

Competing for Entrepreneurial Ideas: Matching and Contracting in the Venture Capital Market

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Motivation

- Venture capital is important for financing entrepreneurs with innovative business ideas
 - Total fund in 2000 (US): **\$180 billion**
- VC market is quite *heterogenous* (Sørensen, 2007)
 - VCs provide different value added ('expertise')
 - Management expertise
 - Industry-specific experience; networks
 - Entrepreneurs have ideas with different market potential
 - E.g. Google, ebay
- **Key Question:** *How does matching between heterogenous VCs and entrepreneurs affect VC contracts?*
 - Investment/allocation of equity?
 - Likelihood of survival?

Related Literature

- Sørensen (*JF*, 2007)
 - VCs, which provide more value added, match with entrepreneurs with more promising business ideas (positive assortative matching)
 - Inderst and Müller (*JFE*, 2004)
 - Search equilibrium model; no heterogeneity
 - Dam (WP, 2007)
 - Matching where VCs differ w.r.t. monitoring ability, entrepreneurs w.r.t. wealth
 - ⇒ Different model; different predictions
 - Legros and Newman (*Econometrica*, 2007)
 - Assortative matching with non-transferable utility
- ⇒ *There is a lot of empirical work on the VC market, but very few theoretical studies*

The Base Model

- **Venture capital market:**
 - $n_E \geq 2$ risk-neutral entrepreneurs
 - Wealth constrained; zero reservation utility
 - n_V risk-neutral venture capitalists (VCs), with $n_V \leq n_E$
- Each entrepreneur i , $i \in E = \{1, \dots, n_E\}$, has 'business idea'
 - **Idea quality:** μ_i , with $\mu_1 \leq \mu_2 \leq \dots \leq \mu_{n_E}$ (vertical ranking)
- Entrepreneur i relies on two critical inputs from venture capital firm (VC)
 - **Capital** K_i
 - **Expertise** (e.g. industry-specific human capital, networks, ...)
- VC j 's expertise, $j \in V = \{1, \dots, n_V\}$: x_j , with $x_1 \leq x_2 \leq \dots \leq x_{n_V}$ (vertical ranking)

The Base Model

- **Match quality function:** $\Omega_{ij} \equiv \Omega(\mu_i, x_j)$
 - Strictly increasing in μ_i (idea quality) and x_j (VC's expertise)
 - μ_i and x_j are common knowledge
- A venture ij can be either successful ($Y_{ij} = 1$), or fail ($Y_{ij} = 0$)
- Entrepreneur i 's effort e_{ij} determines likelihood of success:

$$\text{Prob}[Y_{ij} = 1 | e_{ij}] = e_{ij}$$

- Entrepreneur's effort cost: $c(e_{ij}) = e_{ij}^2/2$
- If venture is successful ($Y_{ij} = 1$), its gross profit is $\pi(K_{ij}, \Omega_{ij}) \geq 0$
 - $\pi(K_{ij}, \Omega_{ij})$ is increasing and concave in K_{ij} and Ω_{ij}
- VC j offers entrepreneur i the contract $\{\lambda_{ij}, K_{ij}\}$
 - λ_{ij} : entrepreneur i 's share of profit $\pi(K_{ij}, \Omega_{ij}) \Rightarrow$ **equity share**

VC Contracts without Matching

- Suppose entrepreneur i is matched with VC j
- Optimization problem for VC j :

$$\max_{\{\lambda_{ij}, K_{ij}\}} \Pi_{ij}^V(\lambda_{ij}, K_{ij}, e_{ij}) = (1 - \lambda_{ij})\pi(K_{ij}, \Omega_{ij})e_{ij} - rK_{ij}$$

s.t.

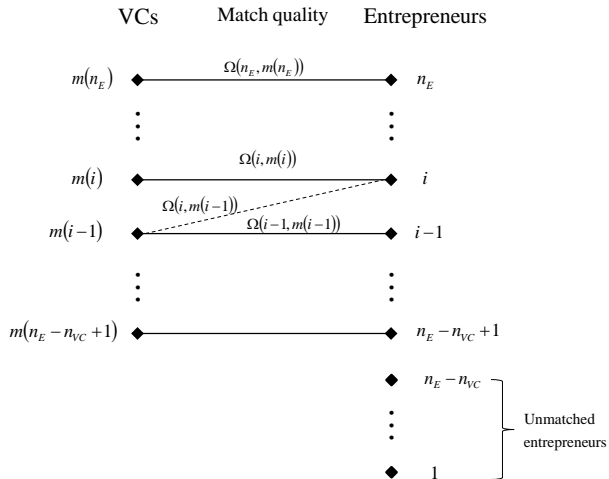
$$e_{ij} \in \operatorname{argmax}_{\tilde{e}_{ij}} \lambda_{ij}\pi(K_{ij}, \Omega_{ij})\tilde{e}_{ij} - \frac{\tilde{e}_{ij}^2}{2}$$

Key Observation: A better match quality Ω_{ij} is mutually beneficial:

$$\frac{d\Pi_{ij}^V(\lambda_{ij}^*, K_{ij}^*, \Omega_{ij})}{d\Omega_{ij}} > 0 \quad \frac{dU_{ij}^V(\lambda_{ij}^*, K_{ij}^*, \Omega_{ij})}{d\Omega_{ij}} > 0$$

⇒ **Matching matters! But how?**

The Matching Ladder



Optimal Contracts with Matching

- Suppose VC j offers entrepreneur i the contract $\{\lambda_{ij}, K_{ij}\}$
 - ⇒ Need to account for entrepreneur i 's reservation utility u_{ij}
 - ⇒ Defined by best alternative contract $\{\lambda_{ik}, K_{ik}\}$ offered by VC k
- ⇒ Optimization problem for VC j :

$$\max_{\{\lambda_{ij}, K_{ij}\}} \Pi_{ij}(\lambda_{ij}, K_{ij}, e_{ij}^*) = (1 - \lambda_{ij})\pi(K_{ij}, \Omega_{ij})e_{ij}^* - rK_{ij}$$

$$\text{s.t. (PC): } \lambda_{ij}\pi(K_{ij}, \Omega_{ij})e_{ij}^* - \frac{(e_{ij}^*)^2}{2} \geq u_{ij}$$

- Matching is relevant if u_{ij} is sufficiently high (PC is binding)
 - ⇒ Requires that $\Omega_{i,m(i-1)} > \bar{\Omega}_{i,m(i-1)}$
 - ⇒ Two competing VCs have very similar expertise
 - ⇒ VC must transfer more surplus through the contract $\{\lambda_{ij}^M, K_{ij}^M\}$
 - ⇒ Entrepreneur extracts a **matching rent**

Optimal Contracts with Matching

Observations: Suppose $\Omega_{i,m(i-1)} > \bar{\Omega}_{i,m(i-1)}$; then,

(i) $K_{i,m(i)}^M > K_{i,m(i)}^*$ and $e_{i,m(i)}^M > e_{i,m(i)}^*$;

(ii) $K_{i,m(i)}^M < K_{i,m(i)}^{fb}$ and $e_{i,m(i)}^M < e_{i,m(i)}^{fb}$.

- Competition for high-quality entrepreneurs has two effects:

(i) Improves efficiency of their capital endowments

(ii) Their ventures are more likely to succeed

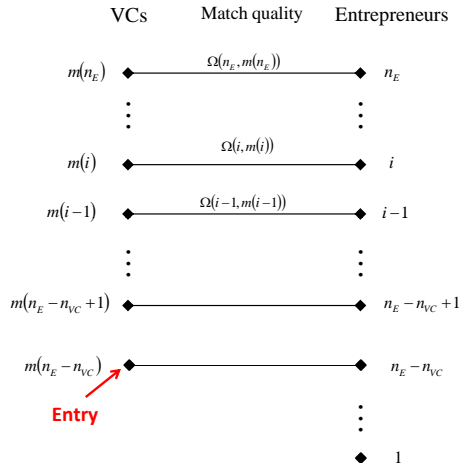
⇒ Matching improves efficiency!

⇒ **But:** Matching does not induce first-best investment and effort levels!

VC Contracts in **Economic Expansions**

- Consider an **economic expansion (boom)**
 - ⇒ More capital is available during booms
 - ⇒ More VCs in market than in economic contractions (busts)
- Intuitively, new VCs enter at the bottom of the latter
 - ⇒ Less 'experienced' than incumbent VCs

VC Contracts in Economic Expansions



VC Contracts in Economic Expansions

- **Key insight:** All entrepreneurs are better-off during a boom, while all incumbent VCs are worse off!
 - ⇒ All ventures are now endowed with more capital
 - ⇒ Entrepreneurs exert more effort ⇒ more likely to succeed!
 - ⇒ Overall efficiency is improved!
- Even entrepreneurs matched with incumbent VCs benefit
 - ⇒ Matching has an *amplifying effect* in the VC market!

Summary

Key contribution to literature:

- Incorporate *endogenous matching* in contractual relationship between heterogenous entrepreneurs and VCs

Key insights:

- Matching is positive assortative
 - High-quality VCs match with high-quality entrepreneurs
- Matching improves efficiency (investment and effort), but still below first-best
- Matching has *amplifying effect* in economic expansions and contractions