Organizational Industrial Organization

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[Industrial Organization] is concerned with how productive activities are brought into harmony with society's demands for goods and services through some organizing mechanism such as a free market, and how variations and imperfections in the organizing mechanism affect the degree of success achieved by producers in satisfying society's wants.

– Scherer (1980)

Organizational Economics and Industrial Organization

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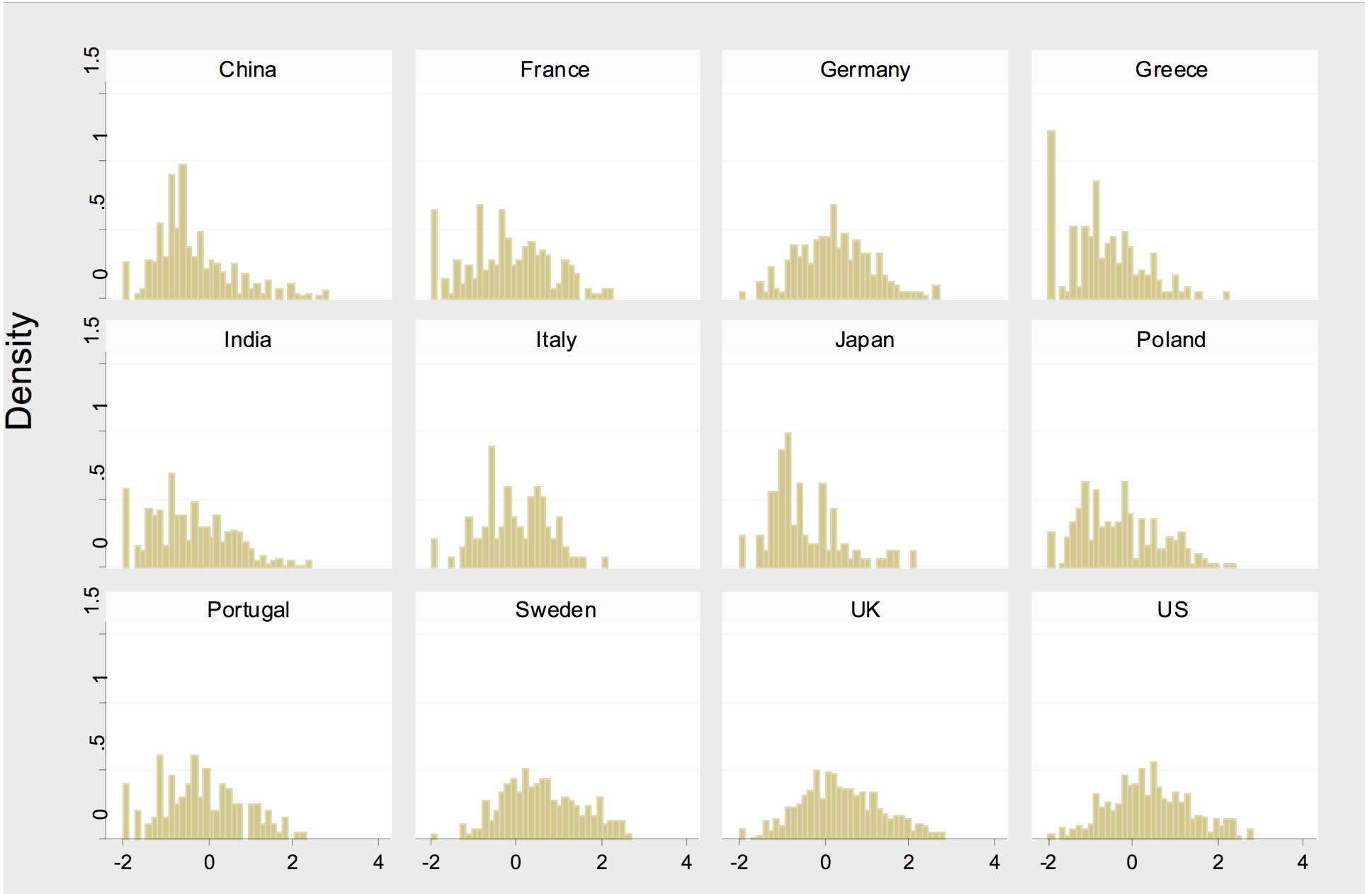
  - Public discussion and events: Enron, MCI, British rail, Continental 3407, lead toys, CEO pay, banking crisis

DECENTRALIZATION VARIES ACROSS FIRMS

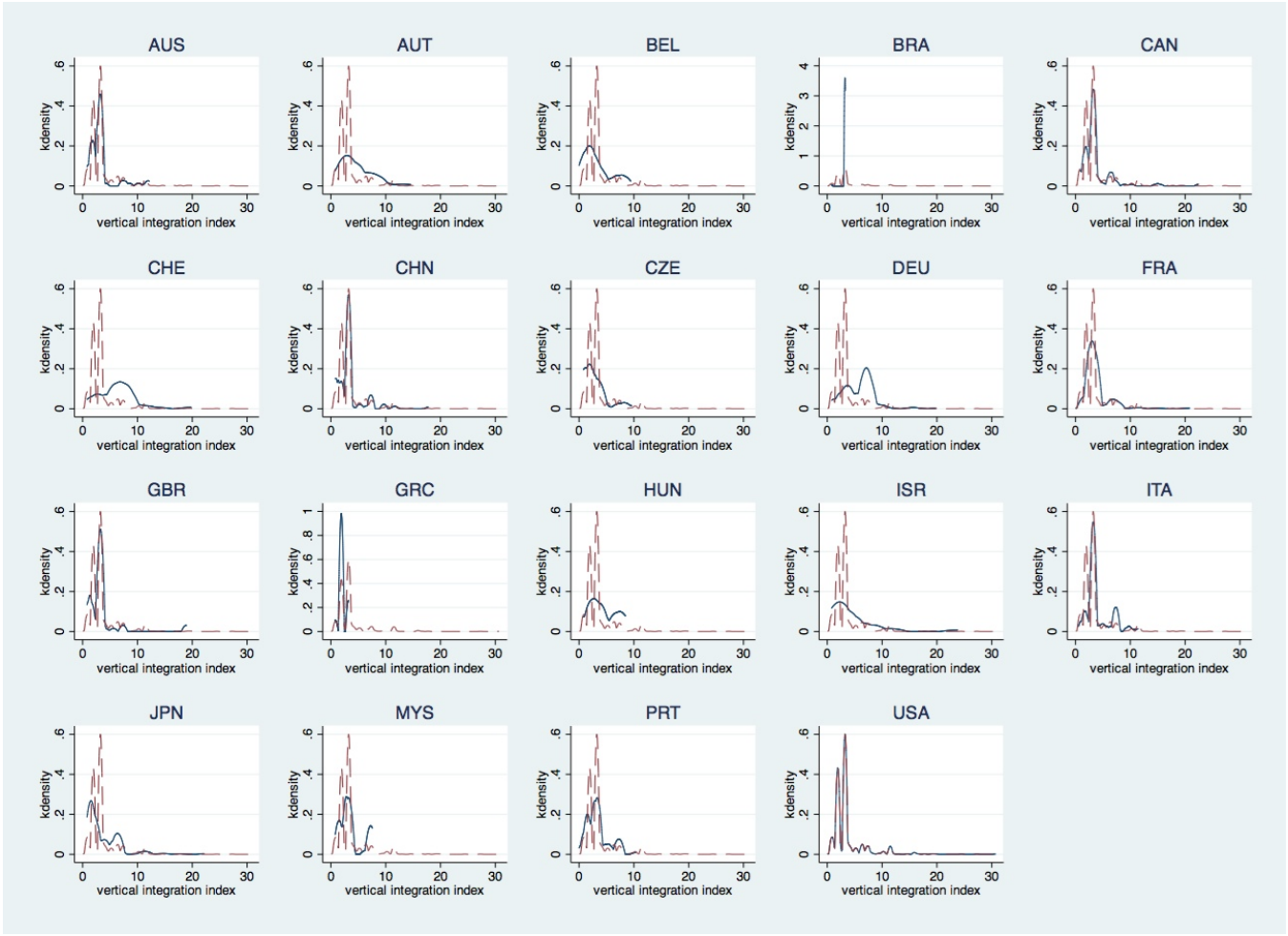
(Bloom, Sadun, vanReenen, 2012)



Vertical Integration also varies across firms

(Alfaro et al. 2016)

Concrete:



Questions for an "Organizational Industrial Organization"

- What deviations from the Arrow-Debreu benchmark can imperfections within firms be expected to generate?
- Do these departures differ from those generated by imperfectly competitive product markets? (OE helps IO)
- Two-way street: organization is endogenous, so the market could be expected to influence organization (IO helps OE)
- Start with perfect competition so that market imperfections don't cloud issues

Questions for an "Organizational Industrial Organization"

- What deviations from the Arrow-Debreu benchmark can imperfections within firms be expected to generate?
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- Start with perfect competition so that market imperfections don't cloud issues
  - This leaves open an important issue (future research) namely the structure of competition is itself endogenous to organizational design (e.g., firm boundaries)

Literature (1)

Legros and Newman, "Incomplete Contracts and Industrial Organization: A Survey"

- Incomplete contracting/ownership: Grossman-Hart (1986); Hart-Moore (1990); Aghion-Bolton (1992)
- Integration as a solution to coordination problems: Alchian-Demsetz (1972), Hart-Moore (2005); Mailath-Postlewaite-Volke (2002); Hart-Holmstrm (2002/10)
- X-inefficiency: Leibenstein (1966), Bertrand-Mullainathan (2003)

Literature (2)

Effects of markets on organizations and of organizations on markets

- Incentives: Hart (1983); Schmidt (1997)
- Monitoring in competitive settings: Legros-Newman (1996)
- Firm boundaries in competitive supplier markets: Legros-Newman (2008)
- Market foreclosure and firm boundaries: Bolton-Whinston (1993)
- Make-Buy decisions with monopolistic competition: Grossman-Helpman (2002)
- Hierarchies: Calvo-Wellisz (1979) and Garicano (2000)
- Delegation and imperfect competition: Marin-Verdier (2008), Alonso-Dessein-Mathouschek (2008)

Literature (3)

Empirics

- Industry studies on vertical/lateral integration
  - Airlines: Forbes-Lederman (2009, 2010)
  - Cement and Ready-Mix Concrete: Hortaçsu and Syverson (JPE 2007)
- Cross Industry studies (e.g. Aghion, Griffith, Zilibotti, 2006)
- Cross-country studies
  - Other aspects of organization: reporting structures (Guadalupe-Wulf, 2011); management practice, delegation/decentralization (Bloom, Sadun, vanReenen, 2010, 2012)
  - Vertical Integration: Acemoglu, Johnson, Mitton (2010); Alfaro et al. (2016)

"A Price Theory of Vertical and Lateral Integration"

Patrick Legros and Andrew Newman

- Look at an "incomplete contracts" model in which product market prices interact with organizational design decisions in a perfectly competitive environment
- Prices affect organizational design by affecting the trade-off between financial and private motives of managers
- Embed this organizational model into a standard supply-demand framework

What We Learn

- Determinants of organizational choices are often to be found *outside* the firm (i.e. in the market)
- In particular, **demand matters** as well as liquidity and surplus division
- Consumers — who are usually absent from organization theory — are affected by organizational choices
- An organizational IO can tell us whether the market selects "efficient" organizations.

Ingredients of a Model

- Efficient production requires coordination; managers disagree on which way is best (Hart-Holmström, 2002/10)
- Non-integration: managers make their decisions separately, and this may lead to inefficient production
- Integration: brings in an additional party ("HQ") who has only monetary motives and will therefore maximize the enterprise's output by enforcing a common standard
- Supplier and product markets are perfectly competitive

Results

- Relation between price and organization embodied in supply curve (the "OAS"): non-integration at low prices, integration at higher prices
- Changes in price lead to *coordinated* changes in organization: e.g., an increase in demand may lead to a flurry of integration, i.e., a "merger wave."
- Shocks to some firms (e.g., productivity) *propagate* and lead to reorganization of "unshocked" firms
- These organizational effects will in turn feed back to quantity, price, and welfare: possibly too little integration at low prices

Technology

- Two types of supplier: A and B; production requires one of each be paired
- Economy has large numbers of each type, with A's outnumbering the unit measure of B's
- Large number of HQ's (more than the number of B's)
- For each provider, a decision is rendered indicating the way in which production is to be carried out.
- A decision $a \in [0, 1]$, and B decision $b \in [0, 1]$
- Minimizing output loss requires decisions made in each part of the firm should coincide: output is
  - 1, with probability $1 - (a - b)^2$
  - 0, with remaining probability
  - outcomes independent across firms

Managers

- Each supplier run by a risk-neutral manager
  - A manager's payoff is $y - (1 - a)^2$: "1" is best
  - B manager's payoff is $y - b^2$: "0" is best
  - $y \geq 0$ is income
  - cost functions reflect differences in the technology managers run, differences in conduct workforces find convenient, or disagreement over best ways to manufacture or market product
- A and B managers have zero cash endowments
- HQ's have zero opportunity cost, preferences y and cash endowments $h > 0$

Contracts

- Decisions are not contractible
- Costs are private and non-contractible
- Right to make decisions can be reassigned by contract
- Output generated by the firm is contractible (for monetary incentives)
- Managers bear the cost of decisions even if they don't make them

Tradeoffs

Change of organization $\Longrightarrow$ change in incentive problem

- Non-integration: managers undervalue coordination, overvalue private costs.
- Integration: HQ undervalues managers' costs, overvalues coordination.

Markets

Supplier Market

- B managers match with A managers;
- A's are on the long side and B's are on the short side
- HQ market

Contracts

- Ownership structure of the relationship: nonintegration (N) or integration (I)
- Shares $\mathbf{s}$ (endogenous) of managerial revenue P accruing to manager A, B and HQ if relevant.
- Ex-ante transfers π_A, π_B from HQ to A, B.

Product Market

- Competitive; demand function is $D(P)$

Steps in constructing organizational industry equilibrium

Fix $\underline{u}_A$, P

Focus on a single A-B pair

- Look at one A-B pair
- For each organization N, I, find s such that the Nash equilibrium outcome maximizes B's payoff given $\underline{u}_A$.
- Select the organization that maximizes B's payoff.

Derive industry equilibrium

- Stable match of A's and B's and a market clearing price P.
- For each P derive industry supply.
- Set $S = D$ to clear the product market.
- Yields organizational choices, as well as price and quantity.

Integration: Transferability

Conditions on Contracting

- HQ *must have a positive share*: "disinterested HQ" not possible since could renegotiate her share once she has control of the firm decisions
- Debt can be used *but* HQ has to contribute at least part of her cash.

HQ's expected surplus if positive share

Proportional to $1-(a-b)^2$, $a=b=1/2$ is Pareto optimal among the perfectly coordinated decisions; hence $Q^I = 1$. Managerial welfare is fully transferable by $\mathbf{s}$ and $\pi = (\pi_A, \pi_B)$:

$$u_A^I(\mathbf{s}, \pi, P) = s_A P - 1/4 + \pi_A,\ u_B^I(\mathbf{s}, \pi, P) = s_B P - 1/4 + \pi_B$$

$$\pi_A + \pi_B = s_H P \Rightarrow W^I(P) = P - 1/2$$

Nonintegration: Nontransferability

A chooses a and B chooses b.
The unique Nash equilibrium is

$$a^N = 1 - s_A \frac{P}{1+P}; b^N = s_B \frac{P}{1+P}.$$

Thus ($s_A + s_B = 1$)

$$a^N - b^N = \frac{1}{1+P},$$

and expected output is

$$Q^N(P) = 1 - \frac{1}{(1+P)^2}$$

independent of **s** and increasing in P.

Nonintegration: Nontransferability

Managers' total payoff is not fully transferable

$$u_A^N(P)(s,P) = Q^N(P)s_A P - s_A^2\left(\frac{P}{1+P}\right)^2$$

$$u_B^N(s,P) = Q^N(P)s_B P - s_B^2\left(\frac{P}{1+P}\right)^2.$$

Total payoff $W^N(\mathbf{s},P)$ maximized at $s_A = s_B = 1/2$, minimized at $s_A = 0$ or $s_A = 1$.

Comparing Organizations

Total Managerial Payoff Comparison

$$W^N\left(\frac{1}{2}, P\right) > W^I(P)$$

but $W^N(0, P) > W^I(P)$ only if $P < 1$.

Relative Positions depend on price

- For *low* (< 1) prices non-integration dominates,
- For *higher* (> 1) prices, the two frontiers cross.

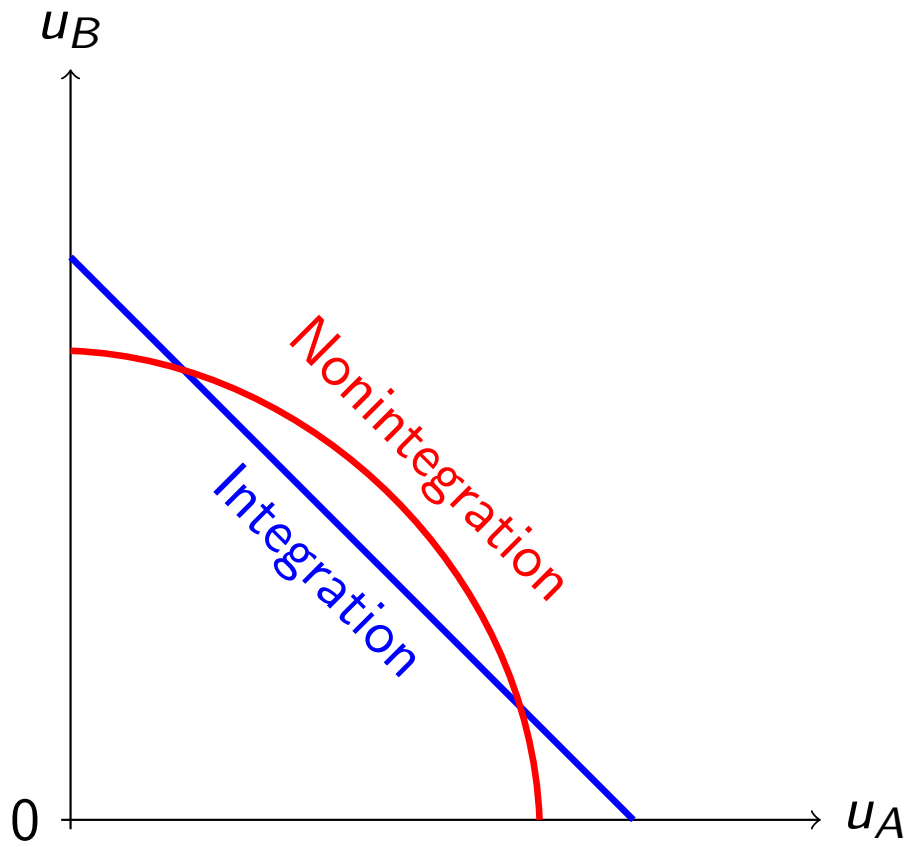
Case $\underline{u}_A = 0$

Optimal to have $s_A = 0$, $s_B = 1$: B gets $W^N(0, P)$ if $P < 1$ and gets $P - 1/2$ if $P > 1$.

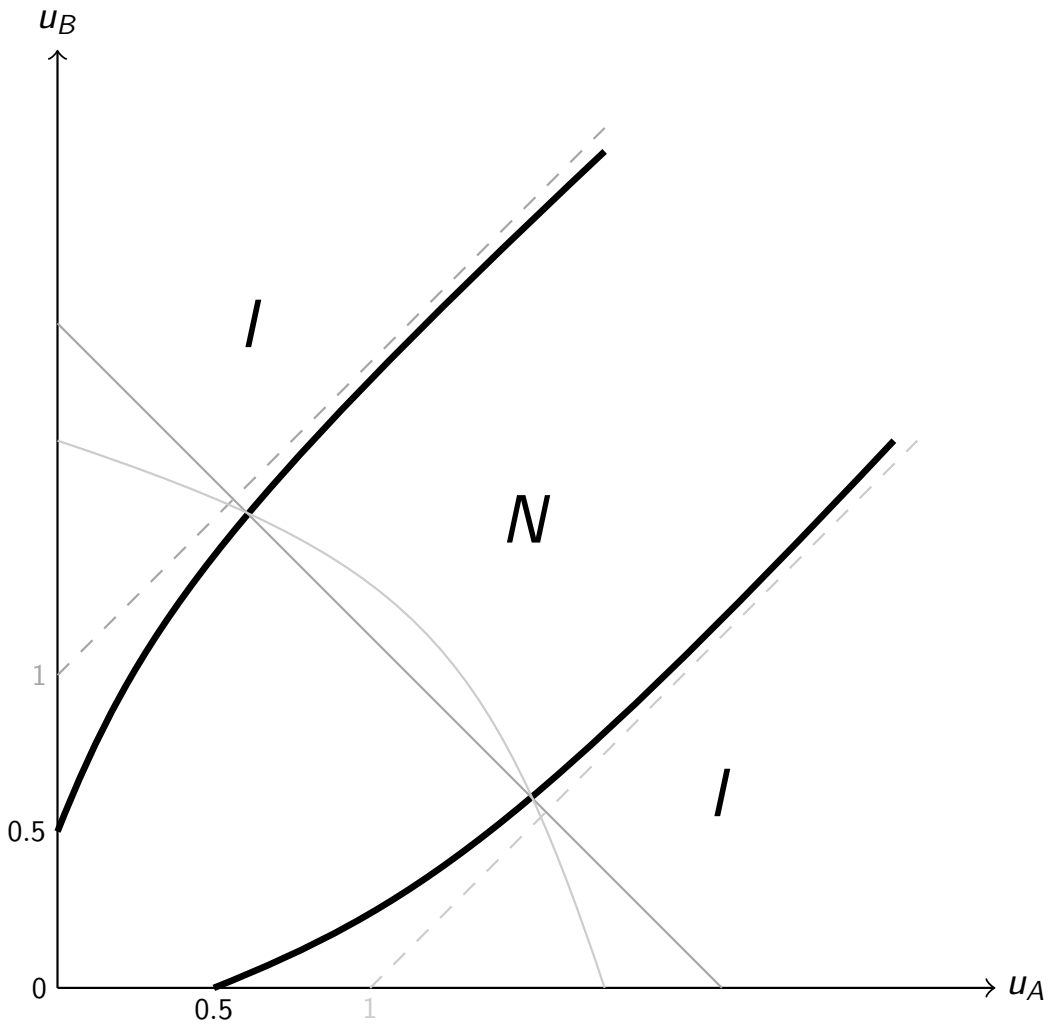
Typical Frontiers for High Prices

Choice of Organization: a function of A's payoff

The organizational choice depends on the "terms of trade" in the supplier market



Surplus Division and Integration



"The Organizationally Augmented" Supply Curve

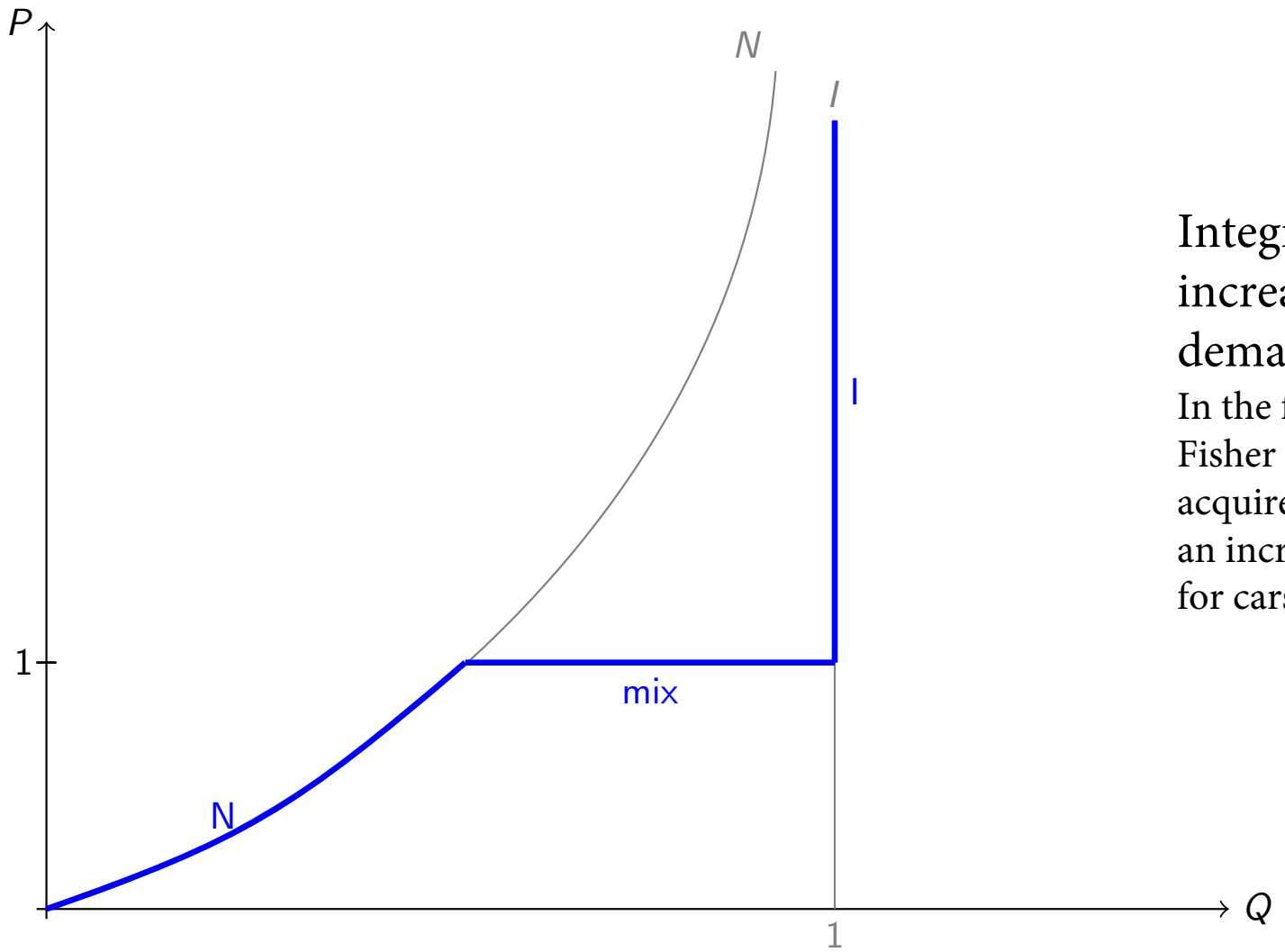
Assume $\underline{u}_A = 0$. Let α be the fraction of integrated firms; total supply at price P is then

$$S(P,\alpha) = \alpha \underbrace{(1)}_{\textit{integration}} + (1-\alpha) \underbrace{\left(1 - \left(\frac{1}{1+P}\right)^2\right)}_{\textit{nonintegration}},$$

where

$$\alpha = \begin{cases} 0 & \text{if } P < 1 \\ 1 & \text{if } P > 1 \end{cases}$$

Supply



Integration is increasing with demand.

In the famous GM-Fisher Body case, GM acquired FB following an increase in demand for cars.

Application 1: Airlines

Forbes-Lederman (2009, 2010)

- Heterogeneity of ownership structures
- Integration more likely on routes that are more valuable (i.e. higher P)
- Airline integration appears to be partly demand driven (movement along the OAS)

Application 2: Cement, Exogenous Heterogeneity

Hortaçsu-Syverson (2007)

(1) Lower prices with more integration

(2) Integrated firms tend to be more productive

(3) Heterogeneity in ownership structures (for the same "technology")

- Finding (1) seems at odds with our OAS
- However, we have ignored exogenous heterogeneity until now: supply side effects matter also in this example:
  (1)-(2) explained if multiple productive levels and markets with more integrated firms are those with more productive firms, and therefore have lower prices
- However, still need demand effects for otherwise could not explain (3)

Application 2: Cement

Exogenous Heterogeneity

- Proportion z of firms with productivity $R > 1$ and $1 - z$ with productivity 1
- $D(P) = \frac{3}{4}P^{-1}$ (at $z = 0$ equilibrium price is 1 with no integration)
- R-firms integrate when $P > 1/R$
- Equilibrium is $P(z) \in [1/R, 1]$, decreasing with z
- For $P(z) \in (1/R, 1)$, all R-firms are integrated, rest are not: **finding (2)**
- As z increases from 0, the proportion of integrated firms increases, while price decreases: **finding (1)**
- Let z^* solve ($z^* < 1$): $zR + (1 - z)\left(1 - \frac{1}{(1+P)^2}\right) = \frac{3}{4}P^{-1}$
- Then for $z > z^*$, $P = 1/R$, and heterogeneity among high productivity firms: **finding (3)**.

Application 3: Organizational Dampening of Technological Shocks

$$\Sigma(P) = \begin{cases} (1-z)Q^N(P) + zRQ^N(RP) & \text{if } P \leq 1/R \\ (1-z)Q^N(P) + zR & \text{if } P \in (1/R, 1) \\ 1 - z + zR & \text{if } P \geq 1 \end{cases}$$

Consider two situations: all firms ($z_0 = 1$) with small shock (R_0) or few firms ($z < 1$) with large shock ($R_1 > R_0$), keeping the average productivity the same.

$$zR_1 + 1 - z = R_0 \Leftrightarrow z = \frac{R_0 - 1}{R_1 - 1}$$

Consider an isoelastic demand $P^{-\epsilon}, \epsilon > 1$

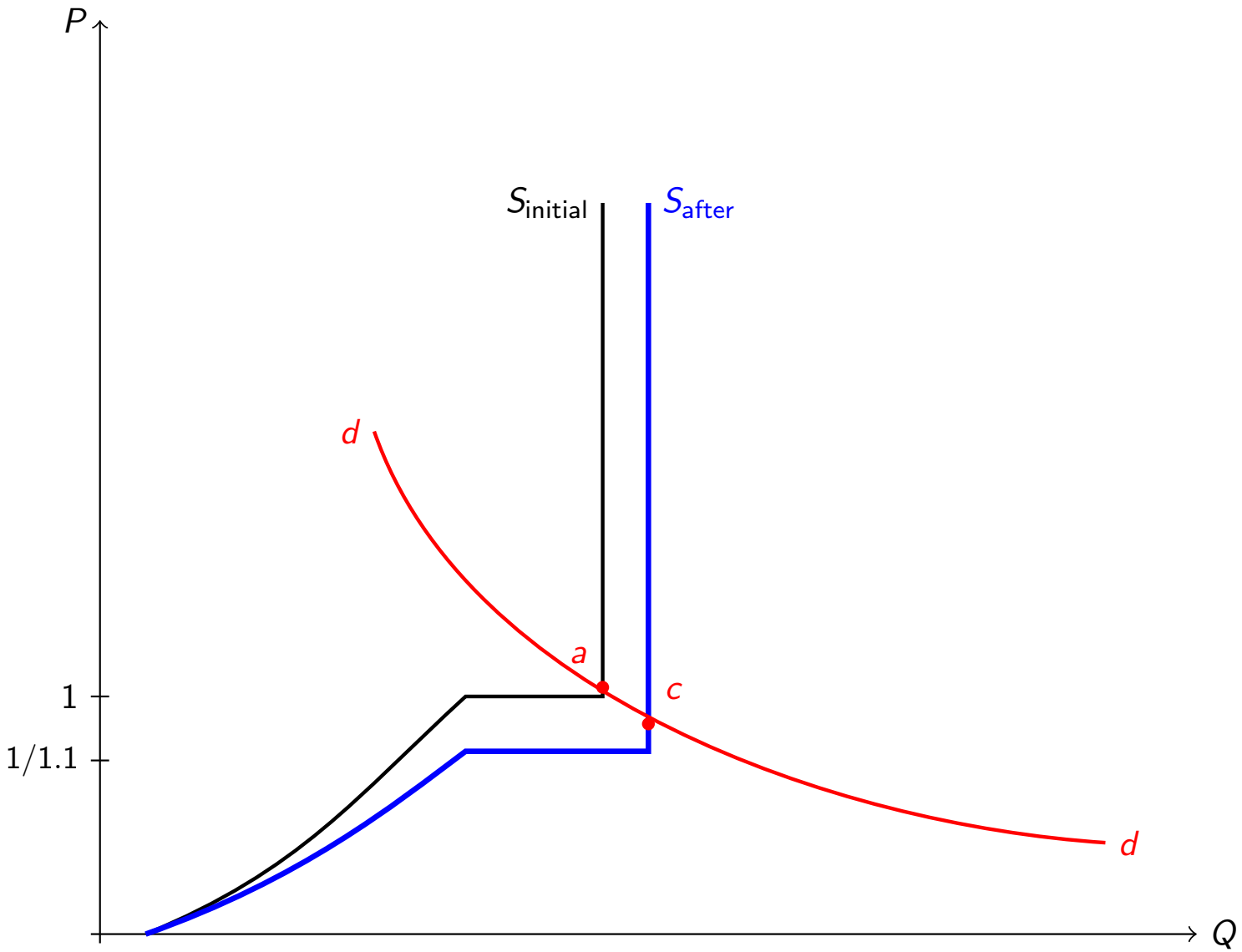
Widespread Small Shock

Reorganization

- Initial equilibrium is at $P = 1, Q = 1$ (all firms are integrated)
- After the shock, $R_0 > 1$,
  - the new equilibrium is at $P_0 = 1/R_0^{(1/\epsilon)}$
  - this is greater than $1/R_0$ (since $R_0 > 1$ and $\epsilon > 1$)
- Hence all firms stay integrated
- total output is R_0: Perfect "pass-through" of the aggregate productivity shock

Application: Technological Shocks

Uniform 10% Productivity Increase



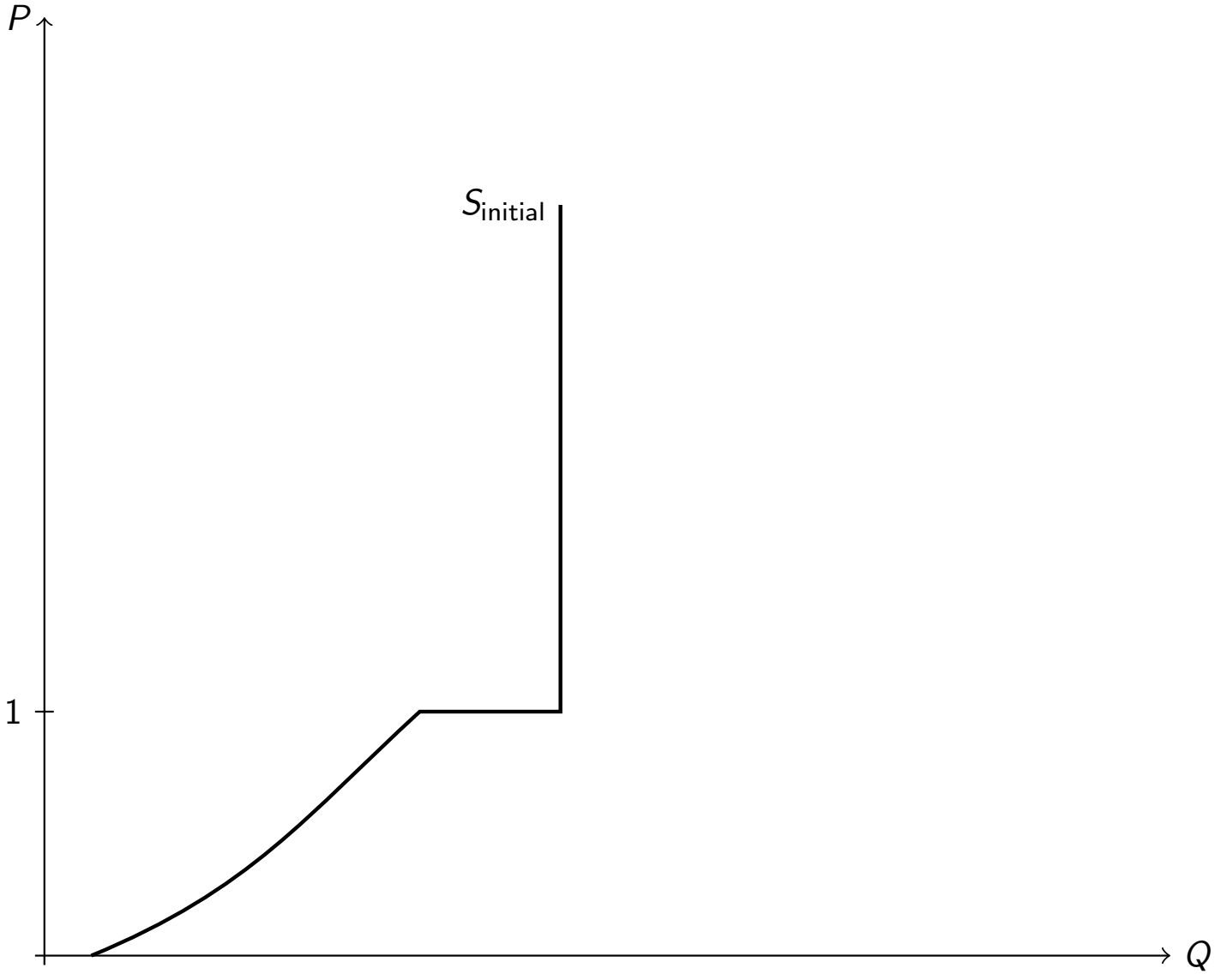
Concentrated Large Shock

Reorganization of *unshocked* firms

- Since the price decreases below 1 (more supply!), *unshocked firms shift to non-integration*
- The total supply is no more than R_0, hence price always at least $1/R_0 > 1/R_1$
- Hence all shocked firms *stay integrated*
- Total output is $zQ^N(P) + 1 - z < R_0$: dampening effect of re-organization
- Under some conditions ($4R_0 + z < 5$) there is complete absorption: no increase in industry output!

Application: Re-Organizational Dampening

10% of Firms Double Productivity



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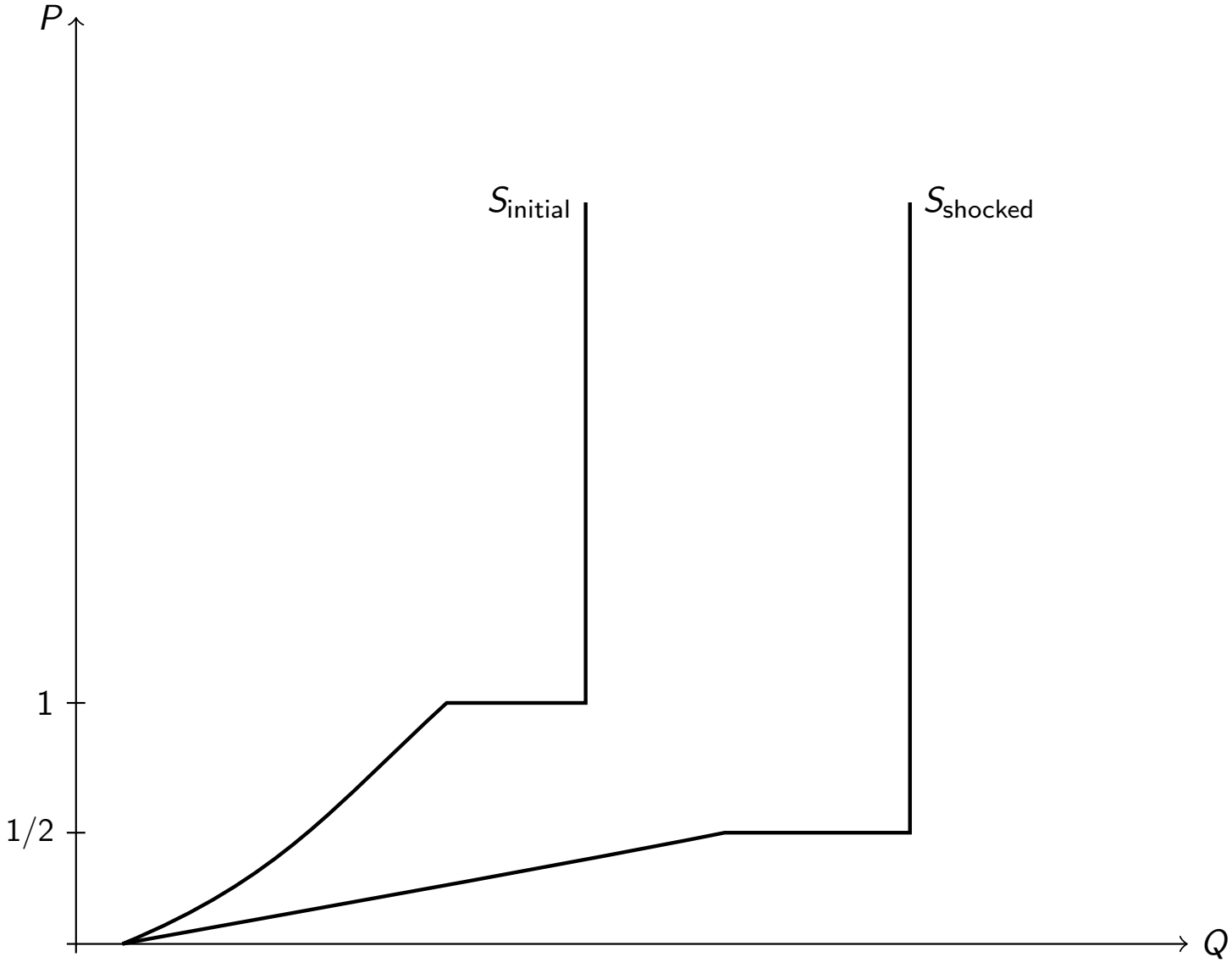
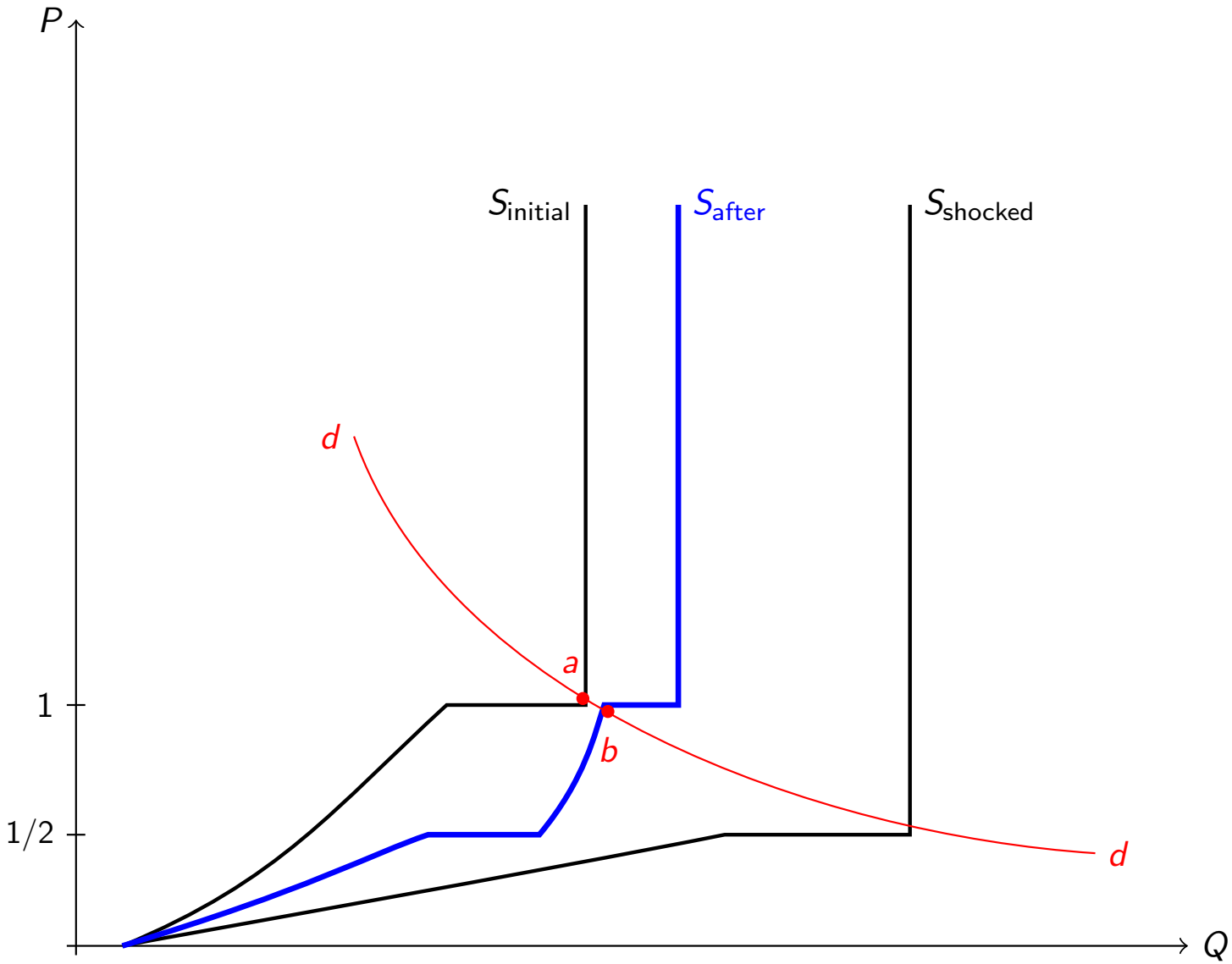


Application: Re-Organizational Dampening

10% of Firms Double Productivity (not to scale)



Summary

- A firm benefiting from a technological shock may not re-organize
- A firm that undergoes a large re-organization need not have experienced a change in technology
- Re-organizational dampening may substantially absorb the aggregate benefit of heterogenous technological change

Welfare

Definition

An equilibrium is ownership efficient if it is not possible to increase *total* welfare by changing firms' ownership structures.

Welfare

Second-Best Efficiency

Costs

- With non-integration, expected output is $Q = 1 - (1 - b)^2$, hence the managerial cost is $c(Q) = \left(1 - \sqrt{1 - Q}\right)^2$
- For manager B, the solution to $\max_b (1 - (1 - b)^2)r - b^2$ is then the same as the solution to $\max_Q Qr - c(Q)$.
- It follows that along the graph $\left(r, Q^N(r)\right)$, we have $r = c'(Q^N(r))$
- For integration, let $r = 1$; raising the probability of integrating by $d\alpha$ raises the expected output by $(1 - \frac{3}{4})d\alpha$ and the cost by $(\frac{1}{2} - \frac{1}{4})d\alpha$, so $c'(Q) = 1$

Welfare

Second-Best Efficiency

When managers have full residual claim on revenues, equilibria are ownership efficient. Supply and marginal cost schedules coincide in equilibrium.

Managerial Firms

- Managers internalize only a fraction γ of the firm's profits
- Output if price is P under non-integration is $Q^N(\gamma P)$
- Main consequence: price-expected output schedule does not coincide with marginal cost anymore.

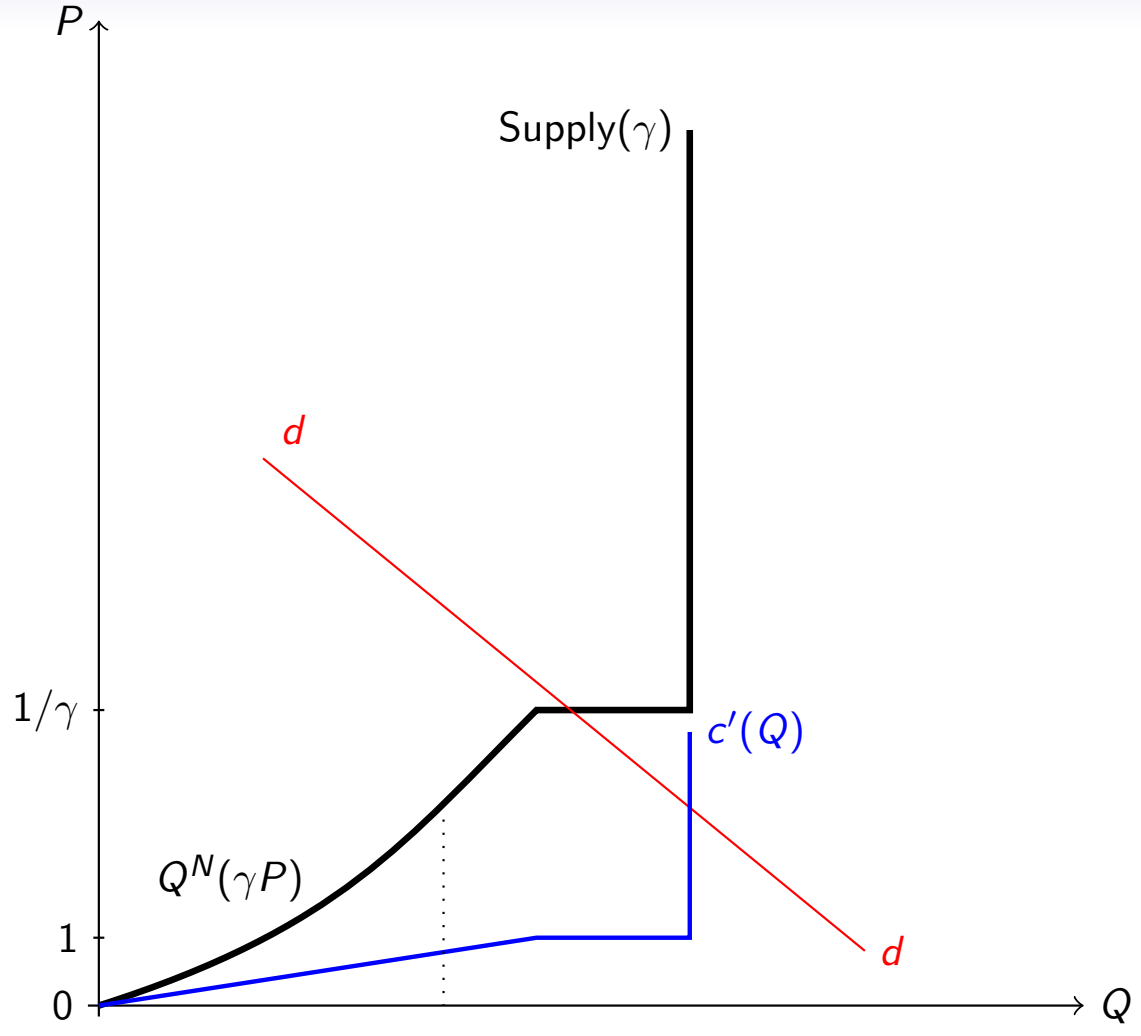


Figure: Ownership Inefficiency when Managers have a Partial Claim on Revenues

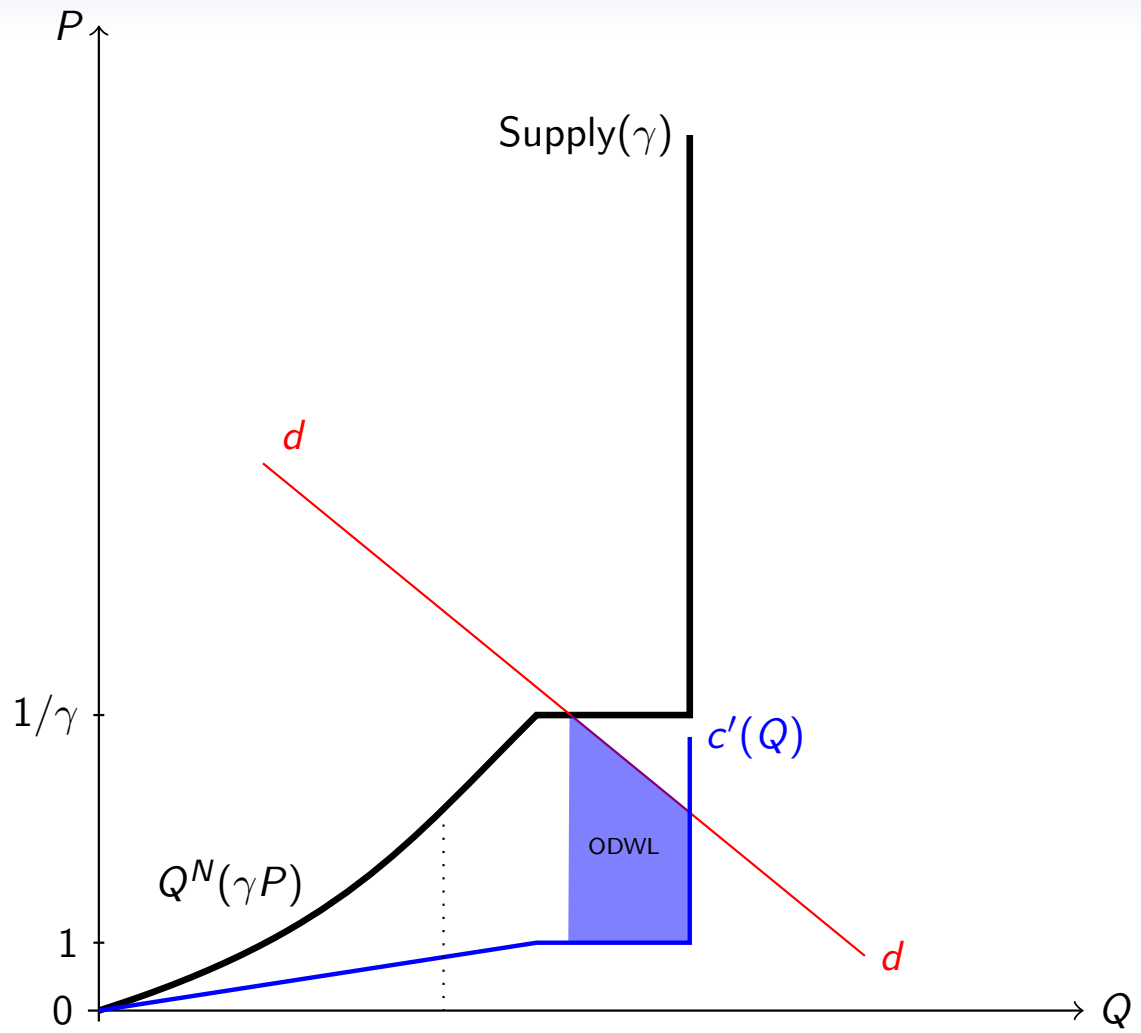


Figure: Ownership Inefficiency when Managers have a Partial Claim on Revenues

Proposition

Suppose that $\gamma < 1$. Then there is a generic set of demands leading to equilibria that are ownership inefficient

- In fact, heterogeneity implies ownership inefficiency
- The set of inefficient equilibrium prices is an interval

Demand Elasticity

- The *more* elastic market demand is, the *larger* is the ODWL
- Opposite relationship with market power: there the *more* elasticity is the *lower* is the DWL.

Extension 1: Cash Endowments

- Allows a type A manager to pay the B with cash
- Weakly raises willingness to pay (so high liquidity A's are matched), but also pushes choice towards nonintegration (since more efficient for managers).


P
price increases
Q

Extension 2: Outside Options

$$u_A^N(\pi, s) = \underline{u}_A$$

$s(\pi; \underline{u}_A)$ is increasing in $\underline{u}_A$: non-integration is more efficient.

Proposition

Higher opportunities for the long side of the market is a force for non-integration.

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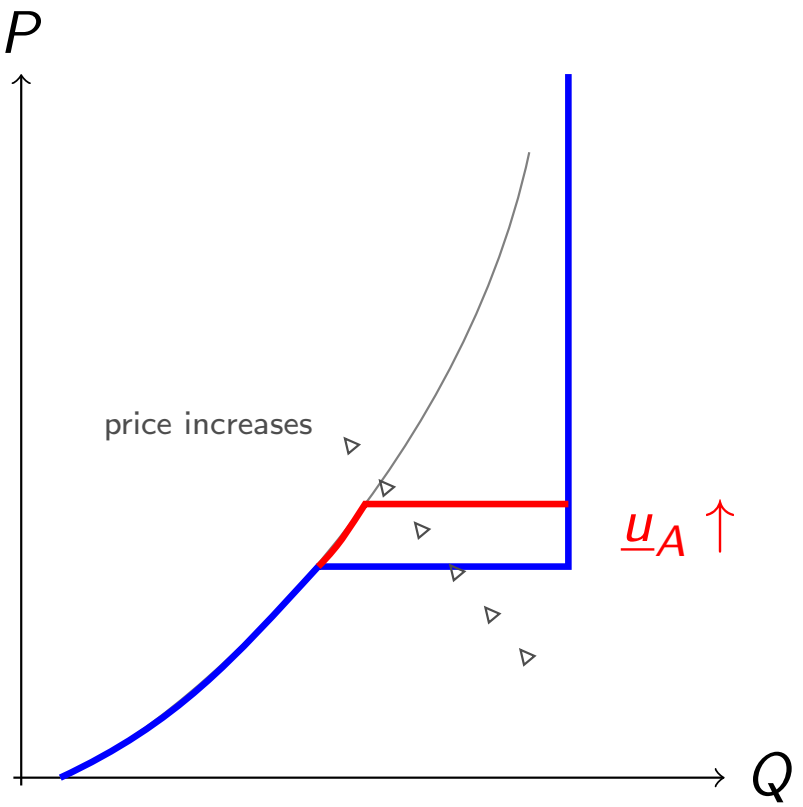
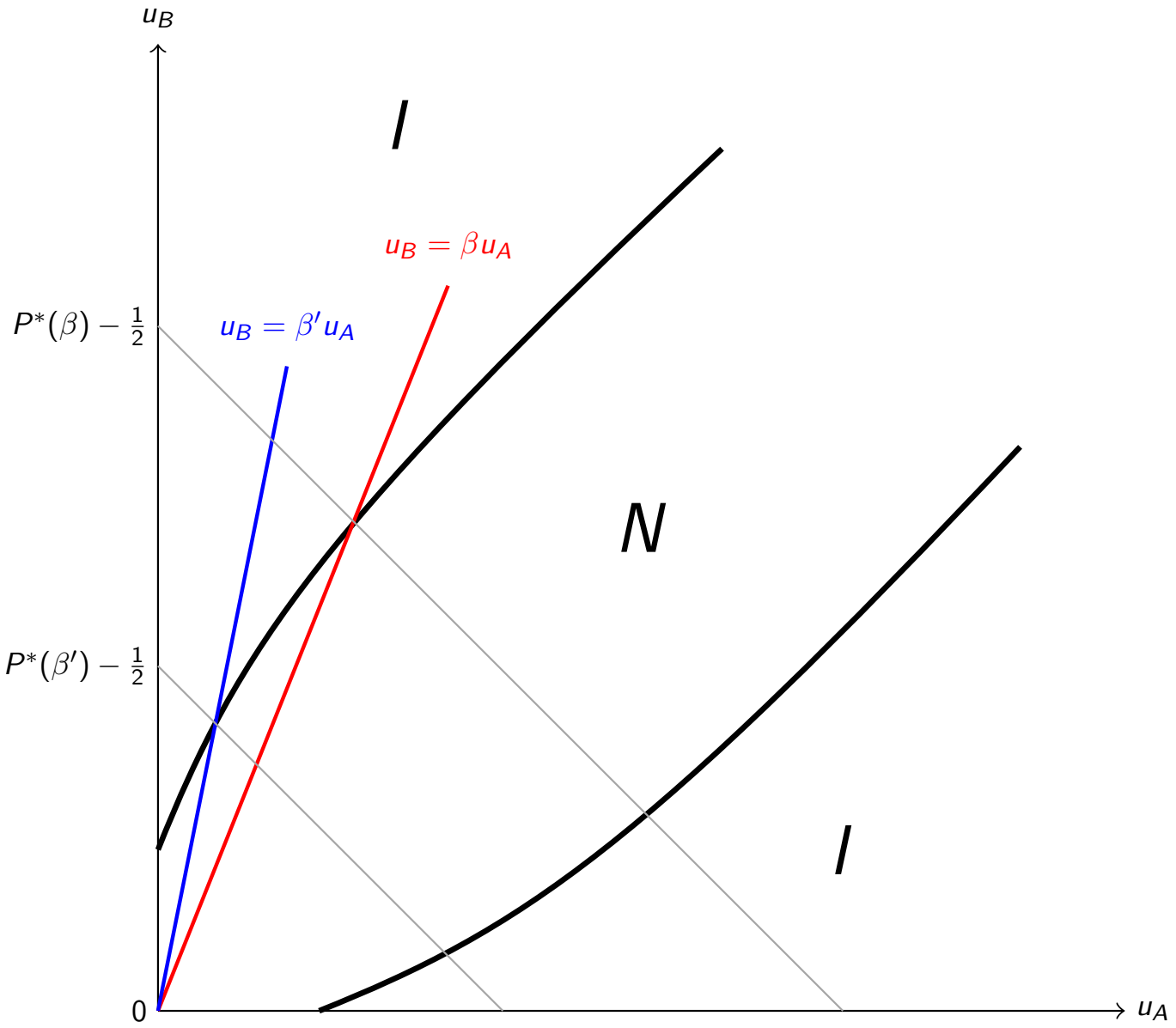


- Application: Mattel and lead toys (Conconi, Legros, and Newman (2012), *JIntE*)

Extension 3: Scale

- Can choose $f(l)$ at cost wl and get revenue $f(l)P$
- Integrated firms behave like "neoclassical firms": $f'(l^I)P = w$
- Non-integrated firms behave like "non-neoclassical firms": $Q^N(Pf(l^N) - wl^N)f'(l^N)P = w$
- Integrated firms have a larger scale: $l^I > l^N$
- Similar analysis with other inputs, e.g. workforce/managerial ability
- Co-variation of size, workforce quality, and integration.

Extension 4: Entry



Some Evidence (Alfaro et al. 2016)

Questions from Different Fields:

- **Organizational Economics** What determines Vertical Integration (VI)?
  - "technological" determinants such as complementarities among assets or adaptation frequency (Coase 1937, Williamson 1975, SGrossman-Hart 1986, Holmström-Milgrom 1991)
  - "pecuniary" or market effects (McLaren 2000; Grossman-Helpman 2002; Legros-Newman 2008, 2013)

- **Industrial Organization** What is the effect of VI on product prices?
  - It raises them (*foreclosure* theories): motivates "divestment" policy (e.g. in gasoline, beer)
  - It lowers them (*efficiency* theories; c.f. the technological theories from OE above)
  - Either way, causality runs *from* VI *to* prices

Can Prices Determine VI?

- **Causality may run the other way**, from prices to VI:
  - If **integration enhances efficiency** (reduces unit cost), but is **costly to implement**, then it is **only worth doing** if the extra output than can be produced under integration is sufficiently valuable, i.e., at **higher prices** (Legros and Newman, 2013).

- The **goal of this pap**er is to provide **evidence for this pecuniary effect**:
  - Empirical challenge: Find sources of price variation that are exogenous to firms' VI decisions.
    - Strategy: exploit in **Most-Favored-Nation (MFN) tariffs**.
    - Through its effect on product prices, **trade policy** affects firm boundaries. MFN tariffs are unlikely to be driven by firms' VI decisions.

Empirical Strategy: MFN Tariffs

- **MFN principle** (GATT article I): countries cannot discriminate between trading partners:
  - If a country grants a special favor to another, it must do the same for all other members
  - Tariff bounds vary substantially both across sectors within countries and across countries for a given sector.

- Long **rounds of multilateral trade negotiations**: at the end of each round, governments commit not to exceed certain tariff rates; tariff bindings can only be renegotiated in a new round of negotiations.
  - MFN tariffs are persistent, significantly more so than integration choices.

- They must be applied in a **non-discriminatory** manner to imports from all countries, which severely limits negotiators' flexibility to respond to lobbying.
  - If they respond to short-term political pressure, governments resort to other measures for regulating imports, such as anti-dumping and countervailing duties (e.g. Finger, Hall and Nelson, 1982).

Empirical Strategy: Approaches

- Empirical analysis of the **organizational effects of tariffs**
  - We construct firm-level vertical integration indices for a large set of countries
- We exploit **cross-country** and **cross-sectoral variation** in 2004 applied MFN tariffs
  - Vertical integration of firms in 2004: MNF tariffs outcome of the eight-year Uruguay Round of trade negotiation that was completed ten years earlier.

Results: Overview

- **Higher MFN tariffs** on final goods lead to **more vertical integration** at the firm level.
- The effect of tariffs on organization is **stronger** for firms
  - serving only domestic market, which are more responsive to domestic prices
  - in sectors in which domestic prices are more responsive to tariffs
- The **magnitud**e is sizable: implied price elasticity of VI between 0.4 and 2.1.
- The positive effect of tariffs on firm-level vertical integration is robust to
  - Including standard drivers of VI, sector-, country-, and sector-country FE
  - Using different VI measures, samples, and econometric methodologies

Causal Effect of Prices on Organization Decisions

- Vertical integration decisions are unlikely to directly affect MFN tariffs on final products, but one may be concerned about possible **omitted variables**, which might be correlated with both the level of protection and firm boundary choices.
  - Results are unaffected when including **additional controls** (firm size, industry concentration, degree to which an industry is declining, import-penetration ratio, import tariffs and tariffs in export markets)
  - Results robust to including **sector-country F.E**., which control for any possible sector-country level unobservables
- We rule out **alternative mechanisms** through which tariffs may affect VI choices:
  - **degree of competition** faced by domestic firms (Aghion *et al*, 2006)
  - **credit constraints** (protected firms may have more cash to acquire suppliers)

Theoretical Framework: Intuition

- The fundamental logic of how product prices influence firm boundaries can be illustrated with a reduced form model, in which **vertical integration enhances productivity**, but **does so at a cost**, which is independent of product price

- Consider a price-taking enterprise choosing output Q and level of integration n:

$$\max_{\{n,x\}} Pg(n)F(x) - c(x) - h(n)$$

- F is increasing in x, $g(.)$ reflects how integration affects productivity $c(.)$ is cost of inputs x, $h(.)$ captures the cost of integration (various sources, depending on the specific theory of integration).

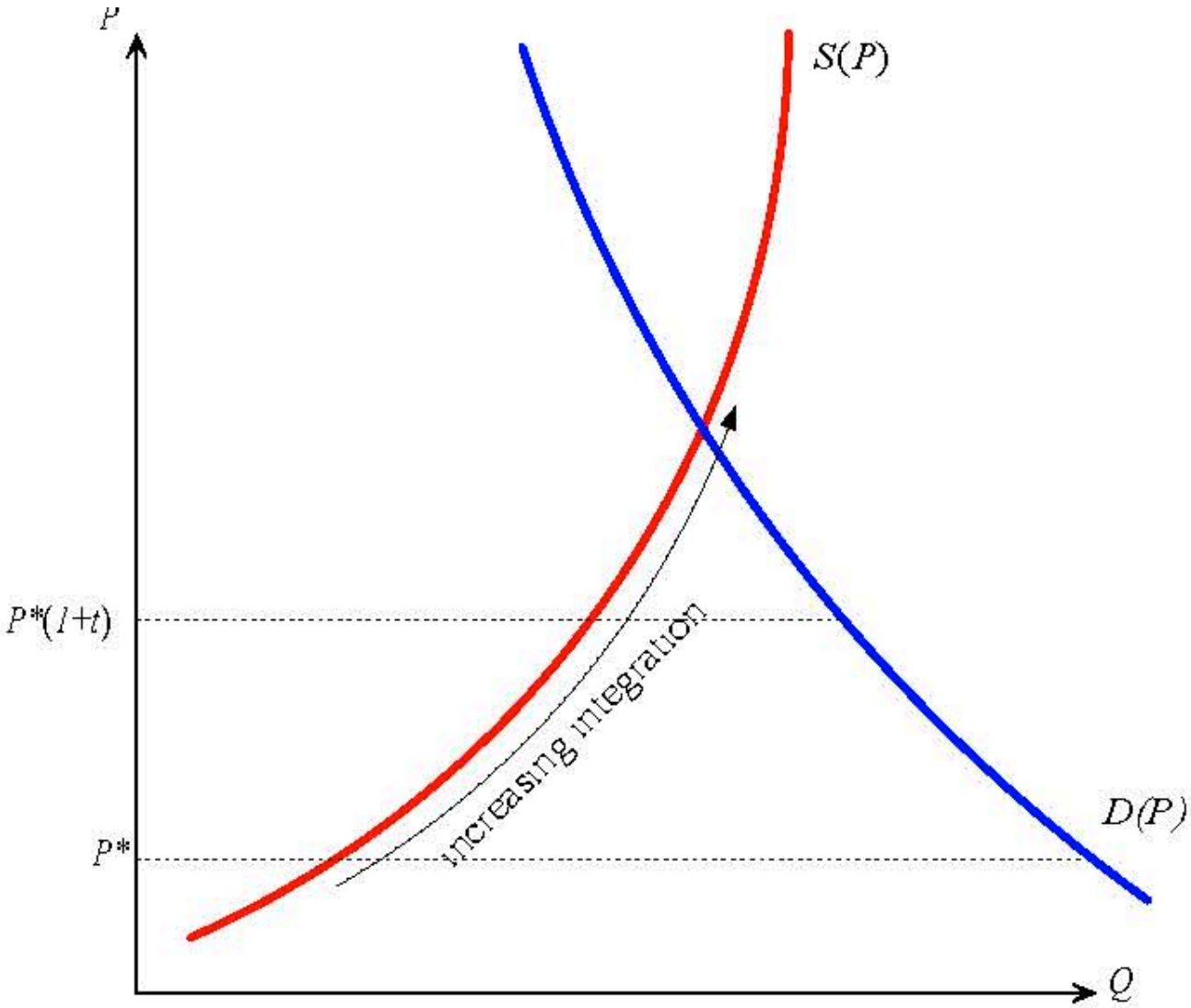
- Suppose **integration enhances productivity** (g is inecreasing); then monotone comparative statics arguments imply that **optimal degree of integration *n* increases with *P*** (Legros and Newman, 2013).

- Intuition: **efficiency gains generated by integration** are **more valuable when the price of output is higher**, so integration incentives are greater at higher prices

Import tariffs and vertical integration

- To verify this prediction, we could simply regress VI measures on industry prices
  - Problem: distinguishing this view (higher prices → more vertical integration) from market-foreclosure theories (vertical integration → higher prices)
- **Trade policy** generates an **exogenous source of price variation**:
  - import tariffs affect prices and are unlikely to be driven by firms' vertical integration decisions
- Consider an import-competing **industry** composed by many price-taking firms within a **small open economy**. Denote with P^* the world market-clearing price
  - An **ad-valorem tariff** increases the domestic price to $P = (1 + t)\, P^*$
- By **raising the domestic price**, the introduction of an **import tariff increases the gains from integration** for domestic firms, leading them to choose a higher n

Equilibrium with an import tariff



Import tariffs and vertical integration

- Empirical analysis will yield estimates of the **tariff elasticity of vertical integration**, but what we are really interested in is the effect of product prices on integration.
  - Import tariffs are expressed in ad-valorem terms: allows deriving the **price elasticity of integration** (without aknowing the price).
- Tariff elasticity of domestic price: $\frac{\partial P}{\partial t}\frac{t}{P} = \frac{t}{1+t}$
- Tariff elasticity of integration: $\beta \equiv \frac{\partial n}{\partial t}\frac{t}{n}$
- Price elasticity of integration: $\frac{\partial n}{\partial P}\frac{P}{n} = \beta\frac{1+t}{t}$
  - For the average tariff of 5%, the price elasticity exceeds the tariff elasticity by twentyfold

Predictions of Theoretical Framework

- P.1: **Higher import tariffs** on final goods should induce **domestic firms** producing these goods to be **more vertically integrated**

- P.2: The effect of tariffs on integration should be **larger for firms serving only the domestic market** (only the domestic price is affected by the tariff and only the domestic price matters for their revenue)

- P.3: The effect of tariffs on integration should be **larger in sectors in which a smaller fraction of imports are exempt from the tariff**

Empirical strategy

- We exploit **cross-country** and **cross-sectoral variation** in 2004 applied MFN tariffs:
  - Outcome of long-term multilateral negotiations (Uruguay Round:1986-1994)
  - GATT/WTO members commit not to exceed agreed tariff bounds; special favors granted to one country have to granted to all others (GATT Article I)
  - Less responsive to political pressure than other trade policies (e.g., anti-dumping)

Data: The WorldBase Dataset

- Database compiled by Dun and Bradstreet, providing **plant-level information** on public and private firms operating in **more than 200 countries and territories**
- Primary industry and up to 5 secondary industries (at 4-digit SIC) of each plant
  - Information on ownership: legal status (domestic and global parent)
  - Operational information: sales, employment, age, etc.
  - Location information (country, state, city)
- Our unit of analysis: firms (we join plants via parent or headquarter)

The WorldBase Dataset: Sample

- Main analysis: focus on manufacturing sector (2000-3999), excluding
  - Countries/territories with less than 80 observations
  - Countries/territories that are not in the WTO
  - Firms with less than 20 employees or no SIC codes
    - Theory less apt for self employment/collection differences.
  - We focus on firms located in one country
    - MNCs (relevant price/tariff hard to identify, strategic behavior)
- Robustness with various subsamples (including multinationals, excluding countries with less than 1000 observations, OECD countries, etc.)

Vertical Integration Index

- To measure vertical integration, we combine information on **firms' production activities** (plants aggregated at the firm level) with data from US **input-output tables** (Fan and Lang, 2000; Acemoglu *et al*. 2009, Alfaro and Charlton, 2009).
  - **Firm-level vertical integration indices**: fraction of inputs used in the production of a firm's final good that can be produced in house.
- We match US 4-digit SIC codes for each firm with the 6-digit IO codes, using the BEA's concordance guide (random matching when multiple).
- The **IO coefficients** represent the dollar value of inputs to produce one dollar of output (opportunity for vertical integration between sectors *i* and *j*).
- Unit of observation: all plants belonging to the same firm (all plants that report to the same headquarter).

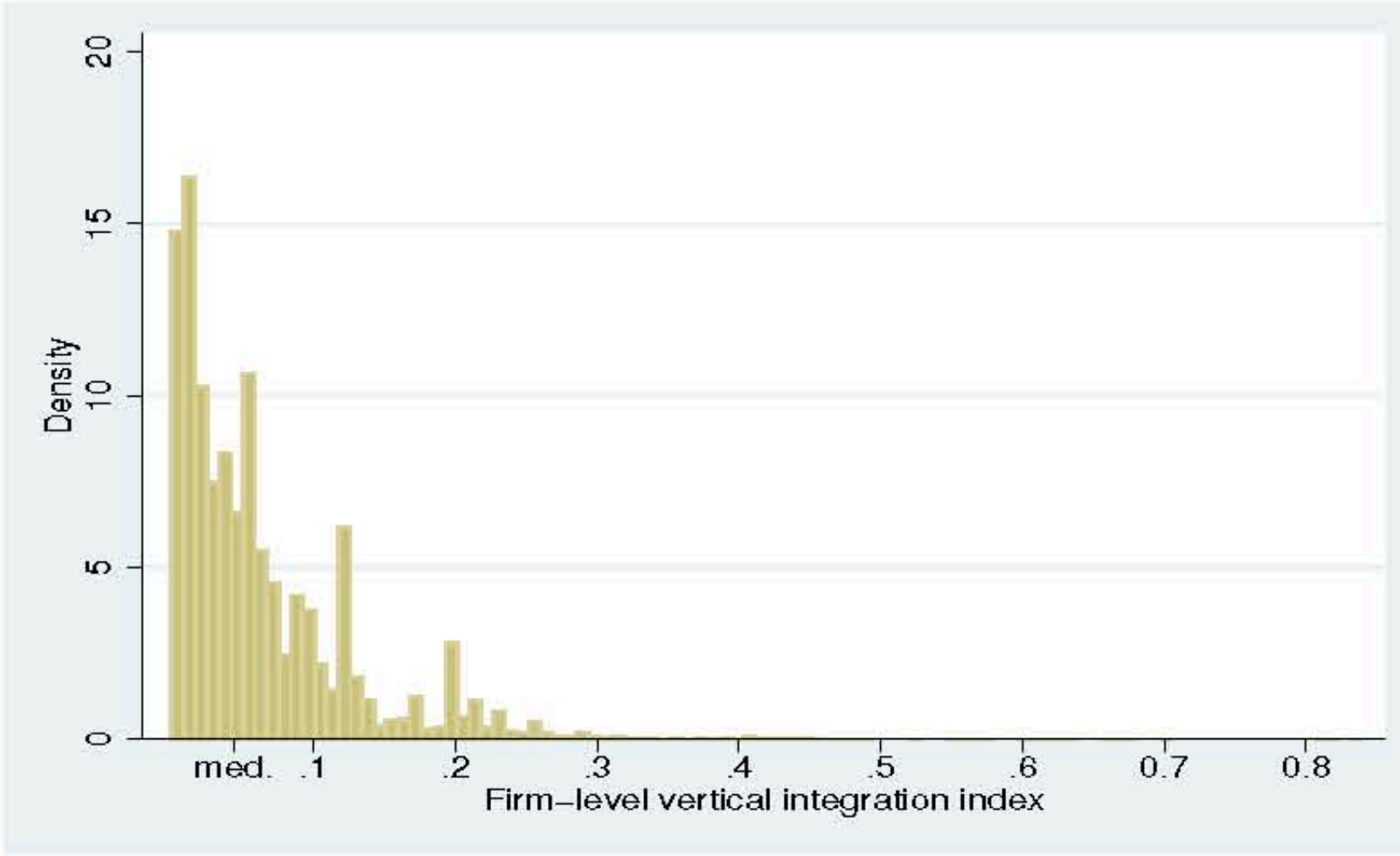
Vertical Integration Index

- For a Japanese plant active in automobiles (59.0301), automotive stampings (41.0201) and miscellaneous plastic products (32.0400), its IO_{ij} coefficients are

		Output (j)		
		Autos	Stampings	Plastics
	Autos	0.0043	0.000	0.0000
Input (i)	Stampings	0.0780	0.0017	0.0000
	Plastics	0.0405	0.0024	0.0560
	SUM	**0.1228**	0.0041	0.0560

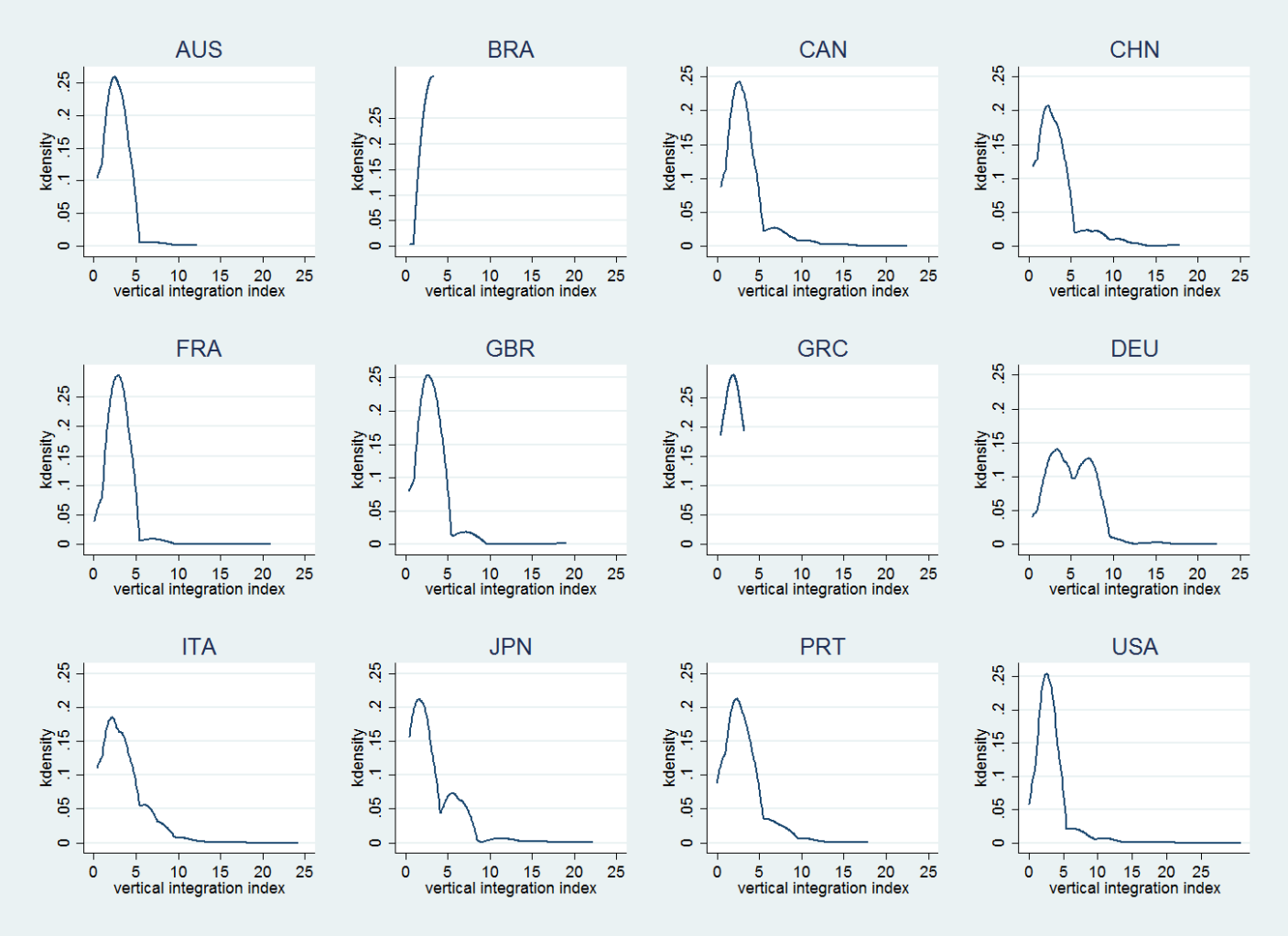
- The IO_{ij} coefficient for stampings to autos indicates that 7.8 cents worth of automotive stampings are required to produce a dollar's output of autos.
- A firm's VI index: sum of IO_{ij} for each industry.
  - 12.3 cents worth of the inputs required to make autos can be produced within this plant (measures the fraction of inputs used in the production of the final good that can be produced in house).

Figure 2: Firm-level vertical integration index



Heterogeneity in VI across countries

Ready-Mix Concrete:



	Main sample	Countries $\geq$ 1,000 plants	Including MNCs
# of plants	225,212	217,723	279,869
# of connected plants	29,214	29,008	64,789
# of multi-plant firms	6,830	6,768	10,224
# of single-plant firms	189,756	182,556	205,062
# of firms	196,586	189,324	215,286
# of MNCs	0	0	18,700
Mean, Vertical integration index	0.0627	0.0640	0.0640
Median, Vertical integration index	0.0437	0.0439	0.0439
Min, Vertical integration index	0.0000	0.0000	0.0000
Max, Vertical integration index	0.8333	0.8333	0.8333
St. dev., Vertical integration index	0.0633	0.0623	0.0645

Trade Data

- Applied **MFN tariffs** for 2004 from WITS database (US-SIC 4 digit-level).
  - Tariffs on final goods in the domestic market.
  - Controls: imported inputs (weighted average using IO data) and export (tariffs on destination using bilateral export shares as weights).
  - For China: MFN tariffs in 1999 and 2007.
- Information on **regional trade agreements** constructed from the WTO Regional Trade Agreements Information System.
  - Includes all **Free Trade Areas** (FTAs) and **Customs Unions** (CUs) in force in 2004 between WTO members, converted in a bilateral dataset.

Other Variables

- Firm-level (WorldBase)
  - $Domestic_f$ = 1 if the firm does not report exporting
  - $Size_f$: firm-level employment instrumented with sector-country dummies
  - *Labor productivity*$_f$: sales/employment instrumented with sector-country dummies
  - MNC_f = 1 if the firm has plants in more than one country
- Sector-level
  - *Capital intensity*$_k$: log capital expenditures/value added (Bartelsmann and Gray, 2000)
  - $Herfindahl_{k,c}$ index based on firms' sales in a given country and sector (WorldBase)
  - $Declining_{k,c,}$: = (-) emp. growth in industry-country1988-1994 (UNIDO)
  - *Import-competing*$_{k,c}$ = log(imports/exports) (Comtrade)
  - $Homogeneous1_k$ = 1, homogeneous according Rauch (1999)
  - $Homogeneous2_k$ =1, import demand elasticity > country median (Broda *et al*, 2006)
- Country-level and bilateral
  - *Legal quality*$_c$: index of the quality of legal institutions (Kaufmann *et al*, 2003)
  - *Financial development*$_c$: domestic credit to private sector % GDP (Beck *et al*, 2006)
  - GDP_c and *GDP per capita*$_c$, *Differences in* GDP_{cc} (WB, WDI)
  - *Colonial relationship*$_{cc'}$, *Contiguity*$_{cc'}$, *Common language*$_{cc'}$ (from CEPII)

	Main sample	Countries $\geq$ 1,000 plants	Including MNCs
# of plants	225,212	217,723	279,869
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Tariffs and Vertical Integration

- To assess validity of our **first prediction**, we estimate the panel regression model:

$$V_{f,k,c} = \alpha + \beta_1 MFN_{k,c} + \boldsymbol{X}_{f,k,c} + \delta_c + \delta_k + \varepsilon_{f,k,c}$$

- Dependent variable: Log of (1+ VI index of firm *f* in country *c*, with primary sector *k)*.
- Controls:
  - Log (1+ MFN tariff applied by country *c* in sector *k*).
  - Interactions between sector and country characteristics
  - Country fixed effects (δ_c).
  - Sector fixed effects at the 4-digit SIC level (δ_k).
- Standard errors clustered at the sector-country level (tariffs vary at the sector-country level, dependent variable varies at the firm level).
- To assess the validity of the **second and third predictions**, we include interactions between the MFN tariff and the variables $Domestic_f$ and $MFNshare_{k,,c}$
  - Use **country-sector fixed effects** in $Domestic_f * MFN_{k,c}$ regression

Tariffs and Vertical Integration

	(1)	(2)	(3)	(4)	(5)
$Tariff_{k,c}$	**0.0203*** **	**0.0202*** **	0.0034	0.0035	
	(0.0061)	**(0.0060)**	(0.0088)	(0.0086)	
$Domestic_f$			-0.0926***	-0.0923***	-0.0880***
			(0.0108)	(0.0109)	(0.0092)
$Tariff_{k,c} \times Domestic_f$			**0.0214*** **	**0.0212*** **	**0.0189*** **
			(0.0054)	**(0.0054)**	**(0.0046)**
$MFN\ Share_{k,c}$					
$Tariff_{k,c} \times MFN\ Share_{k,c}$					
$Capital\ Intensity_k$		0.0322**		0.0321**	
$\times\ Financial\ Development_c$		(0.0142)		(0.0144)	
$Capital\ Intensity_k$		-0.0833		-0.0823	
$\times\ Legal\ Quality_c$		(0.0564)		(0.0573)	
# Observations	196,586	196,586	196,586	196,586	196,586
# Sectors	386	386	386	386	
R^2	0.117	0.117	0.119	0.119	0.002
Sector FE	YES	YES	YES	YES	NO
Country FE	YES	YES	YES	YES	NO
Sector-Country FE	NO	NO	NO	NO	**YES**

Prices Versus Competition

- Two main channels through which tariffs may affect vertical integration:
  - Level of **product prices** (our theory)
  - Degree of **competition** faced by domestic firm (Aghion *et al*, 2006)
- To isolate the effect of product prices, we focus on highly **competitive industries**, in which tariffs should have little effect on the degree of competition
- Sectors for which $Homogeneous1_k = 1$, industries in which goods are traded in organized exchanges, homogeneous according to Rauch (1999)
  - $MFN\ Tariff_{k,c} < 10\%$ (domestic firms face a high level of foreign competition)
  - Sectors in which foreign owned firms operate in the domestic market
  - We exclude concentrated sectors (for which the $Herfindahl_{k,c} > 0.1$)
- We repeat analysis using $Homogeneous2_{k,c}=1$, sectors with high import demand elasticities based on Broda, Greenfield and Weinstein (2006)
- Different criteria to define competitive industries: at least 20 domestic firms operate in the sector; low concentration, low tariffs, presence of foreign firms

Table 2: Tariffs and vertical integration, competitive industries

	Panel A: Homogeneous sectors based on Rauch (1999)							
	(1) Homogeneous sectors, many firms	(2) Homogeneous sectors, many firms	(3) Homogeneous sectors, many firms, low tariffs	(4) Homogeneous sectors, many firms, low tariffs	(5) Homogeneous sectors, many firms, foreign presence	(6) Homogeneous sectors, many firms, foreign presence	(7) Homogeneous sectors, many firms, low concentration	(8) Homogeneous sectors, many firms, low concentration
Tariff$_{k,c}$	**0.0290****	**0.0292****	**0.0380****	**0.0381****	**0.0316****	**0.0315****	**0.0747*****	**0.0982*****
	(0.0117)	**(0.0117)**	**(0.0149)**	**(0.0154)**	**(0.0145)**	**(0.0144)**	**(0.0228)**	**(0.0216)**
Capital Intensity$_k$		0.0063		0.0203		- 0.0035		0.68
x Financial Development$_c$		(0.0524)		(0.0436)		(0.4420)		(0.1610)
Capital Intensity$_k$		-0.0615		-0.2330		0.0499		1.027
x Legal Quality$_c$		(0.1950)		(0.1440)		(0.1870)		(0.7290)
Observations	13,095	13,095	11,279	11,279	10,918	10,918	8,539	8,539
# Sectors	56	56	54	54	53	53	37	37
R^2	0.073	0.073	0.052	0.052	0.068	0.068	0.047	0.047
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	Panel B: Homogeneous sectors based on Broda, Greenfield and Weinstein (2006)							
	(1) Homogeneous sectors, many firms	(2) Homogeneous sectors, many firms	(3) Homogeneous sectors, many firms, low tariffs	(4) Homogeneous sectors, many firms, low tariffs	(5) Homogeneous sectors, many firms, foreign presence	(6) Homogeneous sectors, many firms, foreign presence	(7) Homogeneous sectors, many firms, low concentration	(8) Homogeneous sectors, many firms, low concentration
Tariff$_{k,c}$	**0.0257*****	**0.0248*****	**0.0345*****	**0.0341*****	**0.0363*****	**0.0363*****	**0.0648*****	**0.0639*****
	(0.0083)	**(0.0084)**	**(0.0085)**	**(0.0084)**	**(0.0101)**	**(0.0102)**	**(0.0112)**	**(0.0116)**
Capital Intensity$_k$		0.0216		0.0041		0.0560		-0.0267
x Financial Development$_c$		(0.0248)		(0.0245)		(0.0367)		(0.0299)
Capital Intensity$_k$		-0.1240		-0.0952		- 0.3018**		-0.0840
x Legal Quality$_c$		(0.0875)		(0.1170)		(0.1306)		(0.1400)
Observations	78,437	78,437	69,823	69,823	69,980	69,980	50,315	50,315
# Sectors	337	337	328	328	309	309	234	234
R^2	0.106	0.107	0.099	0.099	0.111	0.111	0.087	0.087
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2: Tariffs and vertical integration, competitive industries

	Panel A: Homogeneous sectors based on Rauch (1999)							
	(1) Homogeneous sectors, many firms	(2) Homogeneous sectors, many firms	(3) Homogeneous sectors, many firms, low tariffs	(4) Homogeneous sectors, many firms, low tariffs	(5) Homogeneous sectors, many firms, foreign presence	(6) Homogeneous sectors, many firms, foreign presence	(7) Homogeneous sectors, many firms, low concentration	(8) Homogeneous sectors, many firms, low concentration
Tariff$_{k,c}$	**0.0290****	**0.0292****	**0.0380****	**0.0381****	**0.0316****	**0.0315****	**0.0747*****	**0.0982*****
	(0.0117)	**(0.0117)**	**(0.0149)**	**(0.0154)**	**(0.0145)**	**(0.0144)**	**(0.0228)**	**(0.0216)**
Capital Intensity$_k$		0.0063		0.0203		- 0.0035		0.68
x Financial Development$_c$		(0.0524)		(0.0436)		(0.4420)		(0.1610)
Capital Intensity$_k$		-0.0615		-0.2330		0.0499		1.027
x Legal Quality$_c$		(0.1950)		(0.1440)		(0.1870)		(0.7290)
Observations	13,095	13,095	11,279	11,279	10,918	10,918	8,539	8,539
# Sectors	56	56	54	54	53	53	37	37
R^2	0.073	0.073	0.052	0.052	0.068	0.068	0.047	0.047
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	Panel B: Homogeneous sectors based on Broda, Greenfield and Weinstein (2006)							
	(1) Homogeneous sectors, many firms	(2) Homogeneous sectors, many firms	(3) Homogeneous sectors, many firms, low tariffs	(4) Homogeneous sectors, many firms, low tariffs	(5) Homogeneous sectors, many firms, foreign presence	(6) Homogeneous sectors, many firms, foreign presence	(7) Homogeneous sectors, many firms, low concentration	(8) Homogeneous sectors, many firms, low concentration
Tariff$_{k,c}$	**0.0257*****	**0.0248*****	**0.0345*****	**0.0341*****	**0.0363*****	**0.0363*****	**0.0648*****	**0.0639*****
	(0.0083)	**(0.0084)**	**(0.0085)**	**(0.0084)**	**(0.0101)**	**(0.0102)**	**(0.0112)**	**(0.0116)**
Capital Intensity$_k$		0.0216		0.0041		0.0560		-0.0267
x Financial Development$_c$		(0.0248)		(0.0245)		(0.0367)		(0.0299)
Capital Intensity$_k$		-0.1240		-0.0952		- 0.3018**		-0.0840
x Legal Quality$_c$		(0.0875)		(0.1170)		(0.1306)		(0.1400)
Observations	78,437	78,437	69,823	69,823	69,980	69,980	50,315	50,315
# Sectors	337	337	328	328	309	309	234	234
R^2	0.106	0.107	0.099	0.099	0.111	0.111	0.087	0.087
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Credit constraints

- Another possible explanation for our results relies on **credit constraints**: protected firms may have more disposable cash to acquire their suppliers

- If this is the reason behind the positive impact of tariffs on vertical integration, **the effect should be stronger in countries and sectors in which credit constraints are more severe**

- We have interacted the tariff variable with the inverse of the measure *Financial Development* and with a standard measure of *Financial dependence* (including the interaction terms separately or together, including a triple interaction between tariffs, financial dependence and the inverse of financial development)

- In all specifications, the **interaction terms were insignificant** and the sign and significance of the tariff coefficient was unaffected.

Including additional controls

- Possible concerns:
  - **Tariffs** that firms face **in export markets** and **tariffs on imported inputs** can be correlated with tariffs on final products and may also affect integration
  - **Large and more productive firms** in **concentrated industries** could be more effective at lobbying for protection and may also be more vertically integrated
  - **Declining industries** tend to be more protected and may also be more integrated

- Results are unaffected when including these **additional controls** in our analysis:
  - Firm size and labor productivity
  - Industry concentration
  - Input tariffs and export tariffs
  - Degree to which an industry is declining
  - Import-penetration ration

Table 3: Tariffs and vertical integration, controlling for possible omitted variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tariff$_{k,c}$	**0.0203*** **	**0.0202*** **	**0.0203*** **	**0.0190*** **	**0.0214*** **	**0.0210*** **	**0.0212*** **	**0.0198*** **	**0.0183*** **
	(0.0061)	**(0.0060)**	**(0.0074)**	**(0.0058)**	**(0.0065)**	**(0.0059)**	**(0.0059)**	**(0.0057)**	**(0.0061)**
Capital Intensity$_k$		0.0322**	0.0333**	0.0387**	0.0425**	0.0401**	0.0319**	0.0390**	0.0507**
x Financial Development$_c$		(0.0142)	(0.0161)	(0.0154)	(0.0176)	(0.0187)	(0.0146)	(0.0189)	(0.0234)
Capital Intensity$_k$		-0.0833	-0.0785	-0.100*	-0.106	-0.103	-0.0836	-0.0944	-0.127
x Legal Quality$_c$		(0.0564)	(0.0617)	(0.0604)	(0.0682)	(0.0711)	(0.0577)	(0.0705)	(0.0885)
Input Tariff$_{k,c}$			0.0391***		0.0330**				0.0464***
			(0.0142)		(0.0141)				(0.0170)
Export Tariff$_{k,c}$				0.00252	-0.0038				-0.0049
				(0.0052)	(0.0060)				(0.0063)
Concentration$_{k,c}$						0.0128			0.0141
						(0.0228)			(0.0316)
Size$_f$							0.0352***		0.0440***
							(0.0075)		(0.0111)
Labor Productivity$_f$								0.0267***	0.0287***
								(0.0054)	(0.0069)
# Observations	196,586	196,586	154,915	185,630	146,228	178,199	196,586	178,448	133,545
# Sectors	386	386	311	386	311	386	386	386	311
R^2	0.117	0.117	0.119	0.123	0.125	0.117	0.122	0.125	0.132
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Additional Robustness

- **Different samples**:
  - Excluding firms that existed pre-1994
  - Including multinational firms, with plants in more than one country
  - Excluding countries with less than 1000 observations
  - Focusing on OECD countries only
  - Excluding the United States.

Additional Robustness Checks

- **Alternative measure of vertical integration**, constructed based on all the firm's activities rather than its primary activity.
- **Including multinational firms** (primary activity of the respective domestic ultimate to identify the relevant tariff).
- **Excluding countries with less than 1,000 plants** that are part of firms with at least 20 employees.
- **Different econometric methodologies**: Poisson quai-maximum likelihood estimator, alternative clustering of standard errors (at sector and at country level)

Summary

- Empirical analysis of the **organizational effects MFN tariffs**:
  - We construct firm-level vertical integration indices for a large set of countries.
  - We exploit cross-country and cross-sectoral differences in applied MFN tariffs, as well as time variation in the degree of protection faced by firms.
- **Market conditions – the level of product prices – do affect vertical integration**:
  - Higher tariffs on final goods lead firms to be more vertically integrated.
  - The effect is stronger for firms
    - serving only the domestic market
    - in sectors in which product prices are more sensitive to tariffs

Implications for Policy

- **Positive correlations between prices and VI** have been observed in many industries:
  - Report on the beer industry by the British Monopolies and Mergers Commission found higher retail prices in integrated than non-integrated pubs (Slade, 1998)
  - Increases in gasoline prices in California in the 1990's were associated with increases in the number of vertically integrated gasoline stations (Hastings, 2004)
- **Policymakers appear to have drawn a causal inference from this correlation**, that vertical integration causes higher prices, in line with market foreclosure theories.
- Positive correlations **may be consistent with perfect competition**.

Conclusion

Demand Matters for Organizations

Coordination device, "clustering" of organizational changes. Prices may increase following entry of low cost suppliers. Shocks propagate.

Organization Theory Matters for Industrial Economics

Organization is an important determinant of "conduct" and performance of firms.

Governance Matters for Consumers

Consumers have an interest in the internal organization of firms even absent market power

Mind your P's and Q's: IO as a proving ground for OE

Other models of the firm can be embedded in the market and would lead to different versions of the OAS; may distinguish them empirically based on price/quantity data

Example: Inefficient HQ's

- Suppose that HQ's reduce output by a factor σ
- New indifference condition:
  $PQ^N(P) - c(Q^N(P)) = (1-\sigma)P - \frac{1}{2}$
- Result: integration only occurs in a price interval $[\underline{P}(\sigma), \overline{P}(\sigma)]$:
  "inverted-U shape" relation between price and integration

Horse Race

- Regress $V = \alpha_1 P + \alpha_2 P^2 + \alpha \mathbf{X}$
- Efficient HQ model has $\alpha_1 > 0 = \alpha_2$; inefficient HQ model has $\alpha_1 > 0 > \alpha_2$

• We tried this with our data and could not reject $\alpha_2 = 0$ (i.e., efficient HQ model is consistent with data)