Labor Market Power and Development

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- Differences in GDP per capita across countries explained by differences in aggregate efficiency (Hsieh and Klenow 08).
- Imperfect competition in the labor market leads to efficiency losses and lower aggregate output (Manning 11, Berger 22).

Q: Can differences in labor market power explain the observed differences in GDP p.c. across countries?

This paper

- Build a GE model of oligopsony, featuring
  - Firm heterogeneity in productivity and amenities;
  - Firm granularity and endogenous entry.

- Estimate the model separately for countries with different levels of GDP p.c. using indirect inference.
  - Key parameter: Labor Supply Elasticities.
  - Main target: Firm-Size Wage Premium.

- Quantify the effect of differences in labor market power on GDP p.c. along the development ladder.
  - What would the GDP p.c. in low-income countries be if their labor markets were as competitive as those in high-income countries?

- The labor supply elasticity is increasing with development.
  - estimates range from **0.84** in low-income countries to around **3.14** in high-income countries
  - $\Longrightarrow$ wage markdowns range from **54%** in low-income countries to **24%** in high-income countries.

- Low-income countries would see an increase of up to **45%** in output p.c. with labor supply elasticities comparable to those of high-income countries.

- Differences in labor supply elasticities account for **15%** and **77%** of observed differences in GDP p.c. and wage dispersion across firms.

- Labor market power estimation
  - Azar et al. 22; Amodio and De Roux 23; Brooks et al. 22.
- Welfare implications of labor market power
  - Card et al. 18; Dustmann et al. 22; Berger et al. 22.
- Cross-country income differences and frictions/distortions
  - Bento and Restuccia 17; Guner and Ruggieri 22.

- Static economy.
- Discrete number $\bar{J}$ of heterogeneous potential entrants j, differing in:
  - Productivity $z_j \sim \text{Pareto}(\alpha, \theta)$
  - Amenities $a_j \sim \text{Uniform}(0, \bar{a})$
- In equilibrium only $J^* \leq \bar{J}$ firms enter.
- Continuum of homogeneous workers i of measure L.
- Preference shock over firm$-j$ amenities:
  - $v_{ij} \sim \text{Gumbel}(0, 1)$

- Utility for worker i from working at firm j:

$$U_{ij} = \epsilon^L \ln(w_j) + a_j + v_{ij}.$$

  where w_j is the wage paid by firm j

- Probability of working at firm j:

$$p_j(\vec{\mathbf{w}}_J, J) = \frac{\exp\left(\epsilon^L \ln(w_j) + a_j\right)}{\sum_{k=1}^{J} \exp\left(\epsilon^L \ln(w_k) + a_k\right)}$$

  where $\vec{\mathbf{w}}_J = [w_1, ..., w_J]$.

- Firm-j's labor supply:

$$L_j(\vec{\mathbf{w}}_J, J) = L \times p_j(\vec{\mathbf{w}}_J, J).$$

- Firms' production function

$$Y_j = z_j \ln(L_j)$$

- Profit maximization problem:

$$\max_{w_j} \quad \pi_j(\vec{\mathbf{w}}_J, J) = z_j \ln(L_j(\vec{\mathbf{w}}_J, J)) - w_j L_j(\vec{\mathbf{w}}_J, J)$$
$$\text{s.t. } L_j(\vec{\mathbf{w}}_J, J) = L \times p_j(\vec{\mathbf{w}}_J, J)$$

- Firms enter if $\pi_j(\vec{\mathbf{w}}_J, J) \geq c_e$.

Given $\{L, \epsilon^L, \bar{J}, c_e\}$ and the distributions of firm productivity and amenities, an equilibrium is a vector of labor supply decisions $\vec{\mathbf{p}}^*_{J^*} = [p^*_1, ..., p^*_{J^*}]$, a vector of wages $\vec{\mathbf{w}}^*_{J^*} = [w^*_1, ...w^*_J]$, and a number of firms J^* such that:

- $\vec{\mathbf{p}}^*_{J^*}$ solves the workers' problem;
- $\vec{\mathbf{w}}^*_{J^*}$ solves the firms' problem, i.e.

$$w^*_j = \arg\max_{w_j} \pi_j(\vec{\mathbf{w}}^*_J, J^*) \quad \forall j = 1, ...J^*;$$

- J^* is such that free entry condition holds, i.e.
  - $\pi_j(\vec{\mathbf{w}}^*_J, J^*) \geq c_e \quad \forall j = 1, ...J^*$
  - $\pi_j(\vec{\mathbf{w}}^*_{J^*+1}, J^* + 1) \geq c_e \quad \not\forall j = 1, ...J^* + 1$
  - $J^* < \bar{J}$

- Assume J^* to be sufficiently large $\implies$ no strategic interaction (Card et al., 18)

- Firm$-j$'s labor supply:

$$L_j = Lp_j(w_j) \quad \text{and} \quad p_j(w_j) \approx \xi \exp\left(\epsilon^L \ln(w_j) + a_j\right)$$

  where ξ is a market-level constant

- Firm-level wage-size relationship

$$\ln(w_j) = \frac{1}{\epsilon^L} \ln(L_j) - \frac{1}{\epsilon^L} \left[\ln(L) + \ln(\xi) + a_j\right].$$

P1: The conditional firm-size wage premium is inversely related to the labor supply elasticity.

- Assume J^* to be sufficiently large $\implies$ no strategic interaction (Card et al., 18)

- Firm-j's equilibrium employment:

$$\ln(L_j) = \frac{\epsilon^L}{1+\epsilon^L}\left[\ln(z_j) + \ln\left(\frac{\epsilon^L}{1+\epsilon^L}\right)\right] + \frac{1}{1+\epsilon^L}[\ln(L) + \ln(\xi) + a_j]$$

which implies:

$$\text{var}(\ln(L_j)) = \left(\frac{\epsilon^L}{1+\epsilon^L}\right)^2 \text{var}(\ln(z_j)) + \left(\frac{1}{1+\epsilon^L}\right)^2 \text{var}(a_j)$$

P2: When firm-level productivity is sufficiently dispersed, the firm-size dispersion increases with the elasticity of the labor supply ϵ^L.

- Assume J^* to be sufficiently large $\implies$ no strategic interaction (Card et al., 18)

- Firm-j's equilibrium wage:

$$\ln(w_j) = \frac{1}{1+\epsilon^L}\ln(z_j) - \frac{1}{1+\epsilon^L}a_j + C$$

which implies:

$$\text{var}(\ln(w_j)) = \frac{1}{(1+\epsilon^L)^2}\text{var}(\ln(z_j)) + \frac{1}{(1+\epsilon^L)^2}\text{var}(a_j)$$

P3: The wage dispersion across firms is inversely related to the labor supply elasticity ϵ^L.

- Two sources of labor misallocation:
  - **1. Amenities**
    Since high-amenity firms have market power, they can enter and survive in the economy even if their productivity is low.
  - **2. Strategic interaction**
    When J^* is sufficiently small, the elasticity of labor supply to wages becomes firm-specific and a function of labor market share $\implies$ dispersion in markdown across firms, with larger firms setting higher markdowns.

Summary

- The model yields three predictions:
  - **P1:** The elasticity of wages to firm employment is inversely related to the labor supply elasticity.
  - **P2:** The firm size dispersion is increasing with the labor supply elasticity.
  - **P3:** The firm wage dispersion is decreasing with the labor supply elasticity.
- Limited labor market competition hinders allocative efficiency

- Endogeneity rules out reduced form estimation of the equilibrium conditions to recover ϵ^L:
  - Wages are jointly determined by labor demand and supply.

- Endogeneous entry and unobserved amenities lead to estimation bias.
  - We cannot simply use the OLS estimate of

$$\ln(w_j) = \alpha + \beta \ln(L_j) + \eta_j$$

because

$$\hat{\beta} \neq \frac{1}{\epsilon^L}$$

- This paper's approach: **indirect inference**.

We merge 4 datasets to construct the targeted moments.

- Firm-size wage premium, wage dispersion, and the number of firms taken from World Bank Enterprise Surveys (WBES).
- Average firm size taken from Bento and Restuccia (17).
- Firm size dispersion taken from Poschke (18).
- GDP per capita in PPP terms (2017 USD) taken from the World Bank.

We target the average local labor market (industry-location pair) in 4 artificial countries (representative countries at different stages of development) + Colombia

Sample selection: countries with GPC pc $\geq$ 2000 USD

- Parameters to estimate: $\vartheta = \{\bar{J}, \epsilon^L, L, \alpha, \theta, \bar{a}, c_e\}$.
- $\bar{J}$ calibrated directly from the data (Amodio et al 22).
- The other 6 parameters are estimated via SMM by targeting:
  - Number of firms.
  - Average firm size.
  - Firm size dispersion.
  - Wage dispersion across firms.
  - Firm-size wage premium.
  - GDP per capita.

Firm-size wage premium across countries

- Estimate, separately by country, the following firm-level regression

$$\ln w_{jt} = \alpha + \beta \ln L_{jt} + X_{jt}\gamma + \mu_t + \mu_{s(j)} + \mu_{o(j)} + \epsilon_{jt}$$

  where
  - w_{jt}: annual earnings paid by firm j at time t (labor cost x employee)
  - L_{jt}: number of full-time employees firm j at time t
  - μ_t: year FEs
  - $\mu_{s(j)}$: 3-digit industry FEs
  - $\mu_{o(j)}$: location FEs

- Use the estimated firm-size wage premium $\hat{\beta}$ in the list of targets

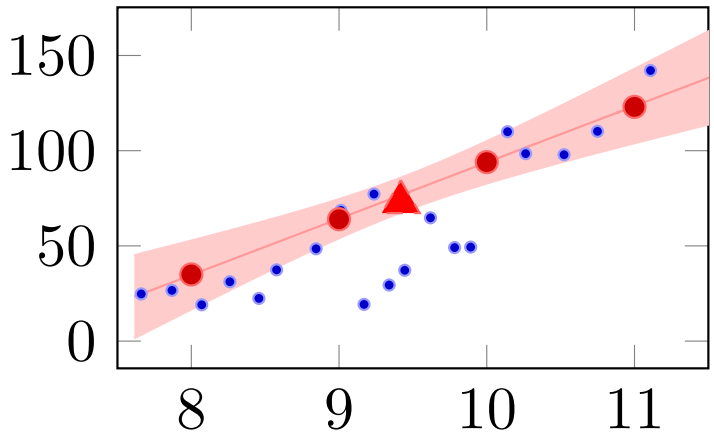
- For each moment, estimate an auxiliary regression:

$$Y_i = \alpha_1 + \alpha_2 \log \text{GDPpc}_i + \eta_i$$

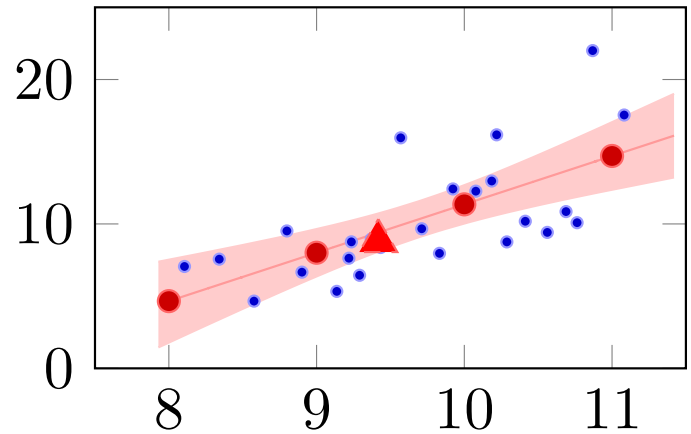
where Y_i is:

  - Mean number of firms, $\bar{J}_i$
  - Average firm size, $\bar{\ell}_i$
  - Firm size dispersion, $\text{IQR}_i(\ell)$
  - Firm-wage dispersion, $\text{St.Dev}_i(\log w)$
  - Firm-size wage premium, $\hat{\beta}_i$

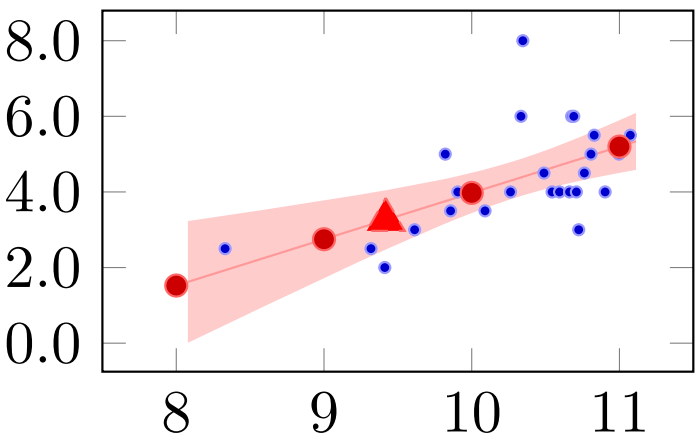
Number of Firms



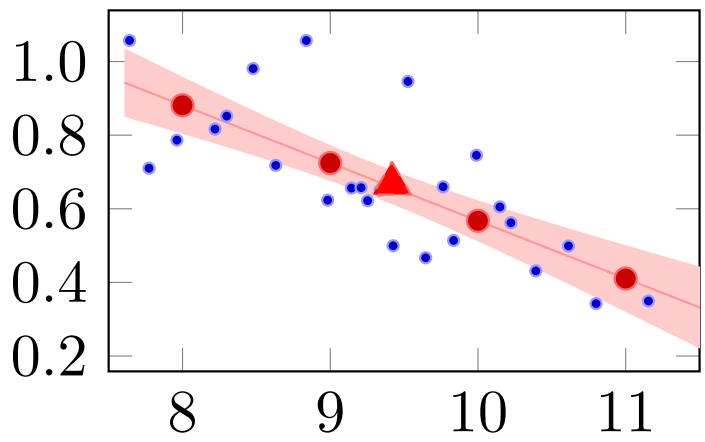
Average Firm Size

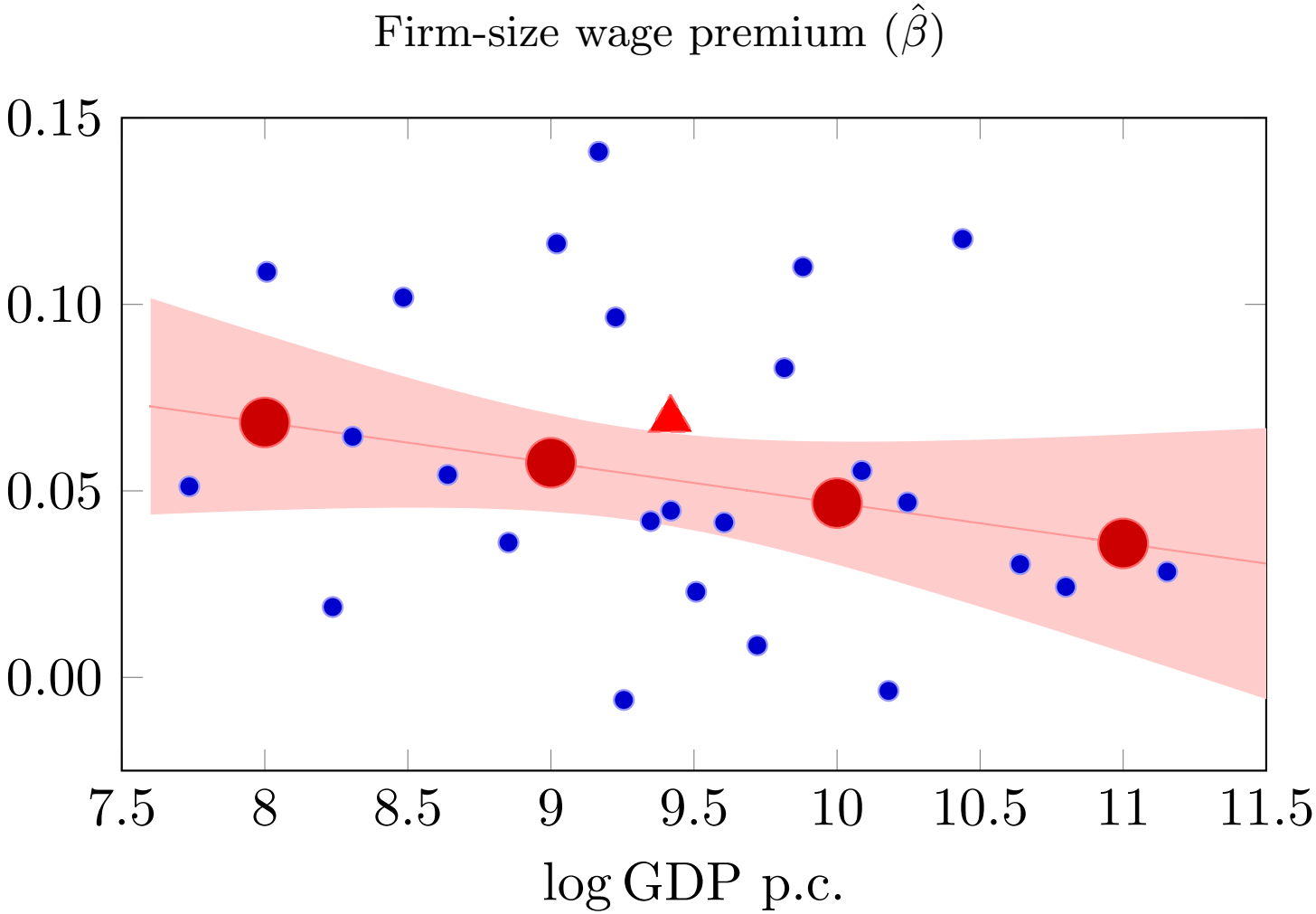


Firm Size Dispersion - IQR



(log) Wage Dispersion - St.Dev.





- The firm-size wage premium declines with GDP per capita

- For each country, we estimate the model separately using the Simulated Method of Moments

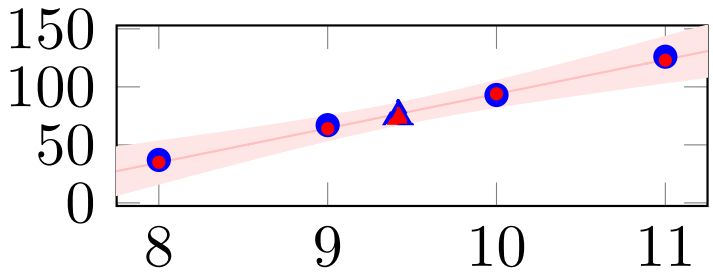
- Loss function

$$\mathcal{L}(\omega) = g(\omega)' \mathbb{I} g(\omega),$$

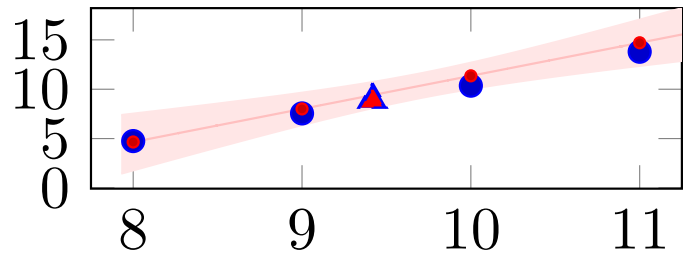
  where $g(\omega)$ is a vector of percentage deviations of each simulated moment with respect to the target.

- Standard errors computed using Delta Method.

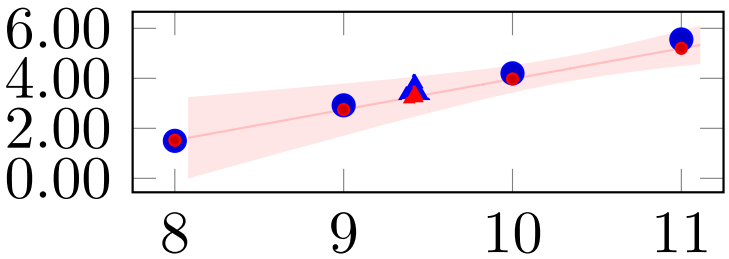
Number of Firms



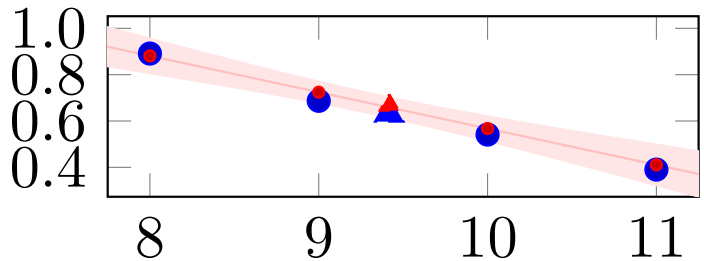
Average Firm Size



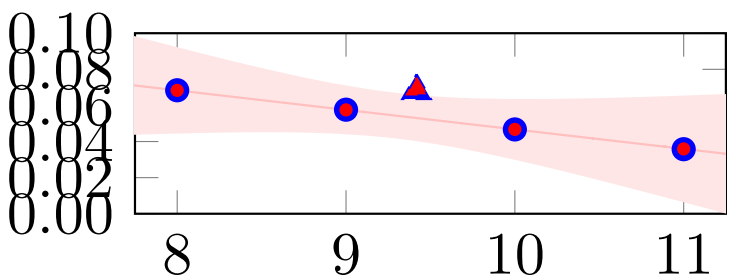
Firm Size Dispersion - IQR



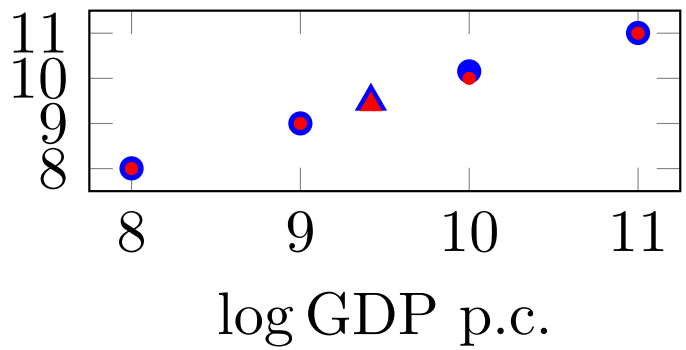
(log) Wage Dispersion- St.Dev.



Firm Size Wage Premium ($\hat{\beta}$)



Log GDP per capita



Estimated Parameters

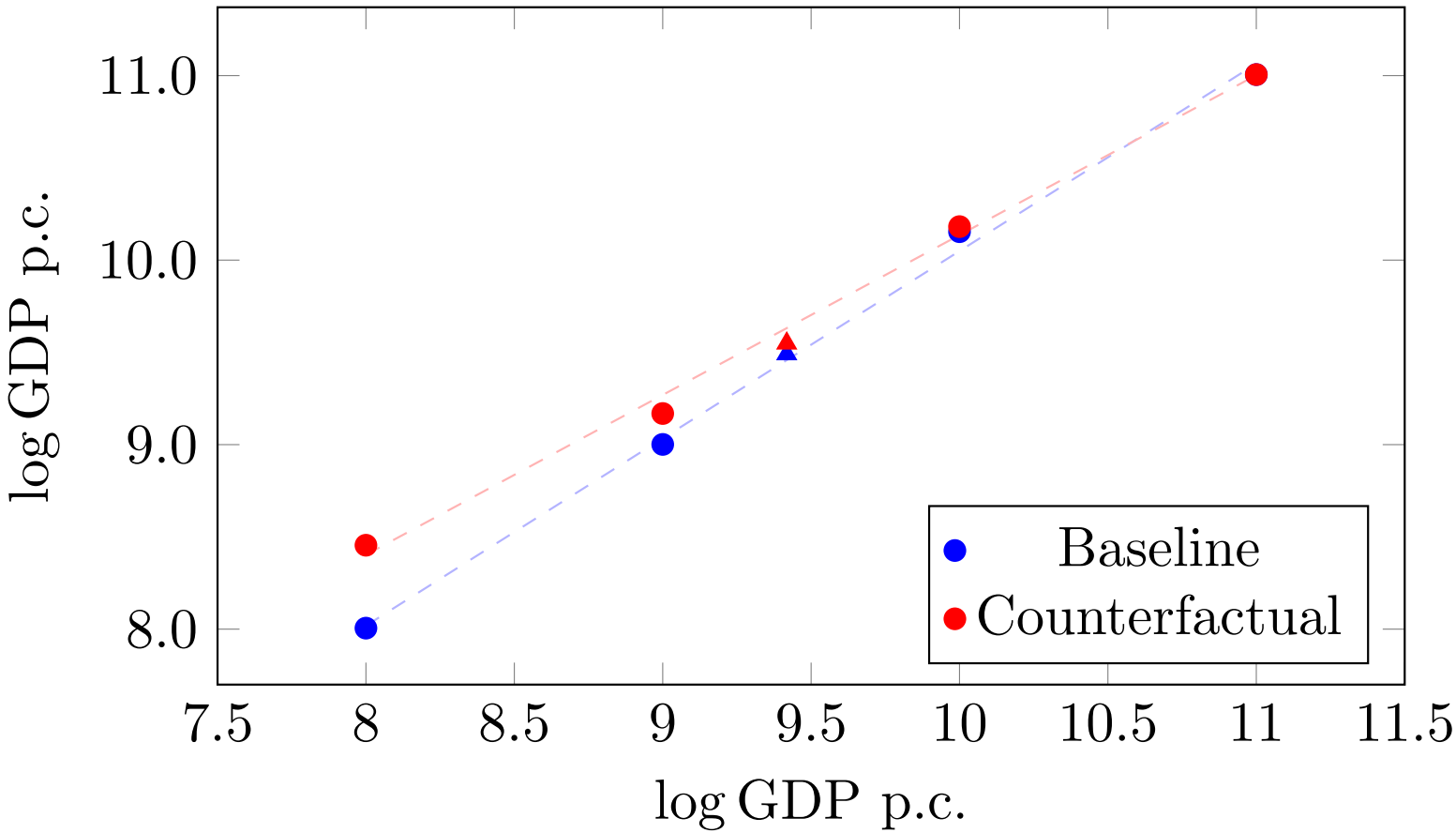
log GDP per capita	Pareto Shape (α)	Uniform Dispersion (b)	LS Elasticity (ϵ^L)	Mass of Workers (L)	Entry Cost (c_e)	Pareto Scale (θ)
8 ($2,980)	1.58	9.05	0.84	175.65	0.82	1561.63
	(0.006)	(1.703)	(0.659)	(71.724)	(0.0)	(0.255)
9 ($8,100)	1.68	6.69	1.74	505.84	1.16	5386.55
	(0.002)	(1.301)	(0.417)	(27.207)	(0.0)	(0.195)
Colombia ($12,300)	1.67	6.62	2.35	671.92	1.23	8951.16
	(0.002)	(0.224)	(0.346)	(16.664)	(0.0)	(0.186)
10 ($22,000)	1.66	6.08	2.66	963.42	1.47	20315.69
	(0.001)	(0.314)	(0.328)	(17.051)	(0.0)	(0.173)
11 ($59,900)	1.88	4.9	3.14	1738.44	1.89	93740.78
	(0.001)	(0.387)	(0.301)	(13.206)	(0.0)	(0.114)

- Wage markdowns range from **54%** in poorest countries to **24%** in the richest.
- Our estimate for Colombia, **2.35**, is very close to that of Amodio and De Roux (2023), i.e. **2.43**
- Robustness checks
- Role of endogenous entry

Using our model we run the following counterfactual:

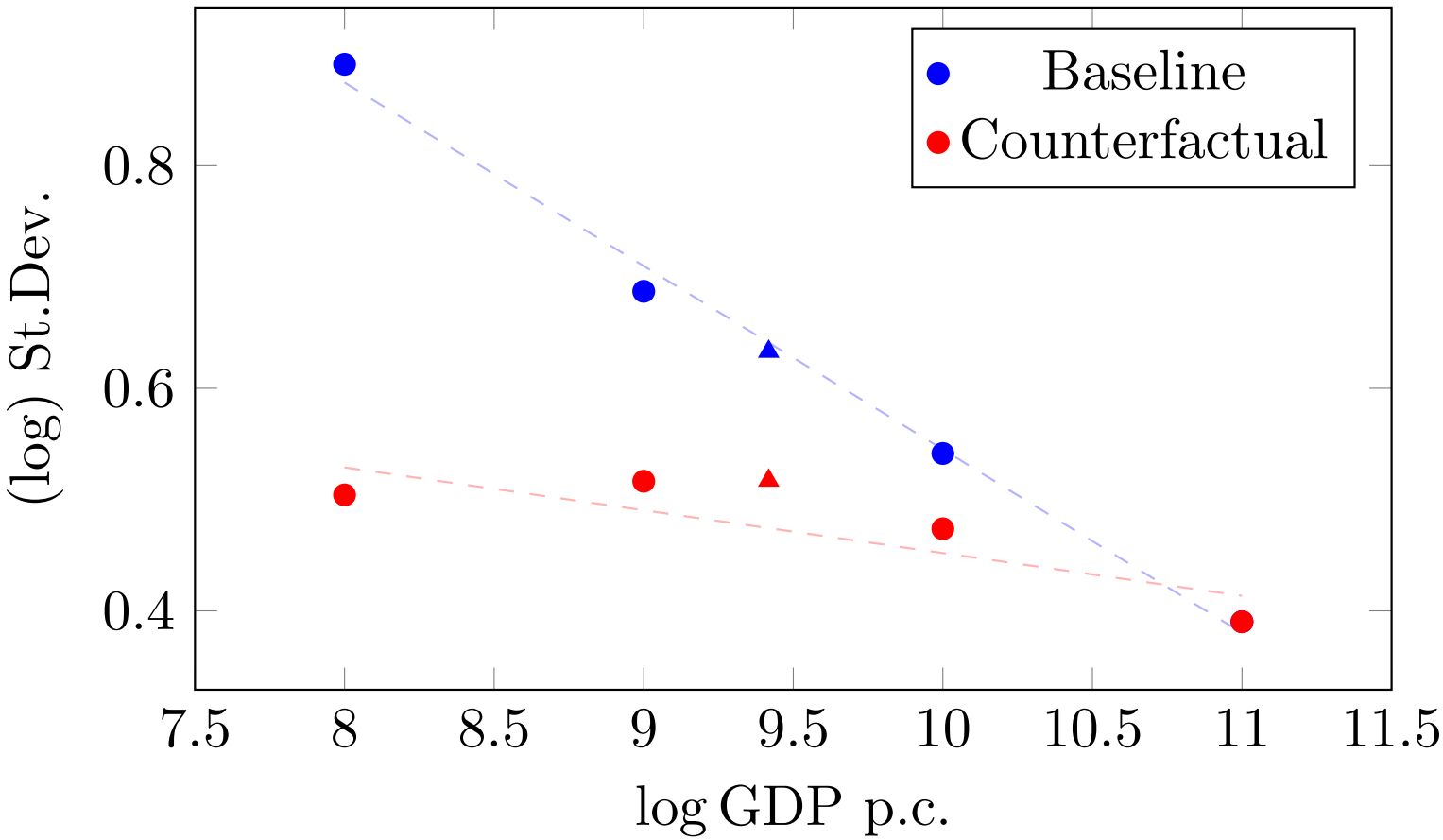
- What would happen if all countries had the labor supply elasticity of the richest one?
- We set the labor supply elasticity of every country equal to that of the country at the highest development stage ($\epsilon^L = 3.14$).
- Other parameters left unchanged.

Closing the Gap: GDP per capita



- Poorest countries could increase GDP p.c. by **45%**
- Differences in labor supply elasticity account for **15%** of observed differences in GDP p.c.

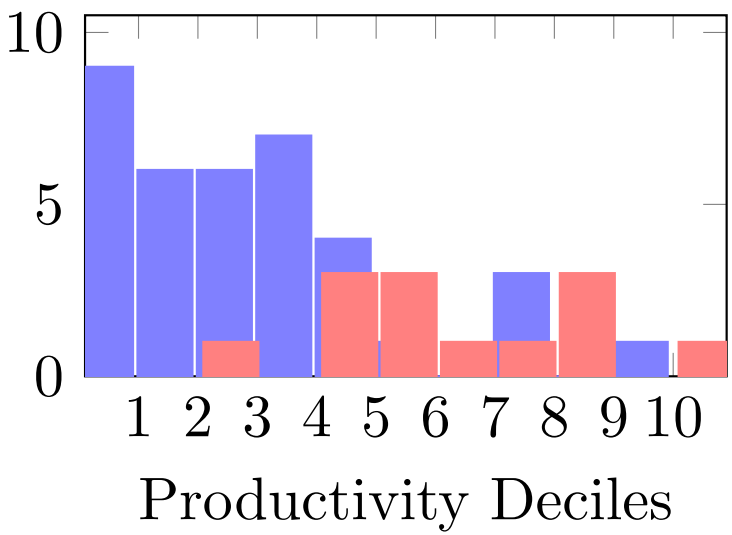
Closing the Gap: Wage Inequality



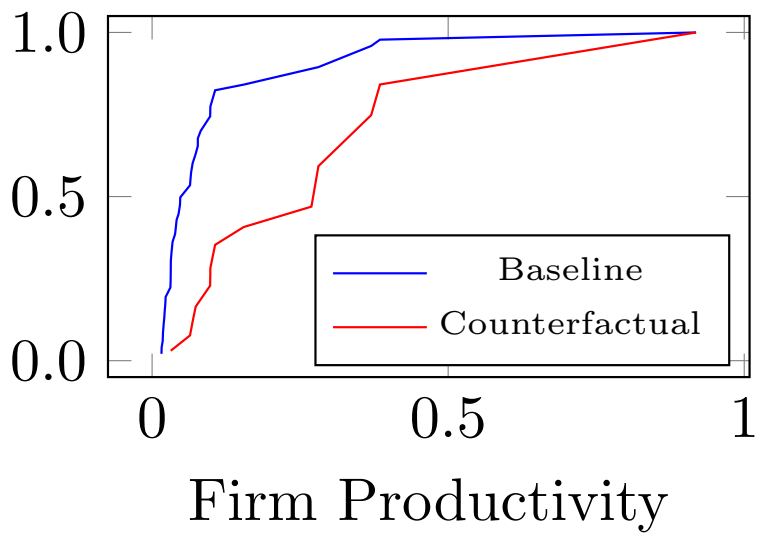
- Differences in labor supply elasticity account for **77%** of observed differences in wage dispersion across firms.

Reallocation Effects of Higher Competition

Number of Active Firms
(GDPpc = 3000$)



Cumul. Share of Employment
(GDPpc = 3000$)



- Higher labor supply elasticity reduces the relative importance of amenities and pushes wages towards MRPL.
- This changes the competitive ranking of firms and reallocates labor towards more productive firms.
- Limited role of strategic interaction

Conclusions

- We use a frontier model of oligopsony to structurally estimate the labor supply elasticity along the development path
- We document that labor market competition is increasing in development
  - Wage markdowns range from **54%** in the poorest countries to **24%** in the richest.
- Poorer countries could increase GDP p.c. up to **45%** with similar labor market competition of the richest ones.
- Differences in labor market power account for **15%** and **77%** of differences in GDP p.c. and wage dispersion across firms.

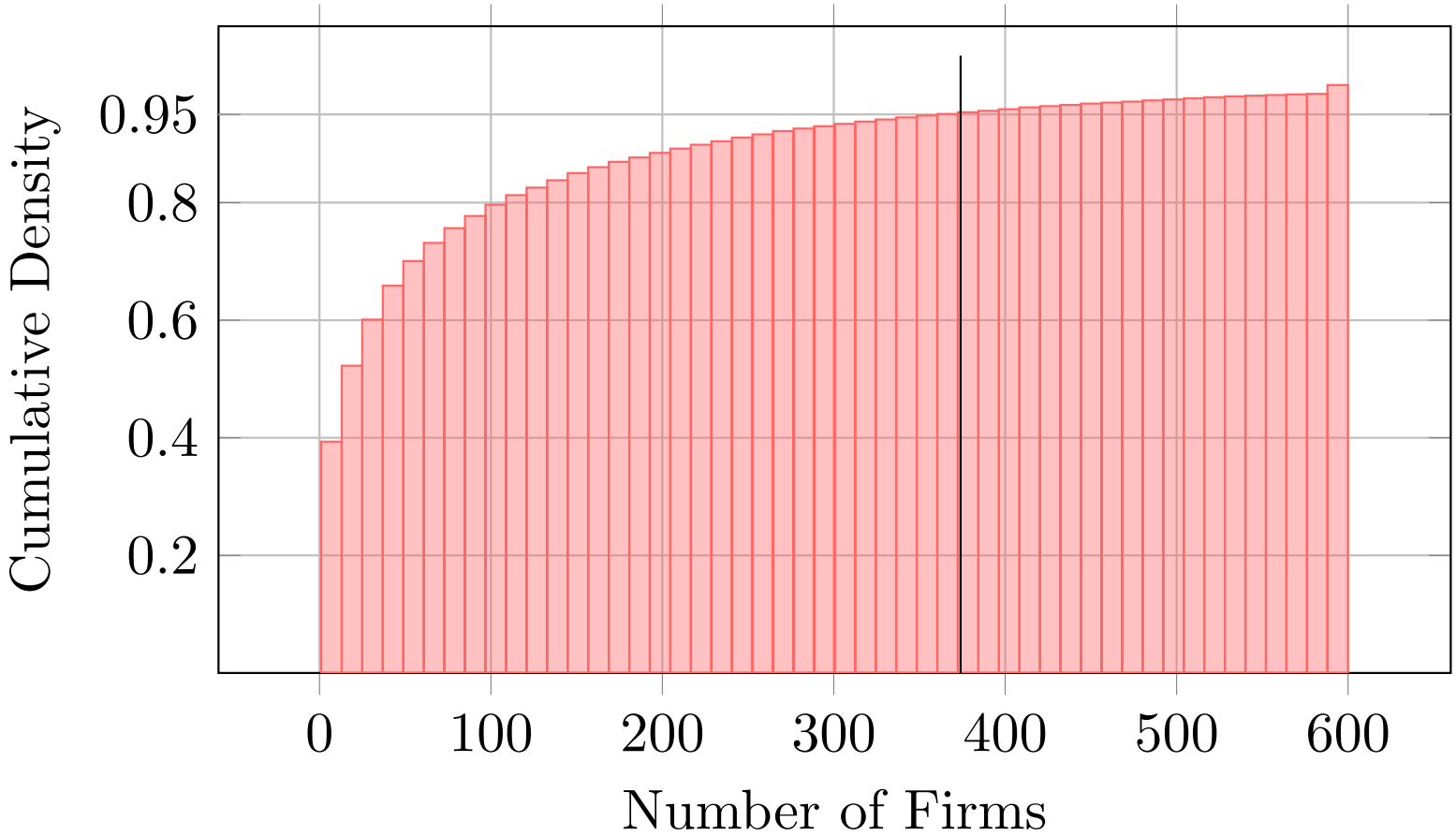
1. Given the number of potential entrants $\bar{J}$ and the distributions $\Phi(z_j)$ and $\Psi(a_j)$, draw the vectors of productivities $\vec{\mathbf{A}}$ and amenities $\vec{\mathbf{a}}$ of potential entrants.
2. Set the initial number of firms equal to the number of potential entrants $J^{x=-1} = \bar{J}$.
3. Solve the fixed point of wage schedules and rank firms by profitability, using the positive profit threshold to guess the starting value $J^{x=0}$.

4 With the current value of J^x, solve the fixed point of wage schedules:
   (a) Guess the vector of wages $\vec{\mathbf{w}}^{i=0} = [w_1^{i=0}, w_2^{i=0}, ..., w_J^{i=0}]$.
   (b) Compute λ using expression 2.
   (c) For each firm $j \in J$:
      i. Solve the profit maximization problem using the current vector $\vec{\mathbf{w}}$ and associated value of λ to obtain an updated wage w_j^{i+1}.
      ii. Adjust the updated wage for smooth convergence using: $w_j^{i+1} = \delta w_j^{i+1} + (1-\delta) w_j^i$ and some $\delta \in (0, 1)$.
   (d) If $\vec{\mathbf{w}}^i$ and $\vec{\mathbf{w}}^{i+1}$ are sufficiently close, the Nash Equilibrium has been found. If not, return to step (b).

5 Given the fixed point of wage schedules $\vec{\mathbf{w}}^*$, compute the vector of firm profits $\vec{\pi}$ and:

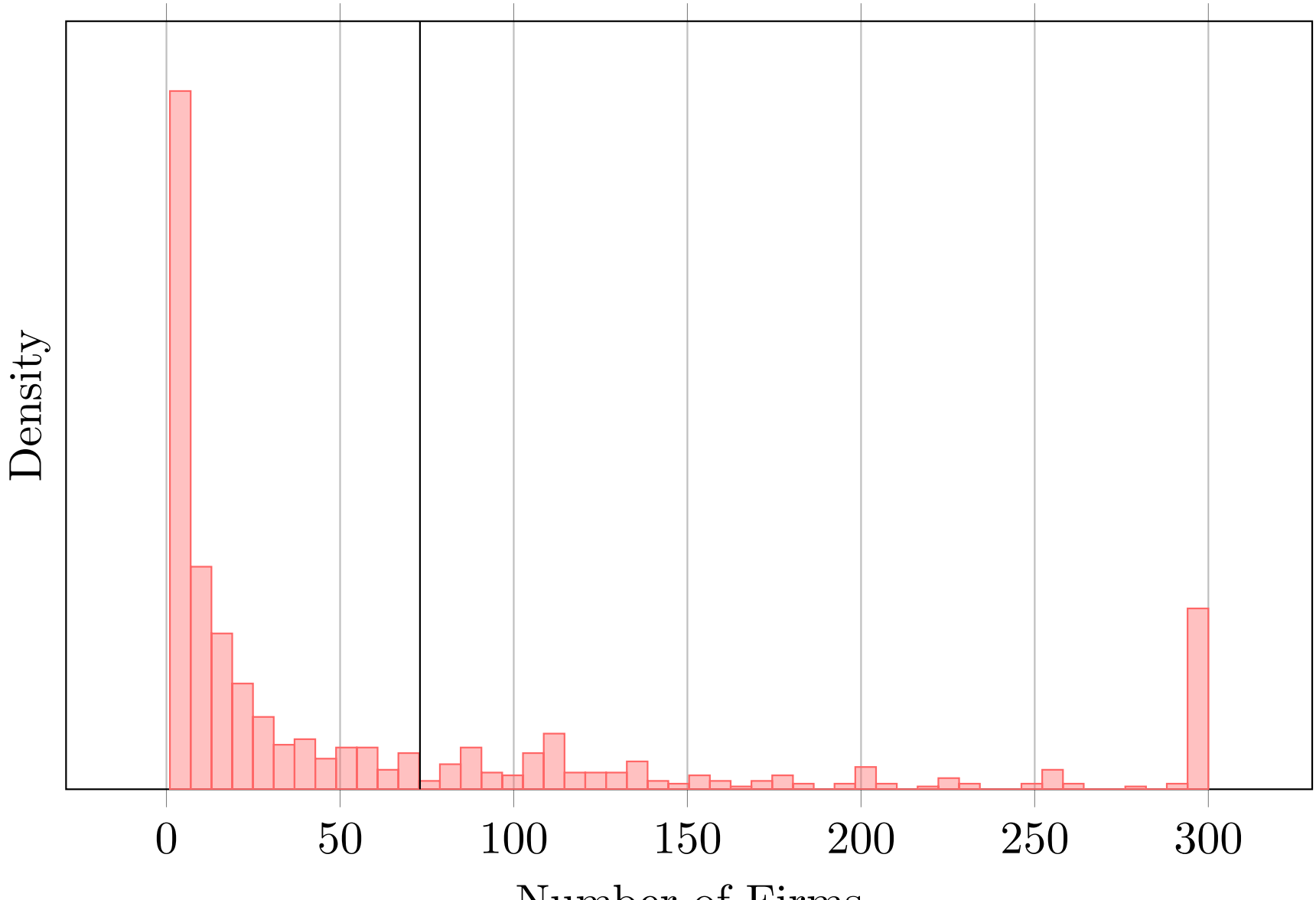
- If $\pi_j \geq 0 \ \forall j$ and $J^{x-1} \neq J^x + 1$ set $J^{x+1} = J^x + 1$ and return to step 4.
- If $\pi_j \geq 0 \ \forall j$ and $J^{x-1} = J^x + 1$ stop with J^x.
- If $\pi_j \ngeq 0 \ \forall j$ and $J^{x-1} \neq J^x - 1$ set $J^{x+1} = J^x - 1$ and return to step 4. The firm removed is the firm with the lowest competitiveness.
- If $\pi_j \ngeq 0 \ \forall j$ and $J^{x-1} = J^x - 1$ stop with J^{x-1}.

Potential number of firms across labor markets



- We fix the number of potential entrants, $\bar{E}$, ex-ante to cover 95% of the observed distribution of the number of firms across local labor markets in the WBES dataset.

Distribution of firms across labor markets in Colombia



Number of Firms over GDP p.c.

R-squared	0.037				N	37889
Number of Firms	Coefficient	Std. err.	t	P$>|t|$	[0.025	0.975]
Intercept	-195.644	7.208	-27.142	0.0	-209.772	-181.516
ln GDPpc	28.9131	0.762	37.957	0.0	27.42	30.406

Mean Firm Size over GDP p.c.

R-squared:	0.271				N=	73
Average Firm Size	Coefficient	Std. err.	t	P> |t|	[0.025	0.975]
Intercept	-19.2718	5.716	-3.372	0.001	-30.668	-7.875
ln GDPpc	3.0607	0.597	5.131	0.000	1.871	4.250

Firm Size Dispersion over GDP p.c.

R-squared:	0.266				N=	42
Std. of Log-Size	Coefficient	Std. err.	t	P> |t|	[0.025	0.975]
Intercept	-0.4292	0.425	-1.010	0.319	-1.288	0.430
ln GDPpc	0.1578	0.041	3.807	0.000	0.074	0.242

Wage Dispersion over GDP p.c.

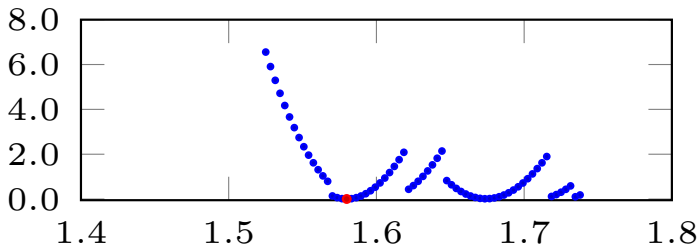
R-squared:	0.339				N	138
Std. of Log-Wage	Coefficient	Std. err.	t	P> |t|	[0.025	0.975]
Intercept	2.0052	0.160	12.551	0.000	1.689	2.321
ln GDPpc	-0.1452	0.017	-8.355	0.000	-0.180	-0.111

Firm Size Wage Premium over GDP p.c.

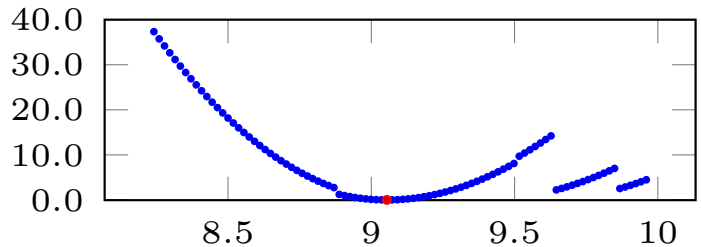
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
log (GDPpc)	-0.0278	-0.0263	-0.0199	-0.0270	-0.0265	-0.0277	-0.0275	-0.0205	-0.0169	-0.0251	-0.0238	-0.0140	-0.0212	-0.0119
	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
Year FE	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Sector FE	No	**Yes**	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Region FE	No	No	**Yes**	No	No	No	No	No	**Yes**	No	No	**Yes**	No	**Yes**
Exporter FE	No	No	No	**Yes**	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Foreign-Owned FE	No	No	No	No	**Yes**	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**
Informal Competition FE	No	No	No	No	No	**Yes**	No	No	No	No	No	No	**Yes**	**Yes**
Publicly-Traded Firm FE	No	No	No	No	No	No	**Yes**	No	No	No	No	No	**Yes**	**Yes**
Firm Age Group FE	No	No	No	No	No	No	No	**Yes**	No	No	No	No	**Yes**	**Yes**
Constant	0.3287	0.3137	0.2443	0.3149	0.3084	0.3224	0.3241	0.2565	0.2152	0.2960	0.2782	0.1750	0.2417	0.1464
	(0.072)	(0.066)	(0.070)	(0.071)	(0.069)	(0.073)	(0.070)	(0.078)	(0.065)	(0.066)	(0.064)	(0.063)	(0.076)	(0.074)

Global Minima in Estimation

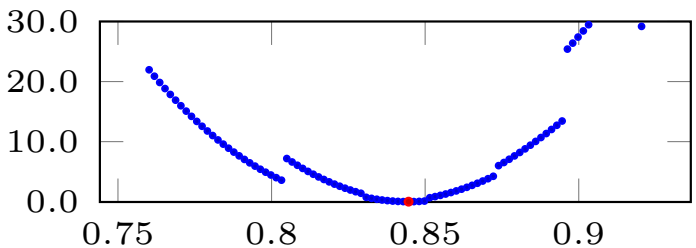
Pareto Shape (α)



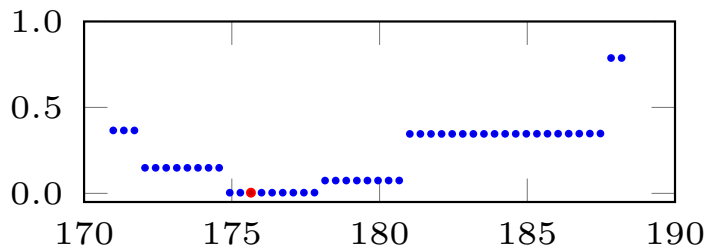
Upper Bound of Uniform (b)



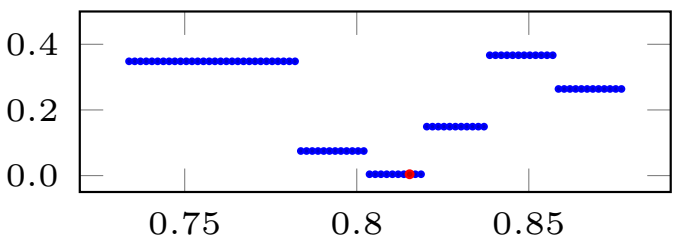
Labor Supply Elasticity (ϵ^L)



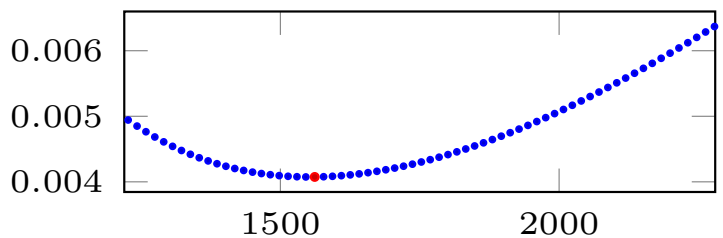
Measure of Workers (L)



Entry Costs (c)



Pareto Scale (θ)



Auxiliary regressions

	Data		Simulated	
Regression	Intercept	Slope	Intercept	Slope
Firm Size Wage Premium	0.155	-0.011	0.154	-0.011
Average Firm Size	-22.152	3.351	-18.887	2.935
Firm Size Dispersion	-8.277	1.225	-9.052	1.320
Wage Dispersion	2.136	-0.157	2.173	-0.162
Number of Firms	-201.862	29.573	-193.093	28.700

- We run cross-country auxiliary regressions to assess the fit
- Model captures how key moments change with GDP p.c.

Robustness I: Distribution of Amenities

A. Baseline: Uniform distribution

	Pareto Shape (α)	Uniform Dispersion (b)	LS Elasticity (ϵ^L)	Mass of Workers (L)	Entry Cost (c_e)	Pareto Scale (θ)
Colombia	1.67	6.62	2.35	671.92	1.23	8951.16

B. Robustness: Exponential distribution

	Pareto Shape (α)	Exponential inverse scale (b)	LS Elasticity (ϵ^L)	Mass of Workers (L)	Entry Cost (c_e)	Pareto Scale (θ)
Colombia	1.55	1.10	2.40	674.78	1.20	7352.49

- Using an alternative distribution for firm amenities does not significantly alter the point estimate for the labor supply elasticity (2.35 vs. 2.40)

Robustness II: WBES Targets

log GDP per capita	LS Elasticity (ϵ^L)	Mass of Workers (L)	Pareto Shape (α)	Pareto Scale (θ)	Uniform Dispersion (b)	Entry Cost (c_e)
8 ($2,980)	0.97	227.95	1.58	1501.07	9.6	1.08
	(0.567)	(56.191)	(0.004)	(0.25)	(0.878)	(0.0)
9 ($8,100)	1.39	517.56	1.9	7540.64	4.56	1.37
	(0.419)	(32.636)	(0.002)	(0.149)	(1.319)	(0.0)
10 ($22,000)	1.93	734.97	2.39	34480.16	4.17	1.12
	(0.332)	(25.267)	(0.001)	(0.078)	(2.159)	(0.0)
11 ($59,900)	3.16	931.32	2.89	144024.74	4.76	1.09
	(0.253)	(17.539)	(0.001)	(0.05)	(0.346)	(0.0)
Colombia ($12,300)	2.19	597.59	2.14	15366.88	6.03	1.17
	(0.292)	(16.866)	(0.001)	(0.107)	(0.337)	(0.0)

- Using WBES targets does not alter the point estimate for the labor supply elasticity over development

Role of endogenous entry

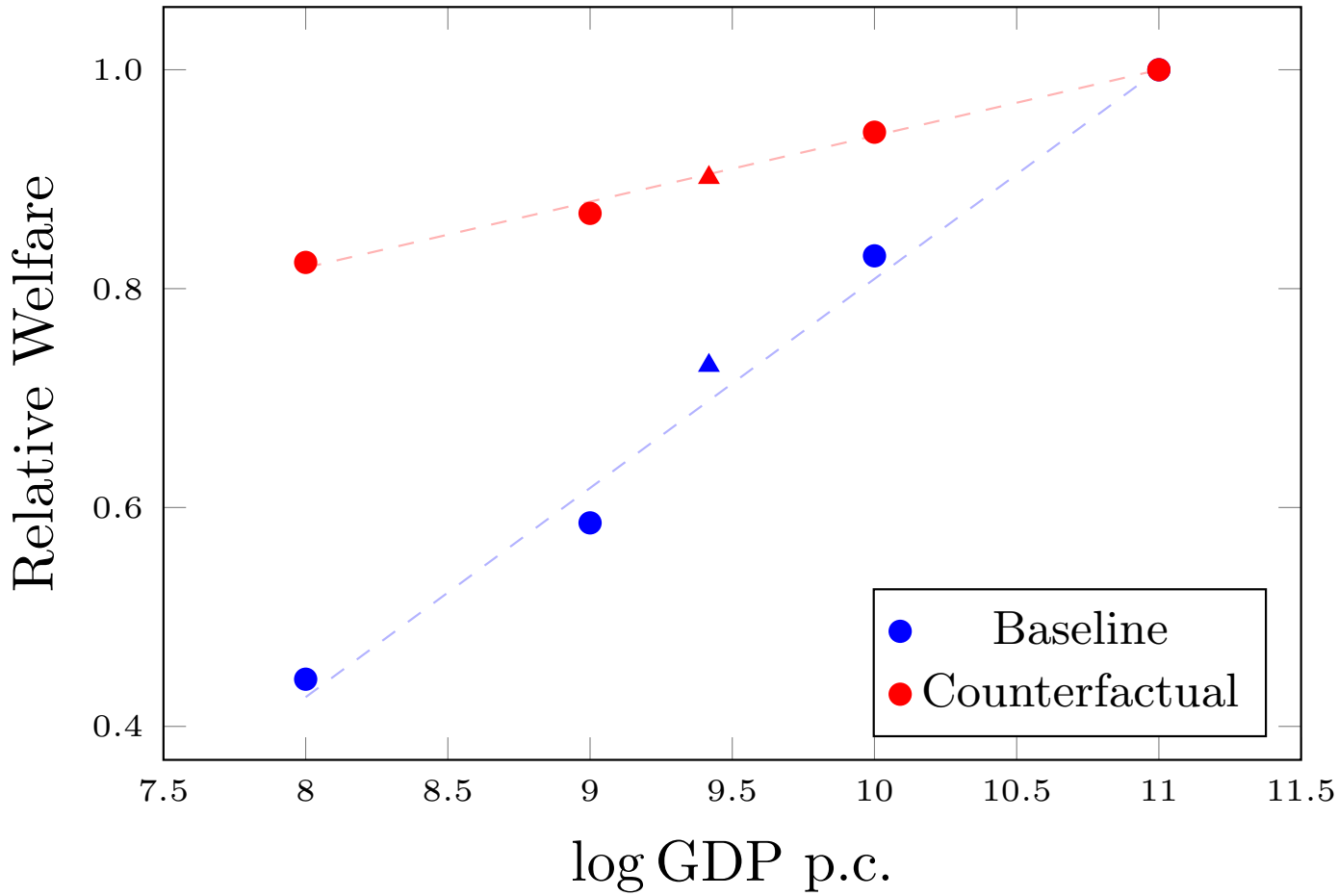
A. Baseline

	Pareto Shape (α)	Uniform Dispersion (b)	LS Elasticity (ϵ^L)	Mass of Workers (L)	Entry Cost (c_e)	Pareto Scale (θ)
Colombia	1.67	6.62	2.35	671.92	1.23	8951.16

B. Zero entry cost

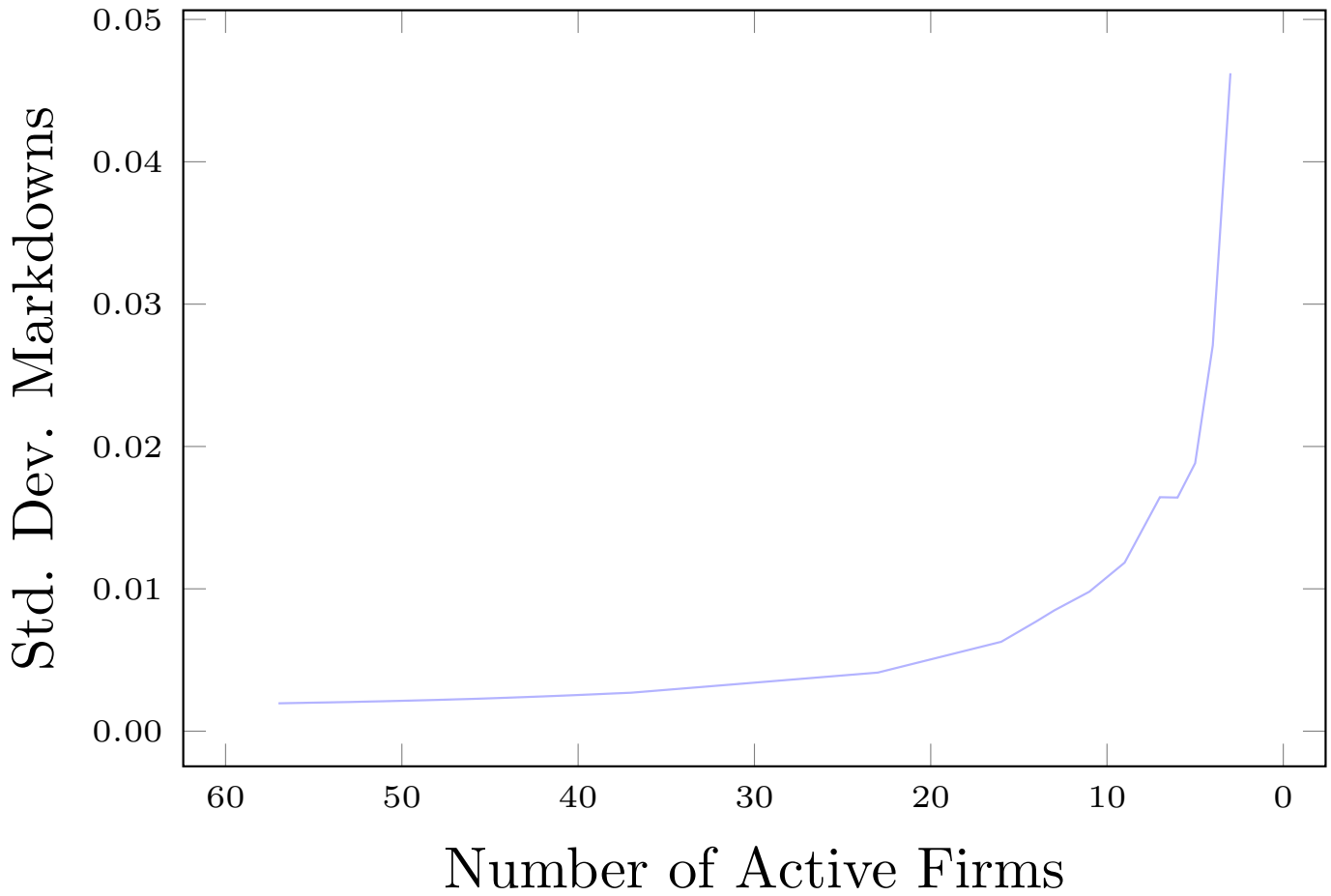
	Pareto Shape (α)	Uniform Dispersion (b)	LS Elasticity (ϵ^L)	Mass of Workers (L)	Entry Cost (c_e)	Pareto Scale (θ)
Colombia	1.50	24.66	8.70	962.85	0.00	7046.08

- Ignoring the equilibrium number of firms leads to largely overestimating the labor supply elasticity (8.70 vs 2.35)



- Large welfare gains from increasing labor supply elasticity in the poorest targeted country

Strategic Interaction in the poorest country



- At the observed number of active firms in the poorest country (37), strategic interaction is limited, and wage markdown is little dispersed