Peer-to-Peer Equity Financing: Contract Design

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Outline

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- Adhami et al. (2018) estimate that until 2017 ICOs raised about $5.3 billion globally

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- We give various extensions, such as different hurdle and reference rates, and management fees.

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  - First-loss: the entrepreneur's capital is used to cover the project loss before the funders get a hit
  - Liquidation boundary: the project terminates and all assets are liquidated when the project loss accumulates to a certain level, e.g., 5% loss.

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- They do not know the risk aversion degree of the entrepreneur either.
- We prove that the first-loss scheme, with a properly chosen incentive rate, can deter all entrepreneurs that are unappealing to the funders and attract some entrepreneurs that are attractive to the funders.

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- Without the liquidation, the entrepreneur of an extremely risky, unprofitable project, which loses all its investment in case of a loss, is willing to raise capital, because the first-loss capital is never used to cover the funders' loss. This entrepreneur is unappealing to the funders.

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- Principal-Agent Problems: Cvitanić and Zhang (2013), Foster and Young (2010), Morrison and White (2005), and Thanassoulis (2013).

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- Public P2P Financing and ICO: Hakenes and Schlegel (2014), Chang (2016), Chen et al. (2016), Åstebro et al. (2017), Asami (2018), and Cong and Xiao (2018); Adhami et al. (2018), Howell et al. (2018), Chod and Lyandres (2018), and Li and Mann (2018).

Literature Review (2)

- First-Loss Capital: He and Kou (2018), Chassang (2013), Cuoco and Kaniel (2011), Basak et al. (2007), Buraschi et al. (2014), and Dai and Sundaresan (2009).

Literature Review (2)

- First-Loss Capital: He and Kou (2018), Chassang (2013), Cuoco and Kaniel (2011), Basak et al. (2007), Buraschi et al. (2014), and Dai and Sundaresan (2009).
- Liquidation boundary: Goetzmann et al. (2003), Hodder and Jackwerth (2007), Quadrini (2004), Clementi and Hopenhayn (2006), and DeMarzo and Fishman (2007).

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Case Study One: TopWater Capital

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- The incentive rate is 40%

Case Study One: TopWater Capital (Cont'd)

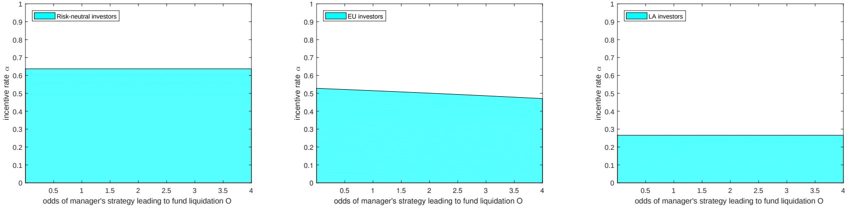

Figure: Range of separation-effective incentive rates in the first-loss scheme with respect to $\mathcal{O}$, the bound on the odds of managers' strategies leading to fund liquidation. Set $w = 10\%$, $\gamma = 0$, $b = 0.91$, and $r = 5\%$. The shaded areas in the left, middle, and right panes represent the ranges corresponding to the cases of risk-neutral investors, EU investors (local RRAD bounded by 2 and LAD bounded by 1), and PT investors (local RRAD bounded by 1 and LAD bounded by 3.25), respectively.

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- The asset value, however, is correlated to certain oil index.
- We can contract liquidation on the oil index.

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- Consider risk-neutral entrepreneurs and risk-neutral funders.
- Range of separation-effective incentive rates:

$\rho = 0.5$	$(4.6\%, 75\%)$
$\rho = 0.9$	$(4.3\%, 68\%)$

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- τ denotes the liquidation time of the project

Model: Payoffs of Traditional Scheme

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- Funder's payoff

$$\tilde{Y}_1 = Y_0 \Bigg\{ \big[\alpha e^r + (1-\alpha)\tilde{R}\big] + \big(w/(1-w)\big)\big(-\tilde{D}\big) \Bigg\},$$

where $Y_0 := (1-w)X_0$

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- An entrepreneur is attractive to the funder if and only if he strictly prefers pledging money to her project through P2P scheme to investing in a risk-free asset.

Model: Preferences (Cont'd)

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- Then the entrepreneur is attracted if and only if $\bar{\alpha}_E(u_E, \tilde{R}, \tau) < \alpha$

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- Then an entrepreneur is attractive to the funder if and only if $\bar{\alpha}_F(u_F, \tilde{R}, \tau) > \alpha$

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- In particular, $\mathcal{U}_{0,1}$ denotes the set of linear utility functions

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- Denote the set of the project returns by

$$\mathcal{R}_0 := \left\{ (\tilde{R}, +\infty) : \mathbb{P}(\tilde{R} = m_1 + 1) = 1 - \mathbb{P}(\tilde{R} = 0) > 0 \right.$$
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- Define
$u_\delta(x) := \left(x^{1-\delta} - 1\right)/(1-\delta),\ \delta \neq 1; \quad u_\delta(x) := \log(x),\ \delta = 1.$

Notations (2)

- There are three groups of entrepreneurs: *perfectly skilled entrepreneurs*, *skilled entrepreneurs*, and *unskilled entrepreneurs*, whose return profiles of the projects are denoted as $\mathcal{R}_P$, $\mathcal{R}_{0,S}$, and $\mathcal{R}_{0,U}$, respectively, where

$$
\begin{aligned}
\mathcal{R}_P &= \left\{(\tilde{R}, +\infty) : \tilde{R} = m_1 + 1 \text{ for some constant } m_1 > e^r - 1\right\}, \\
\mathcal{R}_{0,S} &= \Big\{(\tilde{R}, +\infty) : \mathbb{P}(\tilde{R} = m_1 + 1) = 1 - \mathbb{P}(\tilde{R} = 0) \in (0, 1) \\
&\qquad\qquad \text{for some constant } m_1 > e^r - 1 \text{ and } \mathbb{E}[\tilde{R}] > e^r\Big\}, \\
\mathcal{R}_{0,U} &= \Big\{(\tilde{R}, +\infty) : \mathbb{P}(\tilde{R} = m_1 + 1) = 1 - \mathbb{P}(\tilde{R} = 0) > 0 \\
&\qquad\qquad \text{for some constant } m_1 \geq e^r - 1 \text{ and } \mathbb{E}[\tilde{R}] \leq e^r\Big\}.
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- An unskilled entrepreneur (related to $\mathcal{R}_{0,U}$) has a project generating expected return rate lower than or equal to the risk-free rate.

Without Fund Liquidation (Cont'd)

Theorem

Suppose that there is no liquidation boundary.
(i) The traditional scheme always attracts some entrepreneur who is unappealing to any funder; more precisely, fixing any $\alpha \in (0,1)$ *and any* $u_E \in \mathcal{U}_{\delta,\lambda}$ *with* $0 < \lambda/(1-\delta) < 1 + \alpha(1-w)/w$*, there exists* $(\tilde{R}, \tau) \in \mathcal{R}_{0,U}$ *such that* $\bar{\alpha}_E(u_E, \tilde{R}, \tau) < \alpha$ *and* $\bar{\alpha}_F(u_F, \tilde{R}, \tau) \le \alpha$ *for any* $u_F \in \mathcal{U}$*.*
(ii) Either the incentive rate so low that the first loss scheme deters all entrepreneurs, or the incentive rate is so high that the first loss scheme attracts some entrepreneur who is unappealing to any funder. More precisely, fixing any $\alpha \in \left(0, \min\{\gamma w/(1-w), e^{-r}\}\right]$*, then* $\bar{\alpha}_E(u_E, \tilde{R}, \tau) \ge \alpha$ *for all* $u_E \in \mathcal{U}$ *and* $(\tilde{R}, \tau) \in \mathcal{R}_0$*; fixing any* $\alpha \in \left(\min\{\gamma w/(1-w), e^{-r}\}, 1\right)$ *and any* $u_E \in \mathcal{U}_{\delta,\lambda}$ *with* δ *and* λ *such that*

$$-\lambda u_\delta \left(\gamma - \min(\gamma, e^{-r}(1-w)/w)\right) < 1 - \gamma + \alpha(1-w)/w, \tag{1}$$

there exists $(\tilde{R}, \tau) \in \mathcal{R}_{0,U}$ *such that* $\bar{\alpha}_E(u_E, \tilde{R}, \tau) < \alpha$ *and* $\bar{\alpha}_F(u_F, \tilde{R}, \tau) \le \alpha$ *for any* $u_F \in \mathcal{U}$*.*

Outline

With Liquidation Boundaries

- Assume a liquidation boundary $b \in (0,1)$, i.e., the project is liquidated when it loses b of its initial investment.

$$\tau := \inf\{t \in (0,1] | \tilde{m}_t \leq b - 1\}.$$

In particular, the project is liquidated if and only if $\tau \leq 1$

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$$\tau := \inf\{t \in (0, 1] | \tilde{m}_t \leq b - 1\}.$$

In particular, the project is liquidated if and only if $\tau \leq 1$

- Denote the set of the project returns by

$$\mathcal{R}_b := \{(\tilde{R}, \tau) : \tau \text{ is a random time, } \tilde{R} = m_1 + 1 \text{ on } \{\tau > 1\} \text{ for some constant } m_1 \geq e^r - 1, \tilde{R} = be^{r(1-\tau)} \text{ on } \{\tau \leq 1\}\}.$$

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- The definition of $\mathcal{R}_P$ is the same as the one in the case of no liquidation, because the projects of these entrepreneurs deliver deterministic return rates that are higher than the risk-free return rate.

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- A skilled entrepreneur (related to $\mathcal{R}_{b,S}$) either delivers net return $m_1 > e^r - 1$ at time 1 or leads to liquidation at time τ; in the latter case, the net return at the liquidation time is $b - 1$; moreover, the expected gross return discounted by the risk-free rate is strictly larger than 1.

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- An unskilled entrepreneur (related to $\mathcal{R}_{b,U}$) either delivers return $m_1 \geq e^r - 1$ at time 1 or leads to liquidation at time τ; in the latter case, the net return at the liquidation time is $b - 1$; moreover, the expected gross return discounted by the risk-free rate is less than or equal to 1.

With Liquidation Boundaries

Theorem

Suppose that there is a liquidation boundary $b \in (0,1)$. Then the traditional scheme always attracts some entrepreneur who is unappealing to any funder; more precisely, fixing any $\alpha \in (0,1)$ and $u_E \in \mathcal{U}_{\delta,\lambda}$ with

$$\lambda \frac{-u_\delta(e^{-r}b)}{1-e^{-r}b} < 1 + \alpha(1-w)/w, \tag{2}$$

there exists $(\tilde{R}, \tau) \in \mathcal{R}_{b,U}$ such that $\bar{\alpha}_E(u_E, \tilde{R}, \tau) < \alpha$ and $\bar{\alpha}_F(u_F, \tilde{R}, \tau) \leq \alpha$ for any $u_F \in \mathcal{U}$.

Main Results: Risk-Neutral Funders

Theorem (Risk-Neutral Funders)

Suppose that there is a liquidation boundary $b \in (0,1)$ and consider the first-loss scheme. Denote

$$L := \frac{\gamma w}{1-w}, \quad U := \min\left\{\frac{\gamma w}{1-w} + \frac{wb}{(1-w)(e^r - b)}, \frac{1-b}{e^r - b}\right\}. \qquad (3)$$

Suppose $L < U$. Then, for any given $\alpha \in (L, U)$, the following are true:
(i) All perfectly skilled entrepreneurs and some skilled entrepreneurs are attracted, all unskilled entrepreneurs are deterred; more precisely, fixing any $u_E \in \mathcal{U}$, $\bar{\alpha}_E(u_E, \tilde{R}, \tau) < \alpha$ for all $(\tilde{R}, \tau) \in \mathcal{R}_P$ and for some $(\tilde{R}, \tau) \in \mathcal{R}_{b,S}$, and $\bar{\alpha}_E(u_E, \tilde{R}, \tau) \geq \alpha$ for all $(\tilde{R}, \tau) \in \mathcal{R}_{b,U}$.
(ii) Any entrepreneur who is attracted by the first-loss scheme is attractive to risk-neutral funders; more precisely, $\bar{\alpha}_F(u_F, \tilde{R}, \tau) > \alpha$ for $u_F \in \mathcal{U}_{0,1}$ and any $u_E \in \mathcal{U}$ and $(\tilde{R}, \tau) \in \mathcal{R}_b$ with $\bar{\alpha}_E(u_E, \tilde{R}, \tau) < \alpha$.

Main Results: Risk-Averse Funders

Theorem (Risk-Averse Funders)

Suppose that there is a liquidation boundary $b \in (0,1)$ *and consider the first-loss scheme. Fix* $\delta \geq 0$, $\lambda \geq 1$, *and* $\mathcal{O} > 0$, *and define* $\mathbb{U}(\delta, \lambda, \mathcal{O})$ *(given in the paper). Suppose* $L < \mathbb{U}(\delta, \lambda, \mathcal{O})$. *Then, for any given* $\alpha \in (L, \mathbb{U}(\delta, \lambda, \mathcal{O}))$, *the following are true:*

(i) All perfectly skilled entrepreneurs are attracted, some skilled entrepreneurs are attracted, and all unskilled entrepreneurs are deterred; more precisely, fixing any $u_E \in \mathcal{U}$, $\bar{\alpha}_E(u_E, \tilde{R}, \tau) < \alpha$ *for all* $(\tilde{R}, \tau) \in \mathcal{R}_P$ *and for some* $(\tilde{R}, \tau) \in \mathcal{R}_{b,S}$ *with* $\mathbb{P}(\tau \leq 1)/\mathbb{P}(\tau > 1) \leq \mathcal{O}$, *and* $\bar{\alpha}_E(u_E, \tilde{R}, \tau) \geq \alpha$ *for any* $(\tilde{R}, \tau) \in \mathcal{R}_{b,U}$.

(ii) Any entrepreneur who takes limited risk and is attracted by the first-loss scheme is attractive to all funders with bounded risk aversion; more precisely, $\bar{\alpha}_F(u_F, \tilde{R}, \tau) > \alpha$ *for all* $u_F \in \mathcal{U}_{\delta,\lambda}$ *and any* $u_E \in \mathcal{U}$ *and* $(\tilde{R}, \tau) \in \mathcal{R}_b$ *with* $\mathbb{P}(\tau \leq 1)/\mathbb{P}(\tau > 1) \leq \mathcal{O}$ *and* $\bar{\alpha}_E(u_E, \tilde{R}, \tau) < \alpha$.

Extensions

- Management fees and costs

Extensions

- Management fees and costs
- Different hurdle and reference rates

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- Management fees and costs
- Different hurdle and reference rates
- Limited-liability hurdled contract

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- Management fees and costs
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- Overshoot and random losses

Extensions

- Management fees and costs
- Different hurdle and reference rates
- Limited-liability hurdled contract
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- Random gains

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- Management fees and costs
- Different hurdle and reference rates
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- Multiple periods

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