Superstars or Supervillains? Large Firms in the South Korean Growth Miracle

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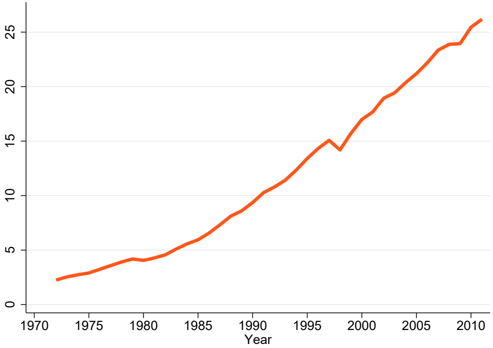
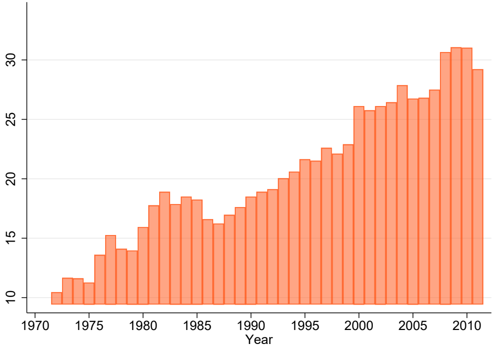
South Korea's growth miracle and firm concentration



Real GDP per Capita
(thousands 2010 USD)



Mfg. sale concentration (%)
(=Top 3 firm sales within each sector / Mfg GO)

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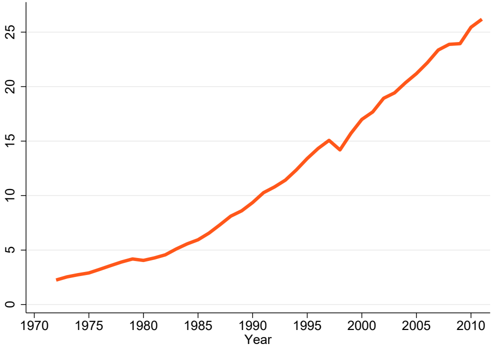

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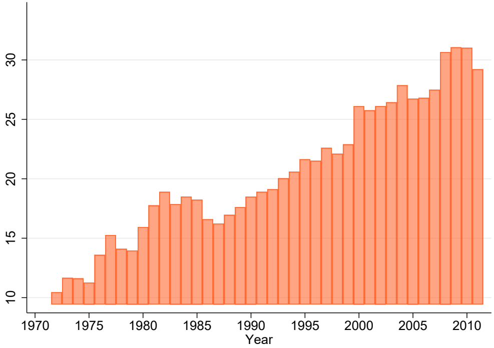

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Today: What is the role of large firms in South Korea's economic performance?

Causes: Productivity? Export demand? Distortions?

Consequences: Market power? Welfare? Real GDP?

Summary of quantitative framework

Quantitative framework

- Small open economy, heterogeneous firms
  1. Productivity (Melitz, 2003)
  2. Export demand (Melitz, 2003)
  3. Labor/capital distortions (Hsieh and Klenow, 2009)
  4. Oligopolistic product markets (Atkeson and Burstein, 2008)
  5. Oligopsonistic labor markets (Berger et al., 2022)

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Analytical results

- Inversion: One-to-one mapping between exogenous shocks 1.-5. and firm market shares
- Aggregation: Total Factor Productivity (TFP) and markups
- Concentration ratio decomposition: sectoral reallocation, productivity, trade, entry-exit

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Quantification

- Novel firm-level panel dataset covering South Korean manufacturing, 1970-2010
- "Full resolution" approach: firms in the model are actual firms in the data

Environment

- Small open economy
  - Representative household supplying labor L and capital K (+)
  - Household trades off consumption against labor/leisure and provides differentiated labor
- Aggregation
  - Continuum of sectors $j \in [0, 1]$ (+)
    - $\mathcal{J}^{\mathrm{M}}$ manufacturing sectors: heter. firms, market power, exports and competitive fringe
    - $\mathcal{J}^{\mathrm{NM}}$ non-manufacturing sectors: (monopolistically) competitive fringe firms
    - Sectoral output combines domestic output and imported inputs
  - Sectoral output is used for aggregates: final consumption and roundabout production
- Baseline: fixed entry

Firms

$$\pi_{fj} = \max_{\{y^H_{fj}, y^F_{fj}, l_{fj}, k_{fj}, m_{fj}\}} \left\{ p^H_{fj} y^H_{fj} + p^F_{fj} y^F_{fj} - (1+\tau^L_{fj}) w_{fj} l_{fj} - (1+\tau^K_{fj}) R^K k_{fj} - P^M_j m_{fj} \right\}$$

(Demand) $\quad y^H_{fj} = \frac{1}{F_j} (p^H_{fj})^{-\sigma_j} (P^H_j)^{\sigma_j - \rho_j} P_j^{\rho_j - 1} E_j \qquad y^F_{fj} = (p^F_{fj})^{-\sigma_j} D^F_{fj}$

(Labor supply) $\quad l_{fj} = \frac{1}{F_j} w_{fj}^{\eta} W_j^{\theta - \eta} W^{-\theta} L$

(Resource constraint) $\quad y^H_{fj} + y^F_{fj} = y_{fj} = a_{fj} l_{fj}^{\gamma^L_j} k_{fj}^{\gamma^K_j} m_{fj}^{\gamma^M_j}$

Propositions

- Proposition 1: Identification of shocks Formal

Given data on:

Domestic sales shares $\{s_{fj}^H\}$
Wage bill shares $\{s_{fj}^L\}$
Capital shares $\{s_{fj}^K\}$
Export sales shares $\{s_{fj}^F\}$

We can back out:

Productivity $\{a_{fj}\}$
Labor distortions $\{(1+\tau_{fj}^L)\}$
Capital distortions $\{(1+\tau_{fj}^K)\}$
Export demand $\{D_{fj}\}$

- Proposition 3: Change in concentration $\begin{cases} \text{Continuing top 3 firms} \\ \text{Entry/exit into top 3} \\ \text{Sectoral reallocation} \end{cases}$ Formal

- Proposition 4: Concentration and TFP Formal

Productivity, distortion, and export demand shocks that increase concentration can decrease sectoral TFP in the firm is initially sufficiently distorted

Data

- Firm balance sheet data, 1972–2011, 11 mfg sectors
  - Sales, employment, exports, fixed asset
  - Sources
    - 1972-1982: Digitized from firm survey data
    - 1983-2011: KIS-VALUE

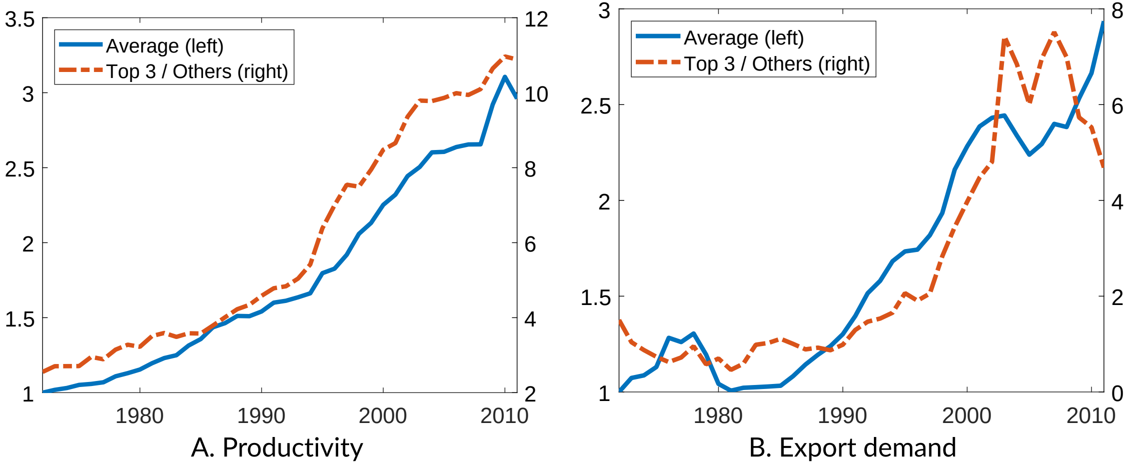
- Sectoral data, 1972–2011, 11 mfg sectors and 8 non-mfg sectors
  - Sales, employment, exports, fixed assets
  - Sources: KLEMS, IO tables from Bank of Korea

Calibration

Param.	Value	Description	Moment	Source
	Elasticities (externally calibrated)			
σ	5	Elast. subst. firms		Literature
ρ	2	Elast. subst. Home vs. Foreign		Boehm et al. (2023)
η	4	Labor supp. elast. firms		Card et al. (2018)
θ	1.89	Labor supp. elast. sectors		Deb et al. (2022)
ψ	0.5	Agg. labor supp. elast.		Chetty et al. (2013)
ζ	0	Gvnt. revenue waste		
	Production and Consumption (estimated or data)			
γ_j^L	0.12–0.46, avg. 0.22	Prod. ftn. labor share		Own estimate
γ_j^K	0.07–0.24, avg. 0.14	Prod. ftn. capital share		Own estimate
γ_j^M	0.41–0.65, avg. 0.57	Prod. ftn. material share		Own estimate
γ_j^i	0–0.75	Intermediate input shares	IO tables	IO tables
α_j	0–0.26	Consumption share	IO tables	IO tables
	Shocks (model inversion)			
a_{fjt}		Productivity	Dom. sales sh.	Data
D_{fjt}		Foreign demand	Export sh.	Data
$1+\tau_{fjt}^L$		Labor distortion	Emp. sh.	Data
$1+\tau_{fjt}^K$		Capital distortion	Cap. sh.	Data
P_{jt}^F		Import price shock	Import shares	Data
ψ_t		Labor supp. pref. shock	Working hours per worker	Data

Estimation

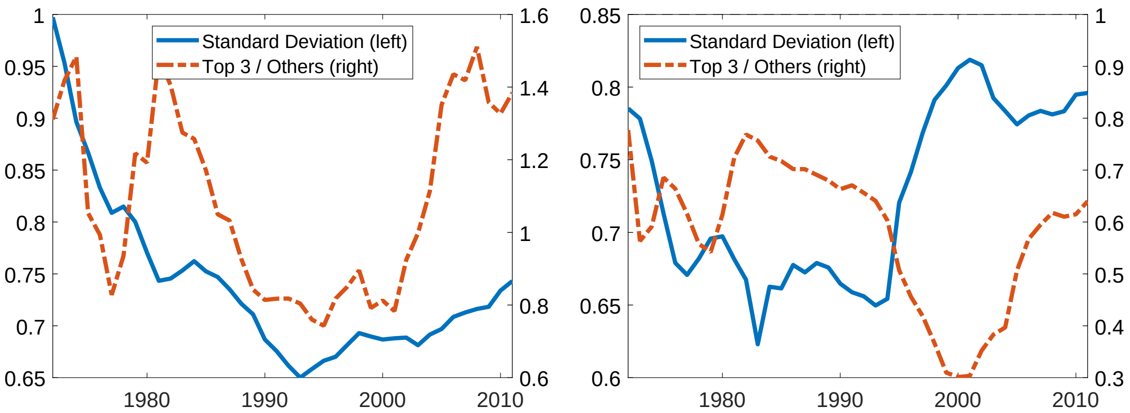
Shocks: productivity and export demand grew faster among top firms



Average: sales-weighted average of all firms

Top3 / Others: unweighted average of top3 firms / that of other firms

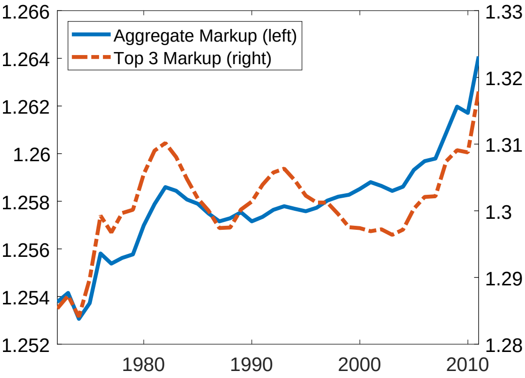
Shocks: less obvious long-run trends in distortions for top firms



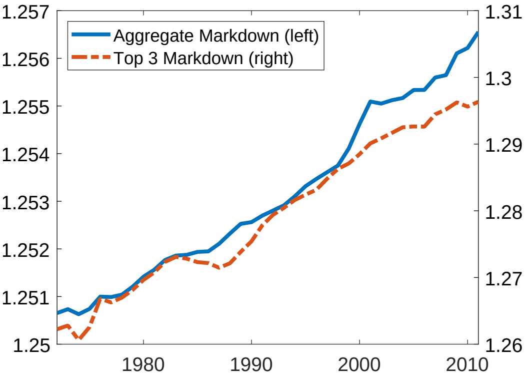
C. Labor distortions (Std. $1+\tau^{L}_{fjt}$)

D. Capital Distortions (Std. $1+\tau^{K}_{fjt}$)

Aggregate markups and markdowns



Aggregate markup $\mathcal{M}_t$



Aggregate markdown $\mathcal{M}_t^L$

Domestic De Loecker et al.

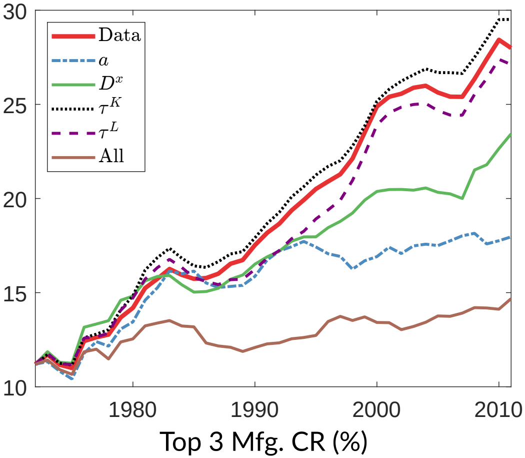
Counterfactuals for growth accounting

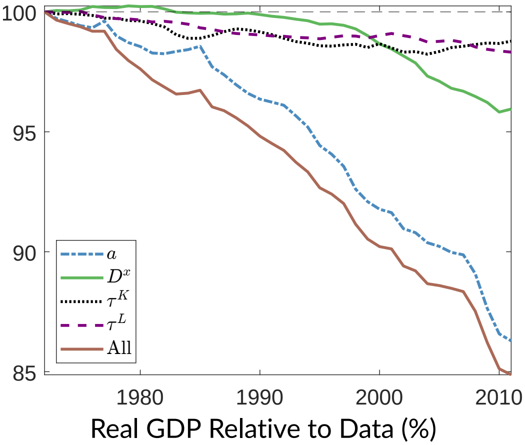
- What if the top 3 have evolved similar to other firms within sectors?
- For each shock $X_{fjt} \in \{a_{fjt}, D^x_{fjt}, 1+\tau^L_{fjt}, 1+\tau^K_{fjt}\}$, apply unweighted average growth rate within sector-age-year

$$\triangle \ln X^{t3,c}_{fjt} = \frac{1}{F^a_{jt}} \sum_{f \in \mathcal{F}^a_{jt}} \triangle \ln X_{fjt}$$

Details

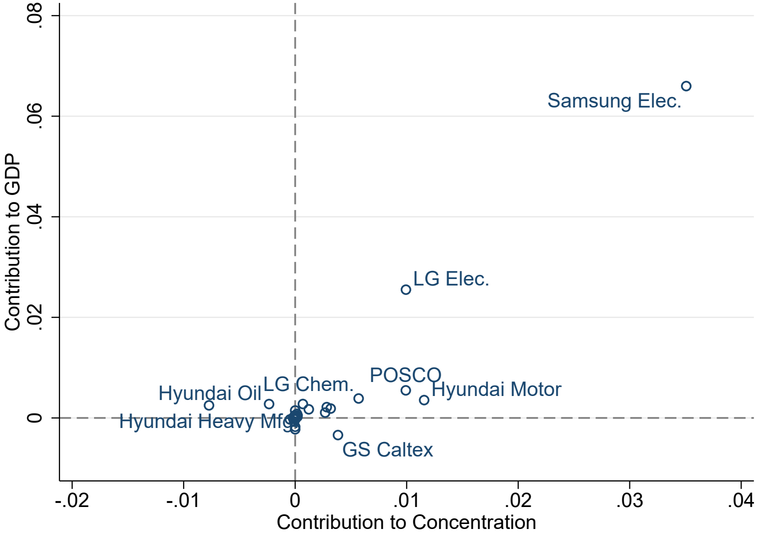
Concentration and real GDP





Markups/Markdowns Welfare Samsung

Superstars or supervillains? Counterfactuals for one firm at a time



Conclusion: superstars or supervillains?

$\rightarrow$ Mostly superstars

- Higher productivity/export demand
- No obvious trend in relative distortions
- Limited impact on markups

Households

GHH (1988) preferences

$$\max_{\{C,L\}} U\left(C - \bar{\psi}\frac{L^{1+\frac{1}{\psi}}}{1+\frac{1}{\psi}}\right)$$
$$s.t.$$
$$PC = WL + \varrho K + \Pi + T$$

Labor composites (Berger et al. 2022)

$$L = \left(\int_0^1 L_j^{\frac{\theta+1}{\theta}} \mathrm{d}j\right)^{\frac{\theta}{\theta+1}}, \qquad L_j = \left(F_j^{\frac{1}{\eta}} \sum_{f\in\mathcal{F}_j} l_{fj}^{\frac{\eta+1}{\eta}}\right)^{\frac{\eta}{\eta+1}}$$

$$W = \left(\int_0^1 W_j^{1+\theta} \mathrm{d}j\right)^{\frac{1}{1+\theta}} \quad \text{and} \quad W_j = \left(\frac{1}{F_j}\sum_{f\in\mathcal{F}_j} w_{fj}^{1+\eta}\right)^{\frac{1}{1+\eta}}$$

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Sectors

Dixit-Stiglitz aggregation:

$$Y_j^H = \left[F_j^{-\frac{1}{\sigma}} \sum_{f \in \mathcal{F}_j} (y_{fj}^d)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \quad \text{and} \quad P_j^H = \left[\frac{1}{F_j} \sum_{f \in \mathcal{F}_j} (p_{fj}^d)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

Armington aggregation:

$$Y_j = \left[(Y_j^H)^{\frac{\rho-1}{\rho}} + (Y_j^F)^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}} \quad \text{and} \quad P_j = \left[(P_j^H)^{1-\rho} + (P_j^F)^{1-\rho} \right]^{\frac{1}{1-\rho}}$$

Import and domestic shares:

$$\lambda_j^F = (P_j^F / P_j)^{1-\rho} \quad \text{and} \quad \lambda_j^H = 1 - \lambda_j^F$$

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Identification of shocks

Closed economy   Distortions   No oligopolistic/monoposonictic/oligopsonistic power   CRS

$$\text{(Domestic sales share)} \qquad s^d_{fj} \propto \left(a_{fj}(1+\tau^L_{fj})^{\gamma^L_j}(1+\tau^K_{fj})^{\gamma^K_j}\right)^{1-\sigma_j}$$

$$\text{(Wage bill share)} \qquad s^L_{fj} \propto s^d_{fj}(1+\tau^L_{fj})^{-1}$$

$$\text{(Capital share)} \qquad s^K_{fj} \propto s^d_{fj}(1+\tau^K_{fj})^{-1}$$

Back

Identification of shocks

Closed economy   Distortions   Oligopolistic but no monoposonictic/oligopsonistic power   CRS

Atkeson and Burstein (2008)

$$\text{(Domestic sales share)} \qquad s^d_{fj} \propto \left(a_{fj} \mu^d_{fj} (1+\tau^L_{fj})^{\gamma^L_j} (1+\tau^K_{fj})^{\gamma^K_j} \right)^{1-\sigma_j}$$

$$\text{(Wage bill share)} \qquad s^L_{fj} \propto s^d_{fj} \left(\mu^d_{fj} (1+\tau^L_{fj}) \right)^{-1}$$

$$\text{(Capital share)} \qquad s^K_{fj} \propto s^d_{fj} \left(\mu^d_{fj} (1+\tau^K_{fj}) \right)^{-1}$$

Markups are functions of s^d_{fj}, λ^H_j

$$\mu^d_{fj} = \frac{\epsilon(s^d_{fj}, \lambda^H_j)}{\epsilon(s^d_{fj}, \lambda^H_j) - 1}, \qquad \epsilon(s^d_{fj}, \lambda^H_j) = \left[\frac{1}{\sigma_j} + \left(\frac{1}{\rho_j} - \frac{1}{\sigma_j} \right) s^d_{fj} + \left(1 - \frac{1}{\rho_j} \right) \lambda^H_j s^d_{fj} \right]^{-1} \qquad s^d_{fj} = \frac{p^d_{fj} y^d_{fj}}{\sum_{g \in \mathcal{F}_j} p^d_{gj} y^d_{gj}}$$

Back

Identification of shocks

Closed economy, Distortions Oligopolistic power Oligopsonistic power CRS

$$
\begin{aligned}
\text{(Domestic sales share)} \quad & s_{fj}^{d} \propto \left(a_{fj}\mu_{fj}^{d}\left(\mu_{fj}^{L}(s_{fj}^{L})\right)^{\frac{1}{\eta+1}}(1+\tau_{fj}^{L})^{\gamma_j^L}(1+\tau_{fj}^{K})^{\gamma_j^K}\right)^{1-\sigma_j} \\
\text{(Wage bill share)} \quad & s_{fj}^{L} \propto s_{fj}^{d}\left(\mu_{fj}^{d}\mu_{fj}^{L}(1+\tau_{fj}^{L})\right)^{-1} \\
\text{(Capital share)} \quad & s_{fj}^{K} \propto s_{fj}^{d}\left(\mu_{fj}^{d}\mu_{fj}^{L}(1+\tau_{fj}^{K})\right)^{-1}
\end{aligned}
$$

Markdowns are functions of s_{fj}^{L}

$$
\mu_{fj}^{L} = \frac{\epsilon^{L}(s_{fj}^{L})+1}{\epsilon^{L}(s_{fj}^{L})}, \qquad \epsilon^{L}(s_{fj}^{L}) = \left[\frac{1}{\eta} + \left(\frac{1}{\theta} - \frac{1}{\eta}\right)s_{fj}^{L}\right]^{-1}, \qquad s_{fj}^{L} = \frac{w_{fj}l_{fj}}{\sum_{f\in\mathcal{F}_j} w_{gj}l_{gj}}
$$

Back

Identification of shocks

Open economy Distortions Oligopolistic power Oligopsonistic power CRS

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\begin{aligned}
\text{(Domestic sales share)} \quad & s^d_{fj} \propto \left(a_{fj}\mu^d_{fj}\left(\mu^L_{fj}(s^L_{fj})^{\frac{1}{\eta+1}}(1+\tau^L_{fj})\right)^{\gamma^L_j}(1+\tau^K_{fj})^{\gamma^K_j}\right)^{1-\sigma_j} \\
\text{(Wage bill share)} \quad & s^L_{fj} \propto s^d_{fj}\left(\Lambda^d_{fj}\mu^d_{fj}\mu^L_{fj}(1+\tau^L_{fj})\right)^{-1}, \\
\text{(Capital share)} \quad & s^K_{fj} \propto s^d_{fj}\left(\Lambda^d_{fj}\mu^d_{fj}(1+\tau^K_{fj})\right)^{-1} \\
\text{(Export share)} \quad & s^x_{fj} \propto s^d_{fj}\left((\mu^d_{fj})^{-1}(D^x_{fj})^{\frac{1}{1-\sigma_j}}\right)^{1-\sigma_j}
\end{aligned}
$$

$$
\Lambda^d_{fj} = \frac{q^d_{fj}}{q^d_{fj}+q^x_{fj}} = \underbrace{\frac{r^d_{fj}/\mu^d_{fj}}{r^d_{fj}/\mu^d_{fj} + r^x_{fj}/\mu^x_{fj}}}_{\text{Data}}
$$

Back

Identification of shocks

Open economy Distortions Oligopolistic power Oligopsonistic power VRTS

(Domestic sales share) $$s^d_{fj} \propto \left(a_{fj}^{-\frac{1}{\gamma_j}} \mu^d_{fj} \left(\mu^L_{fj}(1+\tau^L_{fj})\right)^{\frac{\gamma^L_j}{\gamma_j}} (1+\tau^K_{fj})^{\frac{\gamma^K_j}{\gamma_j}} (s^L_{fj})^{\frac{\gamma^L_j}{\gamma_j(\eta+1)}} (\Lambda^d_{fj})^{\frac{\gamma_j-1}{\gamma_j}} \right)^{-\frac{\gamma_j}{\frac{\sigma_j}{\sigma_j-1}-\gamma_j}}$$

(Wage bill share) $$s^L_{fj} \propto s^d_{fj} \left(\Lambda^d_{fj} \mu^d_{fj} (1+\tau^L_{fj}) \mu^L_{fj} \right)^{-1}$$

(Capital share) $$s^K_{fj} \propto s^d_{fj} \left(\Lambda^d_{fj} \mu^d_{fj} (1+\tau^K_{fj}) \right)^{-1}$$

(Export share) $$s^x_{fj} \propto s^d_{fj} \left((\mu^d_{fj})^{-1} \left((1-\Lambda^d_{fj})/\Lambda^d_{fj}\right)^{\frac{1-\gamma_j}{\gamma_j}} (D^x_{fj})^{\frac{\gamma_j}{1-\sigma_j}} \right)^{-\frac{\gamma_j}{\frac{\sigma_j}{\sigma_j-1}-\gamma_j}}$$

γ_j: RTS ($\gamma_j < 1$: DRS $\gamma_j = 1$: CRS $\gamma_j > 1$: IRS)

Back

Proposition: Inversion

For each sector, given sectoral domestic shares $\{\lambda_j^H\}_{j\in\mathcal{J}^\mathrm{M}}$ and firm sales in domestic and foreign markets $\{r_{fj}^d, r_{fj}^x\}$, the shares $\{s_{fj}^d, s_{fj}^L, s_{fj}^K, s_{fj}^x\}_{f\in\mathcal{F}_j}$ satisfy the following $3\times|\mathcal{F}_j|+|\mathcal{F}_j^x|$ system of equations:

$$s_{fj}^d = \frac{\left(a_{fj}^{-\frac{1}{\gamma_j}}\mu_{fj}^d\left(\mu_{fj}^L(1+\tau_{fj}^L)(s_{fj}^L)^{\frac{1}{\eta+1}}\right)^{\frac{\gamma_j^L}{\gamma_j}}(1+\tau_{fj}^K)^{\frac{\gamma_j^K}{\gamma_j}}(\Lambda_{fj}^d)^{\frac{\gamma_j-1}{\gamma_j}}\right)^{-\frac{\gamma_j}{\frac{\sigma}{\sigma-1}-\gamma_j}}}{\sum_{g\in\mathcal{F}_j}\left(a_{gj}^{-\frac{1}{\gamma_j}}\mu_{gj}^d\left(\mu_{gj}^L(1+\tau_{gj}^L)(s_{gj}^L)^{\frac{1}{\eta+1}}\right)^{\frac{\gamma_j^L}{\gamma_j}}(1+\tau_{gj}^K)^{\frac{\gamma_j^K}{\gamma_j}}(\Lambda_{gj}^d)^{\frac{\gamma_j-1}{\gamma_j}}\right)^{-\frac{\gamma_j}{\frac{\sigma}{\sigma-1}-\gamma_j}}},$$

$$s_{fj}^L = \frac{s_{fj}^d(\Lambda_{fj}^d)^{-1}\left(\mu_{fj}^d(1+\tau_{fj}^L)\mu_{fj}^L\right)^{-1}}{\sum_{g\in\mathcal{F}_j}s_{gj}^d(\Lambda_{gj}^d)^{-1}\left(\mu_{gj}^d(1+\tau_{gj}^L)\mu_{gj}^L\right)^{-1}},$$

$$s_{fj}^K = \frac{s_{fj}^d(\Lambda_{fj}^d)^{-1}\left(\mu_{fj}^d(1+\tau_{fj}^K)\right)^{-1}}{\sum_{g\in\mathcal{F}_j}s_{gj}^d(\Lambda_{gj}^d)^{-1}\left(\mu_{gj}^d(1+\tau_{gj}^K)\right)^{-1}},$$

$$s_{fj}^x = \frac{s_{fj}^d(\mu_{fj}^x/\mu_{fj}^d)^{1-\sigma}D_{fj}^x}{\sum_{g\in\mathcal{F}_j^x}s_{gj}^d(\mu_{gj}^x/\mu_{gj}^d)^{1-\sigma}D_{gj}^x},$$

where

$$\Lambda_{fj}^d = \frac{r_{fj}^d/\mu_{fj}^d}{r_{fj}^d/\mu_{fj}^d + r_{fj}^x/\mu_{fj}^x} = \frac{y_{fj}^d}{y_{fj}}.$$

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Proposition: concentration

(i) Changes in CR^3_{jt} between $t-p$ and t reflect the contributions of continuing top-3 firms and the differential contribution of entering top-3 firms compared to firms no longer in the top 3:

$$\ln \frac{CR^3_{jt}}{CR^3_{j,t-p}} = \underbrace{\frac{1}{\frac{\sigma}{\sigma-1}-\gamma_j}\left[\sum_{f\in\mathcal{F}^{3,cont}_{j,t,t-p}} \omega_{fjt,t-p}\left(\ln\frac{\tilde{a}_{fjt}/\tilde{A}_{jt}}{\tilde{a}_{fj,t-p}/\tilde{A}_{j,t-p}} + \ln\frac{\phi_{fjt}/\Phi_{jt}}{\phi_{fj,t-p}/\Phi_{j,t-p}}\right)\right]}_{\text{Continuing top-3 firms}} - \underbrace{\ln\frac{S^{3,cont}_{jt}}{S^{3,cont}_{j,t-p}}}_{Entry\,/\,exit}.$$

The weights $\omega_{fjt,t-p}$ are defined as

$$\omega_{fjt,t-p} = \frac{\frac{s^{3,cont}_{fjt}-s^{3,cont}_{fj,t-p}}{\ln s^{3,cont}_{fjt}-\ln s^{3,cont}_{fj,t-p}}}{\sum_{g\in\mathcal{F}^{3,cont}_{jt,t-p}}\frac{s^{3,cont}_{gjt}-s^{3,cont}_{gj,t-p}}{\ln s^{3,cont}_{gjt}-\ln s^{3,cont}_{gj,t-p}}}, \quad \text{where} \quad s^{3,cont}_{fj\tilde{t}} = \frac{r_{fj\tilde{t}}}{\sum_{g\in\mathcal{F}^{3,cont}_{jt,t-p}} r_{gj\tilde{t}}}, \quad \tilde{t}\in\{t-p,t\}.$$

Back

Proposition: concentration (cont'd)

(ii) Changes in CR_t^3 between $t-p$ and t can be approximated as follows:

$$
\begin{aligned}
\ln \frac{CR_t^3}{CR_{t-p}^3} &\approx \sum_{j \in \mathcal{J}_M} \omega_{j,t-p}^3 \left(\ln \frac{CR_{jt}^3}{CR_{j,t-p}^3} + \ln \frac{S_{jt}}{S_{j,t-p}} \right) \\
&= \underbrace{\sum_{j \in \mathcal{J}_M} \omega_{j,t-p}^3 \frac{1}{\frac{\sigma}{\sigma-1} - \gamma_j} \left(\sum_{f \in \mathcal{F}_{jt,t-p}^{3,cont}} \omega_{fjt,t-p} \left(\ln \frac{\tilde{a}_{fjt}/\tilde{A}_{jt}}{\tilde{a}_{fj,t-p}/\tilde{A}_{j,t-p}} + \ln \frac{\phi_{fjt}/\Phi_{jt}}{\phi_{fj,t-p}/\Phi_{j,t-p}} \right) \right)}_{\text{Continuing top 3 firms}} \\
&\qquad - \underbrace{\sum_{j \in \mathcal{J}_M} \omega_{j,t-p}^3 \ln \frac{S_{jt}^{3,cont}}{S_{j,t-p}^{3,cont}}}_{\text{Entry/exit}} + \underbrace{\sum_{j \in \mathcal{J}_M} \omega_{j,t-p}^3 \ln \frac{S_{jt}}{S_{j,t-p}}}_{\text{Sectoral reallocation}},
\end{aligned}
$$

where $\omega_{j,t-p}^3 = \frac{\sum_{f \in \mathcal{F}_{j,t-p}^3} r_{fj,t-p}}{\sum_{i \in \mathcal{J}_M} \sum_{f \in \mathcal{F}_{i,t-p}^3} r_{fi,t-p}}$ and $S_{jt} = \frac{R_{jt}}{\sum_{i \in \mathcal{J}_M} R_{it}}$.

Back

Proposition: Concentration and Sectoral TFP

When firms (a) are monopolistically competitive in product markets, (b) competitively hire labor ($\eta \to \infty$), and (c) face export demand that scales with domestic demand ($\tilde{D}_{fjt}$ constant at the firm level), then:

(i) higher productivity a_{fjt} increases a firm's market share s_{fjt} but lowers sectoral productivity A_{jt} if:

$$\underbrace{\sum_{V \in \{K,L,M\}} \frac{\gamma_j^V}{\gamma_j} \frac{\widetilde{MRPV}_{jt}}{\widetilde{mrpv}_{fjt}}}_{\text{Firms' relative subsidy}} \geq \underbrace{\frac{\frac{\sigma}{\sigma-1}}{\gamma_j}}_{\geq 1} \left(1 + \frac{(\phi_{fjt}/\Phi_{jt})^{1-\sigma} - 1}{\sigma}\right),$$

(ii) higher subsidy $\frac{1}{(1+\tau_{fjt}^V)}$, $V = K, L$, increases a firm's market share s_{fjt} but lowers sectoral productivity A_{jt} if:

$$\underbrace{\sum_{V \in \{K,L,M\}} \frac{\gamma_j^V}{\gamma_j} \frac{\widetilde{MRPV}_{jt}}{\widetilde{mrpv}_{fjt}}}_{\text{Firms' relative subsidy}} \geq \underbrace{\frac{\frac{\sigma}{\sigma-1}}{\gamma_j}}_{\geq 1} \left(1 + \frac{(\phi_{fjt}/\Phi_{jt})^{1-\sigma} - 1}{\sigma}\right) - \left(\frac{\frac{\sigma}{\sigma-1}}{\gamma_j} - 1\right) \frac{\widetilde{MRPV}_{jt}}{\widetilde{mrpv}_{fjt}},$$

(iii) higher export demand $\tilde{D}_{fjt}$ increases a firm's market share s_{fjt} but lowers sectoral productivity A_{jt} if:

$$\underbrace{\sum_{V \in \{K,L,M\}} \frac{\gamma_j^V}{\gamma_j} \frac{\widetilde{MRPV}_{jt}}{\widetilde{mrpv}_{fjt}}}_{\text{Firms' relative subsidy}} \geq 1 + \frac{\gamma_j - 1}{\gamma_j} \left(\left(\frac{\Phi_{jt}}{\phi_{fjt}} \right)^{\sigma-1} - 1 \right).$$

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Production function estimation

Derive revenue-based estimating equation by combining production function and demand curve:

$$\ln \frac{r^d_{fjt}}{P^H_{jt}} = \beta^L_j \ln l_{fjt} + \beta^K_j \ln k_{fjt} + \beta^M_j \ln m_{fjt} + \frac{1}{\sigma_j} \ln Y^H_j + \beta^A_j \ln a_{fjt} + \ln u_{fjt}$$

Revenue elasticities (estimated for non-exporters) are ratios of demand and production parameters:

$$\beta^\nu_j = \frac{\gamma^\nu_j}{\frac{\sigma_j}{\sigma_j - 1}} \text{ for } \nu \in \{L, K, M\}.$$

We proceed in four steps:

1. Calibrate demand/substitution elasticities ($\sigma_j = 5$, $\rho_j = 2$ e.g., Boehm et al., 2023), and labor supply elasticities ($\eta = 4, \ \theta = 1.9$ e.g., Card et al., 2018; Deb et al., 2022)
2. Pin down $\widehat{\beta}^M_j$ using materials share
3. Estimate $\widehat{\beta}^L_j$ and $\widehat{\beta}^K_j$ using control function approach a la De Loecker, 2016
4. Back out production parameters: $\gamma^\nu_j = \frac{\sigma_j}{\sigma_j - 1} \beta^\nu_j$ for $\nu \in \{L, K, M\}$.

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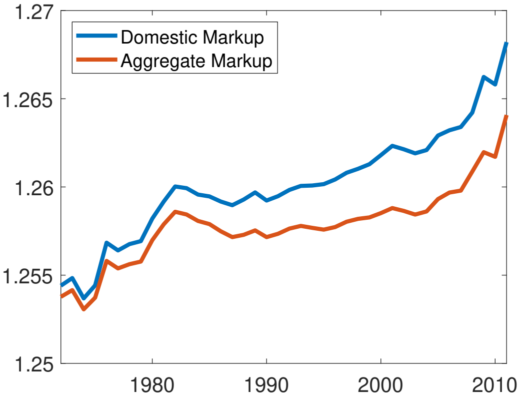
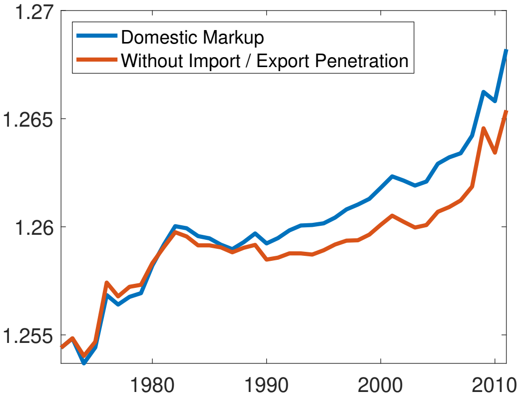
Markups and markdowns



$\mathcal{M}_t$ relative to baseline



$\mathcal{M}_t^L$ relative to baseline

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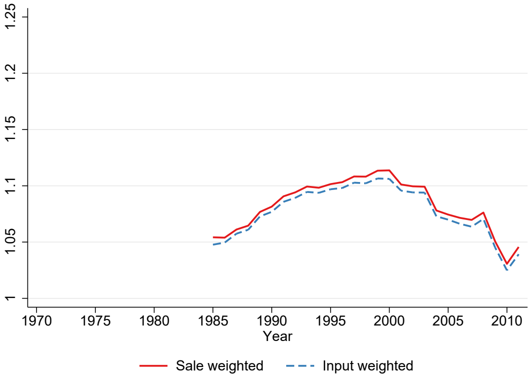
Aggregate Markup based on De Loecker et al. (2020)

A. Time-varying output elasticity



B. Time-invariant output elasticity v

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Counterfactual shocks

DHS growth rate $\widehat{X}$, unweighted average among continuing firms, age bin a:

$$\widehat{X}^a_{jt} = \sum_{f \in \mathcal{F}^a_{jt} \cap \mathcal{F}^{cont,nz}_{jt}} \underbrace{\frac{X_{fjt} - X_{fj,t-1}}{2(X_{fjt} + X_{fj,t-1})}}_{=\widehat{X}_{fjt}},$$

for $X_{fjt} \in \{a_{fjt}, D^x_{fjt}, 1 + \tau^L_{fjt}, 1 + \tau^K_{fjt}\}$

Counterfactual shocks for the top-3 firm f in sector j of age bin a:

$$X^c_{fjt} = \begin{cases} X_{fjt} & \text{if} \quad f \notin \mathcal{F}^{cont,nz}_{jt} \\ (1 + \widehat{X}^a_{jt}) X^c_{fj,t-1} & \text{if} \quad f \in \mathcal{F}^{cont,nz}_{jt} \cap \mathcal{F}^3_{jt} \\ (1 + \widehat{X}_{fjt}) X^c_{fj,t-1} & \text{if} \quad f \in \mathcal{F}^{cont,nz}_{jt} \cap (\mathcal{F}_{jt} / \mathcal{F}^3_{jt}). \end{cases}$$

- Factual values of shocks for firms entering the top-3 in t or firms that have zero values of X_{fjt} in either $t-1$ or t ($f \notin \mathcal{F}^{cont,nz}_{jt}$)
- Make the top-3 firms grow at the same rate as the other firms within the same sector and age bin
- Non-top 3 firms in t ($f \in \mathcal{F}_{jt} / \mathcal{F}^3_{jt}$) get the factual growth rate $\widehat{X}_{fjt}$

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Welfare

Shocks	All shocks	Productivity a_{fjt}	Foreign demand D^x_{fjt}	Labor distortion $1+\tau^L_{fjt}$	Capital distortion $1+\tau^K_{fjt}$
	(1)	(2)	(3)	(4)	(5)
	Panel A. Top 3 firms within sectors				
$\triangle$ Welfare (%)	-4.10	-2.79	-0.68	-0.69	-0.54

Other firms' adjustment Without Oligopoly

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Baseline vs Other Firms' Responses

(1)	(2)	(3)	(4)	(5)	(6)
Counterfactual vs. Factual Shocks					
All shocks			Productivity shocks		
$\triangle$ CR in 2011 (pp)	$\triangle$ Real GDP per capita in 2011 (%)	$\triangle$ Welfare (%)	$\triangle$ CR in 2011 (pp)	$\triangle$ Real GDP per capita in 2011 (%)	$\triangle$ Welfare (%)
Panel A. Baseline					
-13.31	-15.13	-4.10	-10.03	-13.72	-2.79
Panel B. Free Entry					
-13.86	-6.80	-2.00	-10.56	-2.36	-0.52
Panel C. Constant Sectoral Productivity					
-14.92	-3.24	-0.60	-11.96	-2.95	-0.19
Panel D. Productivity Spillovers					
-13.92	-17.55	-5.19	-10.28	-16.40	-3.89

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Shutting down variable markups altogether

Goods market Labor market	Oligopoly Monopsonistic compet.	Monopolistic compet. Oligopsony	Monopolistic compet. Monosonistic compet.
	(1)	(2)	(3)
$\triangle$ Welfare (%)	0.00	1.06	1.07

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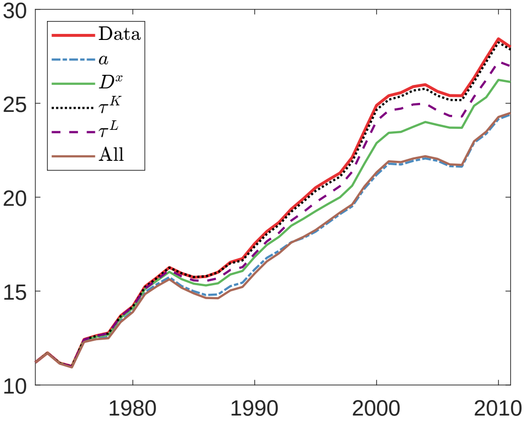
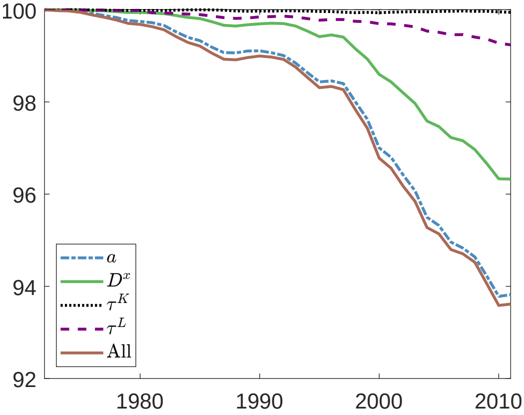
Samsung Electronics

Counterfactual

Make Samsung Electronics's shocks grow as other firms



Top 3 Concentration Ratio Top (%)



GDP relative to the baseline

- $\downarrow$ CR, 3.5pp in 2011 $\downarrow$ GDP, 6.4% in 2011 $\downarrow$ (Discounted) Welfare, 1%

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