A Dynamic Model of Government-Backed Venture Capital

Hyun Joong Kim, University of Utah

David Eccles School of Business
THE UNIVERSITY OF UTAH

Motivation & Research Questions

The discrepancies in the literature on Governmental VC's efficiency

*I. Compared to private VCs, are they **efficient** investors to startups?*
Yes: Lerner(1999); Brander, Du,& Hellmann(2015)
No: Cumming & McIntosh(2006); Brander, Egan,& Hellmann(2010)

II. Do GVC activities crowd in/out private investments in markets?
Crowd out: Brander, Egan,& Hellmann(2010)
Crowd in: Lerner(1999); Guerini & Quas(2016)

Questions:
I. How should we understand the discrepancies on GVC efficiency and build the mechanism beneath?

II. If GVC participation generates inefficiency, then under which conditions and through which channels does it arise?

Key Channel: Dynamic Renegotiations

I. Under static setup & fixed contract between a startup's parties:
(Admati & Pfleiderer(1994); Inderst & Muller(2004))

Imbalanced contract → Misalignment of interests →
Conflicting investment decisions & Inefficient outcomes

*II. The paper's novelty: **Dynamic setup & strategic renegotiations***

Conflicting interests destroy values → Entities resolve them through gradual **renegotiations** on their contract terms (*e.g., equity shares*)

∴ Misalignment does not affect the startup's operation & value:
→ *Maximizes the sum of the **interacting** participants' values*

Main Findings on GVC Efficiency

Assumption:
1. Project exit → financial (**private**) + non-financial (**social**) values

2. Private entities (ENT & PVC) considers financial outcomes only.

3. Only GVC considers social values (+*ceteris paribus*)

Findings: ***The private-public partnership** determines the outcomes*

*I. GVC collaborates with PVC as a **seed investor** (w/o interaction):*
GVC interest ⇏ Startup operation ⇒ Private-value maximization

*II. GVC joins as an **ongoing investor** over time (w/ interaction):*
GVC interest ⇒ Startup operation ⇒ Social-welfare maximization

Model: Continuous-Time Games

I. The model of a general VC-financed startup

State variable: the R&D project's progress over time

$$dX_t = \mu dt + \sigma dB_t, X_0 = x < 0$$

Project exit: $\tau = \inf\{t | X_t = 0\}$

II. The players' (ENT and VCs') actions:

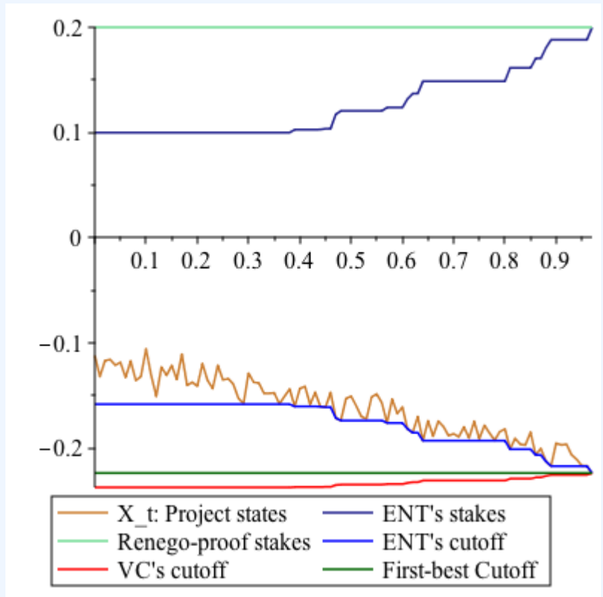
1. **Termination policy** for stop investing:

$$X_t \leq a\left(\frac{The\ entity's\ exit\ payoff}{The\ entity's\ rate\ of\ cost\ every\ instant}\right)$$

2. **Renegotiation policy** to prevent pre-matured termination:
The timing & amount of equity shares it concedes to the other party

III. The Nash Equilibrium Strategies & Outcome:

At some instant, both parties' termination policy clashes;
⇒ Renegotiation/Concession of shares occur;
⇒ The project terminates only when both parties agree to do so;
⇒ Their sum of values is **maximized** & shares are **balanced**.



(Fig. Equity share allocation & termination cutoffs over time)

∴ Analogous to **MM-irrelevance**:
The sums of a startup's ongoing entities' exit payoffs & costs determine the firm's investment choices & outcomes.

IV. Application to the three different VC-financing cases

1. Pure PVC-financing
2. Pure GVC-financing
3. Mixed funding: GVC collaborates with PVC as a seed investor

Results

*I. Under mixed funding with **GVC as a seed investor**:*
- Outcomes identical to those under PVC-financing;
- Maximizes *financial/private value;*
- I.e., GVC participation ⇏ Project operation & outcomes

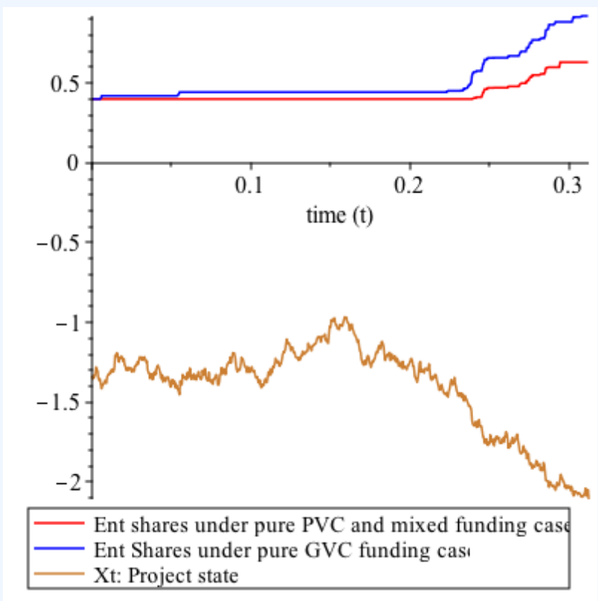
*II. Under GVC-financing **as an ongoing investor**:*
- Maximizes *social welfare*;
- A *longer* project lifespan;
- Suboptimal financial/private values;
- More *founder-friendly* equity share allocation

1. Termination cutoffs:

$$\underbrace{a^{pvc} = a^{mix} = a(\theta)}_{\text{Private Optimum}} > a^{gvc} = \max\left\{\underbrace{a(\theta+\phi)}_{\text{Social Optimum}}, a\left(\frac{\theta}{\gamma}\right)\right\}$$

2. Project lifespans:

$$E[S[a^{pvc}] \wedge \tau] = E^x[S[a^{mix}] \wedge \tau] < E^x[S[a^{gvc}] \wedge \tau]$$



(Fig. Equity allocation over time under the three different VC-financing cases)

Contributions & Policy Implications

*I. The observed **underperformance** does not mean **inefficiency:***
- Due to the tradeoff between **public** & **private** first-bests

II. Public FBs are achieved only under GVC's ongoing involvement:
- Otherwise, GVC's objectives are not reflected.

III. From the perspectives of private entities:
- GVCs may be helpful in providing certain kinds of support;
- May become less useful with actual control over decisions.