Fostering Entrepreneurship: Backing Founders or Investors?

Thomas Hellmann[1] Veikko Thiele[2]

[1]Saïd Business School, University of Oxford

[2]Smith School of Business, Queen's University

Work in Progress – Comments Welcome!

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Motivation

- Rising interest in entrepreneurship globally
  - Based on key role for economic growth
- Silicon Valley envy
  - Silicon Fen, Silicon Desert
- Alternative views on reasons for success
  - Smart gutsy entrepreneurs
  - Experienced investor ecosystem
  - Many other...
- Role of government
  - Should it play an active role?
  - If so, what policies?

Research Questions

- What are the intertemporal dynamics of an entrepreneurial ecosystem?
- What is the importance of experienced investors?
- How do you foster an entrepreneurial ecosystem?
- Should government policies back founders or investors?

Intergenerational Dynamics

- Innovative start-ups need support
  - Half-baked ideas
  - Daunting entrepreneurial process
- Innovative start-ups difficult to support
  - Have domain expertise
  - Understand entrepreneurial process
- Who can help?
  - Experienced investors and advisers
  - Serial entrepreneurs

Famous First Checks

- Andy Bechtolsheim – cofounder of SUN Microsystems (1982)
  - Invested $100,000 in Google (1998), now worth over $360B
  - One of most successful angel investors, with net worth $\sim$ $1.7B
- Peter Thiel – cofounder of PayPal (1998)
  - Invested $500,000 in Facebook (2004) in exchange for 10.2% of the company
  - Initial valuation:

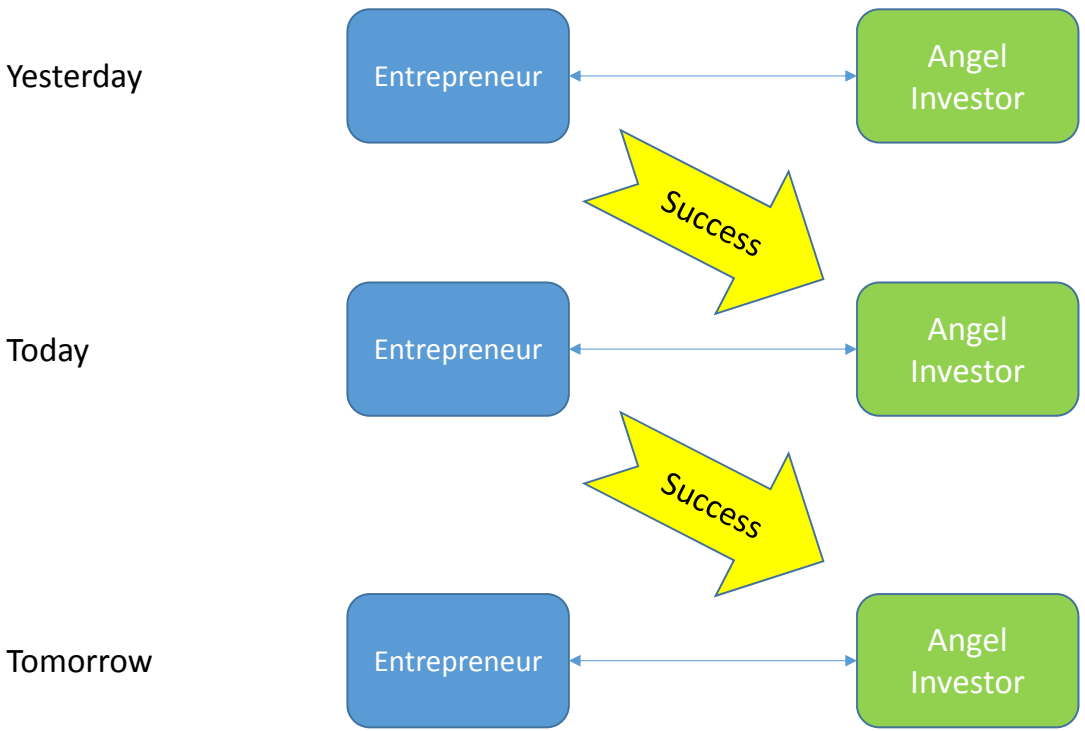
$$V = \frac{\text{investment}}{\text{equity share}} = \frac{\$500,000}{0.102} = \$4,901,960.78$$

- Max Levchin – cofounder of PayPal (1998)
  - Invested $1,000,000 in Yelp (2004), now worth over $2.5B

Famous Venture Capitalists

- Andreessen Horowitz – cofounded by Marc Andreessen and Ben Horowitz (2009)
  - Marc Andreessen founded Netscape (1994) and Opsware (1999)
  - Ben Horowitz cofounded Opsware (1999)
  - Assets under management: $4B
  - Investments include: Skype, Twitter, Facebook, Groupon, Zynga, Airbnb, Jawbone, Foursquare, Instagram
- Sequoia Capital – founded by Don Valentine (1972)
  - Don Valentine cofounded National Semiconductor (1959)
  - Assets under management: $2.7B
  - Investments include: Apple, Google, Oracle, PayPal, Stripe, YouTube, Instagram, Yahoo!, WhatsApp, Skyscanner

Intergenerational Dynamics



Evaluation of Government Policies

- Current research focus: evaluation of individual programs
- Missing: Frameworks for overall policy design
- Relative effectiveness of policies
- Main types of policies:
  - Demand-side policies: backing entrepreneurs
  - Supply-side policies: backing investors

Examples of Supply-side Policies

- Tax based policies
  - US: State-level tax credits for angel investing
  - Canada: Labor-sponsored funds, BC Angel tax credit
  - UK: EIS/SEIS tax credits
- Funding based policies
  - US: SBIC Subordinated funding of VC funds
  - Canada: VCAP funds of funds initiative
  - UK: British Business Bank programs

Examples of Demand-side Policies

- R&D subsidies
  - US: SBIR
  - Canada: SR&ED
  - UK: R&D tax relief
- Start-up help
  - Start-up grants
  - Entrepreneurship training programs
  - Accelerator support programs

Key Insights from Model (1)

- Ecosystems have intertemporal dynamics
- Importance of role switching: entrepreneurs become investors
- Experience only created over time
- No guarantee that ecosystem will emerge: multiple equilibria
- Need critical mass of successful entrepreneurs that become investors to next generation

Key Insights (2): Effect of Policies

- Demand-side policies that ‘back founders’
  - Increase the number of entrepreneurs & investors
  - Reduce valuations
- Supply-side policies that ‘back investors’
  - Increase the number of entrepreneurs & investors
  - Increase valuations
- Benchmark model without intergenerational dynamics
  - Equivalence result: both policies equally efficient
- Full model with intergenerational dynamics
  - Benefit of supply-side policies: create wealthy entrepreneurs

Key Insights (3): Multiple Equilibria

- Steady-state policies
  - To increase level of entrepreneurship in high steady-state equilibrium
- Catalyst policies
  - To reach high steady-state equilibrium
  - Temporary policies
  - Unleash dynamic market forces
- International boundary policies
  - Two-country model with one high and one low steady state equilibrium
  - Capital inflows from high to low
  - Brain drain from low to high

Prior Literatures

- Josh Lerner (2012): 'Boulevard of Broken Dreams'
- Cross-country evidence on government VC
  - Brander, Du, Egan and Hellmann (2010)
- Specific program evaluations
  - SBIR: Lerner, Gans and Stern
  - R&D: Zhao and Ziedonis
- Much broader literature on agglomeration, growth & taxation

Overview

1. Base Model
   - Benchmark: no intergenerational dynamics
   - Dynamic model with angel investors
2. Alternative Policies
   - Catalyst policies
   - International boundaries
   - Alternative steady-state policies
3. Conclusion

Economic Environment

- Overlapping generations model with risk-neutral parties
  - Discount factor δ
- Measure of entrepreneurs (E) in each period: n_E
  - Cost of starting business: $I \in [0, 1/\mu_E]$, drawn from uniform distribution $\Gamma_E(I)$
- Each entrepreneurs lives for three periods:
  - **Period 1:** active founder (start-up)
  - **Period 2:** wealthy investor if start-up was successful
  - **Period 3:** retirement: consumption of entire wealth

Period 1: Active Entrepreneur

- Start-up requires investment $\phi > 0$
  - Provided by investor(s) in exchange for equity α
- Venture succeeds with probability ρ, generating payoff $y > 0$
- Venture fails with probability $1 - \rho$, generating a zero payoff
  - Extension (TBD): ρ depends on entrepreneur's private effort

Period 2: Wealthy Investor

- Wealth comes from successful start-up (previous period):

$$w = (1 - \alpha_{-1})\, y$$

- Investment options:
  - (i) Invest $k_A \leq w$ in start-ups $\Rightarrow$ angel investor (A)
  - (ii) Invest remaining $w - k_A$ in safe asset with return $r > 0$
- Angel investment requires essential skills
  - Successful founder develops skills with probability λ_A
- Proportional cost of angel investment: θk_A
  - $\theta \in [0, 1/\mu_I]$ drawn from uniform distribution $\Gamma_I(\theta)$
  - E.g. legal costs, screening costs etc.

Capital Supply

- Perfect competition: investors take valuation $V = \phi/\alpha$ as given
- Types of investors:
  - Formerly successful entrepreneurs (angels)
    - Measure of angels: $n_A = \lambda_A \rho n_{E-1}$
    - Available wealth w for investment k_A is endogenous
  - General investors with total capital $G \equiv N\widetilde{w}$
    - N is measure of general investors, each having wealth $\widetilde{w}$

Benchmark: No Intergenerational Dynamics

- Benchmark: only general investors ($\lambda_A = 0$)
- General investor – expected utility:

$$EU_G(k_G) = \delta\rho\frac{k_G}{V}y - \theta k_G + \delta\left(1+r\right)\left(\widetilde{w} - k_G\right)$$

- Optimal investment decision:
  - $k_G^* = \widetilde{w}$ if $\theta \leq \widetilde{\theta} \Rightarrow$ invests entire wealth in start-ups
  - $k_G^* = 0$ if $\theta > \widetilde{\theta} \Rightarrow$ invests entire wealth in safe asset
- Marginal investor:

$$\widetilde{\theta} = \delta\left[\rho\frac{1}{V}y - (1+r)\right]$$

- Capital supply from general investors: $I_G = \Gamma_I(\widetilde{\theta})G$

Market Equilibrium

- Each entrepreneur retains equity stake $(1-\alpha)$, with $\alpha = \phi/V$
- Entrepreneur – expected utility:

$$EU_E = \delta^2 \rho \left(1 - \frac{\phi}{V}\right) y(1+r)$$

- Unique market equilibrium (n_E^*, V^*) defined by

  (*i*) Entry condition for entrepreneurs:

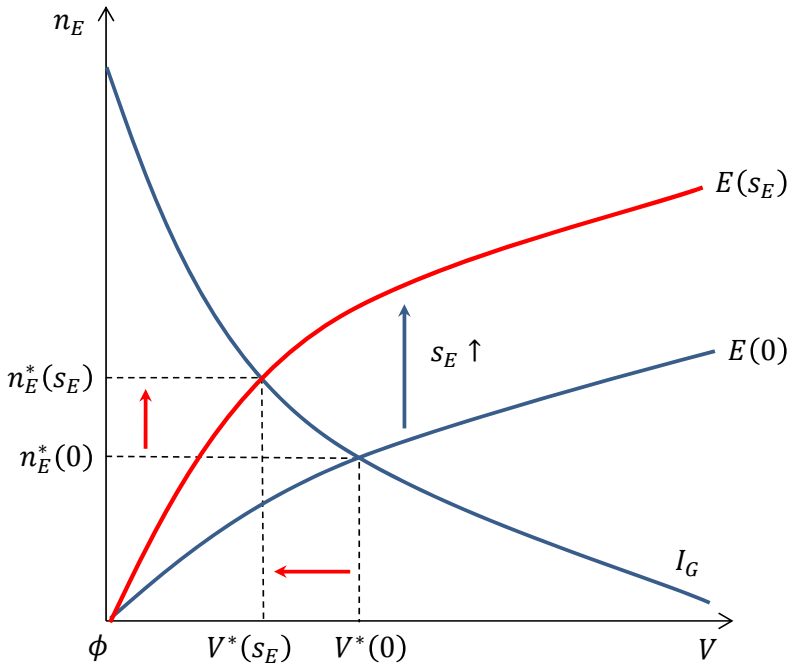
$$n_E = \Gamma_E(EU_E)$$

  (*ii*) Market clearing condition:

$$n_E \phi = \Gamma_I\left(\widetilde{\theta}\right) G$$

Demand-side Policy

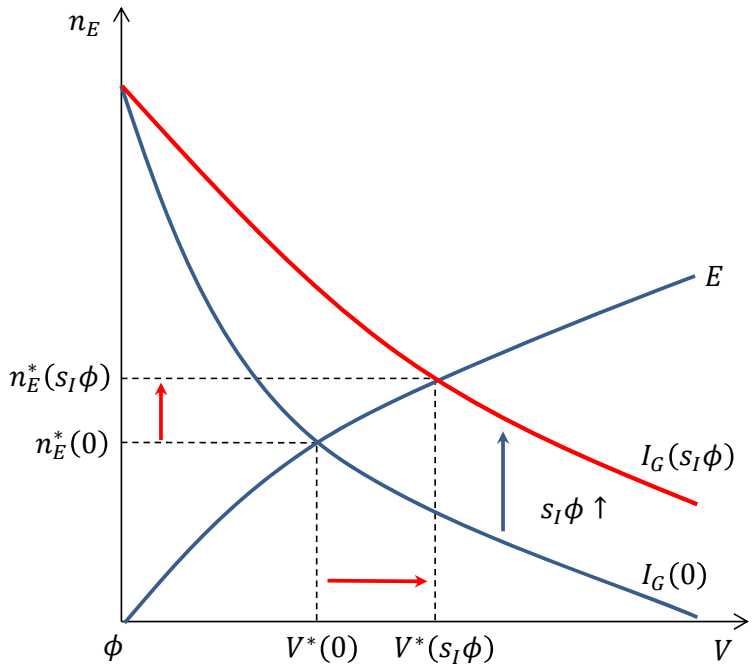
- Entry-subsidy s_E for entrepreneurs



- **Effects:**
  - Increases number of start-ups: $dn_E^*/ds_E > 0$
  - Reduces valuations: $dV^*/ds_E < 0$

Supply-side Policy

- Tax credit s_I for investors



- **Effects:**
  - Increases number of start-ups: $dn_E^*/d(s_I\phi) > 0$
  - Increases valuations: $dV^*/d(s_I\phi) > 0$

Demand-side vs. Supply-side Policies

- **Equivalence result:** both policies are equally efficient, i.e.,

$$n_E^*(s_E) = n_E^*(s_I\phi) \quad \forall \; s_E = s_I\phi$$

- **But:** supply-side policy implies 'richer' entrepreneurs, i.e.,

$$V^*(s_E) < V^*(0) < V^*(s_I\phi) \quad \forall \; s_E = s_I\phi > 0$$

Dynamic Model with Angels

- Now: successful founders can become angel investors ($\lambda_A > 0$)
- Marginal angel:

$$\widehat{\theta} = \delta \left[\rho \frac{1}{V} y - (1 + r) \right]$$

- Capital supply from angels:

$$I_A = \underbrace{\Gamma_I(\widehat{\theta}) \lambda_A \rho n_{E-1}}_{\text{\# of angels}} \underbrace{\left(1 - \frac{\phi}{V_{-1}}\right) y}_{\text{wealth } (w)}$$

- Entrepreneurs – expected utility:

$$EU_E = \underbrace{\rho \delta \left(1 - \frac{\phi}{V}\right) y}_{=w} \left[\lambda_A \left(\int_0^{\widehat{\theta}+1} \left(\delta \rho \frac{1}{V_{+1}} y - \theta \right) d\Gamma_I(\theta) + \int_{\widehat{\theta}+1}^{\overline{\theta}} \delta(1 + r) d\Gamma_I(\theta) \right) + (1 - \lambda_A) \delta (1 + r) \right]$$

Market Equilibrium

- Dynamic market equilibrium defined by

  (*i*) Entry condition for entrepreneurs:

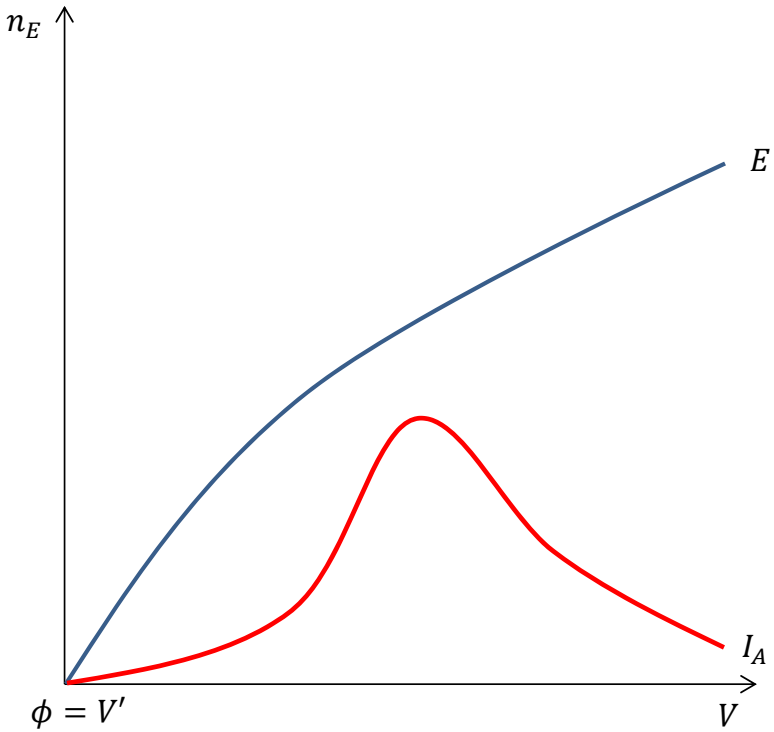
  $$n_E = \Gamma_E(EU_E)$$

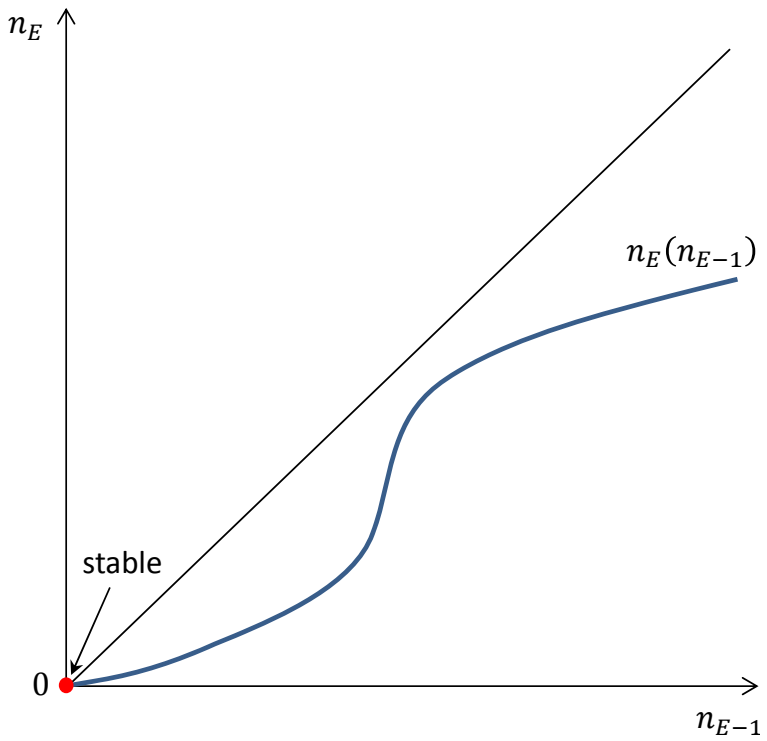
  (*ii*) Market clearing condition:

  $$\underbrace{n_E\phi}_{\text{demand}} = \underbrace{\Gamma_I\left(\widehat{\theta}\right)\lambda_A\rho n_{E-1}\left(1-\frac{\phi}{V_{-1}}\right)y}_{\text{angel capital supply}} + \underbrace{\Gamma_I\left(\widehat{\theta}\right)G}_{\text{general capital supply}}$$

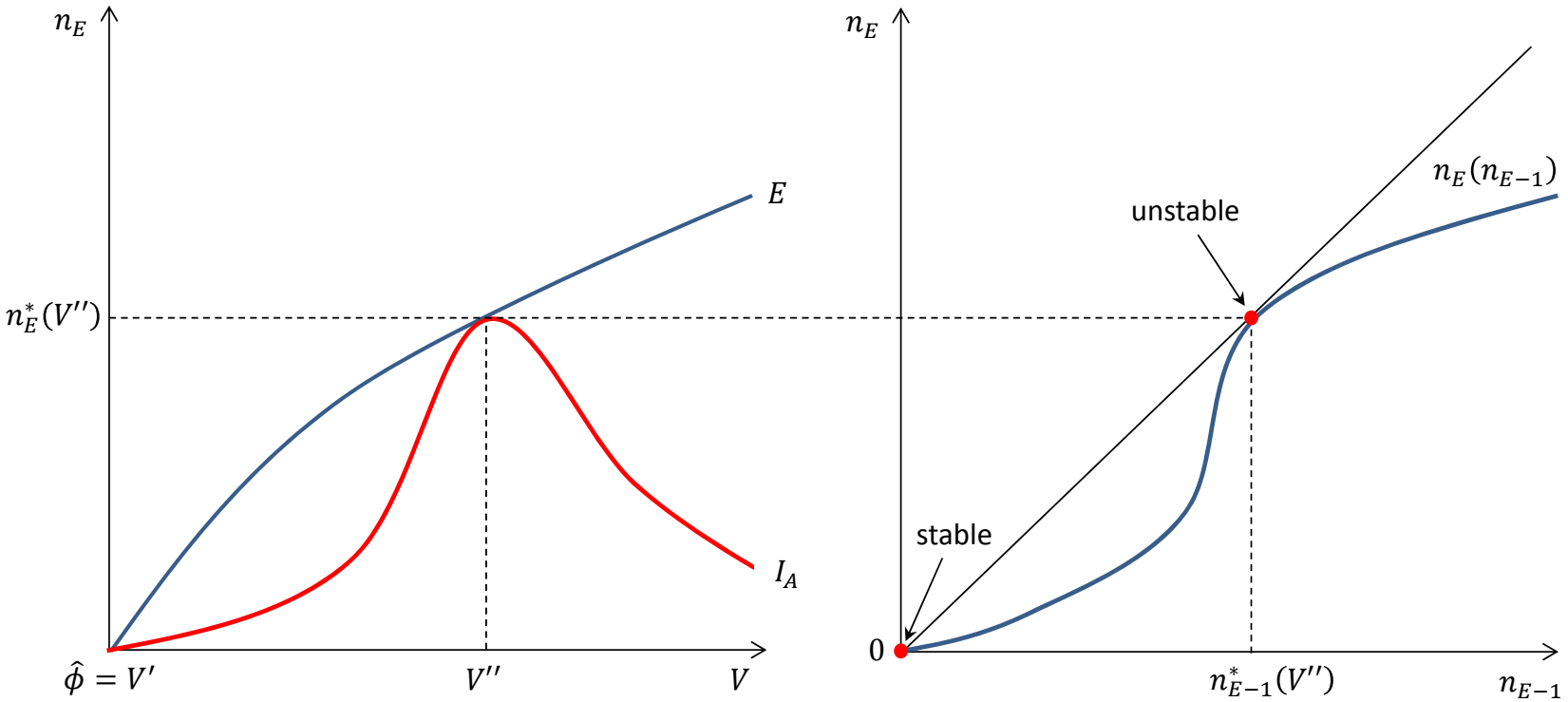
- Stable vs. unstable steady-state equilibria
- For now consider special case with $G = 0$

One Steady-State Equilibrium ($\phi > \widehat{\phi}$)

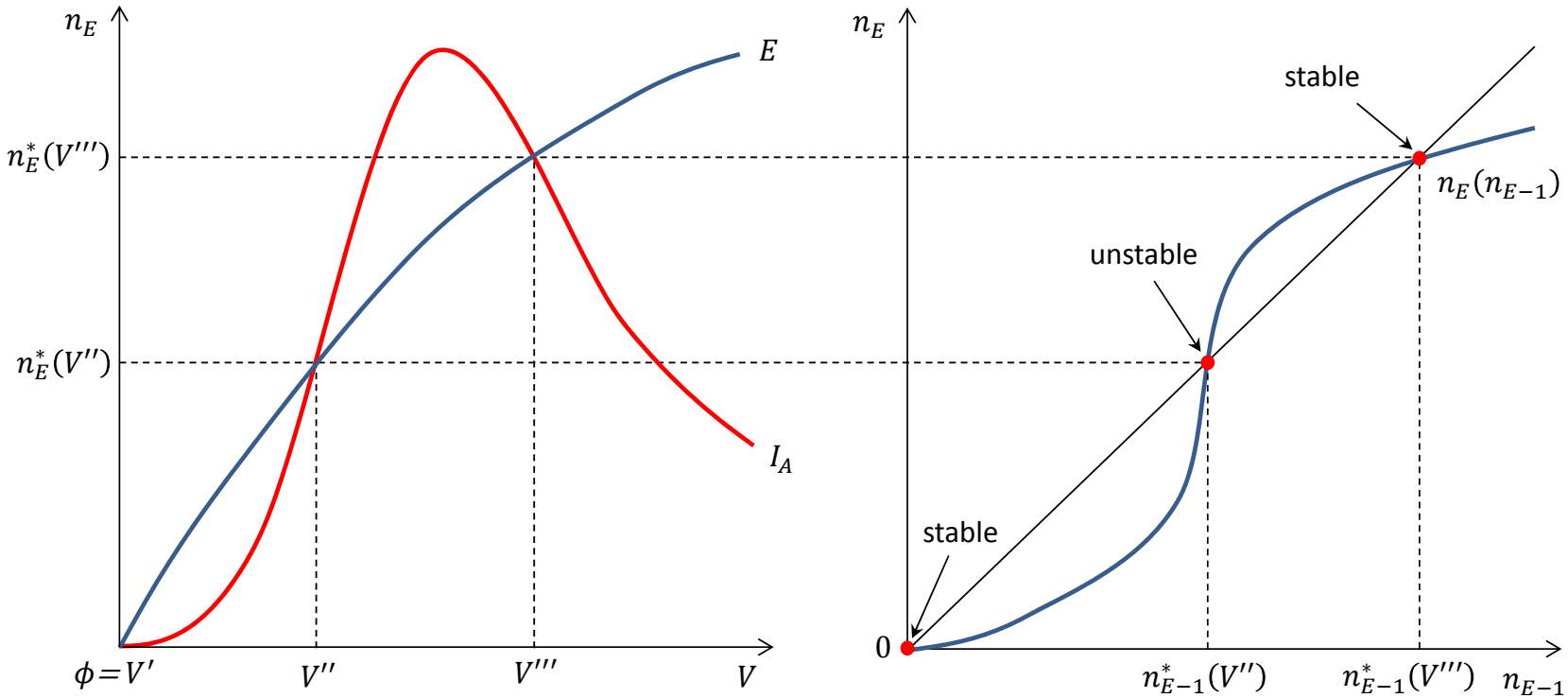




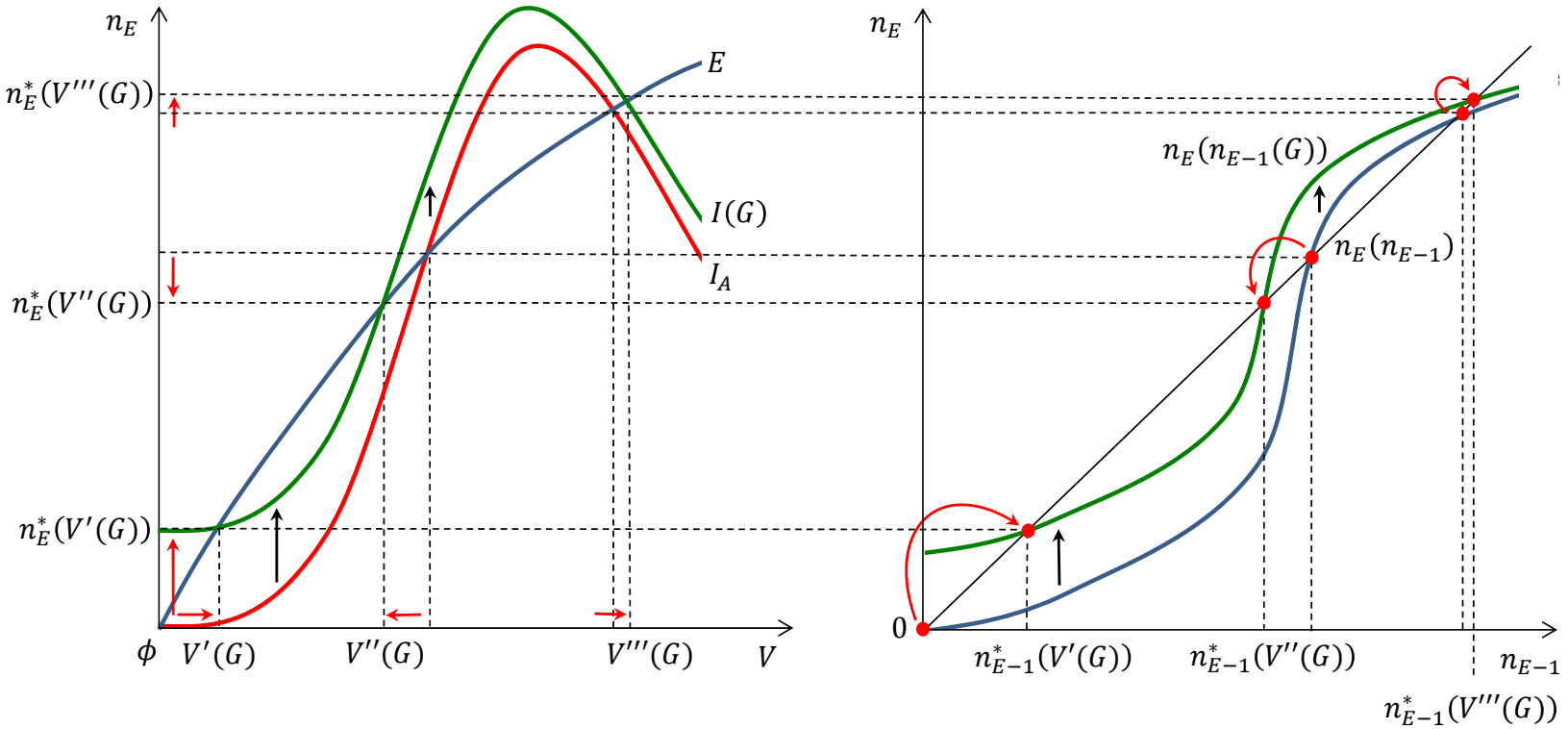
Two Steady-State Equilibria ($\phi = \widehat{\phi}$)



Three Steady-State Equilibria ($\phi < \widehat{\phi}$)



Dynamics with General Investors ($G > 0$)



Demand-side Policy

- Focus on stable steady-state equilibrium $n_E^*(V''') = n_{E-1}^*(V''')$
- Suppose government provides (permanent) entry subsidy $s_E > 0$ to entrepreneurs
  - E.g. investment in education, access to accelerators & incubators
- New entry condition: $n_E(s_E) = \Gamma_E(EU_E + s_E)$
- **Effects of s_E:**
  - Increases number of start-ups: $dn_E^*/ds_E > 0$
  - Reduces valuations: $dV^*/ds_E < 0$
    - $\Rightarrow$ 'poorer' entrepreneurs $\Rightarrow$ 'poorer' angels
- Total cost for government: $C(s_E) = \frac{1}{1-\delta} s_E n_E^*(s_E)$

Supply-side Policy

- Suppose government provides tax credit $s_I k > 0$ to investors
  - E.g. angel tax credit in British Columbia
- New dynamic market equilibrium defined by

  (*i*) Entry condition for entrepreneurs:

$$n_E = \Gamma_E(EU_E(s_I))$$

  (*ii*) Market clearing condition:

$$n_E \phi = \Gamma_I\left(\widehat{\theta} + s_I\right)\left[\lambda_A \rho n_{E-1}\left(1 - \frac{\phi}{V_{-1}}\right) y + G\right]$$

- Tax credit affects demand- and supply-side!
- Total cost for government: $C(s_I) = \frac{1}{1-\delta} s_I \phi n_E^*(s_I)$

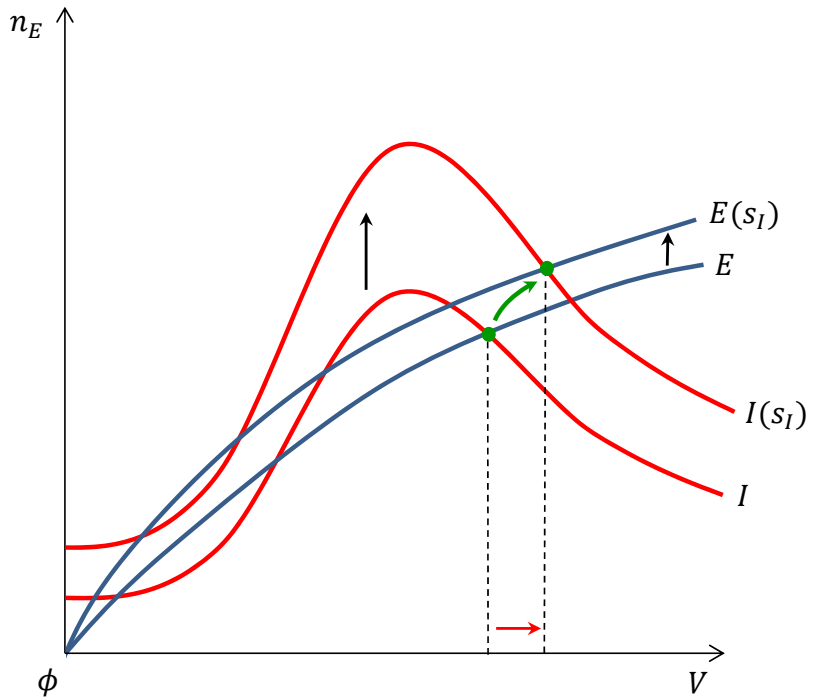
Supply-side Policy

- **Effects of $s_I\phi$:**
  - Increases number of start-ups: $dn_E^*/d(s_I\phi) > 0$
  - Leads to higher valuations: $dV^*/d(s_I\phi) > 0$ if

$$\mu_I^2 \left(\widehat{\theta} + s_I\right)^3 G < \phi \frac{1}{\lambda_A} \mu_E \rho \delta \left(1 - \frac{\phi}{V}\right) y \left[1 + \frac{1}{2}\lambda_A \mu_I \left(\widehat{\theta} + s_I\right)^2\right]^2$$

  $\Rightarrow$ 'richer' entrepreneurs $\Rightarrow$ 'richer' angels
- Two opposite effects on valuation:
  - $s_I\phi > 0$ implies more capital supply $\Rightarrow$ $V \uparrow$
  - $s_I\phi > 0$ makes future angel investment more attractive $\Rightarrow$ more E-entry $\Rightarrow$ $V \downarrow$

Supply-side Policy



Demand-side vs. Supply-side Policies

- Demand-side policy (s_E): $n_E^* \uparrow$ and $V^* \downarrow$
- Supply-side policy (s_I): $n_E^* \uparrow$ and, in general, $V^* \uparrow$

$\Rightarrow$ *Which policy is more efficient?*

- Without dynamics ($\lambda_A = 0$): both are equally efficient, i.e.,

$$n_E^*(s_E, \lambda_A = 0) = n_E^*(s_I\phi, \lambda_A = 0) \quad \forall \; s_E = s_I\phi$$

- With dynamics ($\lambda_A > 0$): when $dV^*/d(s_I\phi) > 0$, supply-side policy is more efficient
  - Proof still incomplete!
- Dynamic feedback loop: supporting investors creates wealthier entrepreneurs $\Rightarrow$ improves future funding supply
- Lower cost to achieve same outcome: $C(\overline{n}_E(s_I\phi)) < C(\overline{n}_E(s_E))$

Alternative Policies

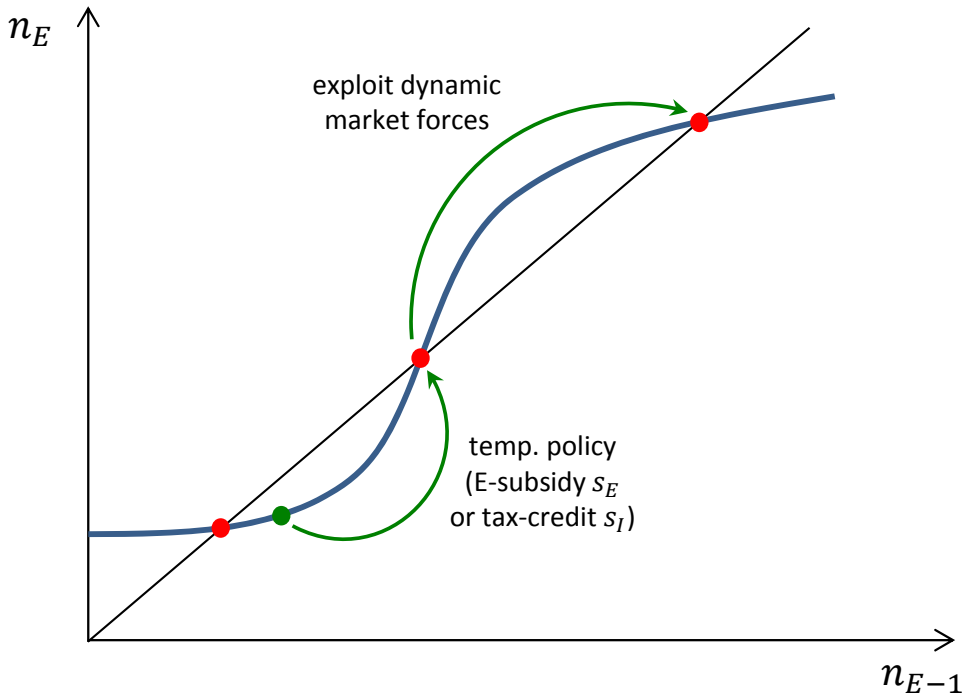
- Policies that affect equilibrium choice
  - Catalyst policies
- International boundaries
  - Capital inflow
  - Brain drain
- Alternative steady-state policies
  - Matching funds
  - Capital gains

Catalyst Policies

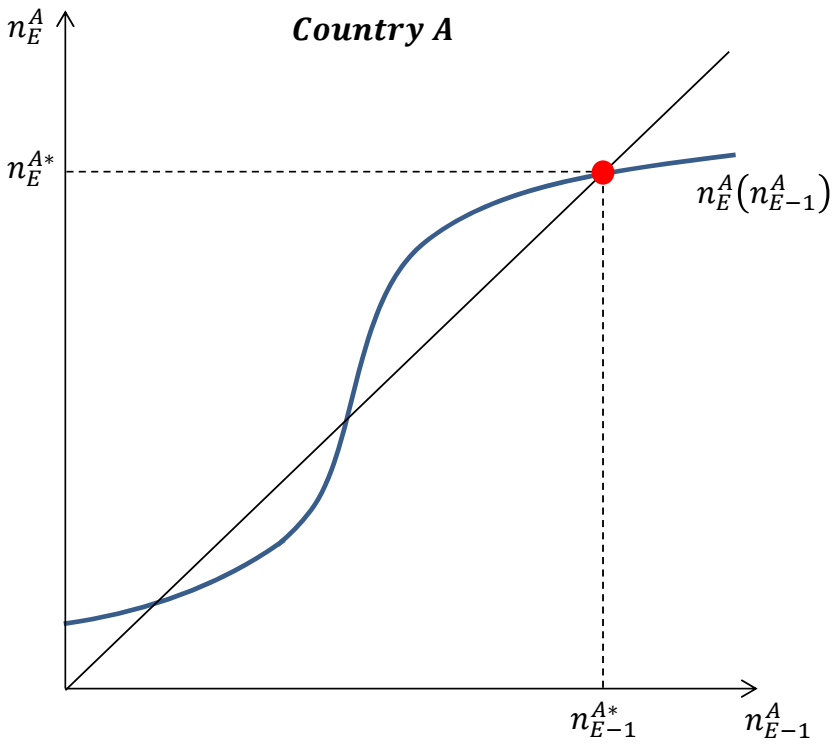
- Suppose there are two stable steady-state equilibria: n'_E and n'''_E
  - Unstable steady-state equilibrium: n''_E, with $n'_E < n''_E < n'''_E$
- Temporary policies:
  - If $n^*_E < n''_E$: 'push market' to n''_E

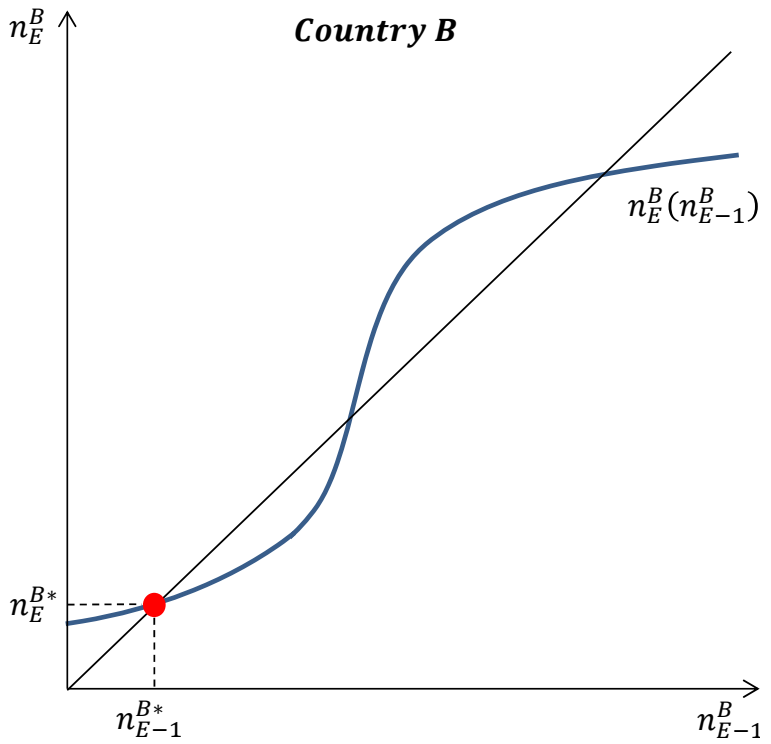
    $\Rightarrow$ use dynamic market forces to reach n'''_E
  - If $n^*_E > n''_E$: boost dynamic adjustment to n'''_E

Catalyst Policies

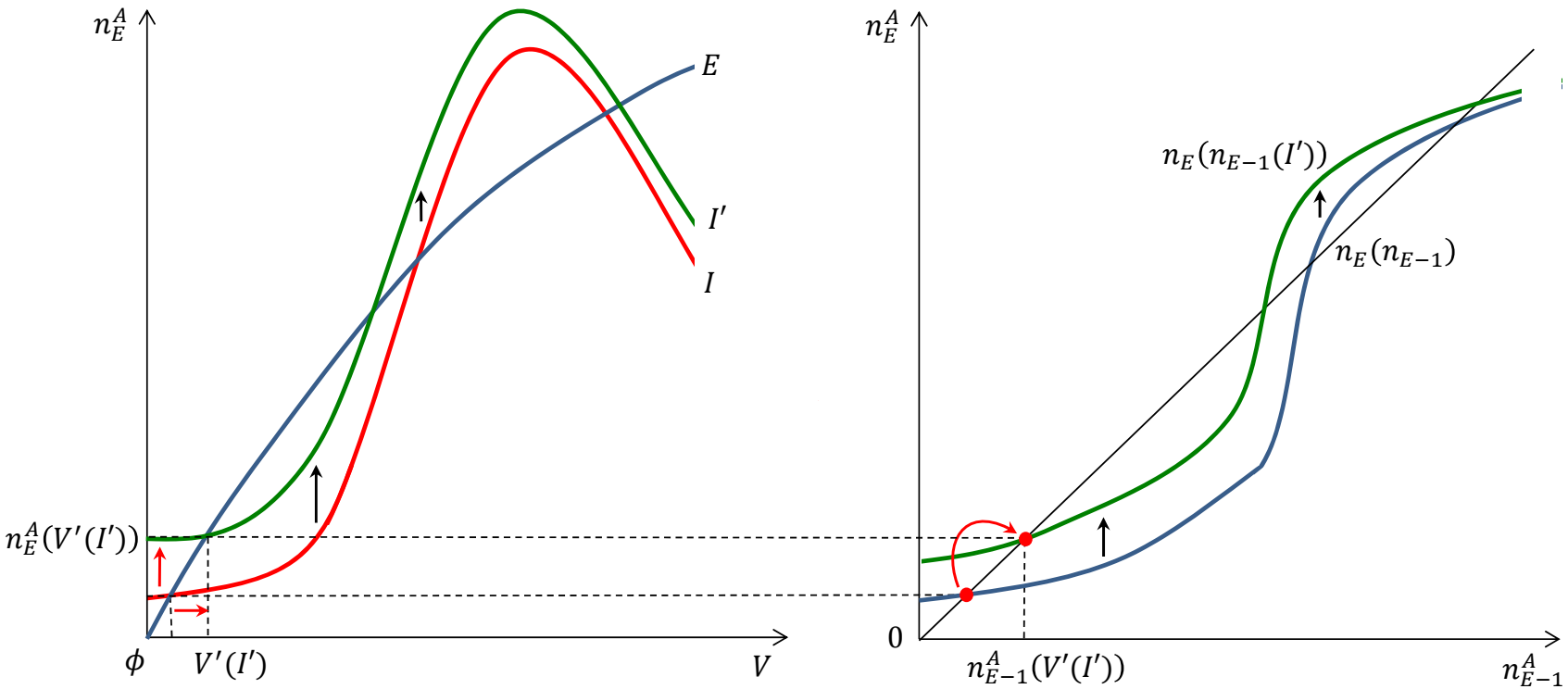


Two-Country Model



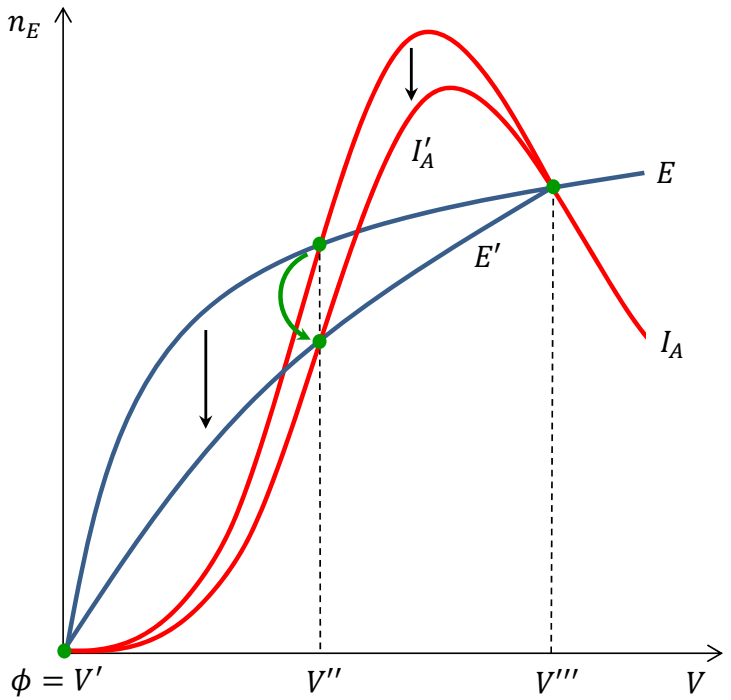


Capital Inflow – Country B

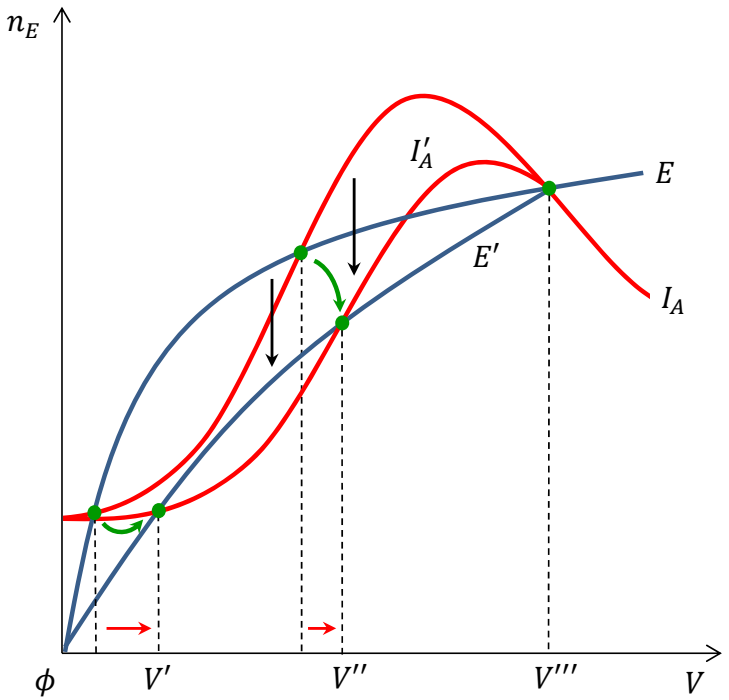


- Low equilibrium supported by foreign investors

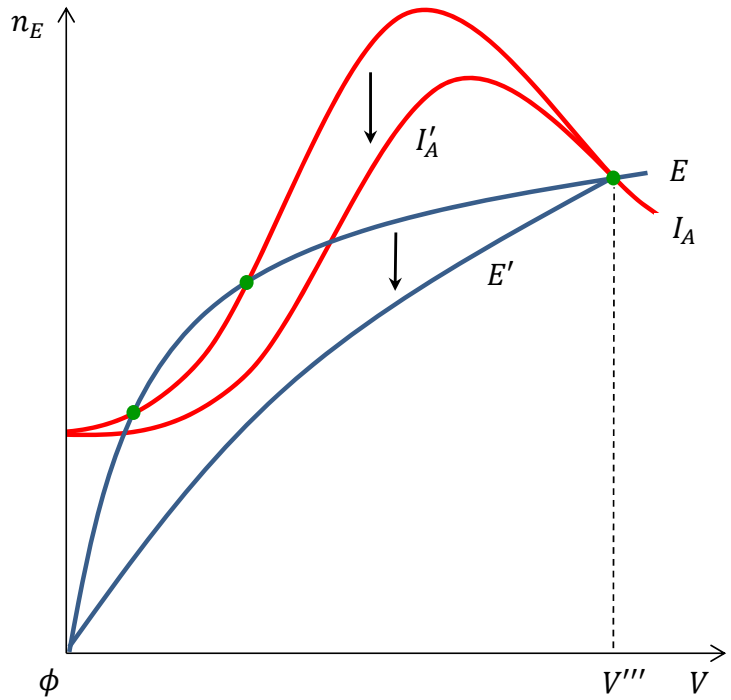
Brain Drain – No General Investors ($G = 0$)



Brain Drain – Few General Investors (G small)



Brain Drain – Many General Investors (G large)



Alternative Policies – Matching Funds

- Suppose government invests η for each dollar invested in start-ups
- New market clearing condition:

$$n_E \phi = (1+\eta)\,\Gamma_I(\widehat{\theta}) \left[\lambda_A \rho n_{E-1} \left(1 - \frac{\phi}{V_{-1}} \right) y + G \right]$$

- Focus on high steady-state equilibrium
- **Effects of η:**
  - Increases number of start-ups: $dn_E^*/d\eta > 0$
  - Increases valuations: $dV^*/d\eta > 0$
- Matching funds behave like investor tax credits!
  - Implies wealthier entrepreneurs $\Rightarrow$ more future angel supply

Alternative Policies – Capital Gains Tax

- Suppose government taxes capital gains at rate τ
- Marginal investor:

$$\widehat{\theta}(\tau) = \delta(1-\tau)\left[\rho\frac{1}{V}y - (1+r)\right]$$

- Effect of reducing τ:
  - Increases number of start-ups: $dn_E^*/d\tau < 0$
  - Leads to higher valuations: $dV^*/d\tau < 0$
    - Messy condition – needs more work...
- Similar effect as investor tax credit
  - But: part of tax relief goes into safe asset $\Rightarrow$ less effective

Conclusion

- Ecosystem model where entrepreneurs become investors
  - Role of entrepreneurial wealth and valuations
- Framework for examining demand- versus supply-side policies
  - Equivalence in static model
  - Valuation effects in dynamic ecosystems model
- Future research
  - Complete current analysis
  - Alternative policies
  - Alternative ecosystem channels