Oligopoly

ECON245 - Winter 24

Modeling market power

- Workhorse models of heterogeneous firms feature
  1. CES demand
  2. Monopolistic competition
- non-starter: markups are (i) homogeneous and (ii) exogenous

$$p_{it} = \frac{\sigma}{\sigma - 1} mc_{it}$$

- two (immediate) ways out
  1. maintain CES demand, assume oligopoly
  2. non-CES demand, maintain monopolistic competition
- both provide new “modules”

Atkeson Burstein 2008

- setting: continuum of sectors, each with a finite number of firms
- nested CES demand: EoS across sectors $\eta > 1, \rho > \eta$ within sectors

$$C = \left(\int_0^1 \alpha_s^{1/\eta} Q_s^{\frac{\eta-1}{\eta}} ds \right)^{\frac{\eta}{\eta-1}}, \qquad Q_s = \left[\sum_{i=1}^{N_s} \xi_s^{1/\rho} Q^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}}$$

- $\rho > \eta$: goods are more substitutable within than across sectors
- expenditure minimization implies demand for each firm i equals

$$Q_i = \xi_i P_i^{-\rho} P_s^{\rho-\eta} D_s, \qquad D_s \equiv \alpha_s P^\eta C$$

- $P_s = (\sum_{i=1}^{N_s} \zeta_i P_i^{1-\rho})^{1/(1-\rho)}$ is the dual price index for sector s
- $P = (\int_0^1 \alpha_s P_s^{1-\eta} ds)^{1/(1-\eta)}$ is the consumer price index

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- when own sector becomes more competitive ($P_s \downarrow$), a firm's demand
  - rises, due to between-sector effects (governed by η)
  - falls, due to within-sector effects (governed by ρ)
  - $\rho > \eta$ implies demand falls, on net
- own-price elasticity varies with a firm's size *relative to its own sector*
  - an atomistic firm takes P_s as given and own-price elasticity is ρ
  - if a firm is the sector, then $P_s = P_i$ and its own-price elasticity is $\eta < \rho$

Bertrand Competition

- firms compete in prices:

$$P_i = \max_P PQ_i - TC_i(q_i)$$

- the optimal price satisfies:

$$P_i = \frac{\sigma_i}{\sigma_i - 1} MC_{it}, \quad \sigma_i = -\frac{d \log Q_i}{d \log P_i} = (1 - S_i)\rho + S_i\eta$$

- $S_i = \frac{P_i Q_i}{\sum_{j=1}^{N_s} P_j Q_j}$ = sales share of a firm i in its own industry
- as expected, own-price demand elasticity declines in a firm's relative size
- a firm's sales share within its sector is hence a sufficient condition for its market power

Microfoundation: Discrete choice

- why does the demand elasticity vary with a firm's size?
- suppose there is a unit continuum of consumers and set $\eta = 1$
- each consumer c spends only buys one good per sector, and their indirect utility from consuming good $i = 1,\ldots,N_s$ is

$$\log V_{ci} = -\log P_i + \frac{1}{\rho - 1}\left(\zeta_i \varepsilon_{c,i}\right)$$

  - $\varepsilon_{i,z}$ is an i.i.d. preference shock, distributed $F(x) = e^{-e^{-x}}$
  - i.e., $\log \varepsilon$ is distributed Frechet (!)
- probability that any consumer purchases firm i's good

$$\pi(P_i, \boldsymbol{P}_{-i}) = \frac{\zeta_i P_i^{1-\rho}}{\sum_{i'=1}^{N} \zeta_{i'} P_{i'}^{1-\rho}} = \zeta_i (P_i/P_s)^{1-\rho}$$

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- LLN gives exact same demand for firm i: $D_i = \zeta_i P_i^{-\eta} P_s^{1-\eta} D_s$
- so CES-type market power derives from heterogeneity in tastes for non-price attributes among consumers. Hence:
  - a firm that raises its price only looses costumers who, at current prices, are on the margin of buying some other firms' product
  - EV-distributed tastes: atomistic firms' share of marginal costumers firms scales inversely with own price (costumers always have infinitely many alternatives)
  - for granular firms, the share of marginal costumers is decreasing in its price, spelling a decreasing demand elasticity

Bertrand Competition

$$P_i = \frac{\sigma_i}{\sigma_i - 1} MC_{it}, \quad \sigma_i = -\frac{d \log Q_i}{d \log P_i} = (1 - S_i)\rho + S_i \eta$$

- first implication of market power: less elastic demand
- second implication : markup elasticity is non-linear in a firm's price

$$\Gamma_i = \frac{\partial \log \mu_i}{\partial \log P_i} = \frac{(\eta - \rho)(\eta - 1) S_i}{\sigma_i (\sigma_i - 1)} < 0$$

- markup is constant in either limiting cases : $\sigma_i(S_i = 0) = \rho, \sigma_i(S_i = 1) = \eta$.
- within "empirically relevant" range, higher S_i implies higher absolute Γ_i
- markup elasticity informs firm-level price responses to shocks

$$d \ln P_i = -\frac{\Gamma_i}{1 - \Gamma_i} d \ln P_s + \frac{1}{1 - \Gamma_i} d \ln MC_i$$

- "full cost pass-through" when $S_i \approx 0$; else, markup partly adjusts

Cournot Competition

- suppose firms compete in quantities
- can show that demand elasticity is now a harmonic sales-weighted average of within- and between-sector elasticities

$$\sigma_i = \left[\frac{1}{\rho}(1 - S_i) + \frac{1}{\eta} S_i\right]^{-1}$$

- same sufficient statistic for market power, $\sigma_i(0) = \rho$ and $\sigma_i(1) = \eta$
- useful for quantification: inverse markup is linear in market share

$$\frac{\sigma_i - 1}{\sigma_i} \equiv \frac{1}{\mu_i} = (1 - 1/\rho) - (1/\rho - \frac{1}{\eta} S_i)$$

- same qualitative implications for price-cost pass-throughs

$$\Gamma_i = \frac{\partial \log \mu_i}{\partial \log P_i} = \frac{(\eta - \rho)(\eta - 1)\sigma_i S_i}{\rho\eta(\sigma_i - 1)} < 0$$

Closing the model

- firms heterogeneous in TFP z_i, as in Melitz 2003
- implies $mc_i = w/z_i$, where w is the wage
- free entry condition to determine the equilibrium number of firms
- in Melitz: order of entry irrelevant (marginal entrant has no effect on sectoral price index), zero profits in equilibrium
- generally, not true with oligopoly: each entrant affects the sectoral price index; each entrant earns positive profits, all prospective entrants would earn negative profits
- hence, order of entry matters and multiplicity becomes an issue
    - generic issue in games with strategic complementarities
- accepted "resolution": assume firms enter in order of productivity

Atkeson Burstein

- Pros:
  - sufficient statistic for markups (sales share) providing a link between empirical concentration and markup literatures
  - maps to discrete data, i.e. takes concentration seriously
- Cons:
  - if number of firms is endogenous, modeling entry is a hassle
  - hard-coded relationship between market share and markups
  - difficult to account for market power in input and output markets simultaneously
- Cournot, quantitatively, gives rise to larger markup variation

Gaubert Itskhoki 2020 (&Vogler 2021)

- A recent example of AB in action
- **Motivation**: Exports are granular
  - The largest exporter accounts on average for $17\,\%$ of sector's exports in 32 developing countries
- **Questions**:
  - Should government policies target individual firms rather than sectors?
  - Are there international spillovers and need for coordination?
- **Method**:
  - A quantitative model that takes seriously the granular nature of exports
  - Model is estimated using French firm-level data

Gaubert Itskhoki: Model Structure

1. Two countries, Home and Rest of the World
   - inelastic labor supply L and $L*$
2. comparative advantage defined at the sector-level (similar to DFS)
   - Continuum of sectors $z \in [0,1]$

$$Q = \exp\left\{\int_0^1 \alpha_z \log Q_z dz\right\}$$

   - Sectors vary in comparative advantage $\log T_z / T_z^* \sim \mathcal{N}(\mu_T, \sigma_T)$
3. Oligopoly within sectors
   - A finite number of firms in each sector K_z

$$Q_z = \left[\sum_{i=1}^{K} q_{z,i}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

GI: Sectors

- Productivity draws in a given sector z
  - Number of potential entrants: Poisson(M_z)
  - Entrants productivity draws: Pareto$(\theta, \underline{\varphi}_z)$
- Expected sectoral productivity is summarized by:

$$T_z = M_z \underline{\varphi}_z^{\theta}$$

- Marginal cost: $c = w/\varphi$ at home and $\tau c/\varphi$ abroad
- Fixed cost of production and exports: F in local labor
- Oligopolistic competition and variable markups
  - Atkeson Burstein: $\{c_i\}_{i=1}^{K_z} \longrightarrow \{s_i, \mu_i, p_i\}_{i=1}^{K_z}$

GI: Market entry and GE

- Assumption: Sequential entry in increasing order of unit cost

$$c_1 < c_2 < \ldots < c_K < \ldots, \text{ where } c_i = \begin{cases} w/\varphi_i & \text{if Home} \\ \tau w^*/\varphi_i^* & \text{if Foreign} \end{cases}$$

- Profits: $\Pi_i = \frac{s_i}{\sigma_i(s_i)} \alpha_z Y - wF$
- Entry: $\Pi_K^K \geq 0$ and $\Pi_{K+1}^{K+1} < 0 \longrightarrow$ determines K_z
- General equilibrium
  - GE vector: $X = (Y, Y^*, w, w^*)$
  - within-sector allocations: $Z = \{K_z, \{s_{z,i}\}_{i=1}^{K}\}_{z \in [0,1]}$
  - labor market clearing and trade balance

Properties of the Granular Model

- Home export share - realized comparative advantage

$$\Lambda_z^* = \frac{EX_z}{\alpha_z Y*}$$

- Expected home export share (fundamental comparative advantage - this is the limit with monopolistic competition)

$$\mathbb{E}\Lambda_z^* = \frac{1}{1 + (\tau w/w*)^{\theta}\, T_z^*/T_z}$$

- Realized home share depends on idiosyncratic realizations of firm productivity: Measure granularity by how much realized differs from fundamental comparative advantage

$$\Gamma_z^* \equiv \Lambda_z^* - \mathbb{E}\Lambda_z^*$$

Gaubert Itskhoki Vogler: Granular Policies

1. Merger of two large home firms
2. Granular import tariff on individual large foreign exporter
3. Industrial policy of promoting national champions

- Welfare analysis

$$\hat{W} \equiv \frac{d \log Y}{d \log P}$$

Producer surplus **Consumer surplus**

$$= \frac{d\text{GovRev}}{Y} + \int_0^1 \alpha_z \frac{d\Pi_z}{\alpha_z Y} dz - \int_0^1 \alpha_z d \log P_z dz$$

- partial equilibrium, sector level effect:

$$\hat{W}_z = \frac{d\text{GR} + d\Pi_z}{\alpha_z Y} - d \log P_z$$

Merger

- Consider a merge of the two largest domestic firms in a sector
- Merger leads to a productivity spillover

$$\varphi'_{z,2} = \varphi_{z,2} + \gamma(\varphi_{z,1} - \varphi_{z,2})$$

- Merged firm produces both products and sets common markup

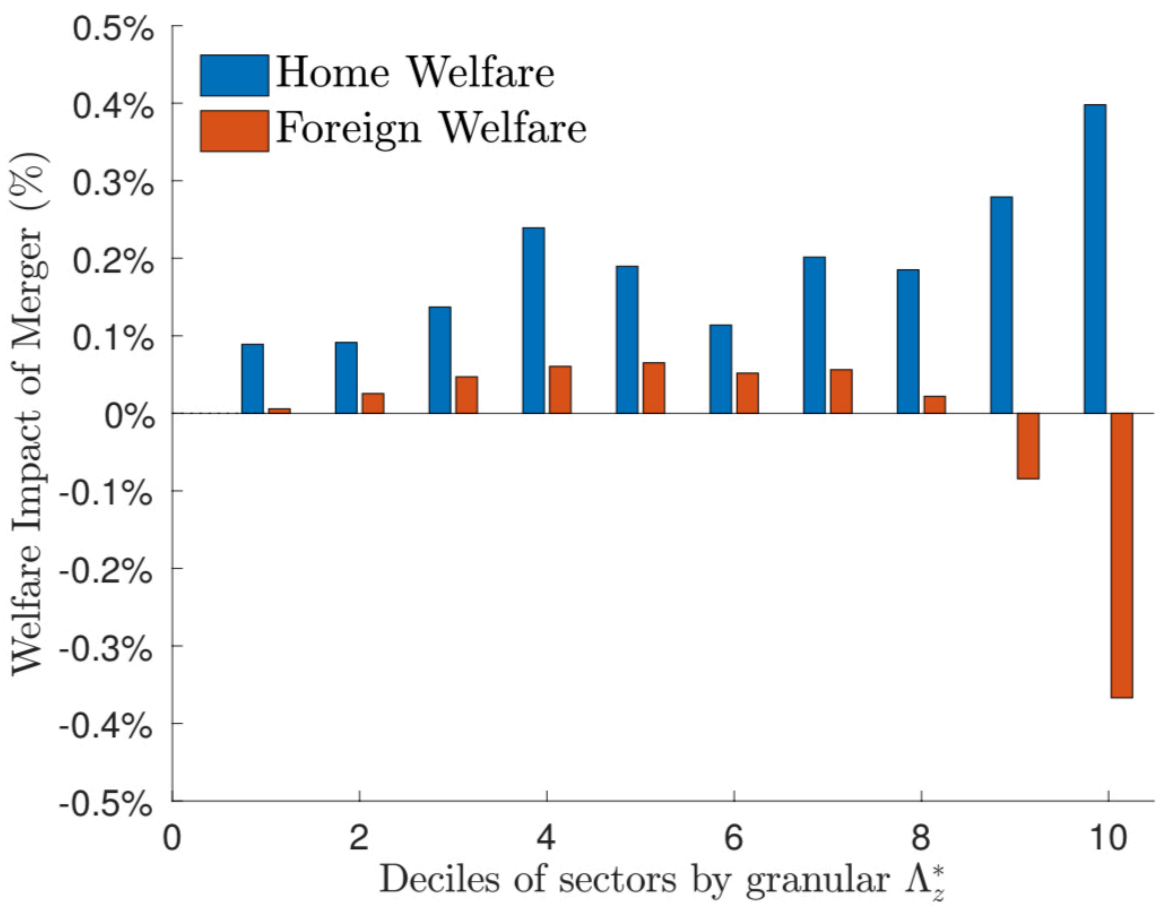
$$\mu'_{z,1} = \mu'_{z,2} = \frac{\sigma(s'_{z,1} + s'_{z,2})}{\sigma(s'_{z,1} + s'_{z,2}) - 1}$$

- Tradeoff: Increased productivity vs market power (markups)
- In an open economy, there is also foreign consumer surplus stealing ("beggar-thy-neighbor")

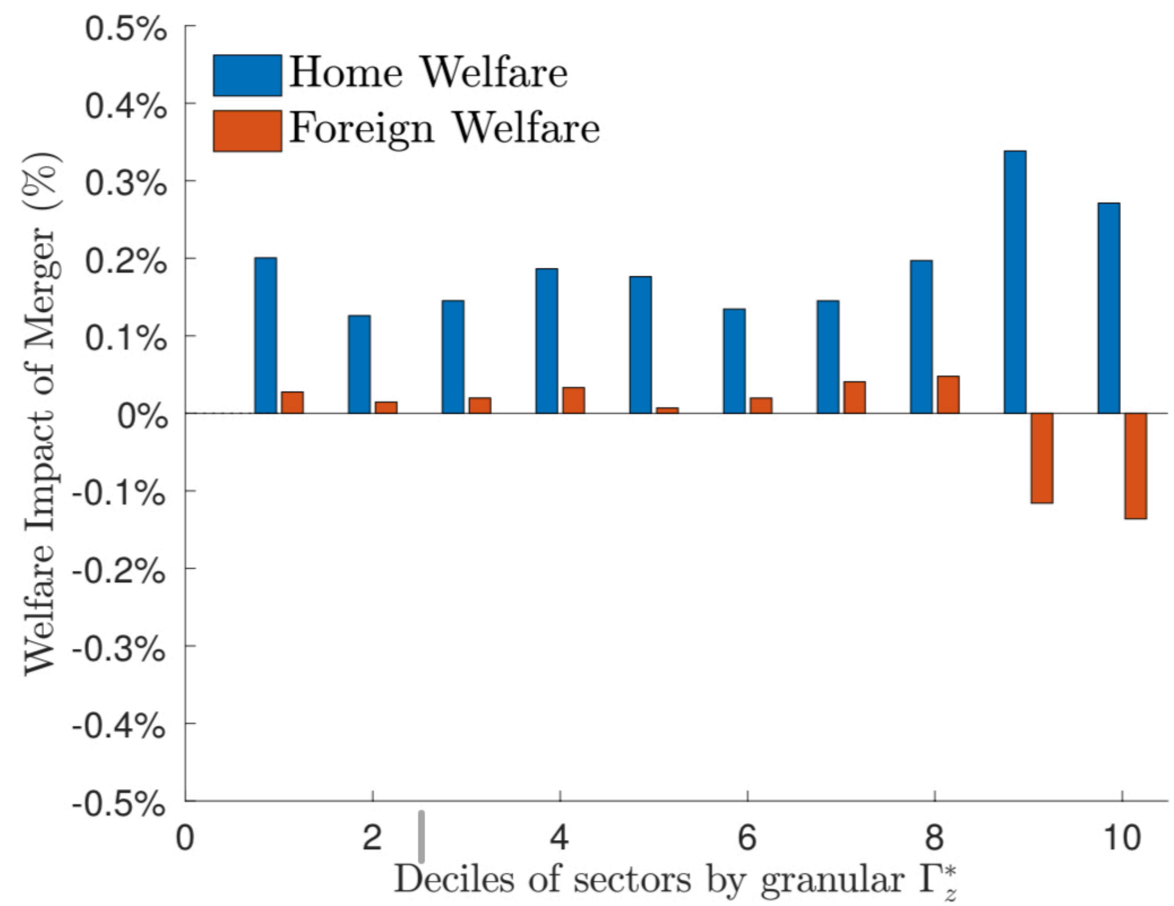
Welfare effects of mergers

- In the most granular sectors, increased market power outweighs productivity effect
    - Home gains through higher consumer surplus, while foreign consumer surplus is stolen by the merged firms

(a) Welfare effects by Λ_z^*



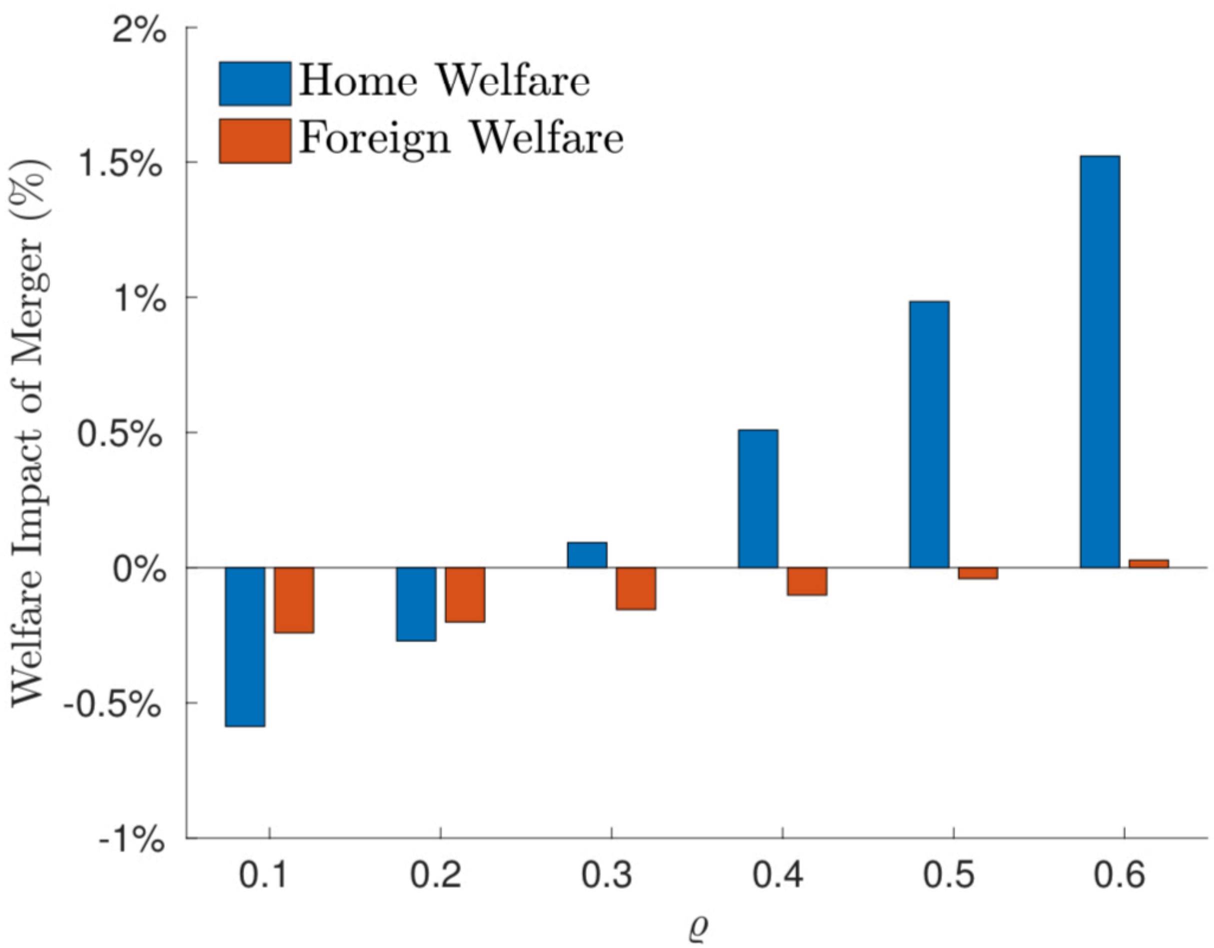
(b) Welfare effects by Γ_z^*



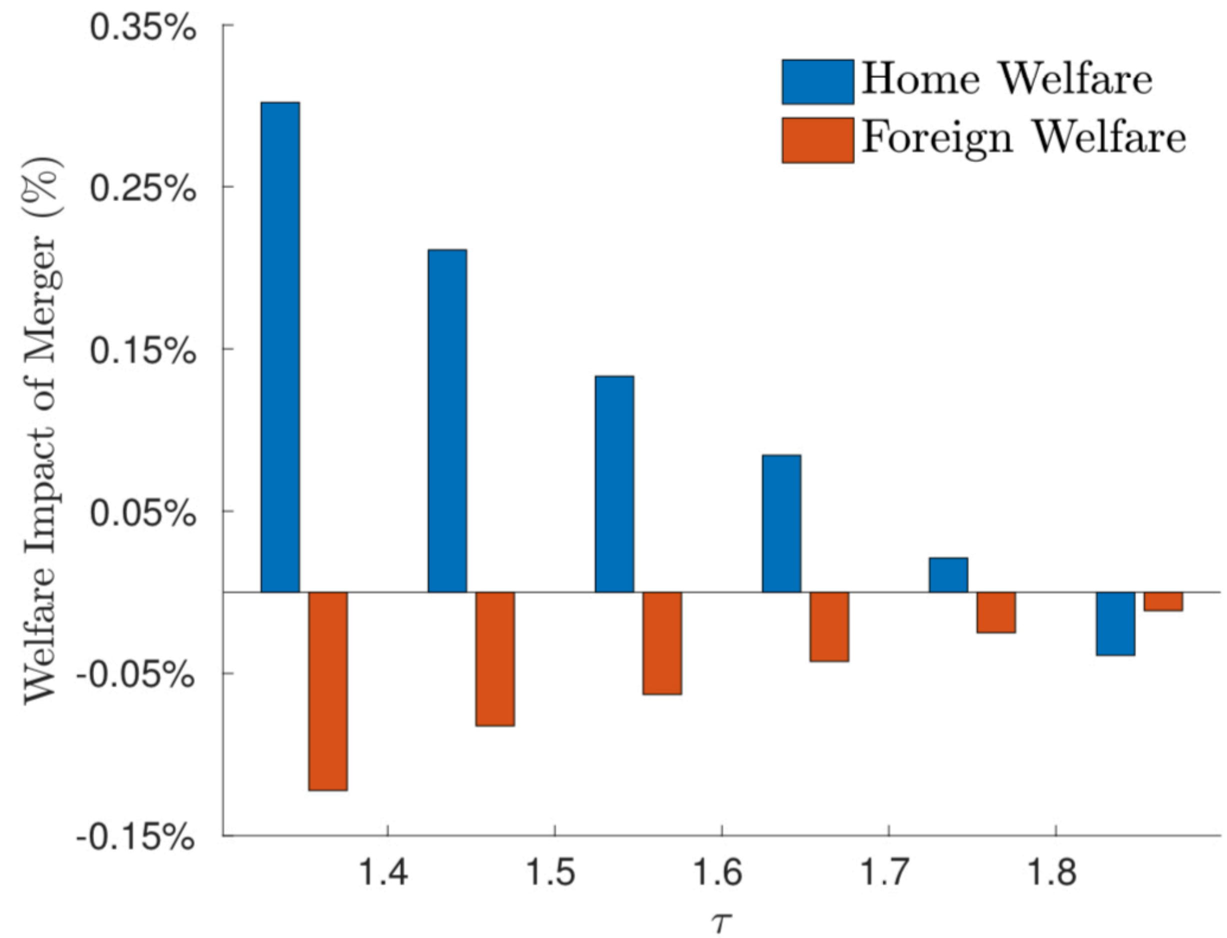
Dependence on parameters

- Impact of productivity spillovers and trade cost
- In top-20% of sectors by home comparative advantage

(a) Impact of productivity spillover ϱ



(b) Impact of trade openess τ



Conclusion Gaubert Itskhoki

- At the sectoral level, granular firms play a central role in the global economy
- Should government policy be designed at the firm-level?
- They provide a tractable, quantifiable framework to address a variety of policies
- Thoughts
  - framework can be used to connect to the “place-based” agenda in urban/ geography - at the regional level, most firms are “granular”, yet in the aggregate a region might be atomistic.
  - What if sector’s themselves are granular in the economy?

More on the Atkeson Burstein Phenotype

- The model has been widely applied in macro and trade,...
  - Amiti, Itskhiki, Konings (2013, 2019): Exchange-rate disconnect (large firms have lower mark-up elasticities, so movements in costs of imported inputs are not passed on to prices)
  - Edmond Midrigan Xu (2018): Trade reduces mark-up distortions by increasing competition, which reduces sales shares and markups
  - de Loecker, Eeckhout Mongey (2021): Business dynamism and markups
  - …
- can be applied to model monopsony in factor markets
  - labor markets: Berger, Mongey, Herkenhoff 22
  - factor markets: Morlacco 22