# Theory and Evidence for Crowdfunding over Multiple Periods

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**Abstract:** Over the last decades, crowdfunding has grown as a path to finance a wide variety of projects, and several research studies - both theoretical and empirical - have been done about it. This work aims to contribute to the theory by offering a model that derives the expected raised funds and the odds of success of a crowdfunding campaign that aims to supply both a private good and a public one with contributions received over several periods. Using such a model, simulations are made to make predictions about how factors like population size and price of contribution affect the campaign outcomes. Moreover, it makes an empirical contribution using new data on the trajectory of contributions of hundreds of crowdfunding campaigns to study how we should expect contributions to arrive over time and how elements like the financing system can affect the success ratio of crowdfunding.

JEL Codes: D70, D82, H41

## 1 Introduction

Despite the hardships predicted by classic microeconomic theory for the public financing of projects, crowdfunding has become a very relevant tool for gathering resources in the modern economy. Through internet communication, reward-based contributions, and commitment mechanisms, organizations like Kickstarter and Indiegogo raise billions for thousands of projects yearly - most of them related to art and technology. Such achievements haven't gone unnoticed by academia, with dozens of empirical papers being written about how the traits of campaigns, backers and projects affect funding, as well as several theoretical ones modeling this form of financing and its benefits.

However, there are still several limitations on both theoretical and empirical research on such subject. First, the models developed so far commonly assume that the funding occurs over a single period or that the duration of the process is irrelevant - something that has been shown to be wrong in several papers - and that the reward offered for the contribution is the only benefit taken from participating on the funding - ignoring the possibility that the success of the project may have value to the contributor in itself. Second, the empirical work done usually only uses data from after the crowdfunding's ending, which means it doesn't allow for analyses of how contributions arrive while the campaign is going. This work aims to address both theoretical and empirical limitations.

First, I develop a model in which if the crowdfunding campaign is successful it offers both private goods to the contributors and a public good for the whole population. The goods have different values for each agent and such values may come from material benefits - e.g. prizes - or "psychological" ones - e.g. empathy gains from financing social projects. In this scenario, the agents may choose to contribute for two reasons: they want the private good exclusive to contributors and they want to raise the odds of having the public good produced.

The static model is expanded to a dynamic campaign with several periods. This expansion allows for both the analysis of how duration influences the amount of contribution and of how contributions arrive over time in different crowdfundings - approaches not explored before in the theoretical literature as far as I'm aware. With such addition, the agents not only consider the direct impact of their contribution to the campaign's success but also its effect on the others' choice to contribute in the future.

Second, simulations for the static case are run to study how changes in aspects of the campaign - e.g. price of contribution, duration, and population size - affect the expected amount of funds raised and the probability of success of the project. In particular, I find that very low or very high price levels usually yield smaller odds of success, because the first requires a lot of people to contribute and the second, puts the cost of contribution so high that people will only contribute if they value the goods very much. Moreover, I find that bigger populations of possible contributors raise the odds of success but tend to reduce the probability of an agent contributing due to the free-rider effect.

Third, to test the results predicted by the simulations and to enable a study of the dynamics of contribution arrivals over time, daily data from hundreds of projects from two of the biggest crowdfunding platforms - Kickstarter and Indiegogo - is gathered through data scrapping and studied. Among the most noticeable patterns in the data, it is possible to mention the fact that successful projects usually achieve their goals early, contributions tend to arrive at a slower pace over time but individual contributions do not tend to get smaller, and "All-or-Nothing" funding - Kickstarter model - apparently has odds of success much bigger than "Keep-it-all" funding - Indiegogo typical model.

Therefore, this work makes several contributions to the literature on crowdfunding. First, the model proposed offers predictions on how the campaign and backers' traits can affect funds raised and the odds of success for a project that gives both private and public goods and gathers resources through several periods. Second, for a given distribution of values of the private and public goods across the population, the model can give the prices that maximize either the odds of success or expected funds raised. Third, the empirical analysis gives new evidence on how contributions for a project arrive over time, which provides meaningful insights into how long it takes to finance a project and what model of financing gives better results regarding odds of success.

## 2 Related literature

This work offers both a theoretical model and an empirical analysis of new data on crowdfunding campaigns, which contribute to two different albeit deeply connected literatures. Firstly, The model proposed for the campaigns follows the literature on economic models for crowdfunding created by several works during the last decade - Belleflamme et al. (2013), Hakenes and Schlegel (2014), Chang (2016), Strausz (2017), Ellman and Hurkens (2019). These papers shared the common goal of offering models with heterogeneous agents that explain how different factors affect crowdfunding's results, but they differ in their focuses and on the elements included in the models.

In that sense, most papers focused on the perspective of firms using crowdfunding as a way to gather resources to finance the development of new products, including aspects like post-crowdfunding sales (Belleflamme et al. (2013)) not present in this work. It's also common that different forms of uncertainty are included - e.g. regarding the good's quality (Chang (2016)) or the delivery of the goods if the project is successful (Strausz (2017)). Moreover, the value given to the private good among the potential contributors also varies over papers: common unknown value with different signals (Chang (2016)), two levels of value (Ellman and Hurkens (2019), Strausz (2017)) or continuous space of value (Belleflamme et al. (2013)). However, none of these works seem to have included the possibility of crowdfunding financing a public good, nor the impact of campaign duration on odds of success and funds raised - an effect found to be relevant in several empirical works (Deng et al. (2022)).

Secondly, the empirical analysis adds to a long literature of research on the determinants of crowdfunding success (comprehensive review by Deng et al. (2022)). In particular, it contributes to the study of how aspects from the campaign that can be chosen by the project's creator - e.g. duration, price, model of financing - affect the crowdfunding results, in line with the influential work Mollick et al. (2014). It differs from most of the current literature for offering an analysis of how contributions arrive over time for different projects, something hard to find due to the data publicly available usually accounting only for the final results of past campaigns.

# 3 Setup

## 3.1 Variables

- $\Gamma \subset \mathbf{R}^{+2}$: support of the distribution of the values of private and common goods
- $(\alpha_p^i, \alpha_c^i) \in \Gamma$: values of the private good and of the common/public good for contributor $i$
- $f(\cdot, \cdot) : \mathbf{R}^{+2} \to \mathbf{R}^+$: density probability function of the private and common values
- $p \in \mathbf{R}^+$: price of contribution
- $T \in \mathbf{N}^*$: last period of the crowdfunding
- $X \in \mathbf{N}^*$: initial amount of contributions needed
- $N \in \mathbf{N}^*$: initial amount of potential contributors
- $x_t \in \{0, ..., X\}$: number of contributions needed in $t$
- $c_t^i \in \{0, 1\}$: contribution made by contributor $i$ in $t$

## 3.2 Game design

In the crowdfunding campaign, a group of agents can make contributions to the realization of a project. The campaign is successful if the number of contributions is equal to or above the minimum established. The players can contribute only once but can choose when to contribute. By the end of the crowdfunding campaign, if it's successful, every player receives one unit of the public good and every agent who contributed receives one of the private good and has to pay the price for his contribution. The timing of the game is as follows

At $t = 1$, every player receives private information about their preferences $(\alpha_p^i, \alpha_c^i)$ and the information about the specifications of the crowdfunding campaign $(Cr = (p, T, X))$ and of the population's traits $(Pop = (\Gamma, f, N))$ are common knowledge. Thus, all players have access to the information set $I_1 = (p, T, \Gamma, f, X, N)$. Then, based on the information set and their preferences, every player decides if they are gonna contribute $(c_1^i = 1)$ or not $(c_1^i = 0)$.

At $t = 2$, the players are informed of the current state of the campaign $(x_2, n_2)$, where $n_2 = N-(X-x_2)$ is the number of people who can still contribute

- so their information set becomes $I_2 = (p, T, \Gamma_2, f, (X, x_2), (N, n_2))$. Then, the players who haven't contributed decide to contribute or not in this period. These steps are repeated at every period until $t = T$ with the information set of period $t$ being given by $I_t = (p, T, X, \Gamma_t, f, N, x^t, n^t)$, with $x^t$ and $n^t$ being the histories of contributions needed and potential future contributors for each period.

At the end of $t = T$, every player who contributed pays the price of contribution and, if the campaign is successful, every player receives the public good and everyone who contributed receives the private good.

### 3.3 Utility function

The contributor $i$'s utility is given by

$$U_i(c) = \alpha_p^i c + \alpha_c^i - pc$$

Where $c \in \{0, 1\}$ is the contribution given.

# 4 Equilibrium at $t = T$

### 4.1 Contributor's choice

If the player has already contributed by $t = T$, he can do nothing in the last period. Otherwise, contributor $i$'s problem in the last period is as follows:

$$\max_{c_T^i \in \{0,1\}} \pi_1(\alpha_p^i + \alpha_c^i)c_T^i + \pi_2(\alpha_c^i)(1 - c_T^i) - pc_T^i$$

Where $\pi_1$ is the probability of crowdfunding success if contributor $i$ contributes and $pi_2$ is the probability of success if they don't.

Therefore, the problem is solved by the following relations:

$$\pi_1(\alpha_p^i + \alpha_c^i) - p \geq \pi_2(\alpha_c^i) \rightarrow c_t^i = 1$$
$$\pi_1(\alpha_p^i + \alpha_c^i) - p < \pi_2(\alpha_c^i) \rightarrow c_t^i = 0$$

### 4.2 Probability of success

The probability of success given a contributor's choice and his beliefs is the probability that the number of remaining players $(N - 1)$ contributing in $t = T$ is greater or equal to the amount necessary $(x)$:

$$\pi(x, I_t) = Prob(\sum_{j \neq i} c_T^j \geq x | I_t) = Prob(\sum_{j \neq i} c_T^j > x - 1 | I_t)$$

Therefore, it's possible to write the probabilities as $\pi_1(I_T) = \pi(x_T - 1, I_T)$ and $\pi_2(I_T) = \pi(x_T, I_T)$.

Now, notice that $c_T^i = 1$ if and only if the condition $\alpha_p^i(\pi_1) + \alpha_c^i(\pi_1 - \pi_2) \geq p$ is satisfied. In the plane $\alpha_p \mathrm{X} \alpha_c$, this inequality shows that a player $i$ contributes when $(\alpha_p^i, \alpha_c^i)$ is above the line represented by the condition. Therefore, we have

$$P(\pi_1, \pi_2) = Prob(c_T^i = 1|\pi_1, \pi_2) = Prob(\alpha_p^i(\pi_1) + \alpha_c^i(\pi_1 - \pi_2) \geq p|\pi_1, \pi_2)$$

From that, $\sum_{j \neq i} c_T^j = z(I_T) \sim Binomial(N - x - 1, P(\pi_1, \pi_2))$, thus, we have that

$$\pi(x, I_t) = 1 - Bi_{N-x-1, P(\pi_1, \pi_2)}(x - 1) \approx 1 - \mathbf{N}_{N-x-1, P(\pi_1, \pi_2)}(x - 1)$$

Where $Bi_{n,k}(\cdot)$ is the cumulative distribution function of a binomial with parameters $n$ and $k$ and $\mathbf{N}_{n,k}(\cdot)$ is the cumulative distribution function of a normal with parameters $nk$ and $nk(1 - k)$.

### 4.3 Equilibrium

Notice that this formula gives for each player $i$ two non-linear equations with two variables ($\pi_1$ and $\pi_2$):

$$\pi_1 = \pi(x_T - 1, I_T) = 1 - \mathbf{N}_{N-(X-x_T)-1, P(\pi_1, \pi_2)}(x_T - 2) = 1 - \mathbf{N}_1$$

$$\pi_2 = \pi(x_T, I_T) = 1 - \mathbf{N}_{N-(X-x_T)-1, P(\pi_1, \pi_2)}(x_T - 1) = 1 - \mathbf{N}_2$$

which can be put together to form

$$P(I_t) = Prob(c_T^i = 1|P) = Prob(\alpha_p^i(1 - \mathbf{N}_1) + \alpha_c^i(\mathbf{N}_2 - \mathbf{N}_2) \geq p)$$

Where $P(I_t)$ is the belief held by a player with the information set $I_t$ that a random player of the group of possible contributors is gonna contribute. Any belief $P(I_t)$ that satisfies such condition can be rationalizable, so it's necessary to impose conditions on expectations for the game to have a single equilibrium (a discussion on the assumption's choice is included in the Appendix).

**Assumption 1 (Optimistic beliefs):** If more than one belief $P(I_t)$ is rationalizable, then the players use the highest belief in their decisions.

With Assumption 1, there will be a unique pair of probabilities $(\pi_1, \pi_2)$ possible in $t = T$. Since the decision of contributing or not depends only on the probabilities and on parameters previously defined $T$ $(\alpha_p^i, \alpha_c^i, p)$, this assumption is enough to establish the existence of a unique equilibrium for the game.

### 4.4 Comparative Statistics

To examine some properties for a single period of crowdfunding, a few simulations are made. For simplicity, it's assumed, first, that, $\alpha_p^i \sim N(m, (\frac{m}{2})^2)$ and $\alpha_c^i = \alpha_p^i$ - i.e. the private values are distributed according with a normal of mean $m$ and standard deviation $\frac{m}{2}$ and the common value is equal to the private one for every player. Second, that $Cr^* = \{1, 1, 5\}$, $x_t^* = 5$ and $N^* = 10$ is the baseline configuration of the crowdfunding - i.e. it's a single period game with the price of contribution equal to 1 unit, 10 possible contributors and 5 contributions needed for success.

#### 4.4.1 Different prices

Figure 1 illustrates how the choice of contribution price, holding the total amount required constant, affects the odds of individual contribution and crowdfunding success. As expected, there exists a tradeoff in lowering contribution prices: more people will be willing to pay, but more contributions are also going to be necessary for the crowdfunding campaign to be successful. The graph shows that in this specific case, the probability of success is maximized when half of the population must contribute, but the odds of a random agent contributing always increase when the price is lowered.

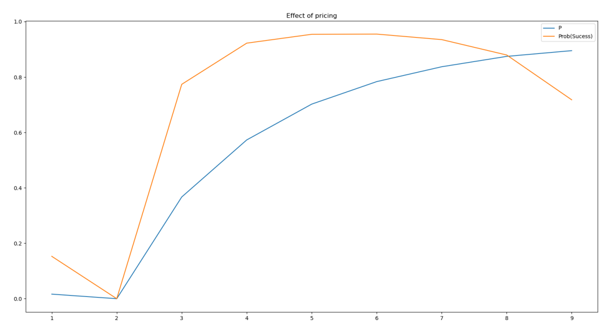


Figure 1: Pricing

#### 4.4.2 Population size

Figure 2 illustrates how the odds of contribution and crowdfunding success change when the population of possible contributors expands holding everything else constant. On one hand, it shows that adding more people to the population quickly raises the probability of crowdfunding success to values close to 1. On the other, the odds of each single agent contributing lowers until reaching a positive constant probability.

Figure 3 explains how that happens. As the probability of success rises, the odds of getting the private value if contributing rises too ($\pi_1$ increases). However, the dominant effect is that the individual contribution becomes much less relevant for the project's success as more people enter the population, causing a free rider effect, where people take the provision of the common good as given and, thus, the utility they gain from it become irrelevant for the contribution ($\pi_1 - \pi_2$ decreases).

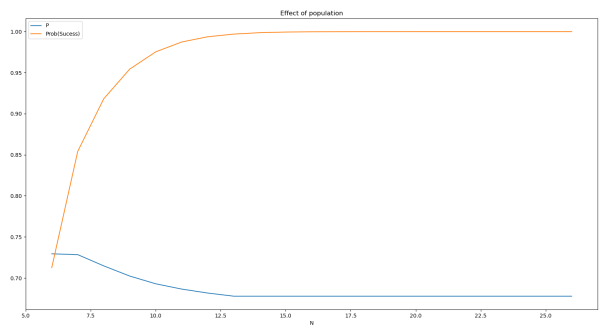


Figure 2: Odds of contribution

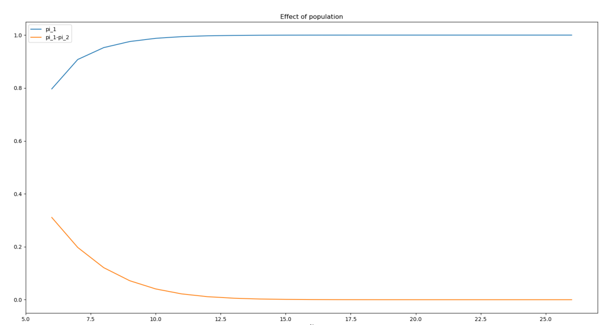


Figure 3: Perceived probabilities

# 5 Equilibrium at $t < T$

To find the equilibrium in previous periods, let's solve the agents' problems recursively.

## 5.1 Value functions

First, let's define the value functions for a player who hasn't contributed yet and for one who has already contributed in the last period:

$$V_{nc}(\alpha_p^i, \alpha_c^i, I_T) = \max\{\pi_1(\alpha_p^i + \alpha_c^i) - p, \pi_2(\alpha_c^i)\}$$

$$V_c(\alpha_p^i, \alpha_c^i, I_T) = \pi_2(\alpha_c^i + \alpha_p^i) - p$$

Now, for the penultimate period, we have:

$$V_{nc}(\alpha_p^i, \alpha_c^i, I_{T-1}) = \max\{E[V_c(\alpha_p^i, \alpha_c^i, I_T)|I_{T-1}, c_{T-1}^i = 1], E[V_{nc}(\alpha_p^i, \alpha_c^i, I_T)|I_{T-1}, c_{T-1}^i = 0]\}$$

$$V_c(\alpha_p^i, \alpha_c^i, I_{T-1}) = E[V_c(\alpha_p^i, \alpha_c^i, I_T)|I_{T-1}, c_{T-1}^i = 0]$$

Notice that it's possible to generalize this formulation to any previous period:

$$V_{nc}(\alpha_p^i, \alpha_c^i, I_t) = \max\{E[V_c(\alpha_p^i, \alpha_c^i, I_{t+1})|I_t, c_t^i = 1], E[V_{nc}(\alpha_p^i, \alpha_c^i, I_{t+1})|I_t, c_t^i = 0]\}$$

$$V_c(\alpha_p^i, \alpha_c^i, I_t) = E[V_c(\alpha_p^i, \alpha_c^i, I_{t+1})|I_t, c_t^i = 0]$$

## 5.2 "No-support-update" assumption

Notice that to solve the model recursively for $t < T$ it's necessary to impose another assumption.

**Assumption 2 (No support update):** The population doesn't update its beliefs on the support of private and public goods values over time - i.e. $\Gamma_t = \Gamma$ for every $t \in \{1, ..., T\}$

With this hypothesis, $V_{nc}(\alpha_p^i, \alpha_c^i, I_t)$ and $V_c(\alpha_p^i, \alpha_c^i, I_t)$ become path-independent - i.e. the value given to each state doesn't depend on the trajectory of contributions that took the campaign to it. This independence means that it is possible to derive the values of every last period scenario using the equilibria found in section 4, derive the values for the possible scenarios in $t = T - 1$ using the last period's values, and so on. Therefore, we would have an algorithm (described in the next subsection) that gives the probability of success and expected raised funds for crowdfundings with any number of periods and contributors.

However, in the absence of such an assumption, the values of the states become path-dependent, because the beliefs about other contributors' preferences depend on the trajectory of contributions. That happens because if players update their beliefs on the support of values based on the preferences revealed when others choose to contribute or not in a period, different trajectories will reveal different information on the other contributors' preferences. Naturally, this consequence makes the original strategy of finding the equilibrium through backward induction unfeasible, since the values of the last period would depend on the path to it.

Notice that excluding the hypothesis doesn't make it impossible to find a solution for the model in theory - it'd still be possible to derive the value for each state given each possible path. Nonetheless, it'd be much more computationally demanding to solve it for long crowdfundings with several contributors, making it, in practice, impossible to derive results for such cases with the current equipment. For example, if a campaign has four periods and needs 100 contributors to have success, 5151 paths take to the state $x_4 = 0$ - i.e. the scenario in which the campaign was successful before the crowdfunding's ending.

## 5.3 Equilibrium solution algorithm

We can affirm that *ex-ante* there are $N+1$ scenarios possible for any player in the last period. That happens because each scenario is defined by the $x_T \in \{0, .., N\}$ since $Cr$ and $Pop$ are predefined and constant. Therefore, from a vector of size $N+1$, it's possible to find the value of every scenario for any player at $t = T$.

Now, notice that the problem for any period is quite similar to the problem for the last one. First, suppose the probability of a random player contributing in $t$ when $x_t = x$ is given by $P_t(x)$. Now, if $bi_{n,k}(\cdot)$ is the probability density function for a binomial of parameters $n$ and $k$, we have that

$$E[V_c(\alpha_p^i, \alpha_c^i, I_{t+1})|I_t, c_t^i = 1] = \sum_{c=0}^{N-(X-x_t)-1} V_c(\alpha_p^i, \alpha_c^i, I_{t+1}(x_{t+1} = x_t - c - 1)) bi_{N-(X-x_t)-1, P_t(x_t)}(c)$$

$$E[V_{nc}(\alpha_p^i, \alpha_c^i, I_{t+1})|I_t, c_t^i = 0] = \sum_{c=0}^{N-(X-x_t)-1} V_{nc}(\alpha_p^i, \alpha_c^i, I_{t+1}(x_{t+1} = x_t - c)) bi_{N-(X-x_t)-1, P_t(x_t)}(c)$$

$$E[V_c(\alpha_p^i, \alpha_c^i, I_{t+1})|I_t, c_t^i = 0] = \sum_{c=0}^{N-(X-x_t)-1} V_c(\alpha_p^i, \alpha_c^i, I_{t+1}(x_{t+1} = x_t - c)) bi_{N-(X-x_t)-1, P_t(x_t)}(c)$$

Therefore, the possible value functions for $t$ are given by the value functions of $t+1$ and by $P_t(x_t)$. Notice that $P_t(x_t)$ is given by

$$P_t(x_t) = Prob(E[V_c(\alpha_p^i, \alpha_c^i, I_{t+1})|I_t, c_t^i = 1] \geq E[V_{nc}(\alpha_p^i, \alpha_c^i, I_{t+1})|I_t, c_t^i = 0])$$

Which, given the possible values in $t + 1$, is a non-linear function of $P_t(x_t)$. Similarly to the last period case, it'll be supposed that the agents have optimistic beliefs about $P_t(x_t)$. Under this hypothesis, it's possible to find the beliefs of equilibrium for every possible last period state using the condition established for the equilibrium in $t = T$, get the value of each state given the beliefs found, and use such values to find the beliefs of $t = T - 1$. Applying this algorithm recursively, it's possible to find the beliefs for every period and, thus predict the trajectory of contributions for any crowdfunding given an initial configuration $I_0$.

# 6 Empirical approach

## 6.1 Data

So far most empirical papers on crowdfunding used the data on Kickstarter's past projects that is publicly available. Kickstarter is currently the biggest crowdfunding platform in the world having gathered over U$ 8 billion for more than 250 thousand projects. The data available offers details on the category of the projects (e.g. Arts, technology), the duration, the number of contributors, the amount contributed, and the value needed for success, so it's been much used to study the factors that affect crowdfunding success. However, it offers little to no detail on the trajectory of contributions over time - which may be related to the current scarcity of intertemporal models

To get intertemporal data, I followed 100 projects from Kickstart and 100 from Indiegogo - the second biggest crowdfunding platform - for over a month through data scrapping. For each day, the current number of contributors, the time until the campaign's ending, the amount contributed and other data were gathered. The hope is that this data provides the material necessary for an empirical analysis of the trajectory of crowdfunding campaigns over time.

Table 1: Kickstarter

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| backers_count | 3,299 | 99.898 | 293.022 | 1 | 2,933 |
| current_ammount | 3,299 | 5,442.249 | 13,906.510 | 0.640 | 152,163.500 |
| goal | 3,299 | 7,604.458 | 13,286.870 | 10.660 | 100,000.000 |
| perc | 3,299 | 3.197 | 6.886 | 0.00001 | 39.731 |
| from_start | 3,299 | 16.557 | 9.826 | 0 | 34 |
| to_end | 3,299 | 16.193 | 18.360 | −32 | 59 |
| avg_cont | 3,299 | 59.694 | 71.429 | 0.640 | 1,060.200 |

Table 2: Indiegogo

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| backers_count | 3,299 | 12.590 | 14.350 | 1 | 113 |
| current_ammount | 3,299 | 4,756.413 | 20,814.610 | 0 | 175,035 |
| goal | 3,299 | 30,056.520 | 71,904.570 | 0 | 540,000 |
| perc | 3,297 | 0.903 | 5.737 | 0.00003 | 58.345 |
| from_start | 3,297 | 19.482 | 10.039 | 0 | 39 |
| to_end | 3,297 | 22.029 | 17.577 | −26 | 59 |
| avg_cont | 3,299 | 299.678 | 1,264.587 | 0.000 | 28,909.170 |

## 6.2 Initial Analysis

First, it's important to make it known that although Kickstarter and Indiegogo are platforms with the same objective and similar structures, they have meaningful differences, their distinct financing systems being the main one. Kickstarter operates in an "all-or-nothing" system in which if the project's goal isn't reached, the value contributed is returned to the contributors. Indiegogo operates in a "flexible goal" system in which the announcer of the project keeps the contribution even if the goal isn't reached.

Analyzing the trajectories for 20 projects of each platform, it's possible to notice that the percentage of the goal reached seems to evolve at a decreasing rate - i.e. contributions tend to slow down over. This goes against the idea that contributors would wait until the end of the project to get more information, but may be coherent with the existence of a free-rider effect - i.e. people become less likely to contribute when their contribution seems less important to the project's odds success.

In both cases, the percentage of contribution in the last period seems consistent with previous findings that indicate over 80% of projects are successful or don't reach 30% of their goal. However - possibly due to the different system of financing - Kickstarter has a success rate of almost 60%, with around 30% of projects gathering little to no resources, while Indiegogo has a success rate of only 10%, with 70% of its projects gathering almost nothing.

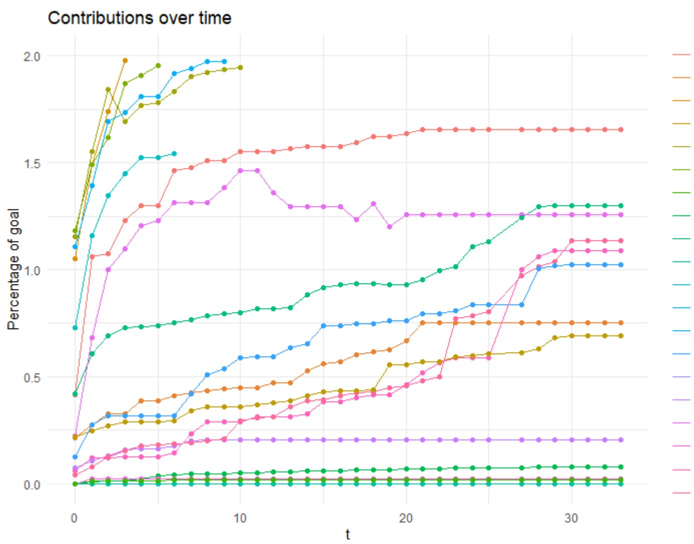


Figure 4: Kickstarter

Table 3: Kickstarter

| | Tiers of contribution | Fraction of projects |
|---|---|---|
| 1 | 0.1 | 0.24 |
| 2 | 0.2 | 0.04 |
| 3 | 0.3 | 0.03 |
| 4 | 0.4 | 0.04 |
| 5 | 0.5 | 0.02 |
| 6 | 0.6 | 0.01 |
| 7 | 0.7 | 0.03 |
| 8 | 0.8 | 0.01 |
| 9 | 0.9 | 0.00 |
| 10 | 1 | 0.00 |
| 11 | >1 | 0.58 |

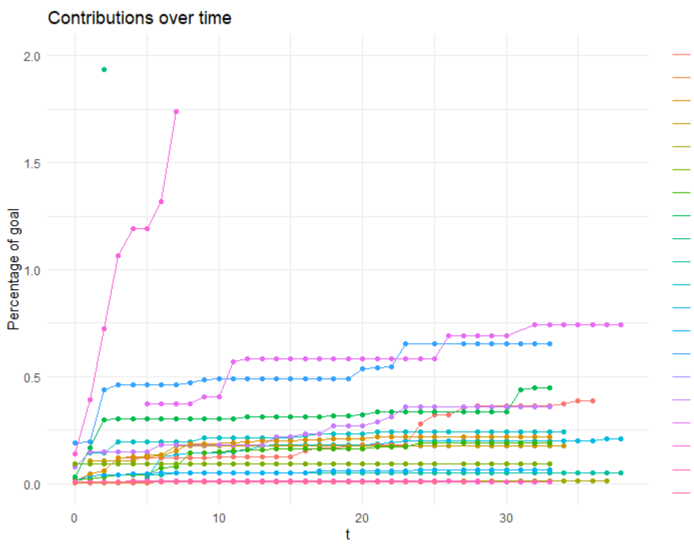


Figure 5: Indiegogo

Table 4: Indiegogo

| | Tiers of contribution | Fraction of projects |
|---|---|---|
| 1 | 0.1 | 0.46 |
| 2 | 0.2 | 0.16 |
| 3 | 0.3 | 0.08 |
| 4 | 0.4 | 0.06 |
| 5 | 0.5 | 0.09 |
| 6 | 0.6 | 0.02 |
| 7 | 0.7 | 0.02 |
| 8 | 0.8 | 0.01 |
| 9 | 0.9 | 0.00 |
| 10 | 1 | 0.00 |
| 11 | >1 | 0.10 |

Finally, when we look at how the average contribution changes over time, we see that many projects don't change much in these statistics over the campaign - especially in Kickstarter's case. This phenomenon probably happens because projects often have levels of contribution with different rewards with one of them being chosen more often by contributors (e.g. if a film, book, or game is being financed, the level that offers the product as the reward will most likely be chosen by most). This observation is positive for the model's application because it means single-contribution crowdfunding often isn't distant from real projects.

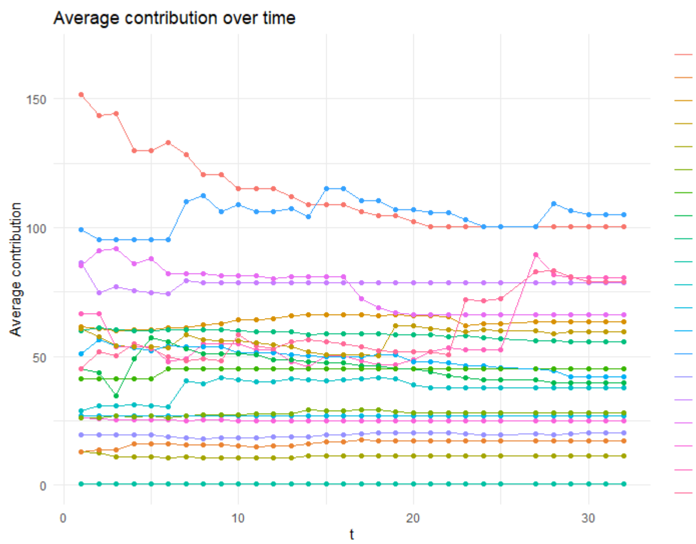


Figure 6: Kickstarter

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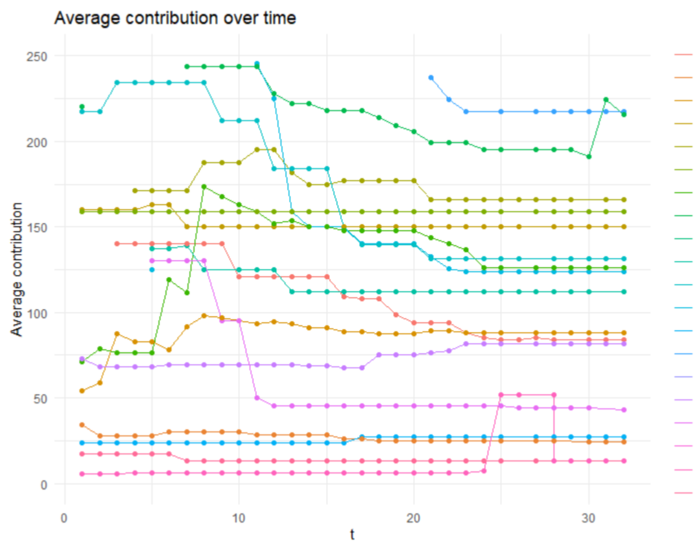


Figure 7: Indiegogo

# 8 Appendix

## 8.1 Motivation for assumption 1

Figure 8 shows how the curves for $Prob(c_T^i = 1|P)$ look under different values of $m$ - i.e. under different mean values for the goods by the contributors. First, it's easy to see that, for any $\{\Gamma, f\}$ and non-trivial $x_t > 1$, $P = 0$ satisfies the rational expectations condition - if no one believes the others are gonna contribute, then no one is gonna contribute. Second, for a given value of $m$, there are, at most, three rationalizable beliefs - the lowest being always $P = 0$ - which means there can be multiple equilibria.

Notice that for higher valuations of the good, the highest belief is the only one that increases, getting close to 1 when the mean value of the private good is much bigger than the contribution demanded. Therefore, intuitively the assumption that this belief is the one used by contributors is the one that makes the most sense.

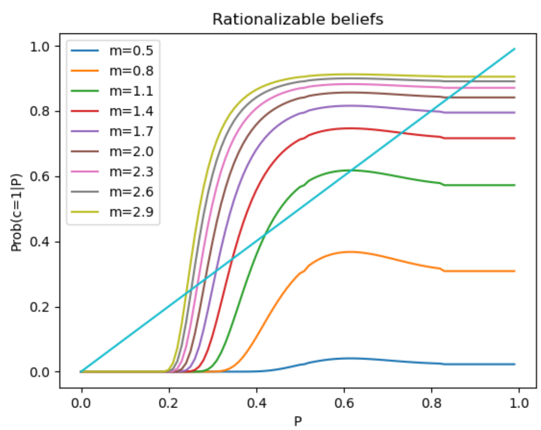


Figure 8: $P = Prob(c_T^i = 1|P)$