Churning in Cities

The Volatility Advantage of Dense Labor Markets

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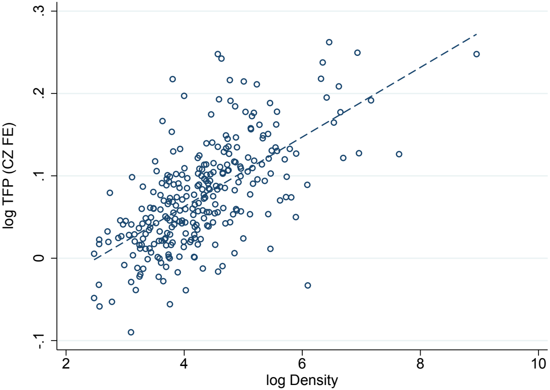
Roadmap

Motivation

The productivity advantage of dense cities



January 2015 cross section of single-plant firms in DADS Postes. Average log productivity ▸ Details conditional on firm characteristics: sector, size bin, age. CZ stands for commuting zone. Slope: 0.042*. Results are robust to controlling for firm growth.

Motivation

1. Productive firms sort into larger/denser cities
   → Low-selection puzzle (Combes et al., 2012)
2. Pooling externalities: agglomeration facilitates cross-hiring between firms (Krugman, 1992)
   → High-productivity firms benefit the most from being able to hire more quickly (Bilal, 2023)
   → High-volatility firms benefit the most from being able to hire more quickly (this paper)

What we do

1. Empirical facts about firm labor volatility across cities
   → Positive correlation between (idiosyncratic component of) employment volatility and city density, conditional on firm productivity
2. Theoretical model, where
   → Firms are heterogeneous both along the productivity and the volatility dimensions
   → Firms' labor demand strategies depend on tightness of the local labor market
3. Empirical model of firm location choice, where firms choose location based on productivity and volatility

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Theory

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Concluding remarks

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Data

- Use French matched employer-employee data 2010-2019 at monthly frequency
  - → Develop measure to capture idiosyncratic component of labor demand volatility
  - → 12 sectors: manufacturing, construction, services (including non-tradables)
- Cities are defined as Commuting Zones (CZs)
  - → $N = 280$ partition continental France
  - → Density of working-age population: measure of urban scale

Firm labor demand volatility

Volatility of employment based on Davis et al. (2006)

- For each firm f and month t:

$$\sigma_{ft} = \sqrt{\frac{1}{2\omega + 1} \sum_{\tau=-\omega}^{\omega} \left(\gamma_{f,t+\tau} - \bar{\gamma}_{ft}\right)^2}$$

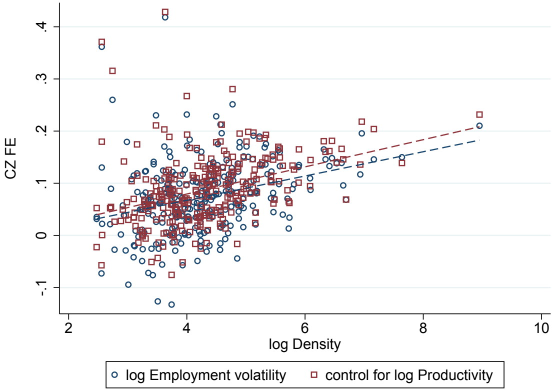
  → γ_{ft} growth rate of number of employees between $t - 12$ and t

  → Time window $2\omega + 1 = 35$: approximately 3 years

  → $\bar{\gamma}_{ft}$: mean value of γ_{ft} over the period

- γ_{ft} residualized in the sector×period and the CZ×period dimensions to measure "idiosyncratic" volatility (di Giovanni, Levchenko, and Mejean, 2014)

Fact 1: Labor demand volatility increases with city size



January 2015 cross section of single-plant firms. Average labor demand volatility conditional on firm characteristics: sector, size bin, age, firm growth (in blue) and log productivity (in red). Slopes: 0.023*** and 0.026***.

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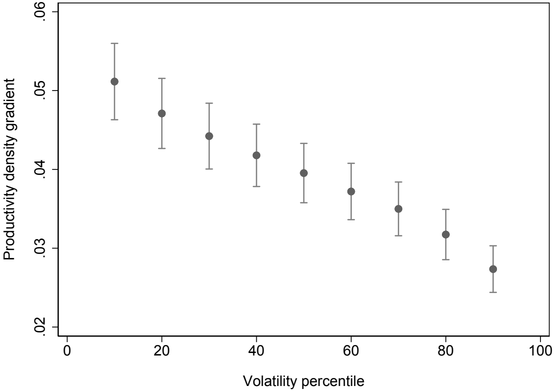
Fact 2: The productivity-density gradient decreases with labor demand volatility



Notes: Conditional correlation between log productivity of firms and density of the commuting zone where they locate, along the distribution of firms' employment volatility. Controls: sector, size bin, firm age, firm growth, and employment volatility. January 2015 cross section of firms.

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Set-up

See Mortensen and Pissarides (1994)

We focus on firms' decision to churn

- Problem of single-job, risk-neutral firms, in continuous time
  - → Partial equilibrium: workers are homogeneous, immobile, always accept offered jobs and do not search on the job
  - → The economy operates at steady-state

- Firms are heterogeneous in terms of
  - → their mean productivity $p \in [\underline{p}, \overline{p}]$ (known ex ante)
  - → their demand volatility $\varepsilon \in [0, 1]$ (known ex ante)

⇒ Sales fluctuate between $p(1 + \varepsilon)$ in high state (h) and $p(1 - \varepsilon)$ in low state (l) at rate σ

Firms' choice

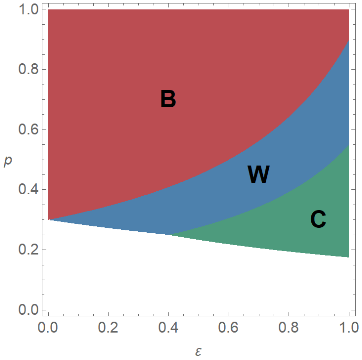
1. A location M $\rightarrow$ operational costs $R(M)$ and job-filling rate $\mu(M)$
   - $\rightarrow$ Assumptions: $R'(M) > 0$ and $\mu'(M) \geq 0$
   - $\rightarrow$ No fixed cost $\rightarrow$ No selection at entry ($\neq$ Melitz, 2003), selection on city size (as in Gaubert, 2018)

2. A strategy s, i.e. what to do in low state
   - $\rightarrow$ Business as usual (B): no adjustment to labor demand
   - $\rightarrow$ Wait-and-see (W): no hiring in low state
   - $\rightarrow$ Churning (C): no workers in low state

$\Rightarrow$ Given (M, s), firms alternate between being vacant, filled or idle

▸ Value functions

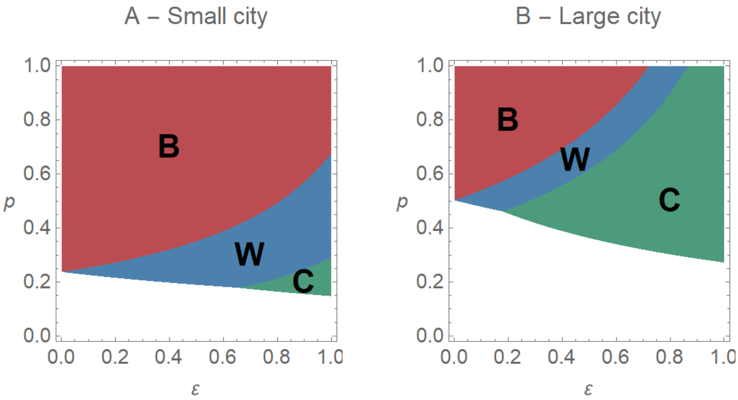
Choosing a strategy



Calibration: $c = 0.1$, $\sigma = 0.01$, $r = 0.01$, $\delta = 0.01$, $\mu(M) = 0.02$, $R(M) = 0.2$, $\chi = 0$, $\overline{p} = 1$.

1. Churning is adopted by more volatile firms
2. Churning allows less productive firms to operate ▸ Proof

Comparative statics



Calibration: $c = 0.1$, $\sigma = 0.01$, $r = 0.01$, $\delta = 0.01$, $\chi = 0$, $\mu(M) = \sigma + B\sqrt{M}$, $R(M) = c + BM^2$, $B = 5/1000$, $\overline{p} = 1$ and $M \in \{2, 8\}$.

1. Denser cities have a higher share of churning firms ▸ Proof
2. Low-productivity firms are more volatile in denser cities

Sorting patterns: key take-aways

- Location level ▸ Illustration
    1. The share of churning firms increases with density ▸ Fact 1
    2. The productivity-density gradient decreases with volatility ▸ Fact 2

- Firm level
    1. More volatile firms sort into denser cities
    2. More productive firms sort into denser cities, especially if they are more volatile

$\Rightarrow$ Location choice model

Roadmap

Firm location choice

- Goal: show that all else equal, firms sort on volatility
- One-stage discrete choice model based on conditional logit estimator
  - → Location choice driven by CZ density × firm{volatility, productivity}
  - → Location controls:
    - general: share of managers and college-educated
    - firm specific: localisation economies ▸ Details
- Sample of new firm openings in 2010-2019

From the model to the data

Need an exogenous measure of volatility: demand volatility

- Measures the firm's exposure to product-specific demand variations
- Firm's product portfolio (in first 2 years since firm's creation)
- Interact with growth rate of product demand (world import data)
- Sum across all products of the firm ⇒ growth of firm-specific product demand $\gamma^D_{f,t+\tau}$
- Calculate volatility: the s.d. over 12 months prior to firm creation

$$\gamma^D_{f,t} = \sqrt{\frac{1}{12}\sum_{\tau=-11}^{0}\left(\gamma^D_{f,t+\tau} - \overline{\gamma^D}_{f,t}\right)^2}$$

→ with $\overline{\gamma^D}_{f,t}$ mean value of $\gamma^D f, t$ over the period

▸ A selected sample ▸ Demand and employment volatility

Results

	CZ choice					
	(1)	(2)	(3)	(4)	(5)	(6)
M	0.551***	0.549***	0.550***	0.550***	0.338***	0.337***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.027)	(0.027)
$M \times \varepsilon$			0.033**	0.032**	0.033**	0.027**
			(0.018)	(0.018)	(0.016)	(0.017)
$M \times p$		0.058**		0.057**	0.048**	0.053**
		(0.021)		(0.020)	(0.018)	(0.015)
$M \times \varepsilon \times p$						0.030**
						(0.013)
CZ controls	No	No	No	No	Yes	Yes
Pseudo R2	0.038	0.039	0.038	0.039	0.045	0.045

Notes: Coefficient estimates from a conditional logit model with firm fixed effects. The sample is based on all firm entries from January 2010 to December 2019 (1,682 entries, N=470,960). M is the log of CZ density, ε is the standardized value of demand volatility, and p is the standardized value of productivity. Standard errors in round parentheses. Results are significant at the 10% significance level (*), 5% level (**), 1% level (***).

- Interaction coefficients robust to region, department, and even CZ FE

Roadmap

Quantitative insights

Work in progress

- What is the role of churning (C) and sorting on volatility (ε) on labor market pooling externalities?
- Use model to examine how the job filling rate $\mu(M)$ changes
  1. With and without the possibility of churning C
  2. With and without sorting on ε
- $\mu(M)$ is now a function of labor market tightness $= \frac{V}{U}$
  - $\rightarrow$ Derive V for each strategy in each city M
  - $\rightarrow$ $U \Rightarrow$ unemployment rate is 10% in each city
  - $\rightarrow$ Numerical simulation $\Rightarrow \mu(M)$ in each city, accounting for the possibility that firms churn
- Result: compared to a model without churning, job filling rates are increased by 8% at the median city density

Quantitative insights

Work in progress

- Up to now: direct effect of churning on pooling externalities
  - → More expensive to operate in larger cities ⇒ if firms are volatile and have the possibility of churning, they will do this more in larger cities
  - → Churning has positive labor market pooling externalities
- Add firm sorting on volatility
  - → Location choice model: distribution of ε by city size
  - → Indirect effect: if firms can choose location based on ε, they will sort into larger cities ⇒ more volatile firms in large cities
- Result: this increases job filling rates by an additional 1% at the median city density
  - → Sorting on volatility further raises the labor market pooling externalities of churning

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Conclusion

New facts about firm location decisions

- Firms that anticipate a volatile activity locate in larger cities:
  - → There is a volatility-density nexus
  - → On top of the well-known productivity-density nexus
- Dense labor market provide “insurance” against volatility:
  - → By enabling labor churning
- Churning and firm sorting on volatility have positive labor market pooling externalities

Roadmap

Productivity

- Combes et al. (2012): for firm f and year y,

$$ln(V_{fy}) = \beta_{0y} + \beta_1 ln(k_{fy}) + \beta_2 ln(l_{fy}) + \sum_{s=1}^{3} \sigma_s l_{sfy} + \phi_{fy}$$

- V_{fy}: value-added, k_{fy}: capital, l_{fy} labor (n. paid hours in y)
- 3 skill levels $\Rightarrow$ l_{sfy}: share of firm's workers with skill level s
- Estimate the equation separately for each 2-digit sector using the Levinshon-Petrin estimation technique, with the Ackerberg, Caves, and Frazer (2015) correction.
- Robustness: OLS TFP is residual $\Rightarrow$ all results hold

$$\hat{\phi}_{ft} = ln(V_{ft}) - \hat{\beta}_{0t} - \hat{\beta}_1 ln(k_{ft}) - \hat{\beta}_2 ln(l_{ft}) - \sum_{s=1}^{3} \hat{\sigma}_s l_{sft}$$

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Volatility-density gradient: Robustness

Dep variable	log volatility of				
	idiosyncratic	idiosyncratic	idiosyncratic		idiosyncratic
	L, yoy	L, yoy	L, yoy	L, yoy	L, mom
	(1)	(2)	(3)	(4)	(5)
log CZ density	.041***	.02***	.034***	.035***	.017***
	(.000)	(.001)	(.001)	(.001)	(.001)
log employment			-.386***	-.389***	-.364***
			(.001)	(.001)	(.001)
log age			-.181***	-.183***	-.113***
			(.001)	(.002)	(.001)
log productivity			-.075***	-.076***	-.056***
			(.002)	(.002)	(.002)
Firm growth			.511***	.506***	.313***
			(.003)	(.003)	(.003)
Share temp workers			.650***	.655***	.839***
			(.008)	(.007)	
sector FE	No	Yes	Yes	Yes	Yes
# Obs	330,552	330,552	330,552	330,552	330,552
Adjusted R^2	.009	.064	.435	.416	.422

Dependent variable: log σ_{ft}. January 2015 cross section of single-plant firms. In column (4), the dependent variable is the volatility of hours. To be consistent, employment and growth are also computed based on hours. *** indicates statistical significance at the 1% level.

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Value functions

$$
\begin{aligned}
rV_s^h(p,\varepsilon,M) &= -c+\mu(M)[F_s^h(p,\varepsilon,M)-V_s^h(p,\varepsilon,M)] \\
&+ \sigma[W_s(p,\varepsilon,M)-V_s^h(p,\varepsilon,M)] \\
rV_s^l(p,\varepsilon,M) &= -c+\mu(M)[F_s^l(p,\varepsilon,M)-V_s^l(p,\varepsilon,M)] \\
&+ \sigma[V_s^h(p,\varepsilon,M)-V_s^l(p,\varepsilon,M)] \\
rF_s^h(p,\varepsilon,M) &= p(1+\varepsilon)-R(M)+\delta[V_s^h(p,\varepsilon,M)-F_s^h(p,\varepsilon,M)] \\
&+ \sigma[C_s(p,\varepsilon,M)-F_s^h(p,\varepsilon,M)] \\
rF_s^l(p,\varepsilon,M) &= p(1-\varepsilon)-R(M)+\delta[W_s(p,\varepsilon,M)-F_s^l(p,\varepsilon,M)] \\
&+ \sigma[F_s^h(p,\varepsilon,M)-F_s^l(p,\varepsilon,M)] \\
rA_s(p,\varepsilon,M) &= \sigma[V_s^h(p,\varepsilon,M)-A_s(p,\varepsilon,M)]
\end{aligned}
$$

- with c vacancy cost and δ exogenous match destruction rate

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Choosing a strategy

Business-as-usual ≻ Wait-and-see

- Business-as-usual ≻ Wait-and-see ⇔

$$\begin{cases} V_B^h + W_B & > & V_W^h + W_W \\ V_B^h + W_B & > & 0 \end{cases} \Leftrightarrow p > p_{BW}(\varepsilon, M) \geq p_B(M)$$

with

$$\begin{aligned} p_B(\overset{?}{M}) & \equiv & R(M) + \frac{c(r+\delta)}{\mu(M)} \\ p_{BW}(\varepsilon, M) & \equiv & f(\overset{+}{\varepsilon}, \overset{+}{M}) p_B(M) \end{aligned}$$

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Choosing a strategy

Wait-and-see ≻ Churning

- Wait-and-see ≻ Churning ⇔

$$\begin{cases} V_W^h + W_W & > & V_C^h + W_C \\ V_W^h + W_W & > & 0 \end{cases} \Leftrightarrow p > p_{WC}(\varepsilon, M) \geq p_W(M)$$

with

$$\begin{aligned} p_W(\varepsilon, M) &\equiv& g(\overset{-}{\varepsilon})p_B(M) \leq p_B(M) \\ p_{WC}(\varepsilon, M) &\equiv& p_{BW}(\varepsilon, M) - h(\overset{+}{\varepsilon}, \overset{-}{M}) \end{aligned}$$

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Choosing a strategy

Churning > Wait-and-see and Business-as-usual

$$\begin{cases} V_C^h + W_C & > & V_W^h + W_W \\ V_C^h + W_C & > & V_B^h + W_B \\ V_C^h + W_C & > & 0 \end{cases} \Leftrightarrow \begin{cases} p < p_{WC}(\varepsilon, M) \quad (< p_{BW}(\varepsilon, M)) \\ p > p_C(\bar{\varepsilon}, \overset{?}{M}) \end{cases}$$

Note: Churning exists iff

$$\begin{aligned} p_{WC}(\varepsilon, M) \quad &> \quad p_C(\varepsilon, M) \Leftrightarrow \varepsilon > \varepsilon^*(M) \\ \Rightarrow \varepsilon^*(M) < 1 \quad \Leftrightarrow & \quad \frac{c}{\mu(M)} < \frac{R(M)}{\sigma} \end{aligned}$$

i.e. expected vacancy cost < expected operational cost under low state

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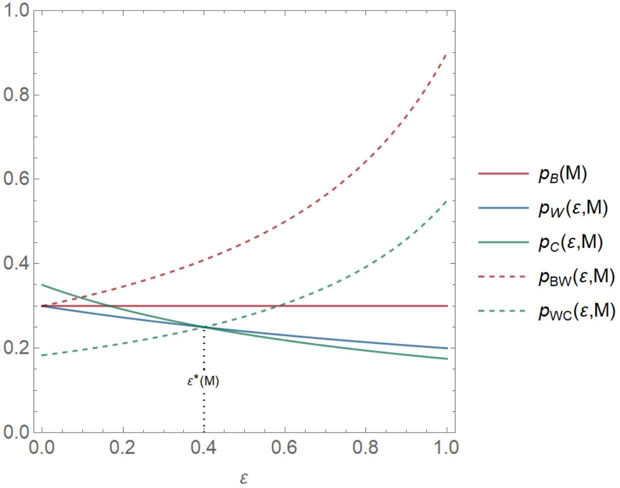
Choosing a strategy: Summary



Calibration: $c = 0.1,\ \sigma = 0.01,\ r = 0.01,\ \delta = 0.01,\ \chi = 0\ \mu(M) = 0.02,\ R(M) = 0.2,\ \overline{p} = 1.$

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Equilibria across city sizes

1. The share of churning firms increases with city size
   - → Under A1 and A2: $\partial p_{BW}(\varepsilon, M)/\partial M > 0 \Rightarrow$ red area decreases with city size
   - → Under no assumption: $\partial[p_{BW}(\varepsilon, M) - p_{WC}(\varepsilon, M)]/\partial M < 0$. Under A2: $\partial p_W(\varepsilon, M)/\partial M > 0 \Rightarrow$ blue area decreases with city size
   - → Under A2: $\partial[p_{WC}(\varepsilon, M) - p_C(\varepsilon, M)]/\partial M > 0$. Under no assumption: $\partial \varepsilon^*(M)/\partial M < 0 \Rightarrow$ green area increases with city size
2. Structural volatility attenuates firm selection with respect to density
   - → The productivity-volatility substitution at entry is represented by $p_W(\varepsilon, M)$ for $\varepsilon \in [0, \varepsilon^*(M)]$ and $p_C(\varepsilon, M)$ for $\varepsilon \in [\varepsilon^*(M), 1]$
   - → Under A2, $\partial^2 p_W(\varepsilon, M)/\partial\varepsilon\partial M < 0$ and $\partial^2 p_C(\varepsilon, M)/\partial\varepsilon\partial M < 0$ $\Rightarrow$ volatility and productivity are more substitute for allowing the entry of firms in larger cities

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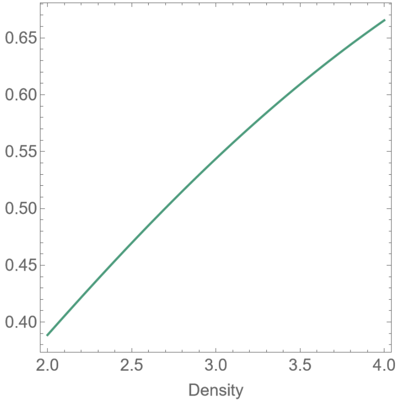
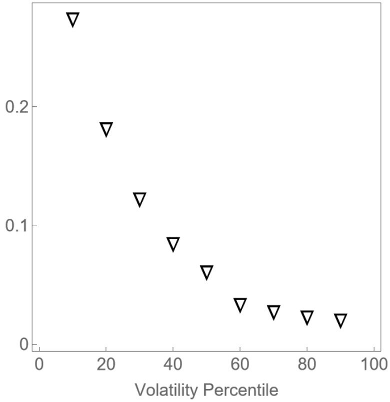
Illustration

A - Share of churning firms



B - Productivity gradient



Calibration: $c = 0.1$, $\sigma = 0.01$, $r = 0.01$, $\delta = 0.01$, $\mu(M) = \sigma + B\sqrt{M}$, $R(M) = c + BM^2$, $B = 5/1000$, $\overline{p} = 1$. We assume that p and ε are independent, ε is uniformly distributed over $[0, 1]$ and p follows a (truncated) Pareto distribution, so that $h(p, \varepsilon) = 4(0.1^4)/p^5$. The optimum is found by a numerical search. Back to Main

Localization economies

Localization economies: sectoral network following Mayer, I. Mejean, and Nefussi (2010)

$$SN^{s}_{i,y-1} = \sum_{u<y} \sum_{a} D^{s}_{ai,u} \tag{1}$$

- $D^{s}_{ai,u}$: dummy variable equal to one for all firms a of sector s located in CZ i and created in year u or before
- Only include firms with positive employment
- Specific to the firm's sector

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Demand volatility: a selected sample

Mean characteristics of samples

	Not Missing	Missing	T-test
Size	24.95	10.12	57.55
	(35.44)	(20.22)	[0.00]
Age (years)	24.21	16.89	68.69
	(14.49)	(12.13)	[0.00]
log CZ Density	5.03	5.62	-55.00
	(1.43)	(1.78)	[0.00]
log Productivity	2.93	3.19	-57.50
	(0.59)	(0.71)	[0.00]
Growth of employment	0.01	0.04	-14.33
	(0.23)	(0.33)	[0.00]
log Employment volatility	-2.24	-1.72	-88.52
	(0.79)	(0.77)	[0.00]
residualized log Employment volatility	-1.78	-1.75	-6.25
	(0.61)	(0.63)	[0.00]
N observations	19,297	311,255	

Notes: Means and standard deviations in round brackets, p-values of T-tests in square brackets. Residualized log employment volatility is the residual from regressing employment volatility on CZ, sector, firm size, and age FEs, firm growth, as well as log productivity.

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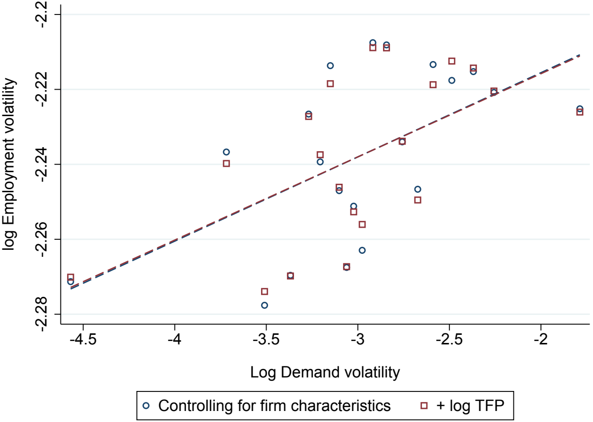
Demand volatility is predictive of employment volatility



January 2015 cross section of single-plant firms with information on demand volatility. Correlation is conditional on CZ FEs and firm characteristics: sector, size bin, age, growth rate.

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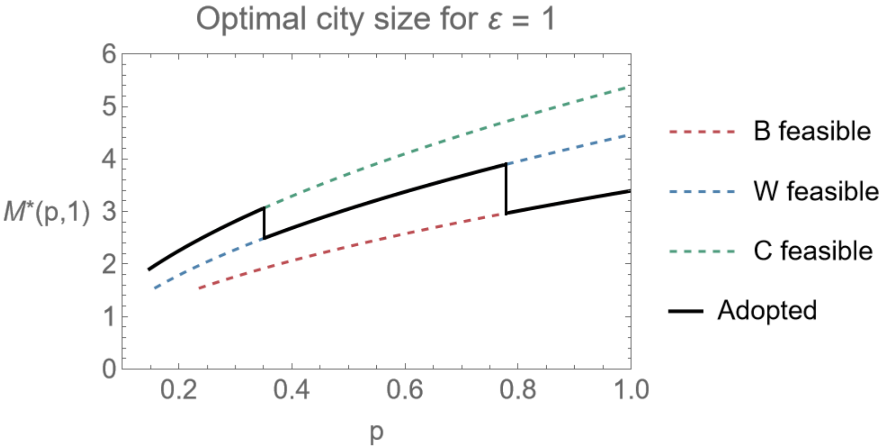
City choice for the most volatile firms



Calibration: $c = 0.1$, $\sigma = 0.01$, $r = 0.01$, $\delta = 0.01$, $\mu(M) = \sigma + B\sqrt{M}$, $R(M) = c + BM^2$, $B = 5/1000$, $\overline{p} = 1$. The optimum is found by a numerical search.

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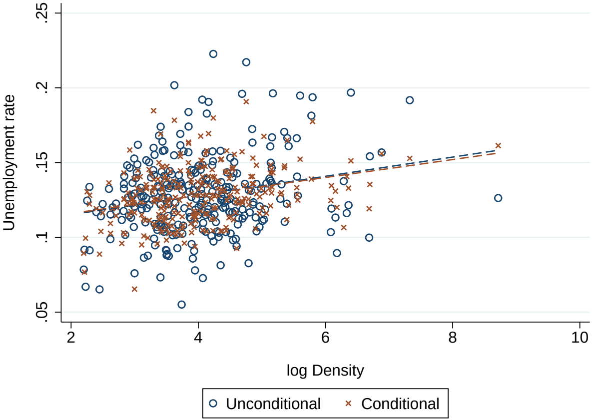
CZ unemployment and density



Notes: Unemployment rate of the working-age population (aged 15-54) by commuting zone as a function of (working-age) population density. Red: controlling for the share of university graduates in the population above 15, the share of managers among employed workers, the shares of old and young workers in the working-age population, and 22 (old) region fixed effects. Source: 2018 Census

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References I

Ackerberg, Daniel A., Kevin Caves, and Garth Frazer (2015). "Identification Properties of Recent Production Function Estimators". *Econometrica* 83.6, pp. 2411–2451.

Bilal, Adrien (Mar. 2023). "The Geography of Unemployment". *The Quarterly Journal of Economics*.

Combes, Pierre-Philippe et al. (2012). "The Productivity Advantages of Large Cities: Distinguishing Agglomeration From Firm Selection". *Econometrica* 80 (6), pp. 2543–2594.

Davis, Steven J et al. (2006). "Volatility and Dispersion in Business Growth Rates: Publicly Traded versus Privately Held Firms". *NBER Macroeconomics Annual* 21.

di Giovanni, Julian, Andrei Levchenko, and Mejean (2014). "Firms, Destinations, and Aggregate Fluctuations". *Econometrica* 82 (4), pp. 1303–1340.

Krugman, Paul (Dec. 1992). *Geography and Trade*. Vol. 1. The MIT Press.

References II

Mayer, T., I. Mejean, and B. Nefussi (2010). "The location of domestic and foreign production affiliates by French multinational firms". *Journal of Urban Economics* 68 (2), pp. 115–128.

Mortensen, Dale T. and Christopher A. Pissarides (1994). "Job Creation and Job Destruction in the Theory of Unemployment". *The Review of Economic Studies* 61.3, pp. 397–415.