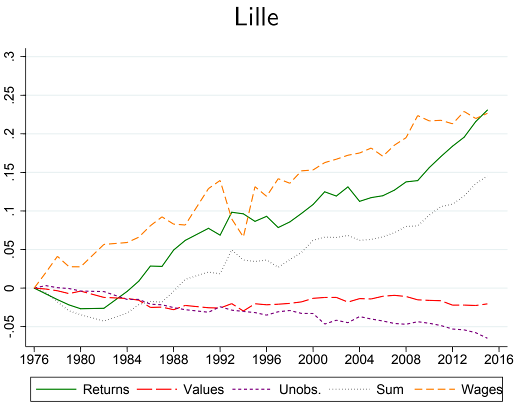
Decomposition of wage growth: Paris and Marseille





Decomposition of wage growth: Lyon and Lille





Robustness

- **Different measures of agglomerations**:
  - City size constant over time.
  - Urban area (Insee definition)
  - Urban units (Insee definition)
  - Smaller kernel
- **Learning effects** (cf. De la Roca and Puga, 2017)