Financing Efficiency of Securities-Based Crowdfunding

David C. Brown  
University of Arizona

Shaun William Davies  
University of Colorado, Boulder

Federal Reserve Bank of Philadelphia

September 29, 2017
Crowdfunding Basics

- Predominantly rewards-based (Kickstarter, Indiegogo) or donation-based (Go-Fund-Me) platforms
Crowdfunding Basics

- Predominantly rewards-based (Kickstarter, Indiegogo) or donation-based (Go-Fund-Me) platforms
  - Rely on contributors’ private valuations / benefits
Crowdfunding Basics

- Predominantly rewards-based (Kickstarter, Indiegogo) or donation-based (Go-Fund-Me) platforms
  - Rely on contributors’ private valuations / benefits
  - Campaigns benefit from the “wisdom of the crowd”
Crowdfunding Basics

- Predominantly rewards-based (Kickstarter, Indiegogo) or donation-based (Go-Fund-Me) platforms
  - Rely on contributors’ private valuations / benefits
  - Campaigns benefit from the “wisdom of the crowd”
- Securities-based crowdfunding is young, but growing rapidly
Crowdfunding Basics

- Predominantly rewards-based (Kickstarter, Indiegogo) or donation-based (Go-Fund-Me) platforms
  - Rely on contributors’ private valuations / benefits
  - Campaigns benefit from the “wisdom of the crowd”
- Securities-based crowdfunding is young, but growing rapidly
  - Several years of double-digit growth in Europe
Crowdfunding Basics

- Predominantly rewards-based (Kickstarter, Indiegogo) or donation-based (Go-Fund-Me) platforms
  - Rely on contributors’ private valuations / benefits
  - Campaigns benefit from the “wisdom of the crowd”
- Securities-based crowdfunding is young, but growing rapidly
  - Several years of double-digit growth in Europe
  - Online in US as of May 2016
Crowdfunding Basics

- Predominantly rewards-based (Kickstarter, Indiegogo) or donation-based (Go-Fund-Me) platforms
  - Rely on contributors’ private valuations / benefits
  - Campaigns benefit from the “wisdom of the crowd”
- Securities-based crowdfunding is young, but growing rapidly
  - Several years of double-digit growth in Europe
  - Online in US as of May 2016
- Financing traditionally relies on common-valued assets
Crowdfunding Basics

- Predominantly rewards-based (Kickstarter, Indiegogo) or donation-based (Go-Fund-Me) platforms
  - Rely on contributors’ private valuations / benefits
  - Campaigns benefit from the “wisdom of the crowd”

- Securities-based crowdfunding is young, but growing rapidly
  - Several years of double-digit growth in Europe
  - Online in US as of May 2016

- Financing traditionally relies on common-valued assets

- How well will traditional crowdfunding intuition translate to securities-based crowdfunding?
Crowdfunding Basics

- Predominantly rewards-based (Kickstarter, Indiegogo) or donation-based (Go-Fund-Me) platforms
  - Rely on contributors’ private valuations / benefits
  - Campaigns benefit from the “wisdom of the crowd”
- Securities-based crowdfunding is young, but growing rapidly
  - Several years of double-digit growth in Europe
  - Online in US as of May 2016
- Financing traditionally relies on common-valued assets
- How well will traditional crowdfunding intuition translate to securities-based crowdfunding?
- How efficient is financing from securities-based crowdfunding?
Introduction

Ingredients in Early Venture Financing

- Early ventures cannot be undertaken without some minimum threshold level of capital
Introduction

Ingredients in Early Venture Financing

- Early ventures cannot be undertaken without some minimum threshold level of capital
  - To some degree, seed capital campaigns are inherently “all-or-nothing”
Introduction

Ingredients in Early Venture Financing

- Early ventures cannot be undertaken without some minimum threshold level of capital
  - To some degree, seed capital campaigns are inherently “all-or-nothing”
- Entrepreneurs rarely acquire seed financing from a single investor
Introduction

Ingredients in Early Venture Financing

- Early ventures cannot be undertaken without some minimum threshold level of capital
  - To some degree, seed capital campaigns are inherently “all-or-nothing”
- Entrepreneurs rarely acquire seed financing from a single investor
  - Venture financing is syndicated (from small or big “crowds”)

Crowdfunding Efficiency

Brown and Davies
Introduction

Ingredients in Early Venture Financing

- Early ventures cannot be undertaken without some minimum threshold level of capital
  - To some degree, seed capital campaigns are inherently “all-or-nothing”

- Entrepreneurs rarely acquire seed financing from a single investor
  - Venture financing is syndicated (from small or big “crowds”)

- Syndicates may be fragmented and fail to coordinate their collective information
Ingredients in Early Venture Financing

- Early ventures cannot be undertaken without some minimum threshold level of capital
  - To some degree, seed capital campaigns are inherently “all-or-nothing”
- Entrepreneurs rarely acquire seed financing from a single investor
  - Venture financing is syndicated (from small or big “crowds”)
- Syndicates may be fragmented and fail to coordinate their collective information
  - Investor actions may appear non-cooperative
Introduction

Ingredients in Early Venture Financing

- Early ventures cannot be undertaken without some minimum threshold level of capital
  - To some degree, seed capital campaigns are inherently “all-or-nothing”
- Entrepreneurs rarely acquire seed financing from a single investor
  - Venture financing is syndicated (from small or big “crowds”)
- Syndicates may be fragmented and fail to coordinate their collective information
  - Investor actions may appear non-cooperative
- If funded, ventures exhibit diminishing returns on invested capital
Introduction

Ingredients in Early Venture Financing

- Early ventures cannot be undertaken without some minimum threshold level of capital
  - To some degree, seed capital campaigns are inherently “all-or-nothing”
- Entrepreneurs rarely acquire seed financing from a single investor
  - Venture financing is syndicated (from small or big “crowds”)
- Syndicates may be fragmented and fail to coordinate their collective information
  - Investor actions may appear non-cooperative
- If funded, ventures exhibit diminishing returns on invested capital
  - Investor profits are scarce
Introduction

This Paper

- We consider venture financing efficiency when (i) financing is **all-or-nothing**, (ii) financing requires **multiple non-cooperative** investors, and (iii) project returns are allocated on a **pro-rata** basis.
We consider venture financing efficiency when (i) financing is all-or-nothing, (ii) financing requires multiple non-cooperative investors, and (iii) project returns are allocated on a pro-rata basis.

In particular, we focus on two crowdfunding settings.
This Paper

We consider venture financing efficiency when (i) financing is **all-or-nothing**, (ii) financing requires **multiple non-cooperative** investors, and (iii) project returns are allocated on a **pro-rata** basis.

In particular, we focus on two crowdfunding settings:

- **Pivotal Setting:** Small number of non-cooperative, privately informed investors choose whether or not to provide capital to a project.
  - Investors consider the impact of their own decisions and the expected actions of other investors.
We consider venture financing efficiency when (i) financing is all-or-nothing, (ii) financing requires multiple non-cooperative investors, and (iii) project returns are allocated on a pro-rata basis.

In particular, we focus on two crowdfunding settings:

**Pivotal Setting:** Small number of non-cooperative, privately informed investors choose whether or not to provide capital to a project.

- Investors consider the impact of their own decisions and the expected actions of other investors.

**Non-Pivotal Setting:** Large number of non-cooperative, privately informed investors choose whether or not to provide capital to a project.

- Investors only consider the expected actions of other investors.
We consider venture financing efficiency when (i) financing is all-or-nothing, (ii) financing requires multiple non-cooperative investors, and (iii) project returns are allocated on a pro-rata basis.

In particular, we focus on two crowdfunding settings:

- **Pivotal Setting:** Small number of non-cooperative, privately informed investors choose whether or not to provide capital to a project. Investors consider the impact of their own decisions and the expected actions of other investors.

- **Non-Pivotal Setting:** Large number of non-cooperative, privately informed investors choose whether or not to provide capital to a project. Investors only consider the expected actions of other investors.

More investors → crowd collectively possesses better information about underlying project.
Introduction

Preview of Main Insights

- Coordination frictions and non-cooperative actions erode the benefit of better information
Coordination frictions and non-cooperative actions erode the benefit of better information.

Because the size of the investor profit pie is fixed, investors are asymmetrically exposed to good and bad projects.

- Participating investors receive larger ownership fractions of bad projects.
- This form of the winner’s curse leads to financing inefficiencies → ignore good information.
Introduction

Preview of Main Insights

- Coordination frictions and non-cooperative actions erode the benefit of better information

- Because the size of the investor profit pie is fixed, investors are asymmetrically exposed to good and bad projects
  - Participating investors receive larger ownership fractions of bad projects
  - This form of the winner’s curse leads to financing inefficiencies
    → ignore good information

- Because financing is all-or-nothing, investors are somewhat “hedged” against bad projects
  - Bad projects likely to not achieve sufficient financing
  - This form of the loser’s blessing leads to financing inefficiencies
    → ignore bad information
Introduction

Preview of Main Insights

- Coordination frictions and non-cooperative actions erode the benefit of better information

- Because the size of the investor profit pie is fixed, investors are asymmetrically exposed to good and bad projects
  - Participating investors receive larger ownership fractions of bad projects
  - This form of the winner’s curse leads to financing inefficiencies
    → ignore good information

- Because financing is all-or-nothing, investors are somewhat “hedged” against bad projects
  - Bad projects likely to not achieve sufficient financing
  - This form of the loser’s blessing leads to financing inefficiencies
    → ignore bad information

- A large crowd acts collectively uninformed!
Pivotal Setting

The Model

- Project requires $c > 0$ units of capital to be undertaken
The Model

- Project requires $c > 0$ units of capital to be undertaken
- Project's promised gross rate of return is $\Delta > 1$ (net return $\delta$)
The Model

- Project requires $c > 0$ units of capital to be undertaken
- Project’s promised gross rate of return is $\Delta > 1$ (net return $\delta$)
- Project can be good $G$ or bad $B$ and both outcomes are equally likely:

$$V = \mathbb{1}_G \Delta c - c$$
The Model

- Project requires $c > 0$ units of capital to be undertaken.
- Project’s promised gross rate of return is $\Delta > 1$ (net return $\delta$).
- Project can be good $G$ or bad $B$ and both outcomes are equally likely:
  \[ V = \mathbb{1}_G \Delta c - c \]
- Investors receive conditionally i.i.d. signal regarding project quality and signals are accurate with probability
  \[ \alpha > \frac{1}{2} \]
Pivotal Setting

The Model

- Project requires $c > 0$ units of capital to be undertaken
- Project's promised gross rate of return is $\Delta > 1$ (net return $\delta$)
- Project can be good $G$ or bad $B$ and both outcomes are equally likely:
  \[ V = \mathbb{1}_G \Delta c - c \]
- Investors receive conditionally i.i.d. signal regarding project quality and signals are accurate with probability
  \[ \alpha > \frac{1}{2} \]
- Investors cannot credibly communicate their signals
Pivotal Setting

The Model

- Project requires $c > 0$ units of capital to be undertaken
- Project's promised gross rate of return is $\Delta > 1$ (net return $\delta$)
- Project can be good $G$ or bad $B$ and both outcomes are equally likely:

$$V = \mathbb{1}_G \Delta c - c$$

- Investors receive conditionally i.i.d. signal regarding project quality and signals are accurate with probability

$$\alpha > \frac{1}{2}$$

- Investors cannot credibly communicate their signals
- Each investor chooses whether or not to provide capital
Pivotal Setting

The Model

- Project requires $c > 0$ units of capital to be undertaken
- Project's promised gross rate of return is $\Delta > 1$ (net return $\delta$)
- Project can be good $G$ or bad $B$ and both outcomes are equally likely:
  \[ V = 1_G \Delta c - c \]
- Investors receive conditionally i.i.d. signal regarding project quality and signals are accurate with probability
  \[ \alpha > \frac{1}{2} \]
- Investors cannot credibly communicate their signals
- Each investor chooses whether or not to provide capital
- Investment process is a simultaneous move game
Pivotal Setting

Pivotal Setting: An Example

- $N = 20$ investors
Pivotal Setting: An Example

- $N = 20$ investors
- Investors get correct signals with probability $\alpha = \frac{2}{3}$
Pivotal Setting: An Example

- $N = 20$ investors
- Investors get correct signals with probability $\alpha = \frac{2}{3}$
- Project requires $10,000$
Pivotal Setting

Pivotal Setting: An Example

- $N = 20$ investors
- Investors get correct signals with probability $\alpha = \frac{2}{3}$
- Project requires $10,000$
- Total capital available is $15,000$ (each investor can contribute $750$)
Pivotal Setting

Pivotal Setting: An Example

- \( N = 20 \) investors
- Investors get correct signals with probability \( \alpha = \frac{2}{3} \)
- Project requires $10,000
- Total capital available is $15,000 (each investor can contribute $750)
  \( \rightarrow \) must have 14 investors contribute \( ($750 \times 14 = $10,500$) \)
Pivotal Setting: An Example

- $N = 20$ investors
- Investors get correct signals with probability $\alpha = \frac{2}{3}$
- Project requires $10,000$
- Total capital available is $15,000$ (each investor can contribute $750$) → must have 14 investors contribute ($750 \times 14 = 10,500$)
- Project is ex-ante NPV neutral ($\delta = 1$)
Pivotal Setting

Pivotal Setting: An Example

- \( N = 20 \) investors
- Investors get correct signals with probability \( \alpha = \frac{2}{3} \)
- Project requires $10,000
- Total capital available is $15,000 (each investor can contribute $750) → must have 14 investors contribute ($750 \times 14 = $10,500)
- Project is ex-ante NPV neutral (\( \delta = 1 \))
- After receiving a good signal, investors contribute with probability \( \pi_G \)
Pivotal Setting: An Example

- $N = 20$ investors
- Investors get correct signals with probability $\alpha = \frac{2}{3}$
- Project requires $10,000$
- Total capital available is $15,000$ (each investor can contribute $750$) → must have 14 investors contribute ($750 \times 14 = 10,500$)
- Project is ex-ante NPV neutral ($\delta = 1$)
- After receiving a good signal, investors contribute with probability $\pi_G$
- After receiving a bad signal, investors contribute with probability $\pi_B$
Pivotal Setting

Pivotal Setting: An Example

- $N = 20$ investors
- Investors get correct signals with probability $\alpha = \frac{2}{3}$
- Project requires $10,000$
- Total capital available is $15,000$ (each investor can contribute $750$) → must have 14 investors contribute ($750 \times 14 = 10,500$)
- Project is ex-ante NPV neutral ($\delta = 1$)
- After receiving a good signal, investors contribute with probability $\pi_G$
- After receiving a bad signal, investors contribute with probability $\pi_B$
- Relevant benchmark is a monopolist controlling all capital and signals
**First-Best Benchmark**

- $\pi_G = 1, \pi_B = 0$
- Projects Financed: 96% of Good, 9% of Bad
- Value Add = $8,705\ (= 0.96\delta - 0.09c)$
Pivotal Setting

If Everyone Followed Their Signal...

- $\pi_G = 1$, $\pi_B = 0$
- Projects Financed: 48% of Good, 0% of Bad
- Value Add = $4,786
Pivotal Setting

Second-Best Solution

- $\pi_G = 1$, $\pi_B = 0.2875$
- Projects Financed: 82% of Good, 9% of Bad
- Value Add = $7,350

![Probability Distribution of Number of Contributing Investors]
Pivotal Setting

Competitive Equilibrium

- $\pi_G = 1$, $\pi_B = 0.4543$
- Projects Financed: 94% of Good, 37% of Bad
- Value Add = $5,768$

![Graph showing probability distribution of number of contributing investors for good and bad projects.](image-url)
Loser’s Blessing
Summarizing the Example

- Loser’s Blessing
  - Caused by less likelihood of investing in bad projects
Loser’s Blessing

- Caused by less likelihood of investing in bad projects
- Leads investors to contribute more aggressively, ignoring some bad information
Loser’s Blessing

- Caused by less likelihood of investing in bad projects
- Leads investors to contribute more aggressively, ignoring some bad information

Crowdfunding under-performs a first-best monopolist for two reasons
Loser’s Blessing
- Caused by less likelihood of investing in bad projects
- Leads investors to contribute more aggressively, ignoring some bad information

Crowdfunding under-performs a first-best monopolist for two reasons
- Investors cannot share their private signals and exploit their collective information → Coordination Cost ($8,705 - $7,350)
Pivotal Setting

Summarizing the Example

- Loser’s Blessing
  - Caused by less likelihood of investing in bad projects
  - Leads investors to contribute more aggressively, ignoring some bad information
- Crowdfunding under-performs a first-best monopolist for two reasons
  - Investors cannot share their private signals and exploit their collective information → **Coordination Cost** ($8,705 − $7,350)
  - Investors cannot commit to participation strategies that maximize joint-surplus → **Social Cost** ($7,350 − $5,768)
Pivotal Setting

Social Costs Increase as Crowd Grows

- Financing efficiency hampered by coordination and social costs
- Social costs dominate as $N$ grows large

![Graph showing the relationship between Value-Add % of FB and N, with social cost and coordination cost shaded areas.](image-url)
Non-Pivotal Setting

- Non-pivotal setting considers unit continuum of investors
  - Representative of internet platform crowdfunding
  - Regulation Crowdfunding requires all-or-nothing thresholds
Non-Pivotal Setting

Non-pivotal setting considers unit continuum of investors

- Representative of internet platform crowdfunding
- Regulation Crowdfunding requires all-or-nothing thresholds

By strong law of large numbers, crowd collectively has perfect signal of project quality
Non-Pivotal Setting

- Non-pivotal setting considers unit continuum of investors
  - Representative of internet platform crowdfunding
  - Regulation Crowdfunding requires all-or-nothing thresholds

- By strong law of large numbers, crowd collectively has perfect signal of project quality

- A loser’s blessing cannot exist in equilibrium!
  - If one did exist, a fraction of inventors would not be acting optimally
Non-Pivotal Setting

- Non-pivotal setting considers unit continuum of investors
  - Representative of internet platform crowdfunding
  - Regulation Crowdfunding requires all-or-nothing thresholds

- By strong law of large numbers, crowd collectively has perfect signal of project quality

- A loser’s blessing cannot exist in equilibrium!
  - If one did exist, a fraction of inventors would not be acting optimally

- Winner’s curse can exist and it can subsume private information
Non-Pivotal Setting

- Non-pivotal setting considers unit continuum of investors
  - Representative of internet platform crowdfunding
  - Regulation Crowdfunding requires all-or-nothing thresholds

- By strong law of large numbers, crowd collectively has perfect signal of project quality

- A loser’s blessing cannot exist in equilibrium!
  - If one did exist, a fraction of inventors would not be acting optimally

- Winner’s curse can exist and it can subsume private information

- Crowdfunding outcomes reflect no information
Non-Pivotal Setting

A Loser’s Blessing Cannot Exist

- Suppose $M = 1,000,000$, $\delta = 1$, $\alpha = 0.75$ and $c = 500,000$
Suppose $M = 1,000,000$, $\delta = 1$, $\alpha = 0.75$ and $c = 500,000$

If investors follow their signals:

- Good projects attract $750,000$ and are funded
- Bad projects attract $250,000$ and are cancelled
Suppose $M = 1,000,000$, $\delta = 1$, $\alpha = 0.75$ and $c = 500,000$

If investors follow their signals:

- Good projects attract $750,000$ and are funded
- Bad projects attract $250,000$ and are cancelled

Following signals cannot be an equilibrium

- After receiving a bad signal, investors could contribute risk-free (as they do not internalize their affects on funding outcomes)
Non-Pivotal Setting

A Loser’s Blessing Cannot Exist

- Suppose $M = 1,000,000$, $\delta = 1$, $\alpha = 0.75$ and $c = 500,000$

- If investors follow their signals:
  - Good projects attract $750,000$ and are funded
  - Bad projects attract $250,000$ and are cancelled

- Following signals cannot be an equilibrium
  - After receiving a bad signal, investors could contribute risk-free (as they do not internalize their affects on funding outcomes)
  - However, if all investors contribute, all projects are funded
Non-Pivotal Setting

A Loser’s Blessing Cannot Exist

- Suppose $M = 1,000,000$, $\delta = 1$, $\alpha = 0.75$ and $c = 500,000$

- If investors follow their signals:
  - Good projects attract $750,000$ and are funded
  - Bad projects attract $250,000$ and are cancelled

- Following signals cannot be an equilibrium
  - After receiving a bad signal, investors could contribute risk-free (as they do not internalize their affects on funding outcomes)
  - However, if all investors contribute, all projects are funded
  - Without loser’s blessing, bad signal investors will not contribute
Non-Pivotal Setting

A Loser’s Blessing Cannot Exist

- Suppose $M = 1,000,000, \delta = 1, \alpha = 0.75$ and $c = 500,000$
- If investors follow their signals:
  - Good projects attract $750,000$ and are funded
  - Bad projects attract $250,000$ and are cancelled
- Following signals cannot be an equilibrium
  - After receiving a bad signal, investors could contribute risk-free (as they do not internalize their affects on funding outcomes)
  - However, if all investors contribute, all projects are funded
  - Without loser’s blessing, bad signal investors will not contribute
- In equilibrium, either all projects or no projects are financed – regardless of project type!
Conclusion

Extensions

- In a dynamic setting, homogeneous investors will act simultaneously.
Conclusion

Extensions

- In a dynamic setting, homogeneous investors will act simultaneously
  - With pro-rata allocations, desire to learn induces waiting until last period
Conclusion

Extensions

- In a dynamic setting, homogeneous investors will act simultaneously
  - With pro-rata allocations, desire to learn induces waiting until last period
  - First-come, first-served allocations lead to early investment
Conclusion

Extensions

- In a dynamic setting, homogeneous investors will act simultaneously
  - With pro-rata allocations, desire to learn induces waiting until last period
  - First-come, first-served allocations lead to early investment
  - Ability to cancel contributions leads to simultaneous stay / leave decision in last period
In a dynamic setting, homogeneous investors will act simultaneously

- With pro-rata allocations, desire to learn induces waiting until last period
- First-come, first-served allocations lead to early investment
- Ability to cancel contributions leads to simultaneous stay / leave decision in last period

- Winner’s curse is sensitive to pro-rata assumption
In a dynamic setting, homogeneous investors will act simultaneously

- With pro-rata allocations, desire to learn induces waiting until last period
- First-come, first-served allocations lead to early investment
- Ability to cancel contributions leads to simultaneous stay / leave decision in last period

Winner’s curse is sensitive to pro-rata assumption

- Less-severe decreasing-returns-to-scale mitigate winner’s curse
A direct application is to internet securities-based crowdfunding
A direct application is to internet securities-based crowdfunding

- Regulation Crowdfunding went live in May 2016
A direct application is to internet securities-based crowdfunding

- Regulation Crowdfunding went live in May 2016

- Regulation Crowdfunding designed based on **rewards-based** and **donation-based** crowdfunding best practices
A direct application is to internet securities-based crowdfunding

- Regulation Crowdfunding went live in May 2016

- Regulation Crowdfunding designed based on rewards-based and donation-based crowdfunding best practices

- All-or-nothing thresholds ensure that only the popular, and likely profitable, products receive sufficient financing
A direct application is to internet securities-based crowdfunding

- Regulation Crowdfunding went live in May 2016

- Regulation Crowdfunding designed based on **rewards-based** and **donation-based** crowdfunding best practices
  - All-or-nothing thresholds ensure that only the popular, and likely profitable, products receive sufficient financing

- However, securities-based campaigns differ from reward-based and donation-based campaigns
A direct application is to internet securities-based crowdfunding

- Regulation Crowdfunding went live in May 2016

- Regulation Crowdfunding designed based on rewards-based and donation-based crowdfunding best practices
  - All-or-nothing thresholds ensure that only the popular, and likely profitable, products receive sufficient financing

However, securities-based campaigns differ from reward-based and donation-based campaigns

- Securities-based campaigns involve common value goods while reward-based and donation-based campaigns involve private value goods!
A direct application is to internet securities-based crowdfunding

- Regulation Crowdfunding went live in May 2016

- Regulation Crowdfunding designed based on **rewards-based** and **donation-based** crowdfunding best practices
  - All-or-nothing thresholds ensure that only the popular, and likely profitable, products receive sufficient financing

- However, securities-based campaigns differ from reward-based and donation-based campaigns
  - Securities-based campaigns involve **common value goods** while reward-based and donation-based campaigns involve **private value goods**!

- Our analysis shows that this difference is first-order ⇒ non-cooperative behavior erodes the wisdom of the crowd