

# Jobless Industrialization

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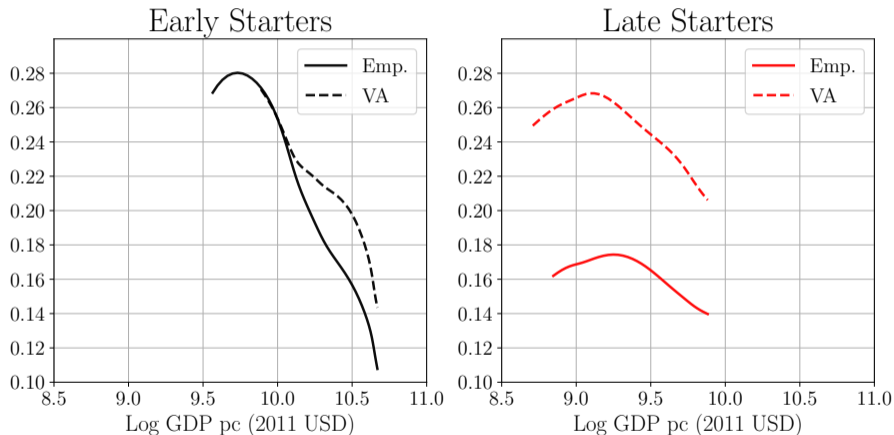
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September 14, 2023

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<sup>1</sup>The views expressed herein do not reflect those of the Federal Reserve Bank of Chicago or the Federal Reserve System.

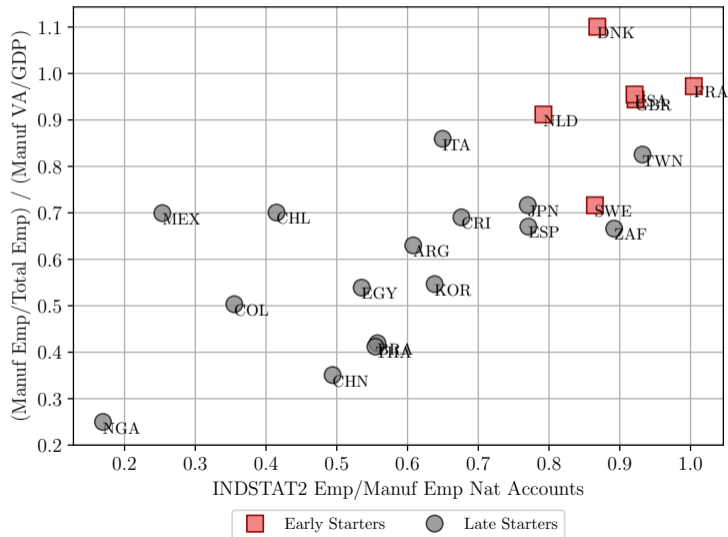
## Manufacturing as a Share of the Economy's Employment and Value Added



**Notes:** Data sources: GGDC 10-Sector Database; Economic Transformation Database; World KLEMS; MOxLAD Database. *Early Starters:* Great Britain, United States, Denmark, France, The Netherlands, and Sweden. *Late Starters:* Argentina, Brazil, Chile, Colombia, Costa Rica, Egypt, Spain, Indonesia, Italy, Japan, South Korea, Mexico, Mauritius, Malaysia, Nigeria, Philippines, Thailand, Taiwan, and South Africa. Late starters must reach a manufacturing value-added share over 20% of GDP at some point in their history to stay in the sample.

# Joblessness and (lack of) modern firms

More detailed



# Jobless Industrialization: Penalty for Backwardness?

## ▶ Early Starters:

- ▶ Out of agriculture toward **labor-intensive manufacturing**.
- ▶ Harsh working conditions and subsistence wages at early stages of development.
- ▶ Gradual improvement in labor conditions as a late byproduct of industrialization.
- ▶ Adoption of welfare and social spending *after* the industrial take-off.

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  - ▶ Adoption of welfare and social spending **after** the industrial take-off.
- ▶ Late Starters
  - ▶ Labor-saving frontier technologies at disposal.
  - ▶ Taxation and regulation on modern employment **during** the industrial take-off.

# This Paper

## Role of technology and distortions in formal markets on jobless manufacturing.

- ▶ GE model of a dual economy with firm heterogeneity.
  - ▶ Occupational choice:
    - ▶ Entrepreneur in modern or traditional technology or modern firm's worker.

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  - ▶ **Detailed module** of modern (manufacturing) firms abiding:
    1. Minimum wage.
    2. Size-correlated distortions (disciplined by the data) in product and input markets.

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  - ▶ **Detailed module** of modern (manufacturing) firms abiding:
    1. Minimum wage.
    2. Size-correlated distortions (disciplined by the data) in product and input markets.
  - ▶ Counterfactual analysis (benchmark against technology explanation):
    - ▶ How much are these distortions needed/enough to generate joblessness?
    - ▶ Which of them?



## Related Literature

- ▶ **Structural Change:**
  - ▶ Huneus and Rogerson (2020), Fan, Peters and Zilibotti (2020) in India.
  - ▶ Premature deindustrialization: Rodrik (2016), Herrendorf et al.(2014, 2022), Fujiwara and Matsuyama (2020), McMillan and Zeufack (2021) for Africa; Sposi et al. (2021) for the role of trade.
  - ▶ Early development literature: Lewis (1979), Harris-Todaro (1970.)
- ▶ **Firm heterogeneity in Rich and Poor Countries:** Hsieh and Klenow (2009); Bento and Restuccia (2020); Eslava, Haltiwanger and Pinzón (2019); Poshke (2018); Alfaro, Charlton and Kanczuk (2009); Missing Middle: Tybout (2000, 2014.)
  - ▶ Misallocation: Hsieh and Klenow (2009), Restuccia and Rogerson (2008), Eslava et al. (2023.)
- ▶ **Informality and trade:** Dix-Carneiro, et al. (2021)
  - ▶ Self-employment: Amodio et al. (2022)
- ▶ **Micro to Macro:** Buera, Kaboski, and Townsend (2021), Buera and Moll (2015), Mestieri et al (2017.)

# Micro to Macro

## Two simple explanations for jobless industrialization

1. **Capital Intensity:** Modern sectors use capital more intensively.
2. **Distortions:** Modern sectors abide by regulations.

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- ▶ One also must look at the entire **firm distribution**:
  - ▶ Gap vs. early starters is largely accounted for by tiny firms...
    - ▶ ... and these firms absorb relatively little employment.
    - ▶ This is acute, though not exclusive, in manufacturing.
    - ▶ Distortions  $(1 + \tau) > 1$  are correlated with size and productivity.

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    - ▶ This is acute, though not exclusive, in manufacturing.
    - ▶ Distortions  $(1 + \tau) > 1$  are correlated with size and productivity.
- ▶ Traditional/small firms outside the realm of regulations.
  - ▶ They do not face  $(1 + \tau) > 1$ .

# An Occupational Choice Model of Dual Development

# Environment: Endowments and Preferences

## Endowments

- ▶  $N$  agents with heterogeneous ability,  $a$ .
- ▶ Each agent is endowed with one unit of time.
  - ▶ Use time to "manage" a technology (modern or traditional) or become a worker.

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## Preferences

- ▶ Defined over two goods (manufactured  $M$  and non-manufactured  $NM$ ).

$$U = \left( \phi_M^{\frac{1}{\rho}} C_M^{\frac{\rho-1}{\rho}} + (1 - \phi_M)^{\frac{1}{\rho}} C_{NM}^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}$$

- ▶  $C_M$  is a nest of different varieties:

1. Traditional vs. modern manufactures:  $C_M = \left( \phi_{M,M}^{\frac{1}{\epsilon}} C_{M,M}^{\frac{\epsilon-1}{\epsilon}} + (1 - \phi_{M,T})^{\frac{1}{\epsilon}} C_{M,T}^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}}$
2. Varieties within formal manufactures  $C_{M,M} = \left( \sum_{i \in N_M} d_i^{\frac{1}{\sigma}} C_{M,M,i}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$



# Environment: Technology and Markets

## Technologies (duality)

- ▶ Two technologies can be operated: Traditional ( $T$ ) and Modern ( $F$ ).
  - ▶ Modern technologies  $\in$  manufacturing, **but** not all manufacturing  $\in$  modern.
  - ▶ Production technologies are mutually exclusive.

$$y_{M,M}(a) = a (k(a)^\alpha m(a)^\phi l(a)^{1-\alpha-\phi})^\gamma$$

$$y_T(a) = a.$$

- ▶ Traditional goods ( $T$ ): numéraire.

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$$y_T(a) = a.$$

- ▶ Traditional goods ( $T$ ): numéraire.
- ▶ Distortions exclusively in the modern sector
  - ▶ Minimum wage payments
  - ▶ Taxes on all hired labor ( $\tau^w$ ); capital rents ( $\tau^k$ ) and revenue ( $\tau^R$ ).
  - ▶ Heterogeneous distortions across modern firms.

## Occupational Choice

Agent, conditional on joint productivity and “appeal” draw, maximizes income solving:

$$\max\{a, wa, \pi(a, d)\}$$

$a$  = income as self-employed.

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$wa$  = income as a worker.

$\pi(a, d)$  = profits from modern entrepreneurship. **Indifference thresholds** |  $d$

1. Self employment =  $a = wa$  = worker (we can pin down  $\bar{a}$ .)
2. Entrepreneurial profits =  $\pi(a, d, \tau) = wa$  worker (we can pin down  $\hat{a}$ .)

Distortions affect these thresholds, and thus the distribution of modern employment.

# Quantification

# Micro data estimation - 1982 to 1989 (for now)

## Firms' FONCs

**Annual Manufacturing Survey:**  $R$ ,  $wl$ ,  $k$ ,  $p$ ,  $p_m$ ,  $wl$ ,  $wl(1 + \tau_l)$ .

- ▶  $\alpha, \phi, \gamma, \sigma$ : joint demand-production estimation (Eslava et al. 2023).
- ▶ For each firm, obtain idiosyncratic  $\Delta = D^{\frac{1}{\sigma-1}} d^{\frac{1}{\sigma-1}} a$  from equilibrium residuals.
- ▶ Solve for composite distortion 
$$\frac{(1-\tau^R)^\gamma}{(1+\tau^k)^{\alpha\gamma} (1+\tau^l)^{\gamma(1-\alpha-\phi)}} = \frac{R}{(\Delta\mu^{-\gamma}\Theta)^{\frac{(\sigma-1)}{\sigma-\gamma(\sigma-1)}}}$$
- ▶ Solve for  $(1 + \tau_k) = \frac{l}{k}(1 + \tau_l)$
- ▶ Solve for  $(1 - \tau_r)$  from composite and individual distortions.

**Outcome: distribution of technology, quality, revenue, and factor distortions.**

- ▶ We use these outcomes as moments in model quantification.

# Preliminary Discussion and Policy Relevance

## Preliminary findings

- ▶ Explaining the Colombian jobless industrialization at the peak requires:
  - ▶ A combination of the different distortions in the model.
  - ▶ Binding minimum wage.
  - ▶ Size-related labor and revenue distortions.
  - ▶ On its own, a particular distortion has limited quantitative explanatory power.
    - ▶ In particular, input market (marginal) distortions.

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## Policy relevance

- ▶ Joblessness extends to today's late industrial processes (India, Africa.)
- ▶ Productivity gap concentrated in the informal (backward) sectors.
- ▶ Within modern manufacturing, misallocation seems to play an important role.
- ▶ Could this be traced back to the late starters' penalty?
  - ▶ Late starters have had more taxation, regulation, bigger governments...
    - ▶ ... relative to early starters at similar development stages.
    - ▶ Does this penalty suggest a different approach toward jobs creation and welfare?



Thank you!

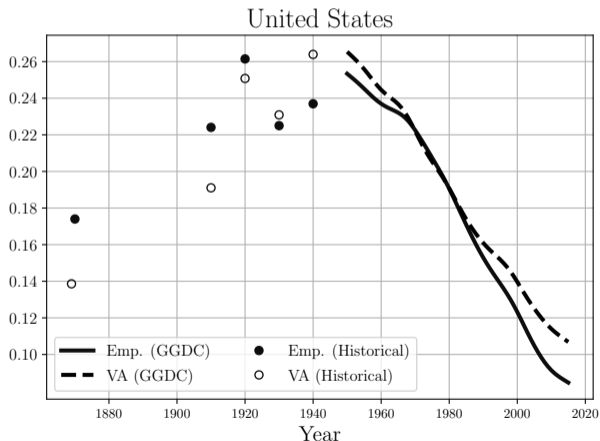
## Additional Slides

# Industrialization and Deindustrialization in the United States (1869–2018)

Shares = f(GDP pc);

[Back to Macro Facts](#)

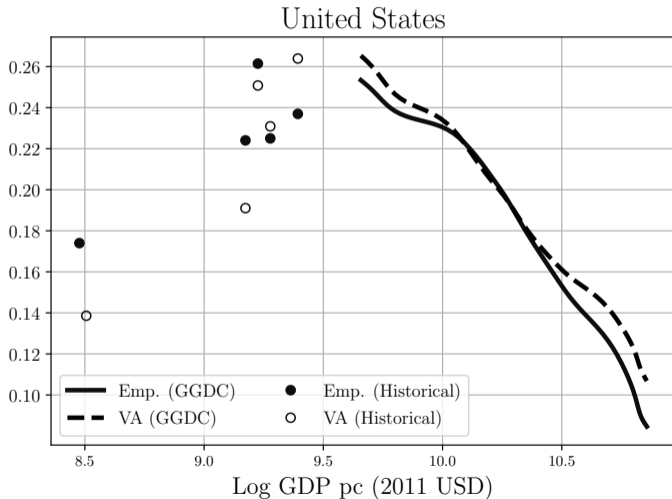
## Manufacturing as a Share of the Economy's Employment and Value Added



Notes: Data sources: GGDC 10-Sector Database; Economic Transformation Database; World KLEMS; Kuznets (1966), Mitchell (2007).

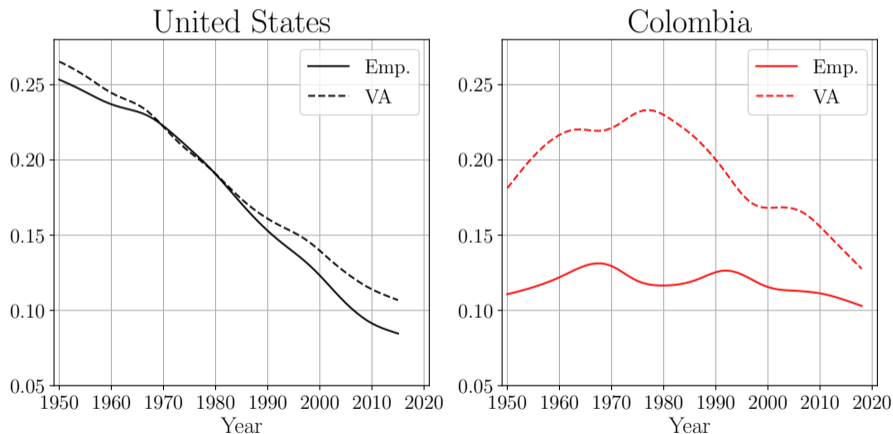
# Manufacturing Employment and Value Added Shares. United States (1869–2018)

Back to shares = f(time)



Notes: Data sources: GGDC 10-Sector Database; Economic Transformation Database; World KLEMS; Kuznets, (1966), Mitchell (2007).

## Manufacturing as a Share of the Economy's Employment and Value Added

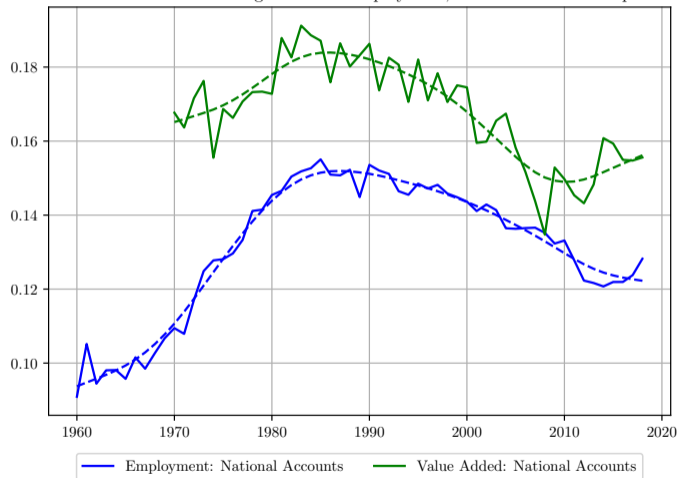


Notes: Data sources: GGDC 10-Sector Database; Economic Transformation Database; World KLEMS; MOxLAD Database.

# Jobless Industrialization. Morocco

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Morocco. Manufacturing Shares of Employment, Value Added and Output



Notes: Data sources: GGDC 10-Sector Database.

# Rodrik (2006) Premature De-industrialization

[Back to Macro Facts](#)
[Econometric Model](#)

	Employment	Nominal Value Added	Real Value Added
Log pop.	0.029 (0.066)	0.053 (0.082)	-0.133 (0.097)
Log pop. sq.	0.002 (0.004)	-0.002 (0.005)	0.006 (0.005)
Log GDP pc	0.400*** (0.120)	0.267** (0.107)	0.206* (0.120)
Log GDP pc sq.	-0.021*** (0.007)	-0.013** (0.006)	-0.008 (0.007)
1960s	-0.017 (0.013)	0.003 (0.016)	0.009 (0.016)
1970s	-0.033* (0.018)	-0.004 (0.022)	0.017 (0.021)
1980s	-0.052** (0.023)	-0.011 (0.028)	0.014 (0.026)
1990s	-0.073** (0.027)	-0.028 (0.033)	0.009 (0.032)
2000s	-0.103*** (0.032)	-0.058 (0.037)	-0.008 (0.037)
2010+	-0.127*** (0.036)	-0.087** (0.042)	-0.035 (0.040)
Obs.	2,269	2,269	2,269
Adjusted $R^2$	0.41	0.27	0.37

# Modern (manufacturing) firm problem (Eslava et al, 2023)

Back to Microdata estimation

$$\max_{\{k,l\}} \left(1 - \tau^R\right) D^{\frac{1}{\sigma}} d^{\frac{1}{\sigma}} y^{1-\frac{1}{\sigma}} - \left(1 + \tau^l\right) wl - \left(1 + \tau^K\right) rk - p_m m \quad (1)$$

$$\pi = \left(1 - \tau^R\right) R \left(1 - \frac{\gamma}{\mu}\right) \quad (2)$$

$$R = \left( \Delta \mu^{-\gamma} \frac{\left(1 - \tau^R\right)^\gamma}{\left(1 + \tau^k\right)^{\alpha\gamma} \left(1 + \tau^l\right)^{\gamma(1-\alpha-\phi)}} \Theta \right)^{\frac{(\sigma-1)}{\sigma-\gamma(\sigma-1)}} \quad (3)$$

where  $\Delta = D^{\frac{1}{\sigma-1}} d^{\frac{1}{\sigma-1}} a$  and  $\Theta = \gamma^\gamma (\alpha r)^\gamma ((1 - \alpha - \phi)w)^{\gamma(1-\alpha-\phi)} (\phi p_m)^{\phi\gamma}$ .

$$\mu^{-1} = \left(\frac{\sigma - 1}{\sigma}\right) (1 - s) \quad (4)$$

$$l = \frac{(1 - \alpha - \phi) r (1 + \tau^k)}{\alpha w (1 + \tau^l)} k \equiv \theta \quad (5)$$



- ▶ Following Rodrik (2006), we estimate the following econometric model

$$\begin{aligned} \text{Man. share}_{it} = & \phi_0 + \phi_1 \log \text{pop}_{it} + \phi_2 (\log \text{pop}_{it})^2 + \phi_3 \log \text{GDP pc}_{it} \\ & + \phi_4 (\log \text{GDP pc}_{it})^2 + \sum_i \gamma_i D_i + \sum_T \phi_T \text{PER}_T + \epsilon_{it}. \end{aligned}$$

- ▶ For Man. Share, we use employment, nominal and real value-added shares as independent variables.
- ▶  $i$  stands for country,  $t$  for year,  $T$  for decade.  $D_i$  are country fixed-effects.
- ▶ Rodrik's emphasis is on the significance of  $\sum_T \phi_T \text{PER}_T$ , which suggest a de-industrialization beyond what one would expect through the hump-shaped explained via income.

## Detailed historical microdata for Colombia over five decades

- ▶ Inform modern firm's module. [Colombia](#)
- ▶ Data for all manufacturing establishments of 10+ employees ("modern").
  - ▶ Includes revenue, input use, and detailed price data.
- ▶ Rich and direct historical data on minimum wage and payroll taxes.
- ▶ **Data + production technology estimates:**
  - ▶ Back distortions from revenue and capital-labor ratio wedges in data.
  - ▶ Distortion-free model: Natural benchmark for "technological joblessness".

# Employment. Regional Estimates

[Back to Macro Facts](#)
[Back to Econometric Model](#)

	All	USA + Europe	Latin America	Asia	Africa
Log pop.	0.041 (0.063)	1.183 (0.823)	0.118* (0.054)	0.190 (0.191)	0.098* (0.055)
Log pop. sq.	0.001 (0.004)	-0.045 (0.030)	-0.001 (0.003)	-0.012 (0.008)	-0.003 (0.003)
Log GDP pc	0.395*** (0.117)	0.944** (0.299)	0.872*** (0.252)	0.843*** (0.156)	0.063 (0.059)
Log GDP pc sq.	-0.020*** (0.007)	-0.049** (0.016)	-0.048*** (0.014)	-0.043*** (0.008)	-0.003 (0.004)
1960s	0.002 (0.016)	0.017 (0.027)	-0.029*** (0.009)	-0.012 (0.017)	0.035 (0.021)
1970s	-0.014 (0.020)	-0.011 (0.029)	-0.053** (0.018)	-0.018 (0.023)	0.030* (0.015)
1980s	-0.032 (0.025)	-0.050 (0.034)	-0.085*** (0.027)	-0.030 (0.035)	0.024 (0.016)
1990s	-0.053* (0.029)	-0.079* (0.039)	-0.104** (0.036)	-0.058 (0.058)	0.018 (0.016)
2000s	-0.082** (0.033)	-0.104* (0.047)	-0.138** (0.043)	-0.082 (0.072)	0.008 (0.009)
2010+	-0.106*** (0.037)	-0.138** (0.049)	-0.153*** (0.045)	-0.096 (0.079)	0.000 (.)
Obs.	2476	552	603	598	723
Adjusted $R^2$	0.39	0.72	0.57	0.48	0.18

# Value Added (Nominal). Regional Results

[Back to Macro Facts](#)
[Back to Econometric Model](#)

	All	USA + Europe	Latin America	Asia	Africa
Log pop.	0.076 (0.092)	0.576 (0.557)	0.086 (0.111)	0.448** (0.156)	0.281** (0.106)
Log pop. sq.	-0.003 (0.005)	-0.023 (0.020)	-0.005 (0.007)	-0.022*** (0.007)	-0.014** (0.005)
Log GDP pc	0.321** (0.127)	-1.418*** (0.348)	0.346 (0.408)	0.808*** (0.188)	-0.016 (0.074)
Log GDP pc sq.	-0.016** (0.007)	0.066*** (0.017)	-0.017 (0.023)	-0.042** (0.010)	-0.000 (0.005)
1960s	0.005 (0.012)	0.017 (0.014)	-0.004 (0.017)	0.002 (0.018)	0.002 (0.035)
1970s	0.007 (0.022)	-0.019 (0.016)	-0.012 (0.027)	0.012 (0.033)	0.026 (0.028)
1980s	-0.002 (0.028)	-0.034 (0.023)	-0.009 (0.042)	0.003 (0.036)	0.031 (0.021)
1990s	-0.020 (0.032)	-0.046 (0.029)	-0.018 (0.059)	-0.012 (0.046)	0.022 (0.019)
2000s	-0.051 (0.037)	-0.073 (0.040)	-0.046 (0.065)	-0.025 (0.051)	0.008 (0.011)
2010+	-0.083* (0.042)	-0.105** (0.043)	-0.080 (0.070)	-0.041 (0.053)	0.000 (.)
Obs.	2381	422	555	652	752
Adjusted $R^2$	0.31	0.85	0.28	0.57	0.36

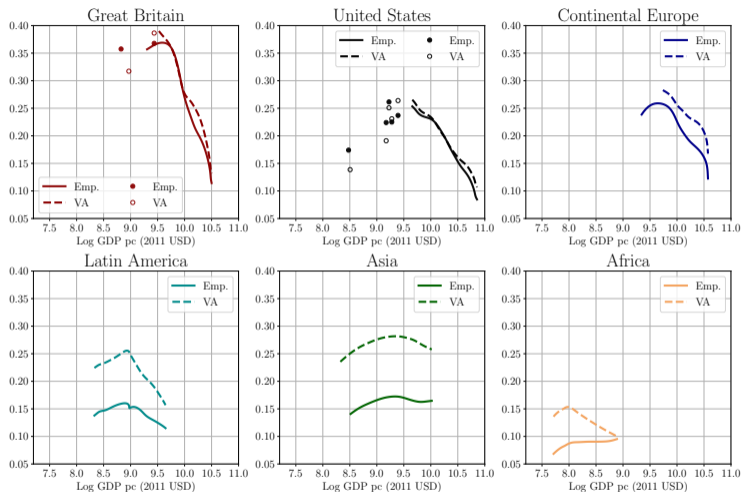
# Value Added (Real). Regional Results

[Back to Macro Facts](#)
[Back to Econometric Model](#)

	All	USA + Europe	Latin America	Asia	Africa
Log pop.	-0.096 (0.097)	-2.863 (1.547)	0.185*** (0.039)	0.029 (0.205)	0.027 (0.048)
Log pop. sq.	0.005 (0.005)	0.108 (0.059)	-0.002 (0.003)	-0.006 (0.010)	-0.000 (0.003)
Log GDP pc	0.263** (0.128)	0.678 (0.383)	-0.178 (0.120)	0.692*** (0.139)	0.071 (0.069)
Log GDP pc sq.	-0.011 (0.007)	-0.026 (0.020)	0.008 (0.006)	-0.033*** (0.009)	-0.004 (0.005)
1960s	-0.017 (0.023)	-0.043 (0.047)	-0.013 (0.007)	0.010 (0.019)	0.037 (0.027)
1970s	-0.013 (0.027)	-0.032 (0.048)	-0.022** (0.008)	0.022 (0.033)	0.044* (0.024)
1980s	-0.019 (0.031)	-0.047 (0.052)	-0.060*** (0.009)	0.025 (0.039)	0.039* (0.018)
1990s	-0.026 (0.035)	-0.053 (0.059)	-0.089*** (0.012)	0.031 (0.046)	0.035** (0.011)
2000s	-0.046 (0.040)	-0.053 (0.076)	-0.112*** (0.018)	0.031 (0.048)	0.015* (0.007)
2010+	-0.075* (0.043)	-0.053 (0.076)	-0.138*** (0.017)	0.020 (0.051)	0.000 (.)
Obs.	2556	562	613	654	727
Adjusted $R^2$	0.29	0.30	0.56	0.79	0.20

# Macro Fact 1: Jobless Industrialization—Additional Countries

Back to Macro Facts



**Notes:** Data sources: GGDC 10-Sector Database; Economic Transformation Database; World KLEMS; MOxLAD Database. Regional aggregations are expressed as simple averages. *Europe*: Denmark, Spain, France, G. Britain, Italy, The Netherlands and Sweden. *Latin America*: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico and Peru. *Asia*: China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Thailand and Taiwan. *Africa*: Botswana, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Nigeria, Senegal, South Africa, Tanzania and Zimbabwe.

# We Incorporate Historical Firm-Level Micro Data (Long-Time Series)

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- ▶ Long Time-Series of Firm Micro Data: Generally Unavailable.
- ▶ Colombian data: unparalleled in scope and detail in most of developing countries.

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  - ▶ Household surveys cover the informal sector and include information on employers, including firm size (at least since 1971).
- ▶ Other countries: GGDC 10-Sector Database; Economic Transformation Database; World KLEMS; MOxLAD Database; Local Data Sources

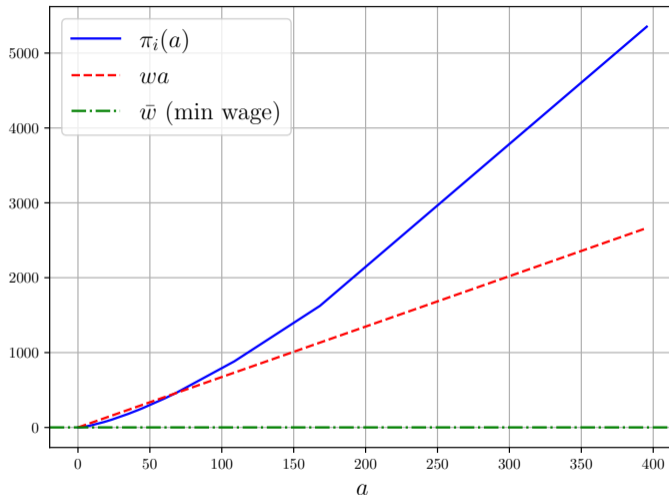
# We Model and Quantify Structural Change with Firm Heterogeneity

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- ▶ Interpret evidence through a model with self-selection in formality in a dual economy.
- ▶ Modern (manufacturing) faces binding labor costs associated to formality relative to traditional (self-employment).
- ▶ Leverage unparalleled establishment-level data covering 7 decades to estimate market-power and distortions in labor, capital, and product markets.

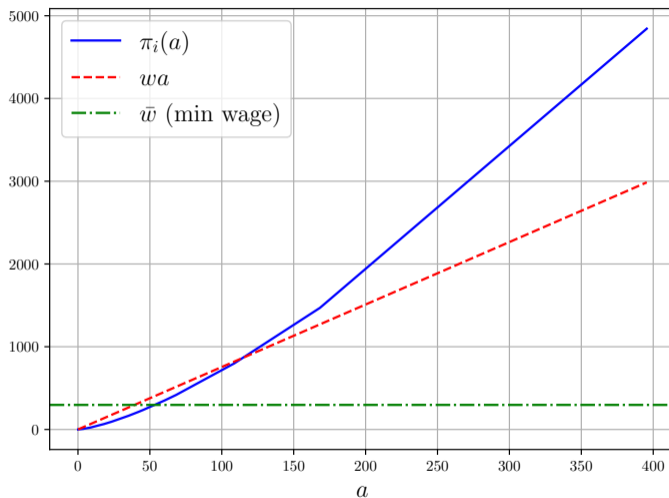
# Occupational Choice: Frictionless

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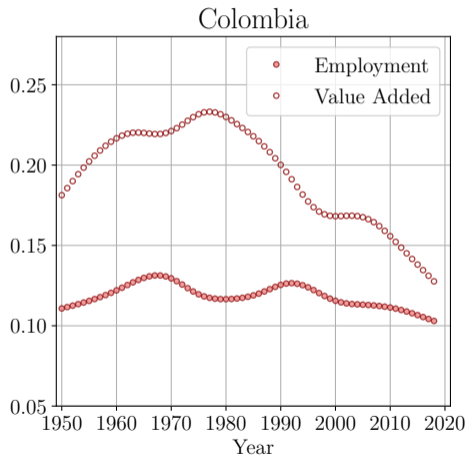
Notes: Equilibrium prices are  $w^* = 6.74$  and  $P_{M,M}^* = 0.01$ .

# Occupational Choice: $\bar{w}$ [Back](#)

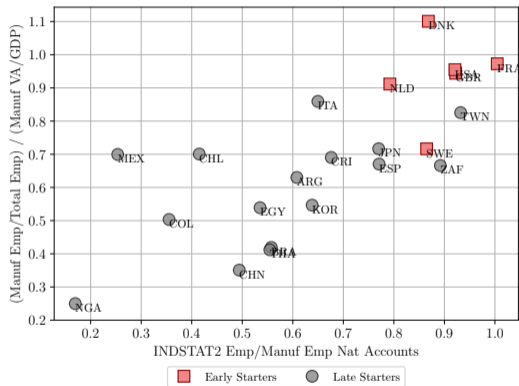


Notes: Equilibrium prices are  $w^* = 7.551$  and  $P_{M,M}^* = 0.02$ .

## Manufacturing Share of the Economy's Employment and Value Added



## Manufacturing in employment relative to VA vs. weight of modern firms in manufacturing employment

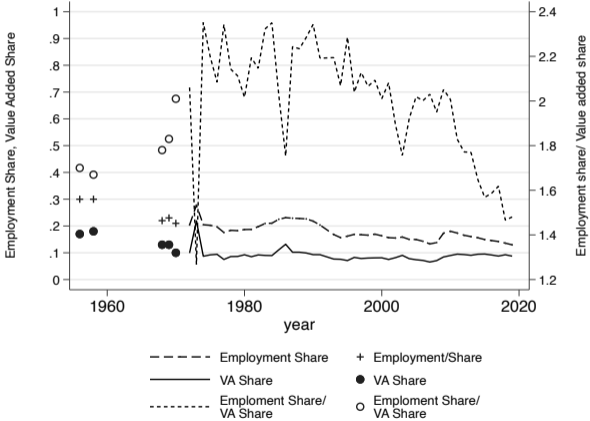


**Notes:** Data sources: GGDC 10-Sector Database; Economic Transformation Database; World KLEMS; MOxLAD Database; INDSTAT2 (UNIDO).

*Early Starters:* Great Britain, United States, Denmark, France, The Netherlands and Sweden. *Late Starters:* Argentina, Brazil, Chile, Colombia, Costa Rica, Egypt, Spain, Indonesia, Italy, Japan, South Korea, Mexico, Mauritius, Malaysia, Nigeria, Philippines, Thailand, Taiwan and South Africa.

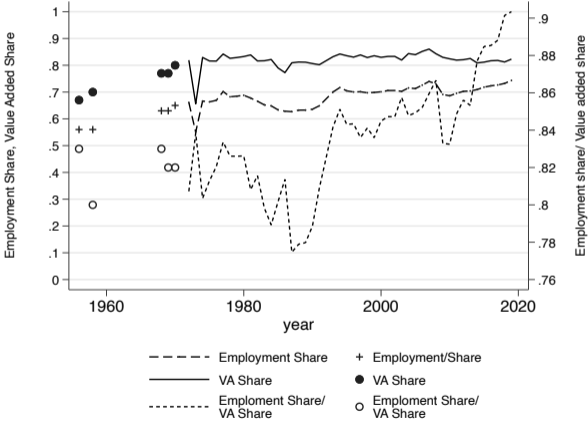
Late starters are defined as countries that had a manufacturing value added share over 20% of GDP at some point in its history.

# Share of manufacturing survey employment and value added represented by different sizes: time series



10 to 50 workers

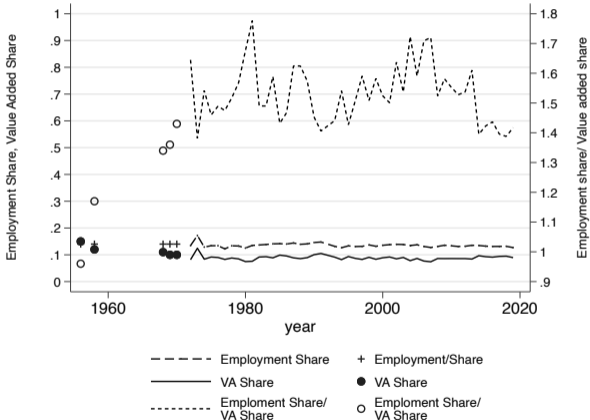
# Share of manufacturing survey employment and value added represented by different sizes: time series



51 to 100 workers



# Share of manufacturing survey employment and value added represented by different sizes: time series



100+ workers

Employer size	Ratio of category's weight in employment to category's weight in ...			Individual-level Survey	
	value added (Manufacturing Survey)	worker earnings (Colombia)	worker earnings (CPS USA)	Weight of category in manufacturing employment (Colombia)	Weight of category in manufacturing employment (USA)
Panel B: 2018					
≤ 10 workers (inc. Self-employed)		1.431	1.294	0.564	0.100
10-50 workers	1.772	0.887	1.174	0.125	0.138
51-100 workers	1.537	0.750	1.138	0.036	0.093
101+ workers	0.856	0.662	0.930	0.276	0.669

The Manufacturing Survey (first column) covers all manufacturing establishments with at least ten employees. The last four columns are based on surveys of individuals representative of all occupied individuals. This is the Annual Social and Economic Supplement of the Consumer Population Survey (ASEC-CPC) for the US. For Colombia, it is the Households Survey (the official source of labor market statistics) in 2018 and the Life Quality Survey in 1997. The Life Quality Survey was also collected in 2018 and yielded similar results to the households' survey.