Efficient Bubbles?

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Introduction

Optimal Firm Creation with Speculation

Is equilibrium firm creation efficient ...

in presence of speculation on financial markets?

- Innovations and bubbles often coincide
- Example: Silicon Valley now

What We Do

- **Speculation**: model capturing the salient features of bubbles
  - heterogenous beliefs about which firms will succeed + short-sale constraints
- **Efficiency**: non-paternalistic planner
  - Pareto order respecting beliefs
- Embed into **models of heterogenous firms** capturing classic externalities of growth theory

$\rightarrow$ Obtain entry wedge formulas

What We Find

Mechanism: different response of business-stealing to speculation

- *Business-stealing* : displacement ignored when sure to pick winners
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General Results: extension to all classic externalities of growth models

- *Appropriability* : surplus to other agents small relative to perceived trading profits
- *General equilibrium effects* : unaffected
- prices in other markets, aggregate demand, aggregate knowledge

Implications: reversal of many results without speculation

- Low labor share typically associated with high entry wedge without speculation, low entry wedge with speculation
  - Similar reversals for other industry characteristics
- Macro characteristics not sufficient to know entry wedge with speculation, micro structure of competition matters

Outline

Basic Model: Business-Stealing Only

General Equilibrium

Other Remarks

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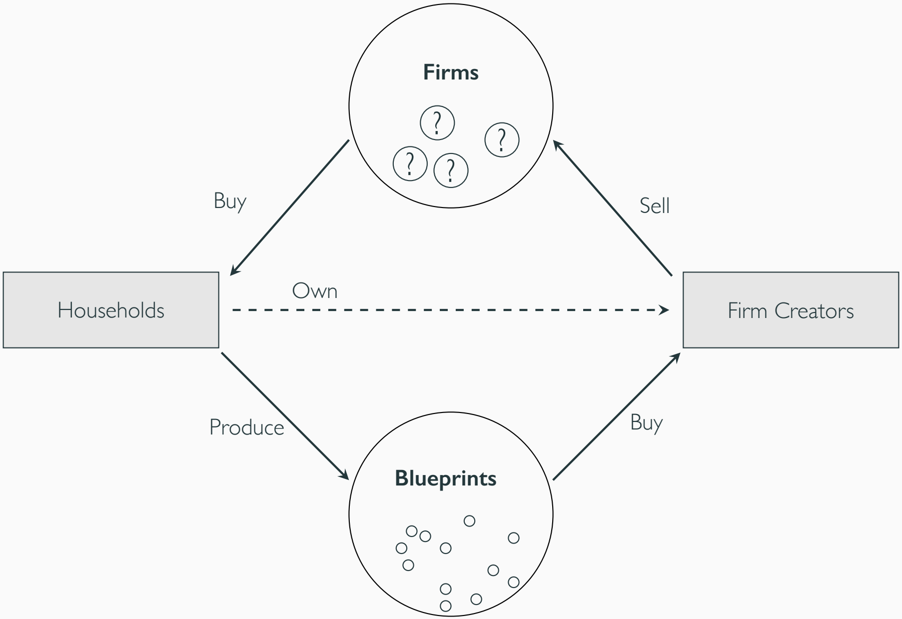
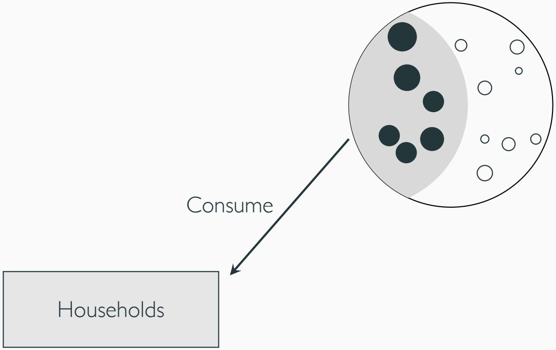
Firm Creation, date 0



Production, date T



Setup

Firm creators

- Can buy one blueprint to create one firm

$$\max_{c \in \{0,1\}} c \cdot (p_{i,0} - p_b)$$

Firms $(i,$ mass $M_e)$

- Productivity a revealed at date T, only top M firms get to produce

$$\pi(a_{i,T}) = a_{i,T}^{\eta} \mathbf{1}\{a_{i,T} \geq \underline{a}\}, \qquad \text{where } \underline{a} = F^{-1}\left(1 - \frac{M}{M_e}\right)$$

Households $(j \in [0,1])$

- Produce blueprints, trade long positions in firms, consume

$$\max_{c_0, s_{i,t}^j \geq 0, b_j} c_0 + \mathbf{E}^j \left\{ \int s_{i,T-1}^j \pi_i di \right\} - W(b_j)$$

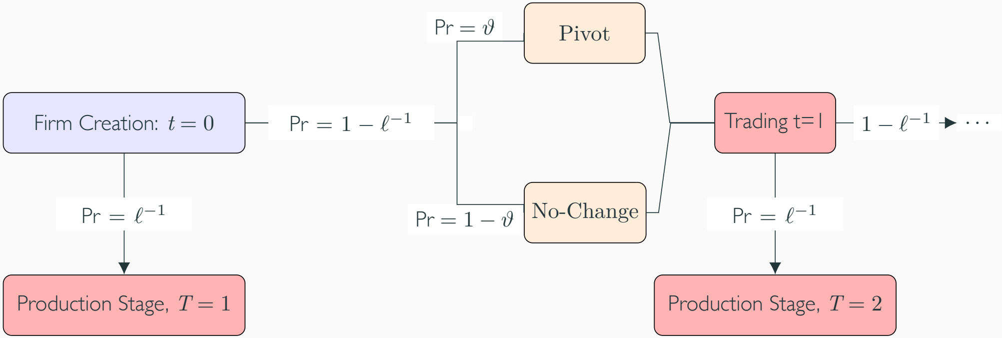
$$\text{s.t. } c_0 + \int s_{i,0}^j p_{i,0} \, di \leq 1 + p_b b_j + \Pi$$

$$\int s_{i,t}^j p_{i,t} di \leq \int s_{i,t-1}^j p_{i,t} di, \quad \forall t, 1 \leq t < T$$

Business-Stealing

- *Key assumption*: only top M firms get to produce
- *Microfoundation 1*: patents
  - M processes to produce a good
  - More productive firms are faster to find a process and patent it
- *Microfoundation 2*: treasure hunt
  - Producing needs a good that nobody owns, only M available in nature
  - More productive firms find the good faster
- *More broadly*: market incompleteness, nobody owns innovations before they are created

Trading Stages



Beliefs

- All households agree on the aggregate distribution of productivity F and transition parameters ℓ and ϑ
  - Pareto with tail parameter γ

$$F(a) = 1 - a^{-\gamma}$$

- Different views on *which* firms will be successful
  - Groups of n firms
  - Prior: think they know productivity ranking within each group
  - Ranking is i.i.d. across households and across pivot

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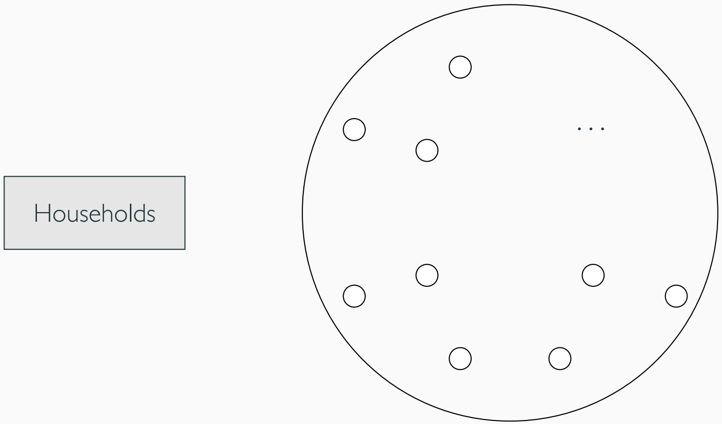
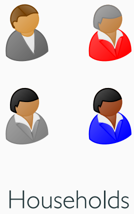
- Useful properties
  - Symmetry: each household only invests in her favorite firms, views their productivity distribution as F^n (maximum of n i.i.d. draws with F)
  - Agreement about aggregate: date-T behavior of the economy independent of date-0 beliefs


Households
. . .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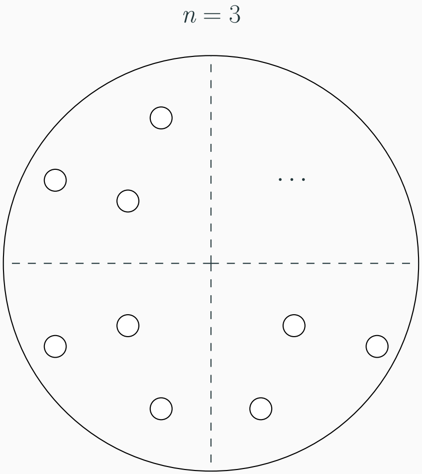
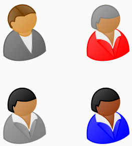

$n = 3$
...

Beliefs



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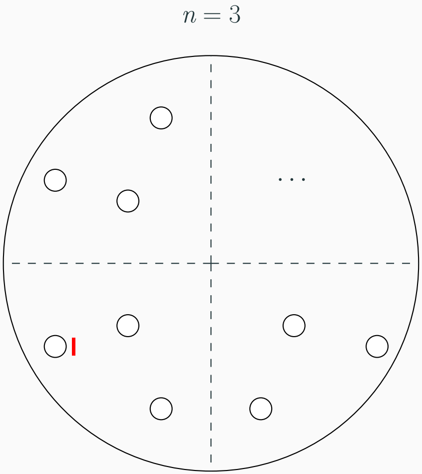

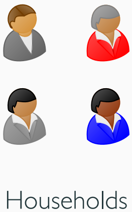
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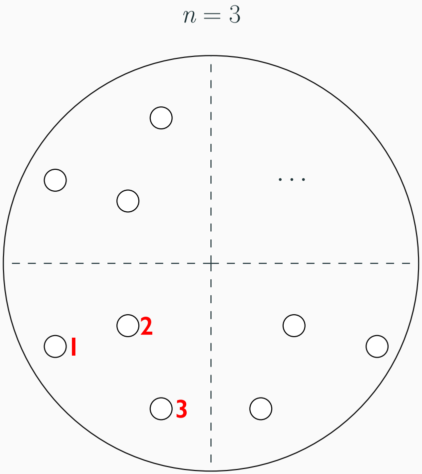
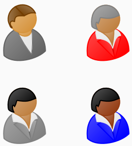
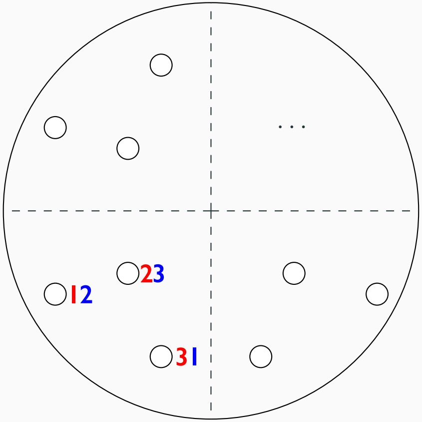
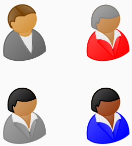

$n = 3$
$\cdots$
1
2
3

Beliefs







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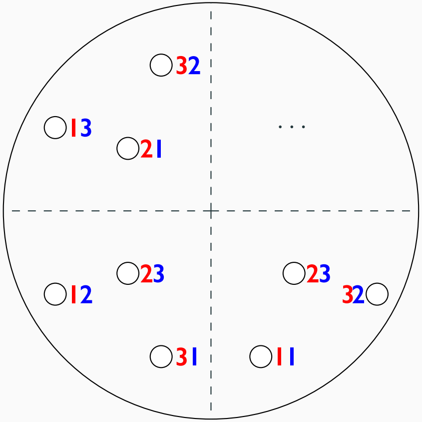

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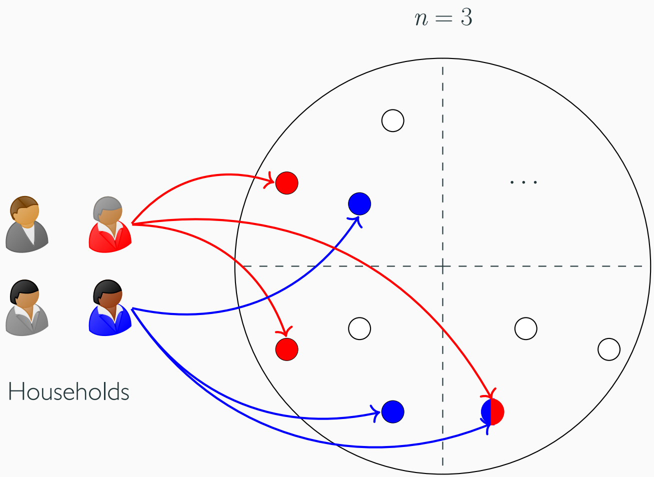

Equilibrium conditions:

- Blueprint creation: $W'(b_j) = p_b$
- Firm creation: $p_b = p_{i,0}$
- Firm investment $p_{i,t} = \ell^{-1}\mathbf{E}^j\{\pi_i\} + (1-\ell^{-1})p_{i,t+1}$, if j buys i at date t

Equilibrium entry:

$$\underbrace{W'(M_e)}_{\propto\, M_e^{\theta}} = \int_{F^{-1}(1-M/M_e)}^{\infty} a^{\eta}\, dF^{n}(a) = \mathcal{I}_n(\eta, M_e)$$

Speculative Bubble

$$p_{i,0} = W'(M_e) = \int_{F^{-1}(1-M/M_e)}^{\infty} a^{\eta}\, dF^{n}(a) = \mathcal{I}_n(\eta, M_e)$$

- **Innovation and bubble**: new ideas $\rightarrow$ reliance of priors $\rightarrow$ differences of opinion
  - Entry M_e and stock price $p_{i,t}$ increasing in disagreement n
  - Price crashes at date T
  - Railroads, electricity, automobiles, radio, micro-electronics, personal computers, bio-technology, the Internet, ...
  - Greenwood Shleifer You (2018): age tilt matters in predicting crash

- **Static overvaluation**: *everybody* agrees the index is overpriced
  - Each household values the index at $\mathcal{I}_1$
  - Result of choice + short-sale constraint, Van den Steen (2004), Miller (1977)
  - Dispersion in ownership (Chen Hong Stein 2002), analyst forecasts (Diether Malloy Scherbina 2002): predict low future returns

- **Dynamic overvaluation**: even most positive investor thinks firm is overpriced
  - Highest valuation is

$$\mathcal{I}_n - (\mathcal{I}_n - \mathcal{I}_1)\, \ell \frac{\vartheta(\ell - 1)}{1 + \vartheta(\ell - 1)},$$

  - Overvaluation increasing in bubble length ℓ and volume per period ϑ, Harrison Kreps (1978) Scheinkman Xiong (2003)
  - Hong and Stein (2007), Greenwood Shleifer You (2018)

Efficiency?

Ample evidence of real effects of market overvaluation, but is it useful?

> *This evidence suggests that market overvaluation may have social value by increasing innovative output and by encouraging firm to engage in ambitious 'moon shots.' (Dong, Hirshleifer, Teoh 2017)*

Measuring Efficiency

- **Welfare criterion 1**: Pareto ranking respecting households' beliefs
  - New firms: low information environment where people must rely on priors
  - Positive interpretation: allocations supported by market participants, "consenting adults"

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- **Welfare criterion 1**: Pareto ranking respecting households' beliefs
  - New firms: low information environment where people must rely on priors
  - Positive interpretation: allocations supported by market participants, "consenting adults"
- **Welfare criterion 2**: All welfare weight on workers subject to participation of investors
  - No need to take a stand on beliefs
  - E.g. taxation of national lottery
  - Equivalent to 1 because perceived utility is transferable in our setup
- **Efficiency measure**: optimal entry tax
  - Proportional tax τ on firm creation, rebated lump-sum to households
  - Equivalent to choosing entry level
  - Equivalent to constrained efficient policies *in this simple model*

Entry Wedge

$$\max_{M_e} \mathcal{U}_j = 1 + M_e \mathbf{E}^j \{\pi_i\} - W(M_e)$$

Optimal entry: $W'(M_e) = \underbrace{\mathcal{I}_n}_{\text{value of extra firm}} + \underbrace{M_e \mathcal{I}_n'}_{\text{displaced value of all other firms}}$

Equilibrium entry: $W'(M_e) = \mathcal{I}_n$

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- Measure of efficiency: entry wedge

$$\tau_n = -\frac{M_e}{\mathcal{I}_n}\frac{d\mathcal{I}_n}{dM_e} = -\mathcal{E}_{\mathcal{I}_n}$$

Entry Wedge

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- Measure of efficiency: entry wedge

$$\tau_n = -\frac{M_e}{\mathcal{I}_n} \frac{d\mathcal{I}_n}{dM_e} = -\mathcal{E}_{\mathcal{I}_n} > 0$$

  - Negative externality: business-stealing

Entry Wedge with Agreement

$$\tau_1(M_e) = \frac{\int_{\underline{a}}^{+\infty} \pi(\underline{a}) \qquad dF(a)}{\int_{\underline{a}}^{+\infty} \pi(a) \qquad dF(a)}$$

- Agreement, $n = 1$

$$\tau_1 = \frac{\gamma - \eta}{\gamma}$$

  - Distance between marginal and average active firm is increasing in profit sensitivity η, decreasing in Pareto tail index γ

Speculation Weakens Displacement

$$\tau_n(M_e) = \frac{\int_{\underline{a}}^{+\infty} \pi(\underline{a}) \frac{F'_n}{F'}(\underline{a})\, dF(a)}{\int_{\underline{a}}^{+\infty} \pi(a) \frac{F'_n}{F'}(a)\, dF(a)}$$

Entry is more efficient with speculation

$$\tau_n < \tau_1$$

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Entry is more efficient with speculation

$$\tau_n < \tau_1$$

- Disagreement increases the distance between the marginal and average producing firm
  - Shift probabilities to the right, monotone likelihood ratio F'_n/F'

High Speculation Limit

In the high speculation limit, $n \to \infty$

- Either entry becomes efficient

$$\tau_n \to 0 \quad \text{if } \theta > \frac{\eta}{\gamma}$$

- Or the wedge converges to the agreement case

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Two forces:

- High n given M_e: sure to be better than marginal firm
- High M_e given n: no relative probability distortions in the tail, $F'_n/F' \to n$
- First one dominates with inelastic entry

Robustness: Competing to Participate

- In baseline marginal firm makes profit.
- Introduce competition for production slots by using goods to advertise (deadweight loss)
  - Advertisement spending threshold $\underline{h}$ to produce
  - Firms solve: $\max_{h \leq \pi(a)} \pi(a)\mathbf{1}\{h \geq \underline{h}\} - h$
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$$W'(M_e) = \int_{\underline{a}}^{+\infty} (\pi(a) - \pi(\underline{a}))\, dF^n(a) = \tilde{\mathcal{I}}_n$$

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- Similar results:
  - Displacement on intensive rather than extensive margin
  - Optimal tax $\tau_n = -\mathcal{E}_{\tilde{\mathcal{I}}_n}$
  - Exact same tax for limit cases τ_1 and τ_∞

Outline

Basic Model: Business-Stealing Only

General Equilibrium

Other Remarks

Model with Input in Fixed Supply

Add a competitive labor market at date T, with wage w

- Households endowed with L units of labor
- Firm production function:

$$y(a) = a\,\frac{\sigma}{\sigma-1}\ell^{\frac{\sigma-1}{\sigma}}$$

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Date-T equilibrium properties:

- Elasticity of aggregate consumption to entry: $\mathcal{E}_{\mathcal{C}} = 1/\gamma$
  - Production function linear in distribution of productivity, elasticity $1/\gamma$ with respect to M_e
- Constant labor share $(\sigma - 1)/\sigma$
- Elasticity of wage to entry: $(\sigma - 1)/\sigma\mathcal{C} = wL$, so $\mathcal{E}_w = 1/\gamma$

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- Elasticity of wage to entry: $(\sigma - 1)/\sigma\mathcal{C} = wL$, so $\mathcal{E}_w = 1/\gamma$
- Firm profits:

$$\pi(a) = \frac{1}{\sigma - 1}\; w^{1-\sigma}\, a^{\sigma}$$

Entry Wedge with Agreement

- Competitive entry:

$$W'(M_e) = \frac{1}{\sigma} \frac{\mathcal{C}}{M_e}$$

- Planner problem: $\max_{M_e} 1 + \mathcal{C} - W(M_e)$

$$W'(M_e) = \mathcal{C}'$$

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- Entry wedge:

$$\tau_1 = 1 - \sigma\mathcal{E}_{\mathcal{C}}$$

  - Ignore decreasing returns $\mathcal{E}_{\mathcal{C}}$
  - Ignore that profits are only $1/\sigma$ of consumption

Entry Wedge with Speculation

- Competitive entry

$$W'(M_e) = \frac{1}{\sigma} \frac{\mathcal{C}}{M_e} \cdot \frac{\mathcal{I}_n(\sigma)}{\mathcal{I}_1(\sigma)}$$

- Planner problem $\max_{M_e} \frac{1}{\sigma}\mathcal{C}\frac{\mathcal{I}_n}{\mathcal{I}_1} + \frac{\sigma-1}{\sigma}\mathcal{C}$

$$W'(M_e) = \frac{1}{\sigma} \cdot \frac{d\left(\mathcal{I}_n/\mathcal{I}_1 \cdot \mathcal{C}\right)}{dM_e} + \frac{\sigma-1}{\sigma} \cdot \frac{d\mathcal{C}}{dM_e}$$

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- **General entry wedge formula**:

$$\tau_n = \underbrace{-\mathcal{E}_{\mathcal{I}_n}}_{\text{business-stealing}} + \underbrace{1+\mathcal{E}_{\mathcal{I}_1}-\mathcal{E}_{\mathcal{C}}}_{\text{general equilibrium}} - \underbrace{(\sigma-1)\mathcal{E}_{\mathcal{C}}\cdot\frac{\mathcal{I}_1}{\mathcal{I}_n}}_{\text{appropriability}}$$

  - Business-stealing: same as before
  - General equilibrium: impact of entry on wage $1+\mathcal{E}_{\mathcal{I}_1}-\mathcal{E}_{\mathcal{C}} = -\mathcal{E}_{\pi(a)}$
  - Appropriability: surplus from labor income

High Speculation

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High Speculation

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As speculation increases, $n \to \infty$,

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- Labor surplus becomes small relative to perceived profits

High Speculation

$$\tau_\infty = \underbrace{\cancel{-\mathcal{E}_{\mathcal{I}_n}}}_{\text{business-stealing}} + \underbrace{1 + \mathcal{E}_{\mathcal{I}_1} - \mathcal{E}_\mathcal{C}}_{\text{general equilibrium}} - \underbrace{\cancel{(\sigma - 1)\mathcal{E}_\mathcal{C} \cdot \frac{\mathcal{I}_1}{\mathcal{I}_n}}}_{\text{appropriability}}$$

As speculation increases, $n \to \infty$,

- Displacement is ignored, if $\theta > 1/\gamma$
- Labor surplus becomes small relative to perceived profits
- **Only general equilibrium effects remain**

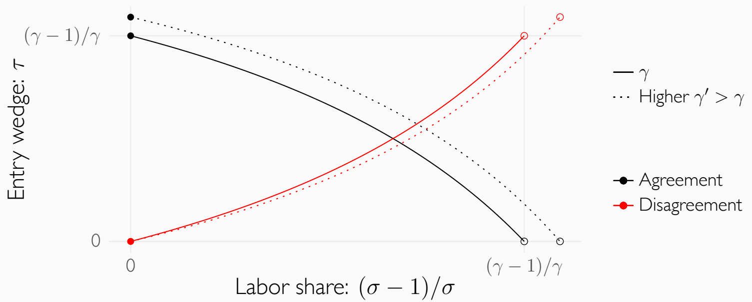
Low labor share has opposite implications for the tax

- Agreement: low labor surplus, higher τ_1

$$\tau_1 = \quad 1 - \sigma \mathcal{E}_{\mathcal{C}} \quad = \frac{\gamma - \sigma}{\gamma}$$

- Speculation: low reliance on labor, low effect on wage, low τ_∞

$$\tau_\infty = -(1-\sigma)\mathcal{E}_w \quad = \frac{\sigma - 1}{\gamma}$$



Role of General Equilibrium effects

- Three economies
  - *Baseline model*

$$\pi(a) \propto w^{1-\sigma} \; a^{\sigma}$$

  - *Dixit-Stiglitz*: monopolistic competition, CES demand with elasticity of substitution σ, linear technology $\rightarrow$ aggregate demand externality

$$\pi(a) \propto w^{1-\sigma} \; \mathcal{C} \; a^{\sigma-1}.$$

  - *Knowledge spillovers*, à la Romer 1986: $y \propto a^{1-\alpha} A^{\alpha} \ell^{\frac{\sigma-1}{\sigma}}$ with A productivity aggregator homogenous of degree 1 (mean, ...) $\rightarrow$ knowledge externality

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- **Same macro behavior** (labor share $(\sigma-1)/\sigma$, $\mathcal{E}_{\mathcal{C}} = \mathcal{E}_w = 1/\gamma$) $\Rightarrow$ **same tax with agreement**

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- **Same macro behavior** (labor share $(\sigma - 1)/\sigma$, $\mathcal{E}_{\mathcal{C}} = \mathcal{E}_w = 1/\gamma$) $\Rightarrow$ **same tax with agreement**
- **Different composition of general equilibrium effects: different taxes with speculation**

Sign Reversal of the Wedge

$$\tau_1 = \frac{\gamma - \sigma}{\gamma}$$
$$\tau_\infty^{\text{AD}} = \frac{\sigma - 2}{\gamma}$$
$$\tau_\infty^{\text{KS}} = \frac{(1-\alpha)\sigma - 1}{\gamma}$$

- Positive externalities push into under-entry
- **The taxes with and without agreement have opposite signs**
  - with low labor share: agreement over-entry, disagreement under-entry
  - with high labor share: agreement under-entry, disagreement over-entry
  - for any labor share if $\gamma = 2$ or $\alpha = 1 - 1/\gamma$

Extensions

- General tax formula applies with minor adjustments for:
  - Variable labor supply
  - Variable number of active firms
  - Advertisement
  - Participation costs
  - Melitz model

- Sign reversals are robust
  - Labor share and Pareto tail index in all specifications
  - Frisch elasticity, elasticity of participation to entry, elasticity of participation costs, ...

Outline

Basic Model: Business-Stealing Only

General Equilibrium

Other Remarks

Implications

- Technological revolutions look like our model
  - Burst of firm creation and high valuations
  - New ideas so people must rely on priors
  - Intense speculation on financial markets
- High entry could also be due to high future productivity:

$$W'(M_e) = A\,\mathcal{I}_n$$

- Important to distinguish the two: radically different tax implications
- Micro data necessary to measure "n"
  - Beliefs: e.g. analyst forecasts
  - Portfolio concentration: e.g. breadth of ownership

Role of the Welfare Criterion

- Alternative welfare criterion: paternalistic planner, evaluate utility under F

$$\max_{M_e} \mathcal{C} - W(M_e)$$

- Under this view, disagreement *is* an entry wedge

$$\tau_n^{\text{pater}} = 1 - \sigma \mathcal{E}_{\mathcal{C}} \frac{\mathcal{I}_1}{\mathcal{I}_n}$$

  - In the limit $\tau_\infty^{\text{pater}} = 1$

Conclusion

A tractable framework to address efficiency of firm creation in presence of speculation

Entry efficiency drastically different with speculation

- Even with more firms, often leads to less over-entry than agreement
- Reversal of role of industry characteristics: labor share, ...
- Competitive structure of the economy important beyond macro properties