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).

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

- Structurally estimate labor supply elasticities for countries with different levels of GDP p.c. using a GE model of oligopsony.
- 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 **0.8** in low-income countries to around **3.2** in high-income countries
  - $\implies$ wage markdowns range from **55%** in low-income countries to **23%** in high-income countries.

- Low-income countries would see an increase of up to **69%** in output p.c. with labor supply elasticities comparable to those of high-income countries.

- Differences in labor supply elasticities account for **22%** and **40%** of observed differences in GDP p.c. and firm-wage dispersion.

Literature

- Labor market power estimation
  - Amodio and De Roux 23; Amodio et al. 22; Azar et al. 22, Brooks et al. 22.

- 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; Poschke 18; 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 $J^* < \bar{J}$ 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:

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

- 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 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:

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

which implies:

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

P2: The conditional 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:

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

which implies:

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

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

- 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.

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

- Strategic interaction 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**.

- 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.

Targeted Moments

- To estimate ϵ^L along the development path, we construct 4 artificial countries via OLS.
- We estimate the model for Colombia separately to validate our results with previous literature.

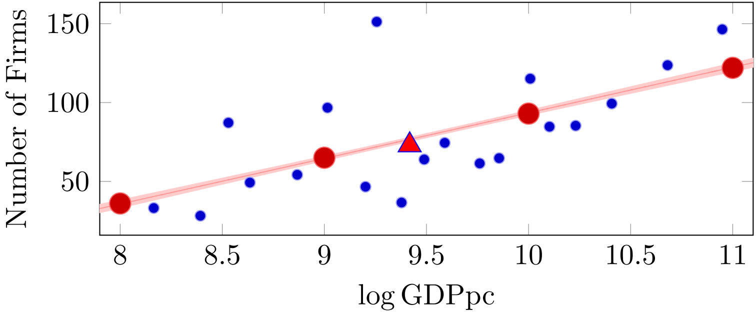
We merge 4 datasets to construct the targeted moments.

- For the firm-size wage premium, the wage dispersion and the number of firms we use the World Bank Enterprise Surveys (WBES).
- For the average firm size we use data from Bento and Restuccia (2017).
- For the firm size dispersion we use data from Poschke (2018).
- For output per capita we use GDP per capita in PPP terms and 2017 USD from the World Bank.

Number of Firms

- Estimate an auxiliary regression using mean number of firms in countries' region-industry tuples

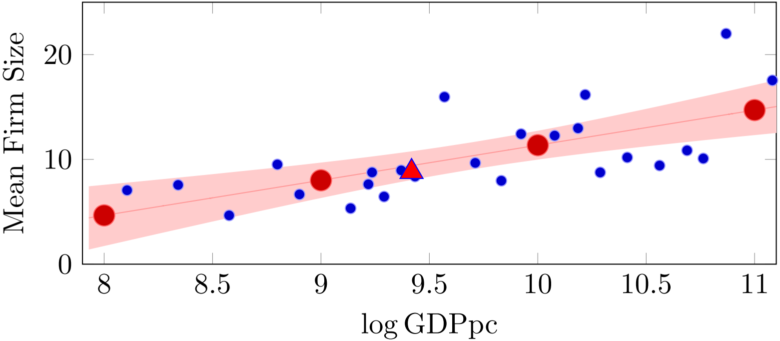
$$J_i = \alpha_1 + \alpha_2 \log(\text{GDPpc}_i) + \eta_i$$



- The number of firms in a local labor market is increasing with development.

- Estimate an auxiliary regression using average firm size:

$$\bar{\ell}_i = \alpha_1 + \alpha_2 \log(\text{GDPpc}_i) + \eta_i$$

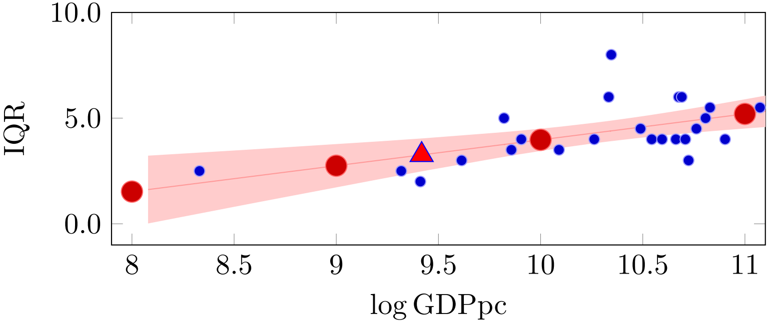


- Average firm size is increasing with development.

Firm size dispersion across countries

- Estimate an auxiliary regression using firm size dispersion

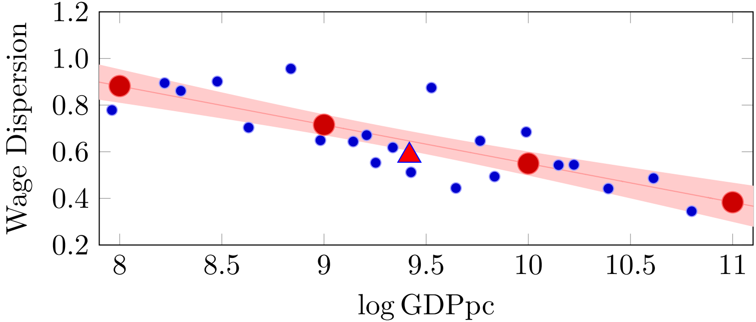
$$\text{iqr}(\ell)_i = \alpha_1 + \alpha_2 \log(\text{GDPpc}_i) + \eta_i$$



- Firm size dispersion is increasing with development.

- Estimate an auxiliary regression using wage dispersion across firms

$$\text{std}(\ln(w))_i = \alpha_1 + \alpha_2 \log(\text{GDPpc}_i) + \eta_i$$



- Wage dispersion across firms is decreasing with development.

Firm-size wage premium across countries

- Estimate, separately for each country, the following regression

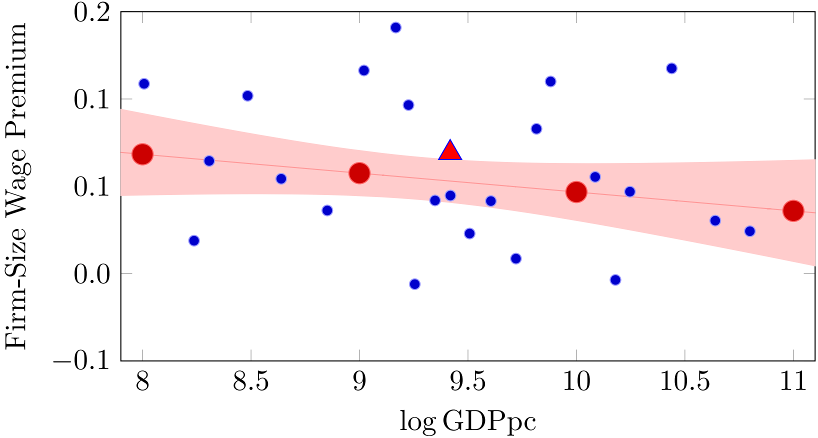
$$\ln(w_{jt}) = \alpha + \beta \ln(L_{jt}) + X_{jt}\gamma + \mu_t + \mu_{s(j)} + \mu_{o(j)} + \epsilon_{jt}$$

controlling for year FEs, μ_t, 3-digit sector FEs $\mu_{s(j)}$, and location FEs $\mu_{o(j)}$

- Estimate an auxiliary regression using the estimated firm-size wage premia:

$$\hat{\beta}_i = \alpha_1 + \alpha_2 \log(\text{GDPpc}_i) + \eta_i$$

Firm-size wage premium across countries



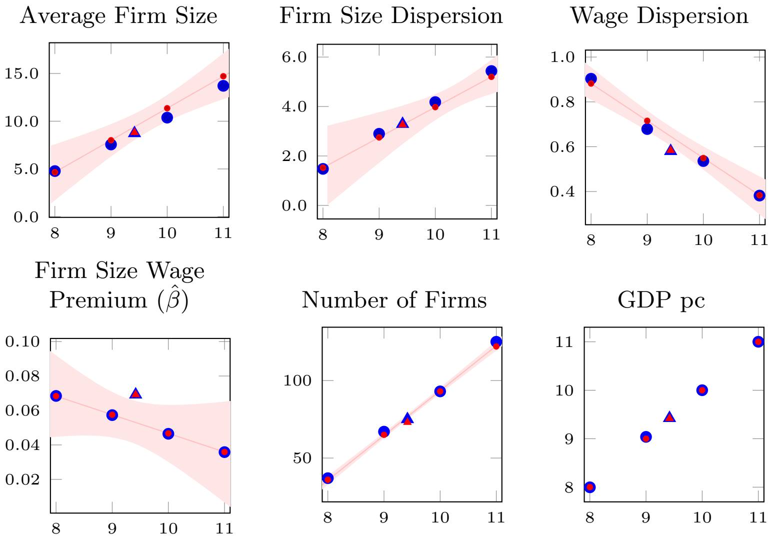
- The firm-size wage premium is decreasing with development.

- For each of the 4 stages and Colombia, we estimate the model via SMM.
- 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.

Model Fit



Average Firm Size
15.0
10.0
5.0
0.0
8
9
10
11
Firm Size Dispersion
6.0
4.0
2.0
0.0
Wage Dispersion
1.0
0.8
0.6
0.4
Firm Size Wage Premium ($\hat{\beta}$)
0.10
0.08
0.06
0.04
0.02
Number of Firms
100
50
GDP pc

	Data		Simulated	
Regression	Intercept	Slope	Intercept	Slope
Firm Size Wage Premium	0.2152	-0.0169	0.2261	-0.0181
Average Firm Size	-19.2718	3.0607	-17.072	2.9161
Firm Size Dispersion	-6.7335	1.0774	-7.0918	1.2640
Wage Dispersion	2.0052	-0.1452	2.1182	-0.1582

- We run the auxiliary regressions on the 4 simulated stages.
- Model does a great job capturing how key moments change with GDP p.c.

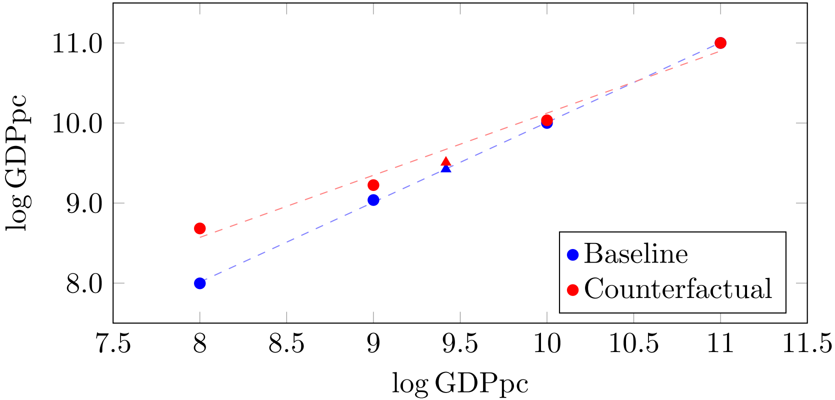
log GDP per capita	Pareto Shape (α)	Uniform Dispersion (b)	LS Elasticity (ϵ^L)	Mass of Workers (L)	Entry Cost (c_e)	Pareto Scale (θ)
8 ($2,980)	1.56	8.76	0.8	176.75	0.83	1513.95
	(0.006)	(2.914)	(0.000)	(120.386)	(0.000)	(0.249)
9 ($8,100)	1.72	6.28	1.65	506.57	1.16	5906.99
	(0.002)	(2.997)	(0.000)	(51.099)	(0.000)	(0.175)
10 ($22,000)	1.71	6.08	2.67	964.64	1.5	19146.58
	(0.001)	(0.129)	(0.000)	(30.687)	(0.000)	(0.154)
11 ($59,900)	1.91	4.91	3.24	1713.09	1.86	95108.08
	(0.001)	(2.234)	(0.050)	(31.072)	(0.000)	(0.118)
Colombia ($12,300)	1.89	4.91	2.42	1713.09	1.14	95108.08
	(0.002)	(0.523)	(0.0)	(30.844)	(0.0)	(0.132)

- Wage markdowns range from **55%** in poorest countries to **23%** in the richest.
- Our estimate for Colombia is very close to that of Amodio and De Roux (2023).

Using our model we run the following counterfactual:

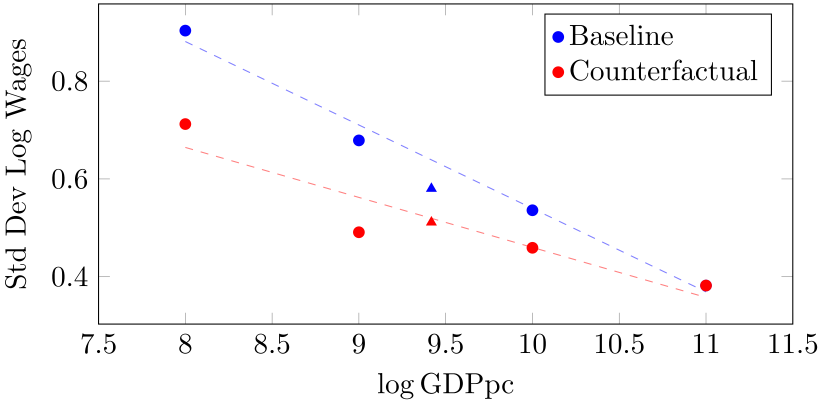
- What would happen if all countries had the labor supply elasticity of the richest one?
- We set the labor supply elasticity of all 5 stages, Colombia and India equal to that of the country at the highest development stage ($\epsilon^L = 3.24$).
- Other parameters left unchanged.

Closing the Gap: GDP per capita



- Poorest countries could increase GDP p.c. by **69%**
- Differences in labor supply elasticity account for **22%** of observed differences in GDP p.c.

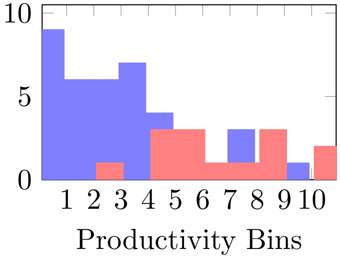
Closing the Gap: Wage Inequality



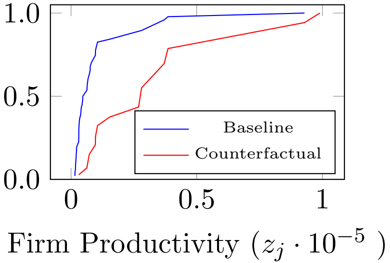
- Differences in labor supply elasticity account for **40%** of observed differences in wage dispersion across firms.

- 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.

Number of Active Firms (8)



Cumul. Share of Employment (8)



- 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 **55%** in the poorest countries to **23%** in the richest.
- Poorer countries could increase GDP p.c. up to **69%** with similar labor market competition of the richest ones.
- Differences in labor supply power account for **22%** and **40%** of GDP p.c. and wage dispersion across firms.

Appendix A1: Solving for equilibrium

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, use the positive profit threshold to guess the starting value $J^{x=0}$. back

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 $\delta \in (0,1)$.

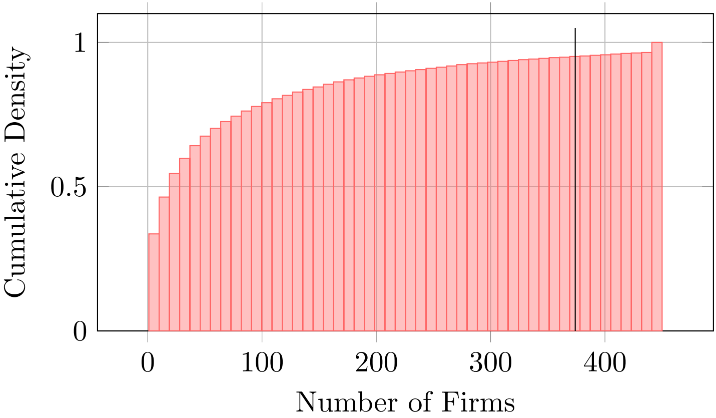
(d) If $\vec{\mathbf{w}}^i$ and $\vec{\mathbf{w}}^{i+1}$ are sufficiently close, the Nash Equilibrium has been found. If not, return to step (b).

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}.

back

Appendix A2: Location-Sector Labor Markets in WBES

- 

Appendix A3: Number of Firms - Regression Results

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

Appendix A4: Mean Firm Size - Regression Results

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

Appendix A5: Firm Size Dispersion - Regression Results

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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

Appendix A6: Wage Dispersion - Regression Results

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

Appendix A7: Firm Size Wage Premium - Regression Results and Robustness

	(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)

Standard errors in parentheses

Appendix B: Global Minima in Estimation