Competition and Organization

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Competition and Organization

Organization of firms is affected by competitive environment

Competitive environment determined by firms

Equilibrium approach: efficiency of market equilibrium; role of institutions and environment on productivity distribution

Key Challenges

Firm-level analysis should depend on competitive environment only via straightforward "sufficient statistics"

Product-market equilibrium depends on firm-level decisions only via straightforward "sufficient statistics"

Develop a model in which these particular interactions are convincing

Agenda

Competition and Managerial Incentives

Productivity and Credibility in Industry Equilibrium

The Quiet Life

Competition improves productivity by:

1. Reallocating production toward efficient firms
2. Improve existing firms by removing "slack"

"The best of all monopoly profits is a quiet life." (Hicks, 1935)

Second effect is intuitively appealing but has been difficult to formalize.

Hart (1983), Nalebuff & Stiglitz (1983), Scharfstein (1988), Hermalin (1992), Schmidt (1997), Raith (2003), Vives (2008)

Goal Today

Incomplete applied theory exercise of trying to formalize the claim that stronger competition improves within-firm productivity

Why formalize? Understand **why**, and more importantly, **when** competition improves productivity.

Formalization clarifies boundaries of informal arguments. Best way to ensure we are applying intuition correctly.

Individual Firm's Problem

Two objectives:

1. Clarify the costs and benefits of removing "slack"
2. Clarify how "competition" affects these costs and benefits

Two periods:

1. Firm chooses effort e to reduce (constant) marginal cost to $c - e$
2. Firm competes in the product market

Individual Firm's Problem

$$\max_{e} Benefits(e) - Costs(e)$$

Individual Firm's Problem

$$\max_{e} \underbrace{Benefits(e)}_{\text{product-market profits}} - Costs(e)$$

Individual Firm's Problem

$$\max_{e} \underbrace{Benefits(e)}_{\text{product-market profits}} - \underbrace{Costs(e)}_{\text{cost of removing slack}}$$

Individual Firm's Problem

<u>Touchstone question</u>

How does competition affect managerial slack?

$$e^*$$

$$\max_e \underbrace{Benefits(e)}_{\text{product-market profits}} - \underbrace{Costs(e)}_{\text{cost of removing slack}}$$

Benefits of Removing Slack

Touchstone question

How does competition affect managerial slack?

$$e^*$$

$$\max_e Benefits(e) - Costs(e)$$

$$Benefits(e) =$$

<u>Touchstone question</u>
How does competition affect managerial slack?

e^*

Benefits of Removing Slack

$$\max_e Benefits(e) - Costs(e)$$

$$Benefits(e) = \max_p (p - (c - e))q(p)$$

Benefits of Removing Slack

<u>Touchstone question</u>

How does competition affect managerial slack?

$$e^*$$

$$\max_e Benefits(e) - Costs(e)$$

$$Benefits(e) = \max_p (p - (c - e))q(p)$$

every firm is a monopolist relative to its residual demand curve

Benefits of Removing Slack

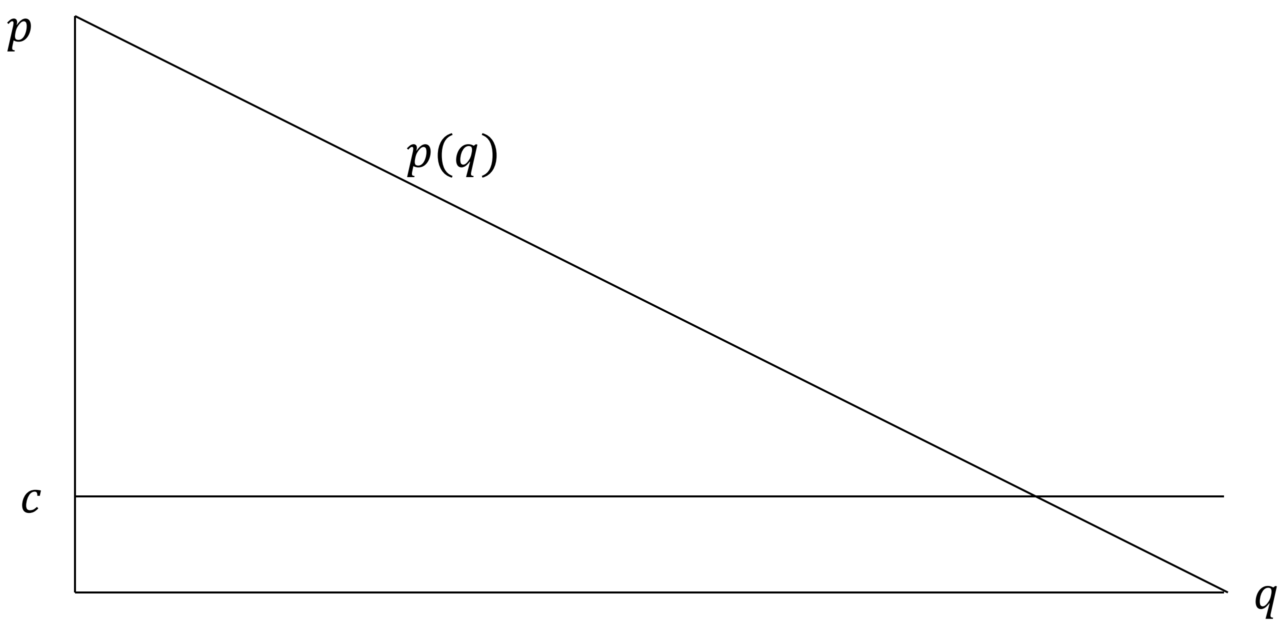
<u>Touchstone question</u>

How does competition affect managerial slack?

e^*

$$\max_e \mathit{Benefits}(e) - \mathit{Costs}(e)$$

$$\mathit{Benefits}(e) = \max_p (p - (c - e))q(p)$$



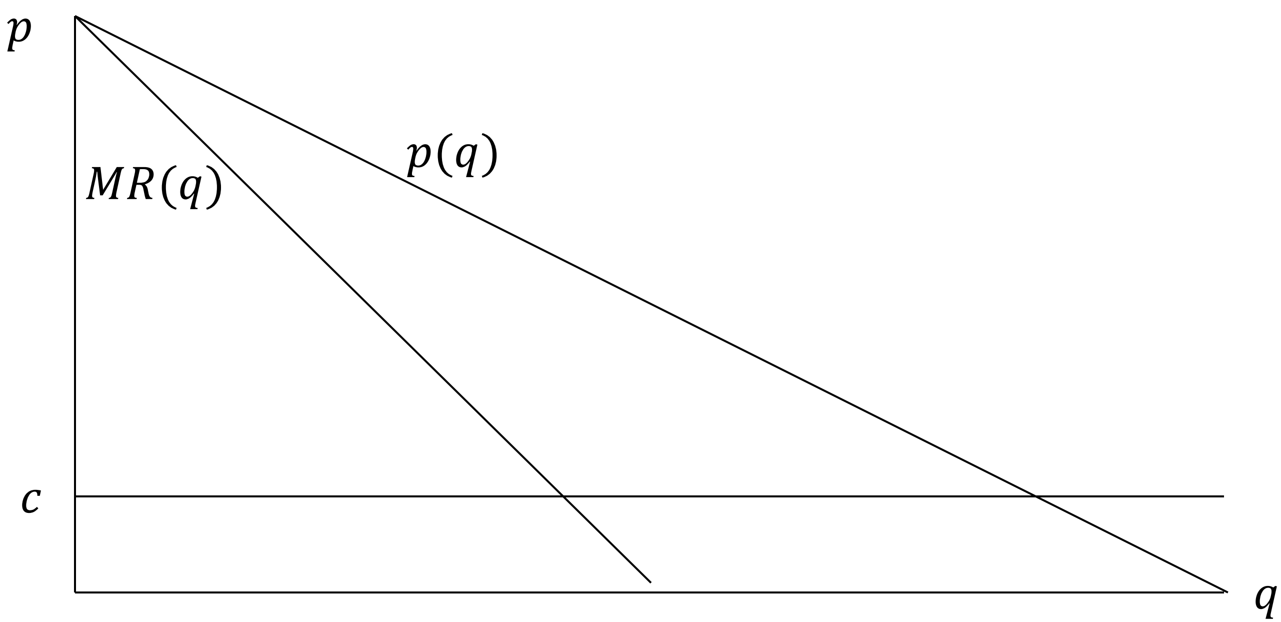
Benefits of Removing Slack

<u>Touchstone question</u>
How does competition affect managerial slack?

$$e^*$$

$$\max_e \textcolor{blue}{Benefits(e)} - \textcolor{red}{Costs(e)}$$

$$\textcolor{blue}{Benefits(e)} = \max_p (p-(c-e))q(p)$$



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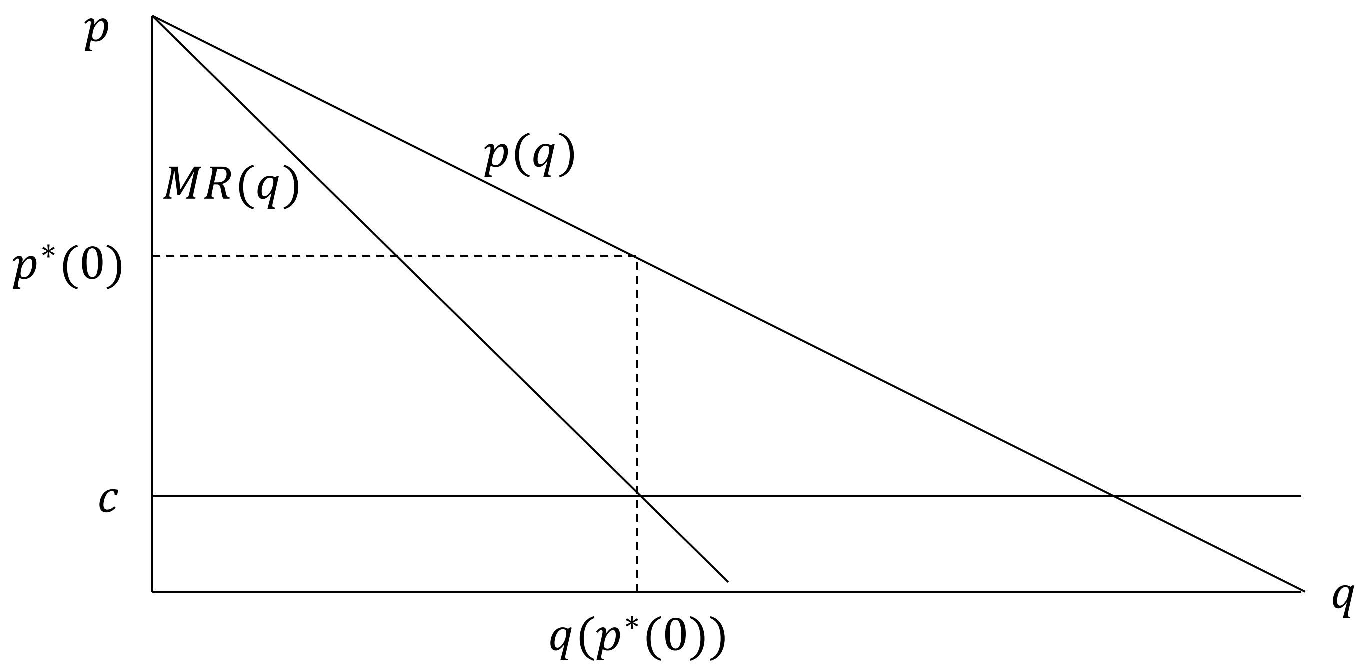

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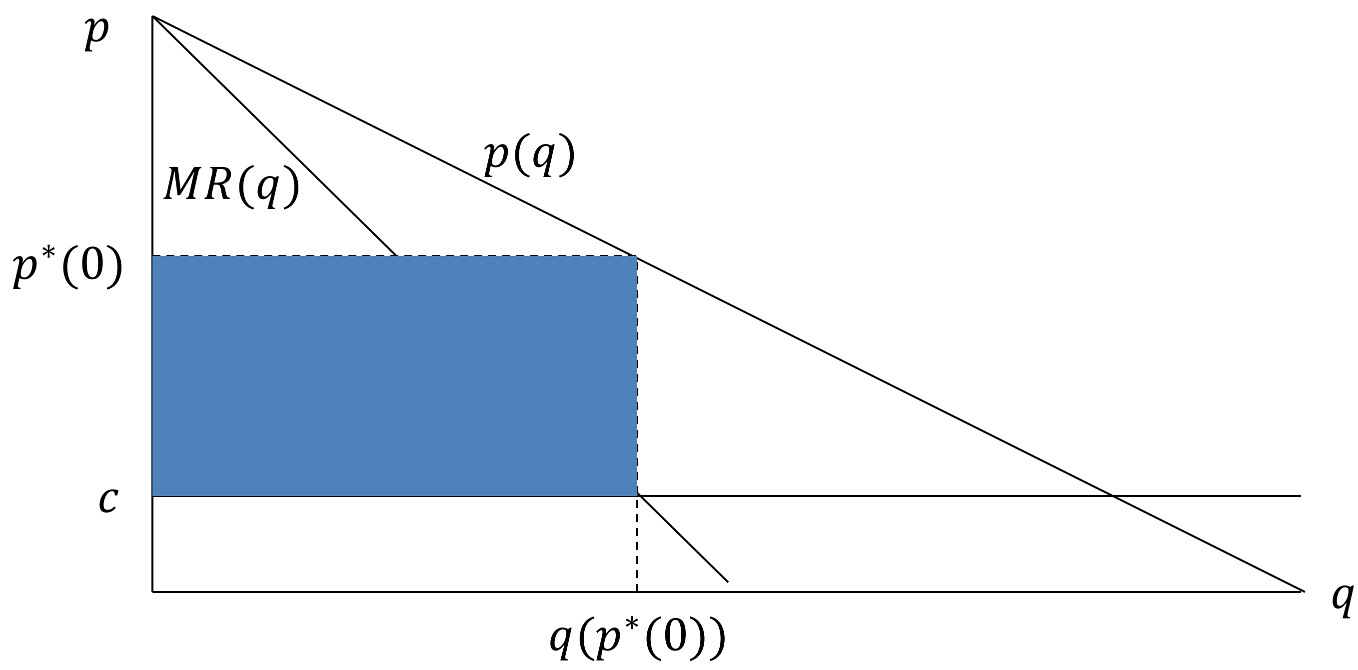


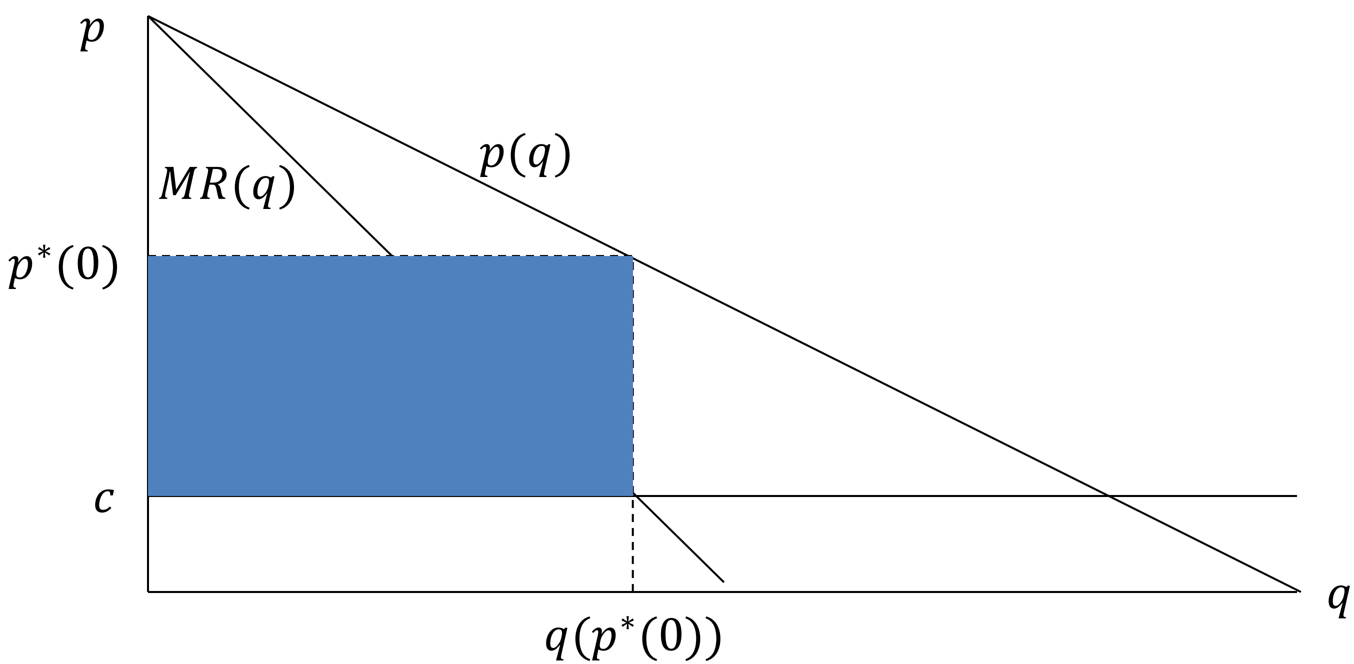
If in Doubt, Apply the Envelope Theorem

Touchstone question
How does competition affect managerial slack?

$$e^*$$

$$\max_e Benefits(e) - Costs(e)$$

$$\frac{d}{de} Benefits(e) = q(p^*(e))$$



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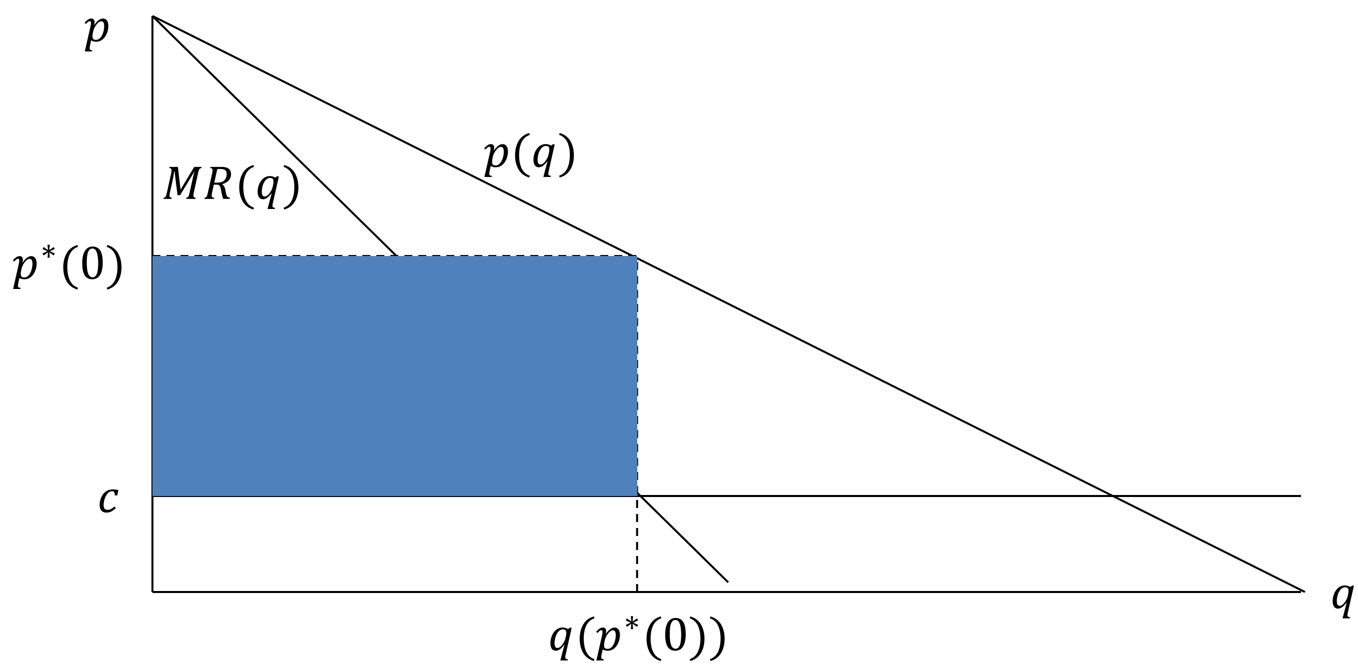
if my marginal costs fall by a dollar, I get one extra dollar for each unit I sell



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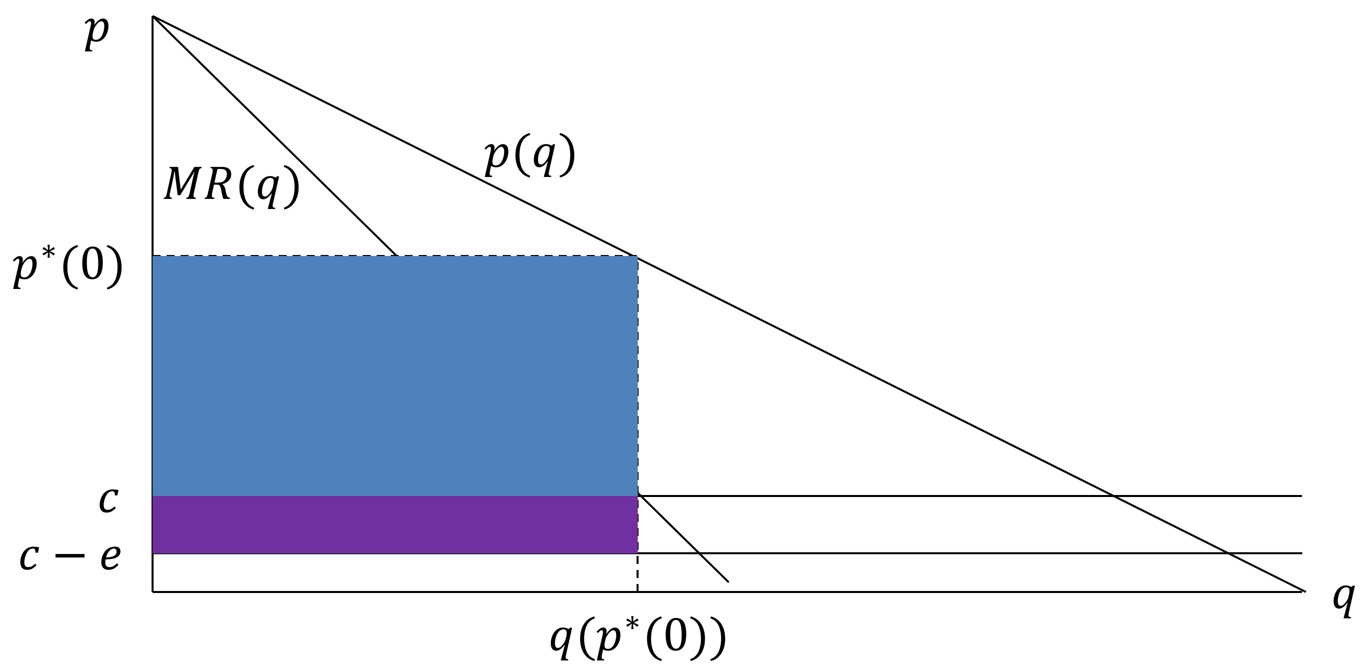

Monopoly to Bertrand

<u>Touchstone question</u>

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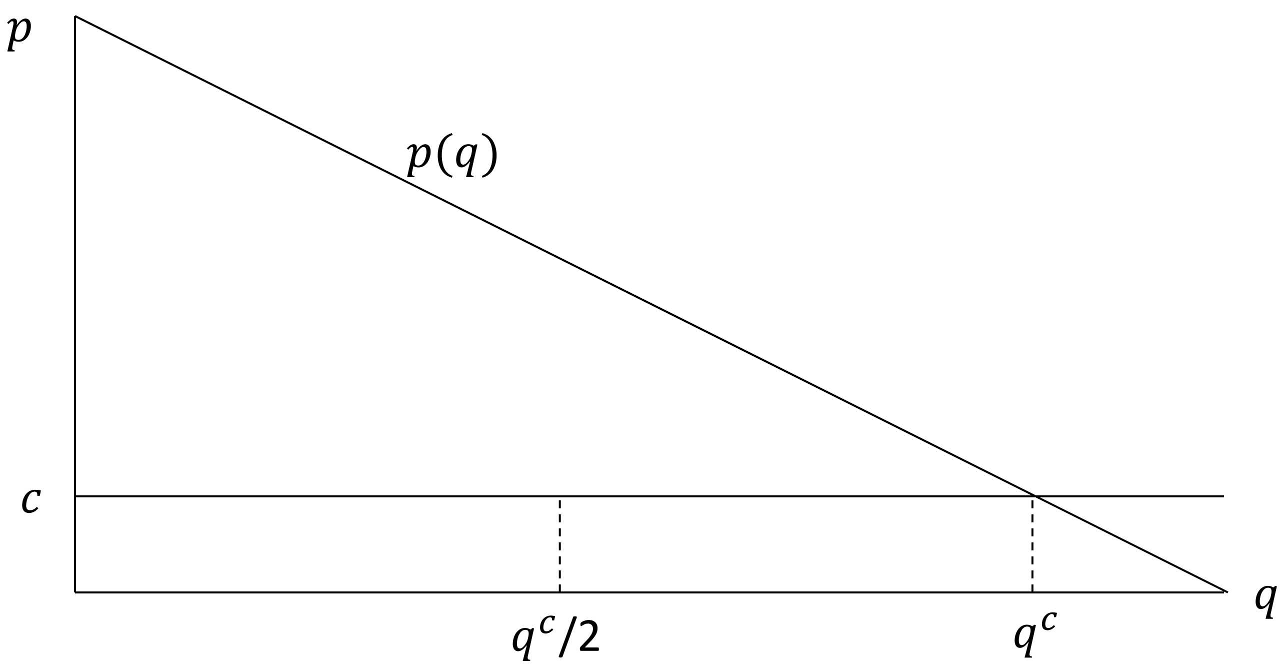

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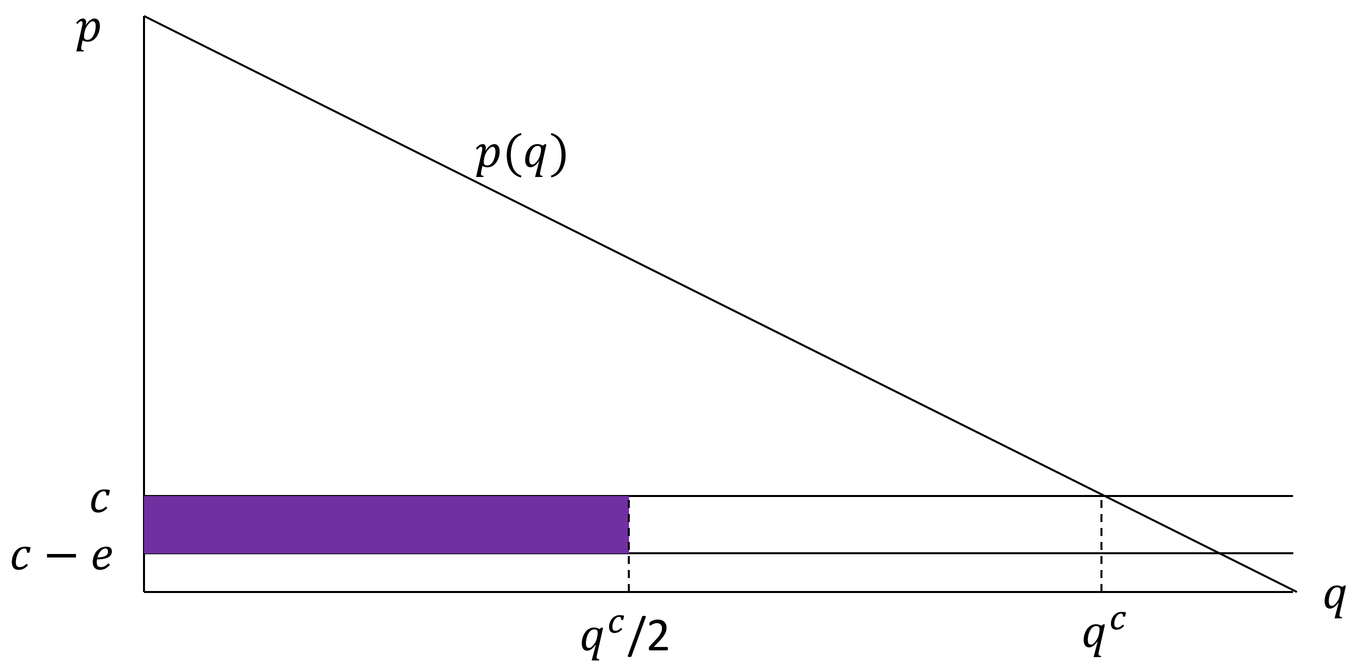

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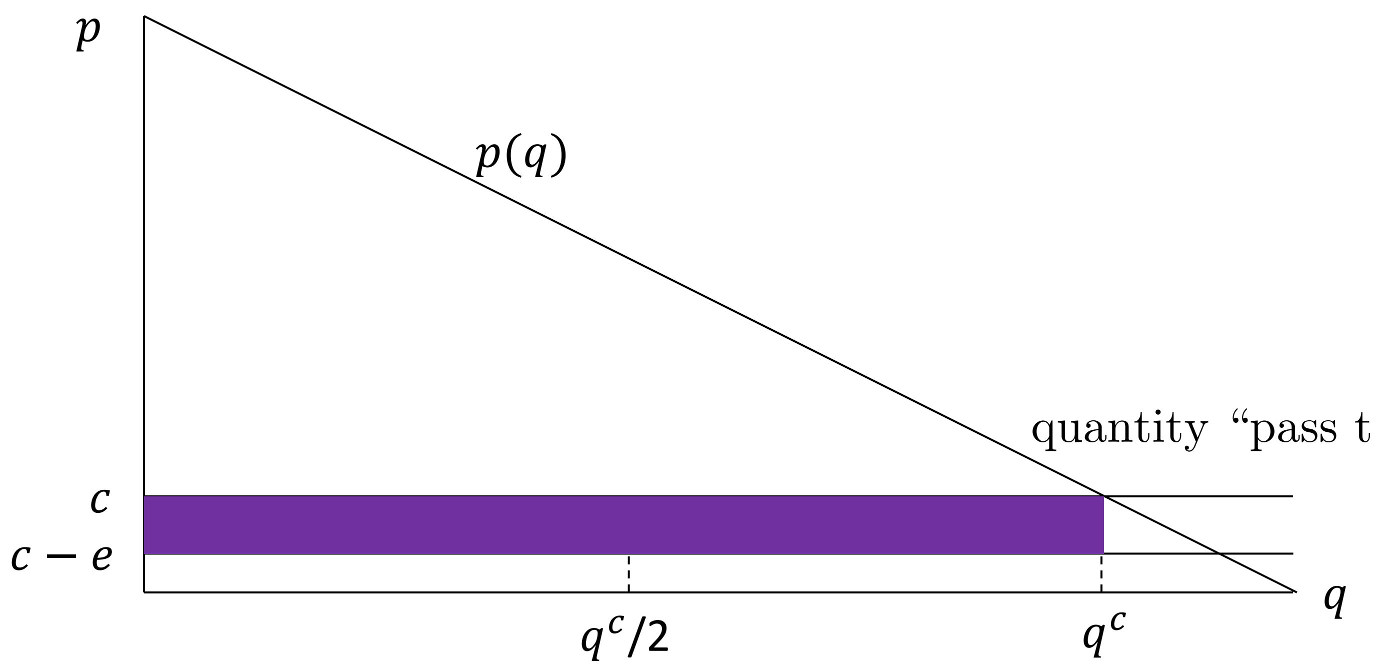

Monopoly to Bertrand

<u>Touchstone question</u>

How does competition affect managerial slack?

$$e^*$$

$$\max_e Benefits(e) - Costs(e)$$

$$\frac{d}{de} Benefits(e) = q(p^*(e))$$

Quantity Pass-Through is Key For Benefits Side

<u>Touchstone question</u>

How does competition affect managerial slack?

$$e^*$$

$$\max_e Benefits(e) - Costs(e)$$

$$\frac{d}{de} Benefits(e) = q(p^*(0)) + \int_0^e QPT(s)ds$$

quantity pass-through:
how much do I increase
my sales if my costs fall?

Quantity Pass-Through is Key For Benefits Side

<u>Touchstone question</u>

How does competition affect managerial slack?

$$e^*$$

$$\max_e Benefits(e) - Costs(e)$$

$$Benefits(e) = eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds$$

Quantity Pass-Through is Key For Benefits Side

<u>Touchstone question</u>

How does competition affect managerial slack?

$$e^*$$

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds \; - Costs(e)$$

What about the Costs?

<u>Touchstone question</u>

How does competition affect managerial slack?

$$e^*$$

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds \; - Costs(e)$$

Touchstone question

How does competition affect managerial slack?

e^*

What about the Costs?

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds \; - Costs(e)$$

$$Costs(e) =$$

Touchstone question

How does competition affect managerial slack?

What about the Costs?

e^*

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds \; - Costs(e)$$

$$Costs(e) = \min_{w \in W} \int w(y)dF(y|e) \qquad \text{subject to}$$

$$\int u(w(y) \; - c(e))dF(y|e) \geq \int u(w(y) \; - c(e'))dF(y|e')$$

$$\int u(w(y) \; - c(e))dF(y|e) \geq \; 0$$

What about the Costs?

Touchstone question

How does competition affect managerial slack?

e^*

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds - Costs(e)$$

$$Costs(e) = c(e) + \underbrace{Risk(e) + Rents(e)}_{\text{agency costs}}$$

<u>Touchstone question</u>

How does competition affect managerial slack?

What about the Costs?

e^*

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds - c(e)$$

$$-(Risk(e) + Rents(e))$$

What is an "increase in competition"?

Touchstone question

How does competition affect managerial slack?

$$e^*$$

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds - c(e)$$

$$-(Risk(e) + Rents(e))$$

Touchstone question

How does competition affect managerial slack?

Many Different Answers

$$e^*$$

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds - c(e)$$
$$-(Risk(e) + Rents(e))$$

Hart (1983), Nalebuff & Stiglitz (1983), Scharfstein (1988): increased competition reveals industry-wide cost shocks through output prices

Hermalin (1992), Schmidt (1997): increased competition reduces profits

Raith (2003), Vives (2008): more competitors; more substitutable products; greater market size; lower entry barriers

Touchstone question

How does competition affect managerial slack?

Many Different Channels

e^*

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds - c(e)$$

$$-(Risk(e) + Rents(e))$$

Hart (1983), Nalebuff & Stiglitz (1983), Scharfstein (1988): increased competition reveals industry-wide cost shocks through output prices

Can use relative-performance evaluation, so $Risk(e)\downarrow$ suggesting $e^*\uparrow$ but as Scharfstein (1988) cautions, this does not imply $Risk'(e)\downarrow$

Touchstone question

How does competition affect managerial slack?

Many Different Channels

e^*

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds - c(e)$$
$$-(Risk(e) + Rents(e))$$

Hermalin (1992), Schmidt (1997): increased competition reduces profits

Hermalin: profits ↓ make agent less willing to substitute away from effort due to income effects, so $Risk'(e)$ ↓, implying e^* ↑

Schmidt: profits ↓ increases *avertable* bankruptcy risk, which agent cares to do b\c she receives rents. In turn, $Rents'(e)$ ↓, implying e^* ↑

In both of these, competition also reduces q, so effects are ambiguous

Touchstone question

How does competition affect managerial slack?

Many Different Channels

e^*

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds - c(e)$$

Raith (2003), Vives (2008): more competitors; more substitutable products; greater market size; lower entry barriers

Assumes markets are "covered": $q(p^*(e)) = \frac{Market\ Size}{\#\ Competitors}$

$$\#Competitors \uparrow \rightarrow q(p^*(e)) \downarrow \rightarrow e^* \downarrow$$
$$Substitutability \uparrow \rightarrow \#Competitors \downarrow \rightarrow q(p^*(e)) \uparrow \rightarrow e^* \uparrow$$
$$Market\ Size \uparrow \rightarrow q(p^*(e)) \uparrow \rightarrow e^* \uparrow$$
$$Entry\ Costs \downarrow \rightarrow \#Competitors \uparrow \rightarrow q(p^*(e)) \downarrow \rightarrow e^* \downarrow$$

Touchstone question

How does competition affect managerial slack?

More Fundamentally

e^*

$$\max_e eq(p^*(0)) + \int_0^e (e-s)QPT(s)ds - c(e)$$

How does an increase in competition affect $q(p^*(0))$ and QPT?

Cournot competition: "lazy competition" reduces $q(p^*(0))$ and does not increase QPT, so $e^* \downarrow$

Bertrand competition: "fierce competition" increases QPT, so $e^* \uparrow$

Unanswered Questions

1. (Theory) How does nature of competition affect whether an increase in competition increases QPT?

2. (Theory) Can firms be inefficiently "too efficient" when competition increases QPT sharply? Arms races?

3. (Empirical) Does an increase in competition tend to increase QPT?

Agenda

Competition and Managerial Incentives

Productivity and Credibility in Industry Equilibrium

Credibility is Important in Production

For a large firm to operate efficiently, it must decentralize

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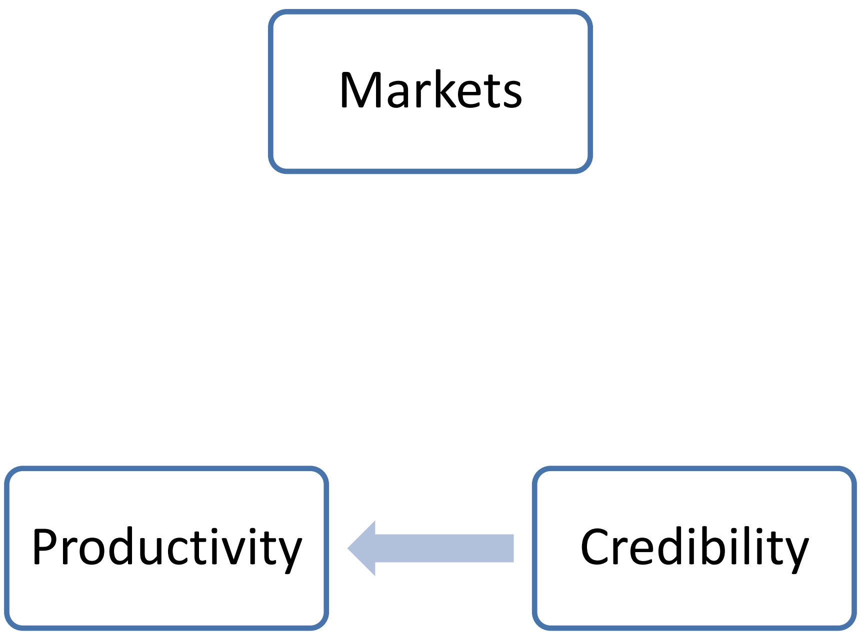
Decentralization requires trust

Credibility is Important in Production

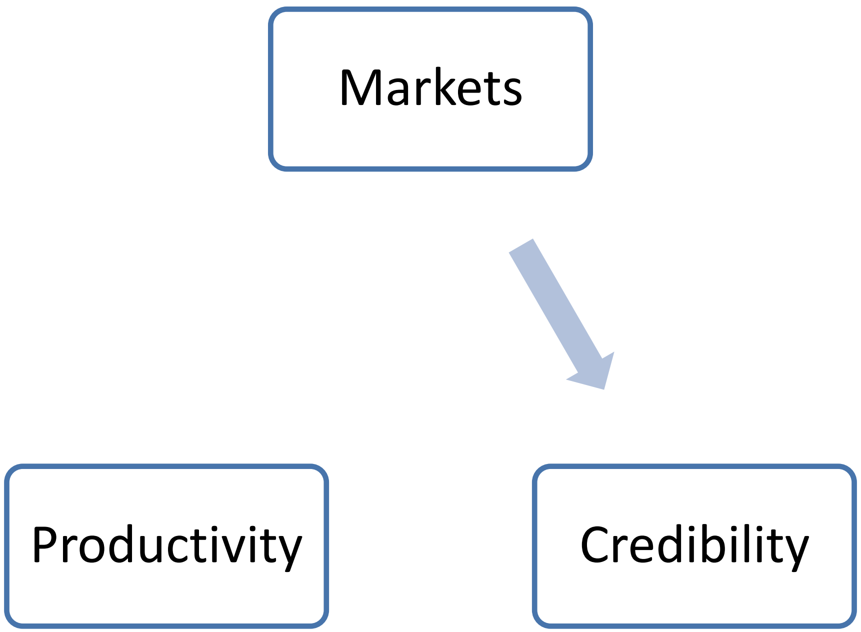


For a large firm to operate efficiently, it must decentralize

Decentralization requires trust

Trust = credibility in a repeated game

Credibility is Important in Production

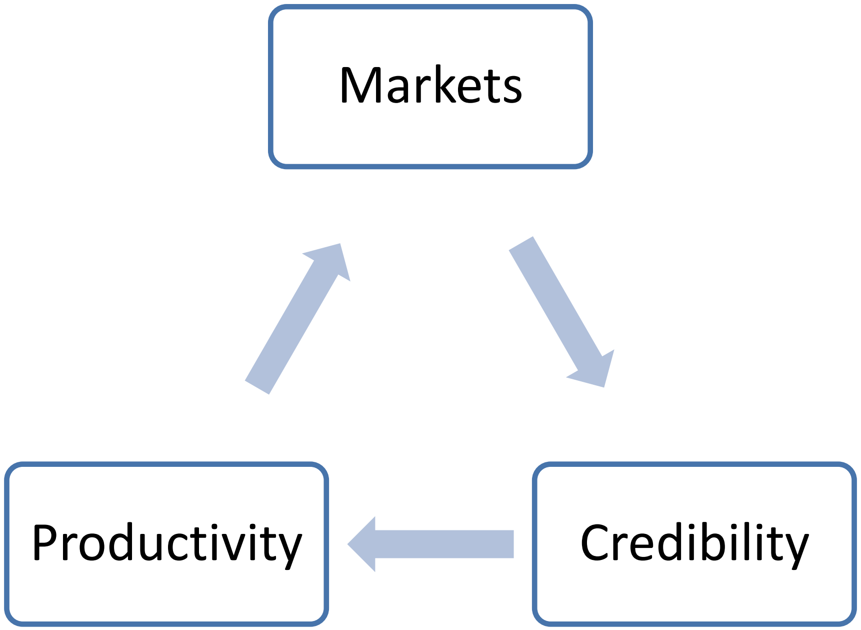


Failure to uphold promises may jeopardize firm's labor-market reputation

Future of firm is at stake in its promises

Future profits serve as collateral

Industry Equilibrium



Future profits are endogenous

Profits, credibility, decentralization, and hence productivity are jointly determined in equilibrium

Firm-Level Heterogeneity

There are "... virtually without exception, enormous and persistent measured productivity differences across producers, even within narrowly defined industries." (Syverson, 2011)

- Dispersion: avg. 90/10 gap is 192% (Syverson, 2004)
- Persistence: Levels (Buera and Shin, 2008; Moll, 2014) and rankings (Baily, Hulten, and Campbell, 1992)

Firm fixed effect: scarce, inalienable resource

Elements of the Theory

Many firms: one owner, (many) manager(s); long-term relationships

Decentralization important in production

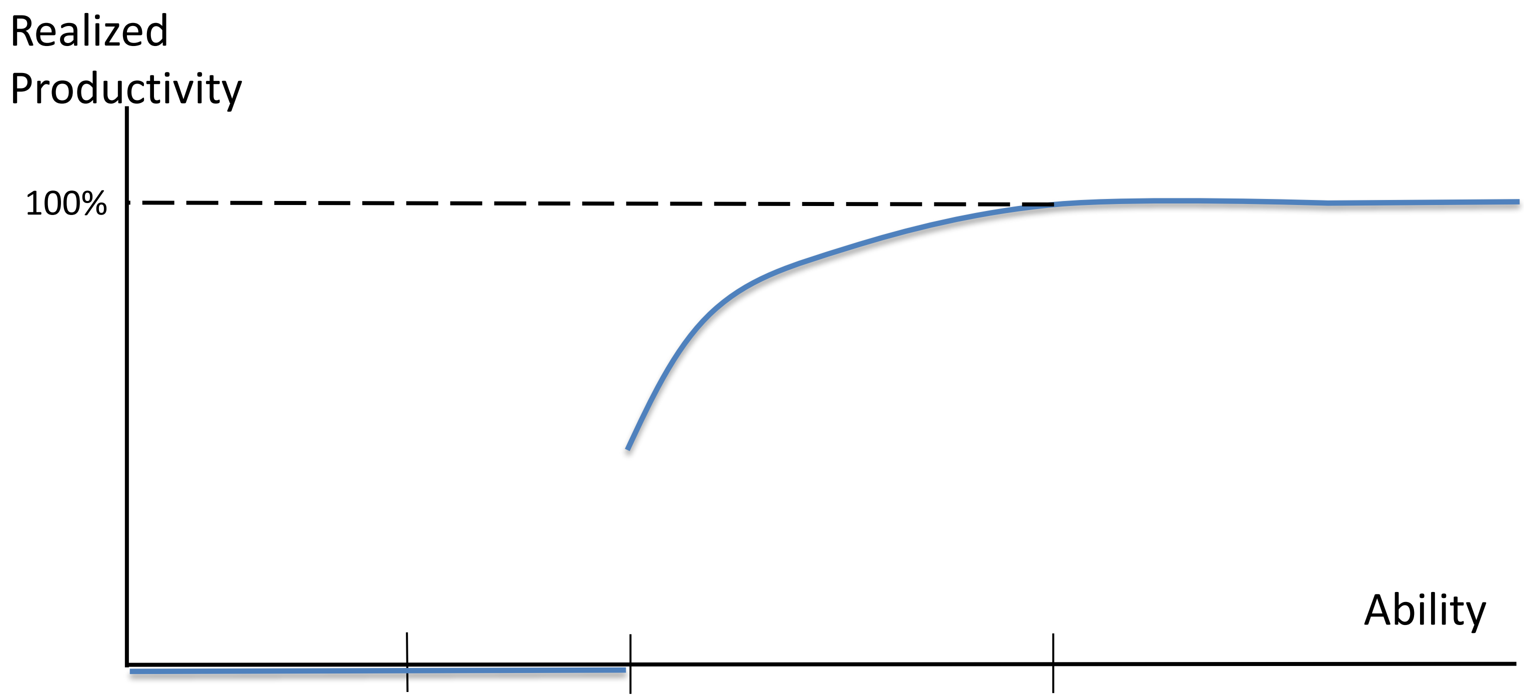
No formal contracts: rewards take the form of contingent promises (relational incentive contracts)

(Exogenously) Heterogeneous firms

Competitive output market: all firms face same output price

THEORETICAL IMPLICATIONS

Stronger Firms Realize their Potential



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Future Profits are Today's Inputs

Are profits allocated efficiently?

Consider giving \$1 in profits/day to a firm:

- Consumption effect: firm is \$1/day richer
- Collateral effect (relaxes constraints)

Profits inefficiently concentrated at the top: pecuniary externality that is not internalized

- Firm income effects with efficiency consequences

Welfare-Improving Tax Scheme

Suppose ability is unbounded from above

Impose a proportional output tax on unconstrained firms

Proposition: a small tax can improve welfare

How Does this Work?

Permanent small marginal tax on high-ability firms, returned lump-sum makes these firms essentially indifferent

Reduced production, so increase in prices

- Transfer from consumers to constrained producers
- Improves efficiency of constrained producers

Progressive firm taxes increase total welfare

What about Subsidizing Small Firms?

Taxing big firms is not the same as subsidizing small firms

Subsidizing small firms (via tax credit funded by nondistortionary head tax) improves their profits by more than cost of tax

Such firms expand, driving down prices, reducing profits of all other firms, some of which are constrained

EMPIRICAL IMPLICATIONS

Productivity is Endogenous

Key: low-ability firms' TFP is more sensitive

Two applications:

1. Within-country, over time: aggregate demand shifts
2. Across countries: institutional environment

Productivity Dynamics Facts

1. Pro-cyclical aggregate productivity

   Hultgren (1960)

2. Pro-cyclical within-firm productivity

   Bartelsman and Doms (2060)

3. Counter-cyclical dispersion

   Baily, Bartelsman, and Haltiwanger (2001), Kehrig (2015)

Many stories for [1] and [2], but [3] is puzzling. All three are consistent with “credibility.”

Cross-Country Facts

1. Lots of productivity dispersion within country

   Syverson (2011) for a survey

2. More productivity dispersion in developing countries

   Hsieh and Klenow (2009), Bartelsman, Haltiwanger, and Scarpetta (2013)

3. Distribution has thick left tail in developing countries

   Hsieh and Klenow (2009)

Better formal contracts reduce importance of credibility, especially benefiting low-ability firms

Conclusion

A model of optimal relational contracts in a competitive environment

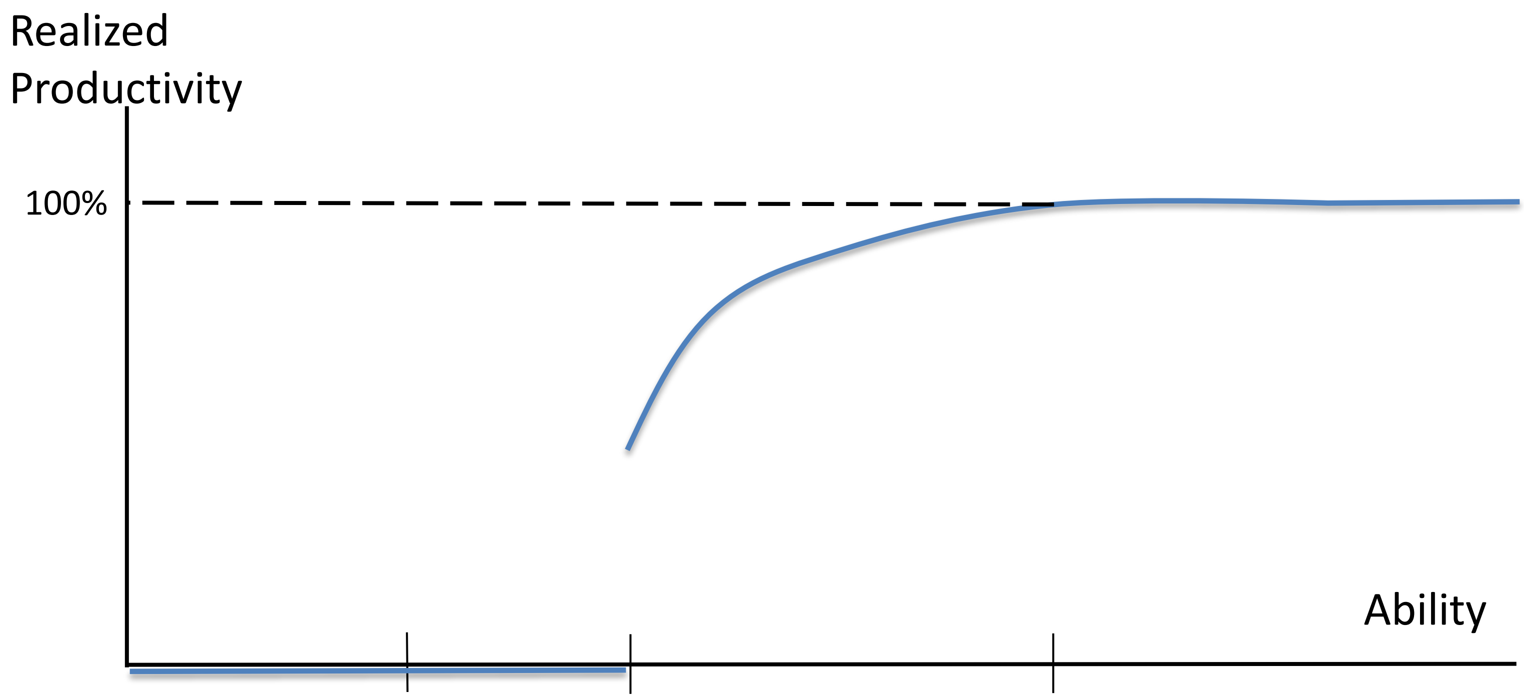
- Firm income effects with efficiency consequences

Inefficient competitive equilibrium

- Profits are inefficiently concentrated at the top
- Distortionary tax can improve welfare

Low-ability firms more constrained and thus sensitive to changes in future competitive rents

Stronger Firms Realize their Potential



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Future Profits are Today's Inputs

1. **Normative**: are profits allocated efficiently?

- Profits inefficiently concentrated at the top: pecuniary externality that is not internalized

- Firm income effects with efficiency consequences

Productivity is Endogenous

2. **Positive**: how do firms of different profitability respond to environment?

A. Changes in aggregate demand?

- Lower-ability firms' productivity more sensitive to demand-driven business cycles

B. Differences in institutional environments?

- Improved formal contracts reduce importance of credibility, primarily benefiting low-ability firms

THE MODEL

The Model

- Continuum of firms of mass 1, indexed by $i \in [0,1]$, each consisting of risk-neutral owner
  - Heterogeneous ability φ ~ Φ (φ)
  - Common discount factor $\frac{1}{1+r}$
- Large mass of risk-neutral managers with outside opportunity $W > 0$
  - Competition among managers ensures they receive W
  - Common discount factor $\frac{1}{1+r}$
- Owner-manager problem produces homogeneous output that is sold into perfectly competitive market at price p_t
- Stationary quasilinear preferences. Demand $D_t(\cdot) = D(\cdot)$

Timing

- Each periods t = 1,2,3,… has several stages

1. Owner *i* has can pay fixed cost F or exit
2. Owner *i* rents capital K_{it} (at rental rate R) and hires mass of managers M_{it}
3. Owner *i* offers each manager *m* a triple $(s_{itm}, b_{itm}, \delta_{itm})$
   - s_{itm} - contractible (non-contingent) payment
   - δ_{itm} - resources allocated to manager
   - b_{itm} - promised bonus iff manager *m* utilizes δ_{itm}

Timing

4. Manager *m* accepts/rejects in favor of *W*
5. If manager *m* accepted, he chooses resources $\hat{\delta}_{itm} \leq \delta_{itm}$ to utilize and keeps remainder
6. Owner *i* observes $\hat{\delta}_{itm}$ and decides whether or not to pay *m* a bonus of b_{itm}
7. Output for firm *i* is realized and sold for p_t

Production

- Production function for firm *i*:

$$y_i\left(\hat{\delta}_{it}, K_{it}, M_{it}\right) = \varphi_i K_{it}^{\alpha}\left(\int_0^{M_{it}} \left(\hat{\delta}_{itm}\right)^{\frac{\theta}{1-\alpha-\theta}} dm\right)^{1-\alpha-\theta}$$

with $\theta < 1 - \alpha - \theta$

- Profit if pay all bonuses

$$\pi_{it} = p_t y_i\left(\hat{\delta}_{it}, K_{it}, M_{it}\right) - RK_{it} - \int_0^{M_{it}} \delta_{itm} dm - \int_0^{M_{it}} (s_{itm} + b_{itm}) dm - F$$

Perfect Public Monitoring

- **Assumption 1:** Future potential managers commonly observes allocated resources, utilization choices, and bonus payments
  - Future competitive rents can be used as collateral
- **Assumption 2:** Managers outside options independent of employment history; capital is not firm-specific
  - No quasi-rents from market frictions

Dynamic Enforcement

- When can firm ensure that $\{\delta_{itm}\}$ will be utilized in equilibrium?
  - Dynamic Enforcement (DE) constraint
- Trigger strategy equilibrium:
  - "Cooperate": δ_{itm} resources transferred, full utilization, promised bonus paid
  - "Punish": owner doesn't pay F, all managers choose $\hat{\delta}_{itm} = 0$, bonuses never paid

Dynamic Enforcement

- If manager m believes owner will pay b_{itm} if $\hat{\delta}_{itm} = \delta_{itm}$, then m will choose δ_{itm} iff

$$b_{itm} + \frac{1}{1+r}\left(U_{i,t+1,m} - \widetilde{U}_{i,t+1,m}\right) \geq \delta_{itm}$$

  - $U_{i,t+1,m}$ = *m*'s continuation value if not renege
  - $\widetilde{U}_{i,t+1,m}$ = *m*'s continuation value if renege

Dynamic Enforcement

- Manager m's constraint:

$$b_{itm} + \frac{1}{1+r}\left(U_{i,t+1,m} - \widetilde{U}_{i,t+1,m}\right) \geq \delta_{itm}$$

Dynamic Enforcement

- Manager m's constraint:

$$b_{itm} + \frac{1}{1+r}\left(U_{i,t+1,m} - \widetilde{U}_{i,t+1,m}\right) \geq \delta_{itm}$$

- After δ_{itm} has been chosen, *i* pays b_{itm} iff

$$\frac{1}{1+r}\left(\Pi_{i,t+1,m} - \tilde{\Pi}_{i,t+1,m}\right) \geq b_{itm}$$

  - $\Pi_{i,t+1,m}$= *i*'s cont. value if not renege on *m*
  - $\tilde{\Pi}_{i,t+1,m}$= *i*'s cont. value if renege on *m*

Dynamic Enforcement

- Manager m's constraint:

$$b_{itm} + \frac{1}{1+r}\left(U_{i,t+1,m} - \widetilde{U}_{i,t+1,m}\right) \geq \delta_{itm}$$

- Owner's constraint:

$$\frac{1}{1+r}\left(\Pi_{i,t+1,m} - \tilde{\Pi}_{i,t+1,m}\right) \geq b_{itm}$$

Can Pool within Dyad

- Manager m's constraint:

$$b_{itm} + \frac{1}{1+r}\left(U_{i,t+1,m} - \widetilde{U}_{i,t+1,m}\right) \geq \delta_{itm}$$

- Owner's constraint:

$$\frac{1}{1+r}\left(\Pi_{i,t+1,m} - \tilde{\Pi}_{i,t+1,m}\right) \geq b_{itm}$$

- Pool (DE) across *m* and *i* ($S = U + \Pi$)

$$\frac{1}{1+r}\left(S_{i,t+1,m} - \tilde{S}_{i,t+1,m}\right) \geq \delta_{itm}$$

Can Pool Across Dyads

$$\frac{1}{1+r}\left(S_{i,t+1} - \tilde{S}_{i,t+1}\right) \geq \int_0^{M_{it}} \delta_{itm} dm$$

Future Surplus Depends on Future Prices

$$\sum_{\tau=t+1}^{\infty}\left(\frac{1}{1+r}\right)^{\tau-t-1}\left[\begin{array}{c} p_{\tau}\varphi_{i}K_{i\tau}\left(\int_{0}^{M_{i\tau}}(\delta_{i\tau m})^{\frac{\theta}{1-\alpha-\theta}}dm\right)^{1-\alpha-\theta} \\ -RK_{i\tau}-WM_{i\tau}-\int_{0}^{M_{i\tau}}\delta_{i\tau m}dm-F \end{array}\right]$$

Rational Expectations Equilibrium

Definition: An **REE** is a sequence of prices $\{p_t\}_t$, capital and management $\{K_{it}, M_{it}\}_{it}$, offers $\{s_{itm}, b_{itm}, \delta_{itm}\}_{itm}$, and utilization choices $\{\hat{\delta}_{itm}\}_{itm}$ such that at each time *t*

1. Given promised bonus b_{itm}, manager *m* for firm *i* optimally chooses utilization level $\hat{\delta}_{itm} = \delta_{itm}$
2. Given price sequence $\{p_t\}_t$, owner *i* optimally makes offers $\{s_{itm}, b_{itm}, \delta_{itm}\}_{tm}$ and chooses capital and management levels $\{K_{it}, M_{it}\}_t$
3. Output, capital, and labor markets for all *t*

Stationary REE; Existence and Uniqueness

Definition: A **stationary REE** is a REE with constant prices, stationary relational contracts, and constant capital, labor, and utilization

Theorem: Suppose D is smooth, decreasing, and satisfies $\lim_{p \to 0} D(p) = \infty$ and $\lim_{p \to \infty} D(p) = 0$, and suppose Φ is absolutely continuous. There exists a unique stationary REE

Existence and Uniqueness

Sketch of Proof:

- Spse within each firm, there is a common conjecture $p_t = p$ for all t
- Fix an owner *i* and assume all other use a stationary relational contract $\left(s_{jtm}, b_{jtm}, \delta_{jtm}\right) = \left(s_{jm}, b_{jm}, \delta_{jm}\right)$ and choose constant capital and management levels $\left(K_{jt}, M_{jt}\right) = \left(K_j, M_j\right)$
- Suppose *i* chooses $(K_{it}, M_{it}) = (K_i, M_i)$ for all t
- Stationary environment ⇒ *i* can replicate any optimal relational contract with a stationary relational contract
- For all *i* $(s_{itm}, b_{itm}, \delta_{itm}) = (s_{im}, b_{im}, \delta_{im})and(K_{it}, M_{it}) = (K_i, M_i)$
- Hence constant aggregate supply $S(p)$
- $S(p)$ is increasing in p and smooth, since Φ is absolutely continuous
- Since aggregate demand has infinite choke price, is decreasing and smooth, there exists a unique price p

Non-Stationary Equilibria?

- Multiplicity? (i.e., is this unique stationary REE the unique REE?)
  - Within firms, could potentially have suboptimal relational contracts (folk theorem)
  - Even conditional on optimal relational contracts, could have non-stationary REE
- Alternating two-price equilibrium

Optimal Relational Contracts

- Suppose constant prices p
- Manager symmetry and diminishing returns implies $\delta_{im} = \delta_i$ for all m
- At steady state, per-period profits are $\pi_i = p\varphi_i \delta_i^{\theta} K_i^{\alpha} M_i^{1-\alpha-\theta} - RK_i - (W + \delta_i)M_i - F$
- Optimal relational contract chooses δ_i, K_i, and M_i to maximize π_i subject to (DE) constraint

$$\frac{\pi_i}{r} \geq M_i \delta_i$$

Unconstrained Problem

$$\max_{\delta_i, M_i, K_i} p\varphi_i \delta_i^{\theta} K_i^{\alpha} M_i^{1-\alpha-\theta} - RK_i - (W + \delta_i)M_i - F$$

Unconstrained Solution

Proposition: If $\varphi > \varphi_S$, optimal solution satisfies

$$\delta^{FB} = \frac{W}{1 - \alpha - 2\theta}\theta$$

$$M^{FB}(\varphi_i, p),\ K^{FB}(\varphi_i, p) \propto H(\varphi_i, p)$$

TFP is $A_i^{FB}(\varphi_i, p) = \frac{y}{K^{\alpha} M^{1-\alpha-\theta}} = \varphi_i (\delta^{FB})^{\theta}$

Constrained Problem

$$\max_{\delta_i, M_i, K_i} p\varphi_i \delta_i^{\theta} K_i^{\alpha} M_i^{1-\alpha-\theta} - RK_i - (W + \delta_i)M_i - F$$

subject to

$$p\varphi_i \delta_i^{\theta} K_i^{\alpha} M_i^{1-\alpha-\theta} - RK_i - (W + \delta_i)M_i - F \geq rM_i\delta_i$$

Solution is Proportional to Unconstrained

Proposition: The optimal solution satisfies

$$\frac{\delta^*(\varphi_i, p)}{\delta^{FB}} = \frac{K^*(\varphi_i, p)}{K^{FB}(\varphi_i, p)} = \frac{M^*(\varphi_i, p)}{M^{FB}(\varphi_i, p)} = \mu^*(\varphi_i, p)$$

TFP is $A_i^*(\varphi_i, p) = \mu^*(\varphi_i, p)^\theta A_i^{FB}(\varphi_i, p)$

Solution is Proportional to Unconstrained

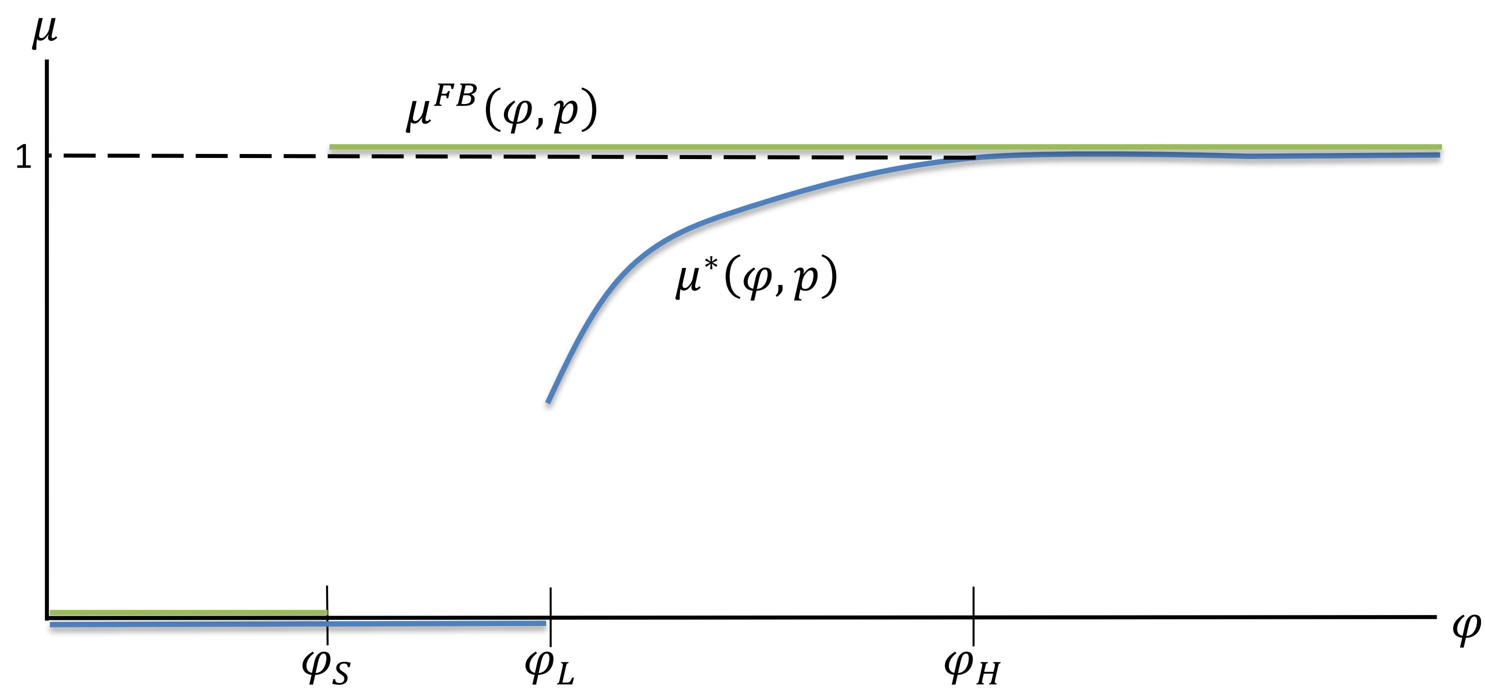
Proposition: The optimal solution satisfies

$$\frac{\delta^*(\varphi_i, p)}{\delta^{FB}} = \frac{K^*(\varphi_i, p)}{K^{FB}(\varphi_i, p)} = \frac{M^*(\varphi_i, p)}{M^{FB}(\varphi_i, p)} = \mu^*(\varphi_i, p)$$

TFP is $A_i^*(\varphi_i, p) = \mu^*(\varphi_i, p)^\theta A_i^{FB}(\varphi_i, p)$

Management as technology

Higher Ability -> Less Constrained



Prices Clear Output Markets

- For given p, firm of ability φ produces $y^*(\varphi, p)$
- Aggregate supply at price p

$$S(p) = \int_{\varphi_L(p)}^{\infty} y^*(\varphi, p) d\Phi(\varphi)$$

- $y^*(\varphi, p)$ is increasing and $\varphi_L(p)$ (the cutoff level) is decreasing, so $S(p)$ is increasing
- Equilibrium prices p^* solve

$$D(p^*) = S(p^*)$$

NORMATIVE IMPLICATIONS

Profits Inefficiently Concentrated at Top

$$L = \pi(\varphi) + \lambda(\varphi)(\pi(\varphi) - rM\delta)$$

- Are competitive rents allocated efficiently? Competitive rents serve two roles:

$$\frac{d\pi^*(\varphi)}{d(-F)} = \underset{Consumption}{1} + \underset{Collateral}{\lambda(\varphi)}$$

  - Goal of production – reallocation is a transfer
  - Collateral for promises – reallocation could improve firms' productivity
- Shadow cost of (DE) constraint is decreasing in φ $\Rightarrow$ profits are inefficiently concentrated at the top

Welfare-Improving Tax Scheme

- Suppose Φ is unbounded from above
- Impose a proportional output tax τ on $\varphi_i \geq \varphi_H(p) + \zeta$ firms, $\zeta > 0$
- Total welfare:

$$W(\tau) = CS + PS(Untaxed)$$
$$+PS(Taxed) + Taxes$$

Theorem: W'(0) > 0

Proof: Step 1 – Price effect

- At $\tau = 0$ and p^0, $\tau \uparrow$ implies $S \downarrow$, so prices must increase
- Therefore

$$\frac{dp^\tau}{d\tau}|_{\tau=0} > 0$$

Theorem: W'(0) > 0

Proof: Step 2 – Simplify

$$W(\tau) = CS + PS(Untaxed)$$
$$+PS(Taxed) + Taxes$$

Theorem: W'(0) > 0

Proof: Step 2 – Simplify

$$W(\tau) = \int_{p^\tau}^{\infty} D(p)dp + \int_{\varphi_L(p^\tau)}^{\varphi_H(p^\tau)+\zeta} \pi^*(p^\tau, \varphi; 0) d\Phi(\varphi)$$

$$+ \int_{\varphi_H(p^\tau)+\zeta}^{\infty} \pi^*(p^\tau, \varphi; \tau)\, d\Phi(\varphi) + T(\tau)$$

Theorem: W'(0) > 0

Proof: Step 2 – Simplify

$$W(\tau) = \int_{p^\tau}^{\infty} D(p)dp + \int_{\varphi_L(p^\tau)}^{\varphi_H(p^\tau)+\zeta} \pi^*(p^\tau, \varphi; 0)d\Phi(\varphi)$$
$$+ \int_{\varphi_H(p^\tau)+\zeta}^{\infty} \pi^*(p^\tau, \varphi; \tau)\, d\Phi(\varphi) + T(\tau)$$

- Let $T(\varphi;\tau) = \pi^*(p^\tau, \varphi; 0) - \pi^*(p^\tau, \varphi; \tau) - O(\tau^2)$
- Then, $T(\tau) = \int_{\varphi_H(p^\tau)+\zeta}^{\infty} T(\varphi;\tau)d\Phi(\tau)$

Theorem: W'(0) > 0

Proof: Step 2 – Simplify

$$W(\tau) = \int_{p^\tau}^{\infty} D(p)dp + \int_{\varphi_L(p^\tau)}^{\varphi_H(p^\tau)+\zeta} \pi^*(p^\tau, \varphi; 0) d\Phi(\varphi)$$
$$+ \int_{\varphi_H(p^\tau)+\zeta}^{\infty} \pi^*(p^\tau, \varphi; 0)\, d\Phi(\varphi) - O\left(\tau^2\right)$$

- Marginal tax + lump-sum subsidy makes unconstrained firms as well off to first-order

Theorem: W'(0) > 0

Proof: Step 2 – Simplify

$$W(\tau) = \int_{p^\tau}^{\infty} D(p)dp + \int_{\varphi_L(p^\tau)}^{\infty} \pi^*(p^\tau, \varphi; 0)d\Phi(\varphi) - O\left(\tau^2\right)$$

Theorem: W'(0) > 0

Proof: Step 3 – Differentiate

$$W'(0) = \frac{d}{d\tau}\int_{p^\tau}^{\infty} D(p)dp \,|_{\tau=0} + \frac{d}{d\tau}\int_{\varphi_L(p^\tau)}^{\infty} \pi^*(p^\tau, \varphi; 0)d\Phi(\varphi) \,|_{\tau=0}$$

Theorem: W'(0) > 0

Proof: Step 3 – Consumers

$$W'(0) = \frac{d}{d\tau}\int_{p^\tau}^{\infty} D(p)dp \,|_{\tau=0} + \frac{d}{d\tau}\int_{\varphi_L(p^\tau)}^{\infty} \pi^*(p^\tau, \varphi; 0)d\Phi(\varphi) \,|_{\tau=0}$$

- Quasi-linear preferences:

$$\frac{d}{d\tau}\int_{p^\tau}^{\infty} D(p)dp \,|_{\tau=0} = -D(p^0)\frac{dp^\tau}{d\tau}\,|_{\tau=0}$$

Theorem: W'(0) > 0

Proof: Step 4 – Producers

$$W'(0) = -D(p^0)\frac{dp^\tau}{d\tau}|_{\tau=0} + \frac{d}{d\tau}\int_{\varphi_L(p^\tau)}^{\infty} \pi^*(p^\tau, \varphi; 0)d\Phi(\varphi)\,|_{\tau=0}$$

- Only a price effect:

$$\frac{d}{d\tau}\int_{\varphi_L(p^\tau)}^{\infty} \pi^*(p^\tau, \varphi; 0)\,|_{\tau=0} = (S(p^0) + \Delta + E[\chi|\varphi \geq \varphi_L])\frac{dp^\tau}{d\tau}|_{\tau=0}$$

- Δ **–** extensive-margin improvement
- $E[\chi|\varphi \geq \varphi_L]$ - intensive-margin improvement

Theorem: W’(0) > 0

Proof: Step 5 – Result

$$W'(0) = -D(p^0)\frac{dp^\tau}{d\tau}|_{\tau=0} + (S(p^0) + \Delta + E[\chi|\varphi \geq \varphi_L])\frac{dp^\tau}{d\tau}|_{\tau=0}$$

- Equilibrium: $D(p^0) = S(p^0)$. Therefore

$$W'(0) = (\Delta + E[\chi|\varphi \geq \varphi_L])\frac{dp^\tau}{d\tau}|_{\tau=0} > 0$$

Summary of Proof

- Small marginal tax on high-ability firms, returned lump-sum $\Rightarrow$ these firms indifferent
- Reduced production, so increase in prices
  - Transfer from consumers to constrained producers
  - Improves efficiency of constrained producers
- Increase in total welfare

What About Subsidizing Small Firms?

- Taxing big firms ≠ subsidizing small firms
- Subsidizing small firms (via tax credit funded by nondistortionary head tax) improves their profits by more than cost of tax
- Such firms expand, driving down prices, reducing profits of all other firms, some of which are constrained

EMPIRICAL IMPLICATIONS

Productivity is Endogenous

Key: low-ability firms' TFP is more sensitive

Two applications:

1. Within-country, over time: aggregate demand shifts
2. Across countries: institutional environment

Productivity Dynamics Facts

1. Pro-cyclical aggregate productivity

   Hultgren (1960)

2. Pro-cyclical within-firm productivity

   Bartelsman and Doms (2060)

3. Counter-cyclical dispersion

   Baily, Bartelsman, and Haltiwanger (2001), Kehrig (2015)

Many stories for [1] and [2], but [3] is puzzling. All three are consistent with "credibility."

Cross-Country Facts

1. Lots of productivity dispersion within country

   Syverson (2011) for a survey

2. More productivity dispersion in developing countries

   Hsieh and Klenow (2009), Bartelsman, Haltiwanger, and Scarpetta (2013)

3. Distribution has thick left tail in developing countries

   Hsieh and Klenow (2009)

Better formal contracts reduce importance of credibility, especially benefiting low-ability firms

Conclusion

A model of optimal relational contracts in a competitive environment

- Firm income effects with efficiency consequences

Inefficient competitive equilibrium

- Profits are inefficiently concentrated at the top
- Distortionary tax can improve welfare

Low-ability firms more constrained and thus sensitive to changes in future competitive rents

Agenda

Competition and Managerial Incentives

Productivity and Credibility in Industry Equilibrium

Conclusion