Efficient Bubbles?

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Introduction
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

→ Obtain entry wedge formulas
What We Find

Mechanism: different response of business-stealing to speculation

• Business-stealing: displacement ignored when sure to pick winners
• Even though speculation increases entry, it mitigates over-entry or even yields under-entry
What We Find

Mechanism: different response of business-stealing to speculation

• *Business-stealing*: displacement ignored when sure to pick winners
• Even though speculation increases entry, it mitigates over-entry or even yields under-entry

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
Outline

Basic Model: Business-Stealing Only

General Equilibrium

Other Remarks
Firm Creation, date 0

Households

Buy

Firms

Buy

Sell

Own

Firm Creators

Produce

Blueprints

Buy
Production, date $T$

Households ➔ Consume

Two groups: Households and Firms

Firms produce goods and services, Households consume.
Setup

**Firm creators**

- Can buy one blueprint to create one firm

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

**Firms \((i, \text{ mass } M_e)\)**

- Productivity \(a\) revealed at date \(T\), **only top** \(M\) firms get to produce

\[
\pi(a_{i,T}) = a_{i,T}^n \cdot 1 \{a_{i,T} \geq a\}, \quad \text{where } a = F^{-1} \left(1 - \frac{M}{M_e}\right)
\]

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

- Produce blueprints, trade long positions in firms, consume

\[
\max_{c_0, s_{i,t}^j \geq 0, b_j} \quad c_0 + E^j \left\{ \int s_{i,T-1}^j \pi_t \, \text{d}i \right\} - W(b_j)
\]

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

\[
\int s_{i,t}^j p_{i,t} \, \text{d}i \leq \int s_{i,t-1}^j p_{i,t} \, \text{d}i, \quad \forall t, 1 \leq t < T
\]
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

Firm Creation: $t = 0$

Production Stage, $T = 1$

$\text{Pr} = \ell^{-1}$

Production Stage, $T = 2$

Trading $t = 1$

No-Change

$\text{Pr} = 1 - \vartheta$

Pivot

$\text{Pr} = \vartheta$

$1 - \ell^{-1} \rightarrow \ldots$
Beliefs

- All households agree on the aggregate distribution of productivity $F$ and transition parameters $\ell$ and $\vartheta$
  - Pareto with tail parameter $\gamma$
    
    $$F(a) = 1 - a^{-\gamma}$$

- 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
Beliefs

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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
Beliefs

$n = 3$

Households
Beliefs

Households

$n = 3$
Beliefs

Households

\[ n = 3 \]
Beliefs

Households

\[ n = 3 \]

Diagram showing households and possible belief distributions.
Beliefs

Households

$n = 3$

13
21
23
12
31
11
32
Households

$n = 3$
Competitive Equilibrium

Equilibrium conditions:

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

Equilibrium entry:

\[
W'\left(M_e\right) = \int_{F^{-1}(1-M/M_e)}^{\infty} a^n dF^n(a) = \mathcal{I}_n(\eta, M_e)
\]
Speculative Bubble

\[ p_{i,0} = W'(M_e) = \int_{F^{-1}(1-M_e)}^{\infty} a^n dF^n(a) = I_n(\eta, M_e) \]

- **Innovation and bubble**: new ideas → reliance of priors → 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
Speculative Bubble

- **Static overvaluation**: everybody agrees the index is overpriced
  - Each household values the index at $I_1$
  - 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
    \[
    I_n - (I_n - I_1) \ell \frac{\vartheta(\ell - 1)}{1 + \vartheta(\ell - 1)},
    \]
  - Overvaluation increasing in bubble length $\ell$ and volume per period $\vartheta$, Harrison Kreps (1978) Scheinkman Xiong (2003)
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”
Measuring Efficiency

- **Welfare criterion 1**: Pareto ranking respecting households’ beliefs
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- **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 $\tau$ on firm creation, rebated lump-sum to households
  - Equivalent to choosing entry level
  - Equivalent to constrained efficient policies *in this simple model*
Entry Wedge

\[
\max_{M_e} U_j = 1 + M_e E^j \{\pi_i\} - W(M_e)
\]

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

Equilibrium entry: \( W'(M_e) = I_n \)
Entry Wedge

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Equilibrium entry: \( W'(M_e) = \underbrace{\mathcal{I}_n}_\text{} \)

• 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

\[
\tau_n = - \frac{M_e}{I_n} \frac{dI_n}{dM_e} = -E I_n > 0
\]

• Negative externality: business-stealing
Entry Wedge with Agreement

\[ \tau_1(M_e) = \frac{\int_a^{+\infty} \pi(a) \, dF(a)}{\int_a^{+\infty} \pi(a) \, dF(a)} \]

• Agreement, \( n = 1 \)

\[ \tau_1 = \frac{\gamma - \eta}{\gamma} \]

• Distance between marginal and average active firm is increasing in profit sensitivity \( \eta \), decreasing in Pareto tail index \( \gamma \)
Speculation Weakens Displacement

\[ \tau_n(M_e) = \frac{\int_a^{+\infty} \pi(a) \frac{F_n'}{F'}(a) \ dF(a)}{\int_a^{+\infty} \pi(a) \frac{F_n'}{F'}(a) \ dF(a)} \]

Entry is more efficient with speculation

\[ \tau_n < \tau_1 \]
Speculation Weakens Displacement

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

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 $F'_n/F'$
In the high speculation limit, \( n \rightarrow \infty \)

- Either entry becomes efficient

\[
\tau_n \rightarrow 0 \quad \text{if } \theta > \frac{\eta}{\gamma}
\]

- Or the wedge converges to the agreement case

\[
\tau_n \rightarrow \tau_1 \quad \text{if } \theta < \frac{\eta}{\gamma}
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In the high speculation limit, $n \to \infty$

- Either entry becomes efficient
  \[ \tau_n \to 0 \quad \text{if} \quad \theta > \frac{\eta}{\gamma} \]

- Or the wedge converges to the agreement case
  \[ \tau_n \to \tau_1 \quad \text{if} \quad \theta < \frac{\eta}{\gamma} \]

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
• In baseline marginal firm makes profit.
• Introduce competition for production slots by using goods to advertise (deadweight loss)
  • Advertisement spending threshold $h$ to produce
  • Firms solve: $\max_{h \leq \pi(a)} \pi(a) 1 \{ h \geq h \} - h$
  • Market clearing: $h$ such that only $M$ firms advertise more
Robustness: Competing to Participate

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  - Firms solve: $\max_{h \leq \pi(a)} \pi(a)\mathbf{1}\{h \geq \bar{h}\} - h$
  - Market clearing: $h$ such that only $M$ firms advertise more
  - Equilibrium: top $M$ firm spend $\pi(a)$, everybody else 0

\[
W'(M_e) = \int_a^{+\infty} (\pi(a) - \pi(a)) \, dF^m(a) = \bar{T}_n
\]
Robustness: Competing to Participate

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- Introduce competition for production slots by using goods to advertise (deadweight loss)
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  - Equilibrium: top \( M \) firm spend \( \pi(a) \), everybody else 0

\[
W'(M_e) = \int_a^{+\infty} (\pi(a) - \pi(a)) \, dF^n(a) = \tilde{\mathcal{L}_n}
\]

- Similar results:
  - Displacement on intensive rather than extensive margin
  - Optimal tax \( \tau_n = -\mathcal{E}_{\tilde{\mathcal{L}_n}} \)
  - Exact same tax for limit cases \( \tau_1 \) and \( \tau_\infty \)
Basic Model: Business-Stealing Only

General Equilibrium

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

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

$$y(a) = a \frac{\sigma}{\sigma - 1} \ell^{\frac{\sigma - 1}{\sigma}}$$
Add a competitive labor market at date $T$, with wage $w$

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

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

Date-$T$ equilibrium properties:

- Elasticity of aggregate consumption to entry: $\mathcal{E}_C = 1/\gamma$
  - 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: $(\sigma - 1)/\sigma C = wL$, so $\mathcal{E}_w = 1/\gamma$
Add a competitive labor market at date $T$, with wage $w$

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  - 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 $\mathcal{E}_w = 1/\gamma$
- Firm profits:

$$\pi(a) = \frac{1}{\sigma - 1} w^{1-\sigma} a^\sigma$$
Entry Wedge with Agreement

• Competitive entry:

\[ W'(M_e) = \frac{1}{\sigma} \frac{C}{M_e} \]

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

\[ W'(M_e) = C' \]
Entry Wedge with Agreement

• Competitive entry:

\[ W'(M_e) = \frac{1}{\sigma} \frac{C}{M_e} \]

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

\[ W'(M_e) = C' \]

• Entry wedge:

\[ \tau_1 = 1 - \sigma \mathcal{E}_C \]

• Ignore decreasing returns \( \mathcal{E}_C \)

• Ignore that profits are only \( 1/\sigma \) of consumption
Entry Wedge with Speculation

- Competitive entry

\[ W'(M_e) = \frac{1}{\sigma} \frac{C}{M_e} \cdot \frac{I_n(\sigma)}{I_1(\sigma)} \]

- Planner problem \( \max_{M_e} \frac{1}{\sigma} C \frac{I_n}{I_1} + \frac{\sigma-1}{\sigma} C \)

\[ W'(M_e) = \frac{1}{\sigma} \cdot \frac{d(I_n/I_1 \cdot C)}{dM_e} + \frac{\sigma - 1}{\sigma} \cdot \frac{dC}{dM_e} \]
Entry Wedge with Speculation

• Competitive entry

\[
W'(M_e) = \frac{1}{\sigma} \frac{C}{M_e} \cdot \frac{I_n(\sigma)}{I_1(\sigma)}
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• Planner problem \( \max_{M_e} \frac{1}{\sigma} C \frac{I_n}{I_1} + \frac{\sigma-1}{\sigma} C \)

\[
W'(M_e) = \frac{1}{\sigma} \cdot \frac{d(I_n/I_1 \cdot C)}{dM_e} + \frac{\sigma-1}{\sigma} \cdot \frac{dC}{dM_e}
\]

• General entry wedge formula:

\[
\tau_n = \text{business-stealing} \quad + \quad 1 + \varepsilon_{I_1} - \varepsilon_C \quad - \quad (\sigma - 1) \varepsilon_C \cdot \frac{I_1}{I_n}
\]

  \begin{align*}
  \text{business-stealing} \\
  \text{general equilibrium} \\
  \text{appropriability}
  \end{align*}

• Business-stealing: same as before
• General equilibrium: impact of entry on wage \( 1 + \varepsilon_{I_1} - \varepsilon_C = -\varepsilon_{\pi(a)} \)
• Appropriability: surplus from labor income
As speculation increases, \( n \to \infty \),
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- Displacement is ignored, if $\theta > 1/\gamma$
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- Labor surplus becomes small relative to perceived profits
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 $\tau_1$
  \[ \tau_1 = 1 - \sigma E_C = \frac{\gamma - \sigma}{\gamma} \]

- Speculation: low reliance on labor, low effect on wage, low $\tau_\infty$
  \[ \tau_\infty = -(1 - \sigma) E_w = \frac{\sigma - 1}{\gamma} \]
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 $\sigma$, linear technology $\rightarrow$ aggregate demand externality
    \[
    \pi(a) \propto w^{1-\sigma} C a^{\sigma-1}.
    \]
  - *Knowledge spillovers*, à la Romer 1986: $y \propto a^{1-\alpha} A^\alpha \ell^{\sigma-1}$ with $A$ productivity aggregator homogenous of degree 1 (mean, ...) $\rightarrow$ knowledge externality
    \[
    \pi(a) \propto w^{1-\sigma} A^{\alpha \sigma} a^{(1-\alpha)\sigma}
    \]
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 \( \sigma \), linear technology \( \rightarrow \) aggregate demand externality

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\[ \pi(a) \propto w^{1-\sigma} A^{\alpha\sigma} a^{(1-\alpha)\sigma} \]

• Same macro behavior \( \) (labor share \( (\sigma - 1)/\sigma, \mathcal{E}_C = \mathcal{E}_w = 1/\gamma) \) \( \Rightarrow \) same tax with agreement
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 \( \sigma \), linear technology \( \rightarrow \) aggregate demand externality
    \[ \pi(a) \propto w^{1-\sigma} C a^{\sigma-1}. \]
  - 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
    \[ \pi(a) \propto w^{1-\sigma} A^{\alpha\sigma} a^{(1-\alpha)\sigma} \]

- Same macro behavior (labor share \( (\sigma - 1)/\sigma, E_C = E_w = 1/\gamma \) \( \Rightarrow \) same tax with agreement

- Different composition of general equilibrium effects: different taxes with speculation
Sign Reversal of the Wedge

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

- 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
• 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:

\[ W'(M_e) = A I_n \]

• 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
• Alternative welfare criterion: paternalistic planner, evaluate utility under $F$

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

• Under this view, disagreement is an entry wedge

$$\tau_{\text{pater}} = 1 - \sigma \mathcal{E} \frac{\mathcal{I}_1}{\mathcal{I}_n}$$

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