Crowdfunding and Online Social networks

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Abstract

Crowdfunding is gaining popularity as a viable means to raise financial capital for good causes, cultural goods, new products, and ventures. Little empirical research has been done to understand crowdfunding and basic academic knowledge of its dynamics is still lacking. By data mining the crowdfunding platform Kickstarter.com and Facebook we collected a large dataset of crowdfunding projects and the ego networks of the entrepreneurs. We study the relation of the success of the Kickstarter project to his social network and to media activities and find a scaling law that predicts the number of clicks on the project website required for a successful project. Examining the results of the social network analysis we concluded that successful initiators on Kickstarter have more friends but a sparser network. Unsuccessful entrepreneurs on the other hand have a higher average degree suggesting a denser network. Our analyses suggest that sparse, and thus diverse networks are beneficial for the success of a project.

1. Introduction

Raising financial capital is an obstacle encountered by many entrepreneurs starting up a new venture. The recent financial crisis made the barrier even higher (Block & Sandner, 2009; Pope, 2011). The difficulties of raising capital from traditional sources such as banks, business angels and venture capitalists result from constraints such as information asymmetries, transaction costs, solid plans, well-defined markets, and track records (Ebben & Johnson, 2005; Bhide, 1992; Cassar, 2004; Cosh et al., 2009). Entrepreneurs

seeking capital need to overcome these financial obstacles, or resort to alternative methods to bootstrap their start-up.

A novel and increasingly popular alternative method to raise financial capital is *crowdfunding*. Here we study the influence of online social networks on the success of a crowdfunding campaign. It will contribute to the field of entrepreneurship by improving our understanding of the way small firms use crowdfunding and online social networks to create sustainable ventures. It also gives insight in the role and composition of the social network of the entrepreneur and the crowdfunding phenomenon in general.

This paper is structured as follows. In section 2 we discuss the crowdfunding phenomenon. Section 3 will address the various studies done to unravel the phenomenon crowdfunding. Section 4 describes the problem definition and the focus of this study. The data collection will be addressed in section 5 followed by the data analysis in section 6. We will discuss our results in section 7 followed by the conclusions in section 8.

2. Crowdfunding

Crowdfunding entails the action of try[ing] to obtain capital from a large audience, where each individual will invest a very small amount (Belleflamme et al., 2010). It is used to raise capital for new venture and products development (e.g., a new video-game console); the creation and production of cultural goods (e.g., music, film and literature), and good causes such as humanitarian, charity and local government projects. The basic concept of crowdfunding is simple: "*an open call, essentially through the Internet, to provide financial resources either in the form of donation or in exchange for some form of reward and/or voting rights in order to support initiatives for specific purposes*" (Lambert & Schwienbacher, 2010). Thus, instead of a small group of traditional sources of entrepreneurial finance, entrepreneurs tap into a large crowd where each member donates a small portion of financial capital (Lehner, 2012). According to (Griffin, 2012), crowdfunding is the Internet equivalent of the old practice of collecting money, where "material or immaterial, rewards are a crucial motivation for contributing" (Kuppuswamy & Bayusm, 2013). It could also be considered as an evolution of the social mode of

resource acquisition using personal relations (Winborg & Landström, 2001). However, instead of approaching friends and family, the entrepreneur addresses anyone in the world interested in investing.

Recently, several crowdfunding platforms emerged on the Web offering functionalities to anyone with a good idea and in need of capital. They provide a marketplace where possible investors come to browse for initiatives and provide for the financial infrastructure. The most popular platform is Kickstarter. Since its beginning in 2009, 116,560 Kickstarter projects were launched and a total of $812 million dollars was invested by 4.9 million backers. In total 49,397 projects have been funded successfully and 11 million 'pledges', expressions of intent to invest by claiming a material or immaterial reward, have been made (Kickstarter.com, 2013).

3. Related work

While many anecdotal success stories on crowdfunding can be found in the popular press, the academic literature on the success of crowdfunding is scarce. One of the earliest empirical studies on the topic of crowdfunding are Lambert and Schwienbacher (2010). In their study they analysed a selection of self-hosted crowdfunding projects and found that, besides raising money, entrepreneurs have additional motivations such as getting public attention and obtaining feedback on the project. They also witnessed that non-profit projects tend to be more successful in raising financial capital. In addition, projects that offer a tangible award/product attract larger amounts of capital than those that offer a service. Building upon this study, Belleflamme et al., (2013) developed an economic model that associates crowdfunding with pre-ordering and price discrimination. They addressed the price discrimination between two groups of consumers: those who pre-order, and therefore invest, and those who wait for the product to be finished before purchasing. By offering an enhanced experience or benefits to the first group, second-degree price discrimination could result in more early investments.

Agrawal et al., (2010; 2011) examined the geography and composition of investors on the crowdfunding platform SellaBand. SellaBand allows music artists to raise money from

"believers" in order to record a professional album. While $2.3 million was invested, only 34 of the 4,712 artists reached their goal of $50,000 in an average of 53 weeks. The authors found that friends, family and fans play an important role in early investments. The average distance between artist and investor was 4,831 km and more than 75% of the financing came from investors more than 50 km away. Investors geographically close to the artist tend, on average, to invest more than the double the amount of investors further away. This is possibly due to the fact that those who co-locate with the artist have offline information (Agrawal et al., 2010).

While Lambert and Schwienbacher (2010) note that investors are more willing to invest if there is a clear tangible outcome, Hemer (2011) argues that investors are not primarily motivated by material rewards. It seems that investors are pre-dominantly motivated by immaterial rewards and intrinsic motives. Examining a large dataset of 48,526 funding efforts representing $237 million, Mollick (2013) found that projects generally succeed by small margins, or fail by large ones. The preparedness, network size and geography of the entrepreneur seem to be associated to an increased change of success. Also successful crowdfunding appears to be related to signals of quality of the proposed project and the geographic factors influence the nature and success of crowdfunding.

4. Problem definition

In the last two decades the field of entrepreneurship has recognized the importance of social capital and social networks in business development (e.g., see Aldrich & Zimmer, 1986; Hoang & Antoncic, 2001; Greve & Salaff, 2003; Casson & Della Giusta, 2007). Social capital is defined as resources embedded in one's social networks, resources that can be accessed or mobilized through ties in the networks (Lin, 2008). In the case of entrepreneurship those resources could entail access to information, knowledge, finance, skills, advice and social legitimacy (Klyver & Hindle, 2007).

Some first attempts to unravel crowdfunding concluded that social capital, the size of the network and the strength of ties seem to be of importance for the success of crowdfunding projects. Large networks still seem associated with successful fundraising

(Mollick, 2013) and strong ties are amongst the early investors (Agrawal et al., 2010 & 2011). Mollick (2013) also suggest that the promoting a project on social media helps the funding process. However, little is known about the composition and effect of the entrepreneurs' online social network. De Carolis et al., (2009) note that when it comes to bootstrapping activities, entrepreneurs draw especially on their weak tie networks. Entrepreneurs with more contacts are more likely to launch and successfully establish new ventures. Does the same apply for crowdfunding?

We consider two dimensions: attributes of the project versus attributes of the initiator including his personal network. Moreover we consider, and under control of the Initiator versus under control of the (potential) crowdfunders. We will study the relation of these attributes in relation to the success of the attempt to raise capital using crowdfunding. The following list of attributes is considered (see Table 1).

Success can be measured in several ways: as the percentage of the goal that is achieved (higher is better), as the total amount of money pledged (higher is better), as the number of days it takes to reach the goal (higher is worse), and as the number of backers. The success indicators are marked in **bold**. Of course these success indicators are not necessarily independent: a greater number of backers will likely lead to a greater amount pledged.

We will then study correlations between success and other factors. This explorative study is especially geared towards the influence of the social network, and the influence of attention on the Web. It is of necessity restricted by what we could data mine. We finally have to explain these correlations, and discuss possible causal relationships explaining correlations.

Table 1: Attributes of the project versus attributes of the initiator

Success in relation to:	**Attributes Project**	**Attributes Person**
Control by Initiator	• Goal Amount • Category • Location, currency • Start/End date • Updates • Signs of viability such as availability Video, availability Picture, awards received for project etc.	• Number of projects initiated earlier • Presales • Sales of previous projects • Awards received as person • Education received • Facebook account, LinkedIn profile etc.
Control Crowdfunder	• **Number of backers** • **Amount Pledged** • **Duration until Success** • Number of clicks on Website • Referrals via Google, Facebook, LinkedIn, YouTube, Google+ • Number of comments • Number of Facebook shares	• Number of Facebook friends • Links between Facebook Friends and resulting social network (having properties like connectedness and density and number of components)

5. Data collection

For this study we have constructed a list of successful and unsuccessful crowdfunding projects on Kickstarter that started between the 1st of January and ended before the 1st of June. Kickstarter only displays recent and on-going projects. We therefore collected a list of 31,371 successful and unsuccessful projects from The KickBack Machine, which keeps track of all projects on Kickstarter, both successful and unsuccessful. The KickBack Machine positions itself as a research tool that allows others to browse crowdfunding successes and failures in order to learn and improve project planning (The

KickBack Machine, 2013). It was accessed during the first week of September 2013. From this list, projects that started in 2013 were selected as the main sample for this study. This resulted in a final list of 8,234 successful and unsuccessful projects. Additional data on these 8,234 projects was accessed from publicly available information on the Kickstarter website.

When the project profile linked to a personal Facebook account we retrieved the number of friends and the full URL of the account. To study the impact of social media on the project, detailed information of the link statistics of the project page were accessed through the Bitly API. Available statistics include the number of clicks during the period the link was shared (e.g., on Facebook, Twitter and YouTube) as well as the geographic distribution of clicks. Bitly is an URL shortening and bookmarking service that shortens a long URL such as http://www.kickstarter.com/projects/ouya/ouya-a-new-kind-of-video-game-console/ into http://kck.st/Mfvs9y. This makes the link easier to share e.g., on Twitter where the number of characters in a post is limited.

To study the online social network of the entrepreneur, we mined the ego network of the initiator that linked to a Facebook account by checking whether friend relations exist amongst the friends of the initiator. This is extremely time consuming and is rapidly becomes infeasible as the number of friends n increases (the algorithmic complexity is $O(n^2)$, even assuming that Facebook would service our requests). We therefore made a further random selection of 100 successful and 100 unsuccessful projects among the projects that linked to a Facebook account choosing 25 successful and unsuccessful projects from each of the four quartiles of the number of Facebook friends.

6. Data analysis

For our data analysis we tested whether correlation exists between the number of Facebook friends, and the number of Bitly referrals on the one hand and the number of backers, the amount pledged, the fraction of the goal reached and the duration on the other hand. We also considered internal correlations. Since the data varies by several orders of magnitude between projects, we use logarithmic scales (to base 10) except for

the duration. This turns out to give quite reasonable distributions. For interpretation purposes, we also considered the amount pledged per backer even though this indicator clearly depends on the other success indicators (even linearly after taking logarithms).

To study the network of the initiator, we made an undirected graph visualizations with the open-source tool Gephi. From each network we calculated the average degree, network diameter, average path length, number of shortest paths in the network, graph density, modularity, number of found communities and the number of weakly connected components.

7. Results

Table 2 displays the dataset we collected. In total we collected 8,234 projects. Of these projects, 3,785 (45.9%) were successful, 3,797 (46.1%) were unsuccessful, 634 (7.7%) were cancelled and 18 (0.3%) were suspended. The largest categories were found to be Film & Video, Music and Publishing. Technology was found to be the smallest category.

Table 2: The number of project retrieved per category

Category	Total	Successful	Unsuccessful	Cancelled	Suspended
Art	718	350	333	34	1
Comics	256	161	83	11	1
Dance	89	71	17	1	0
Design	528	202	253	70	3
Fashion	436	138	259	35	4
Film & Video	1803	813	829	158	3
Food	392	183	185	23	1
Games	672	261	312	97	2
Music	1535	911	557	67	0
Photography	203	72	120	11	0
Publishing	1042	344	611	86	1
Technology	291	109	149	31	2
Theater	269	170	89	10	0

The success of Kickstarter projects varies wildly between different projects. Figure 1 gives the distribution of goal amount in Dollar (Min = 1, 1st Qu =2,000, Med =5,000, Mean = 31,930, 3rd Qu = 15,000, Max = 31,000,000), pledged amount in Dollar (Min = 0, 1st Qu = 186, Med = 1,433, Mean = 11,020, 3rd Qu = 5,510, Max = 5,702,000) and percentage of the goal reached (1st Qu = 3.0, Med = 40.7, 3rd Qu = 113.2). We can clearly see the very sharp peak at 100% of the percentage of the goal reached (please note the log scale necessary and the enormous variation) Figure 2 gives the distribution of number of backers (1st Qu = 4, Med = 23, 3rd Qu = 75), goal per backer (1st Qu =50, Med = 178, 3rd Qu = 1570), and pledged amount per backer (1st Qu = 31.1, Med = 51.2, 3d Qu = 84.2). We added 0.1 to the number of backers, which after taking logarithms is essentially mapping 0 backers to -1 and leaving all others unchanged. We see that a non-negligible number of Kickstarter projects attract no backers at all (614 or 6.5 %). We can also see that the goal per backer has a rather broad asymmetric distribution with a lot of mass to the right of the mode (the peak) leading to a median well above the median for the amount per backer pledged. We can also see that the distribution of the pledged amount per backer is clearly bimodal. The high backers (pledged > 5000$) are almost all associated to successful projects, with very few backers, whereas the amount the low backers pledge is essentially independent of the number of backers (1st Qu = 31.1, Med = 50.0, 3rd Qu = 80.8).

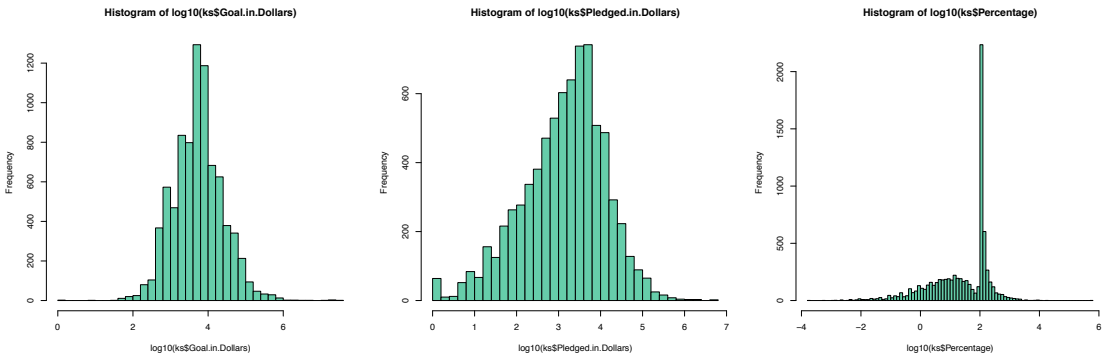

Figure 1: Distribution of goal amount, pledged amount and percentage of goal pledged (N=8324)

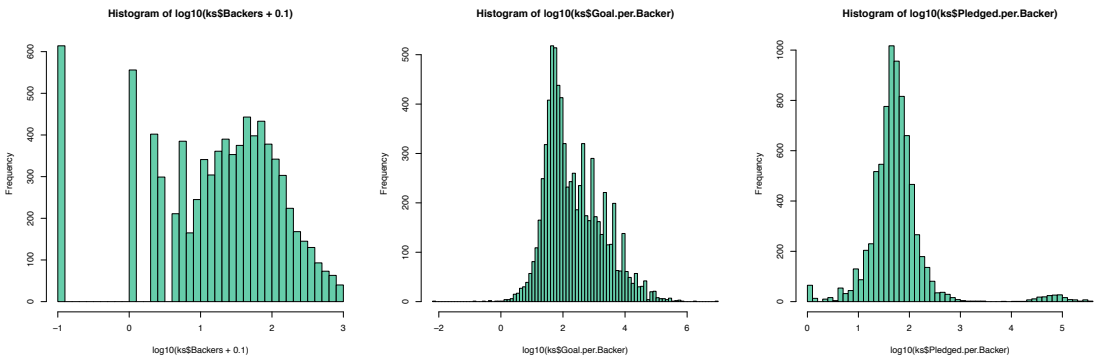

Figure 2: Distribution of Backers, Goal/Backer and Pledged/Backer (N=8234)

To see whether success depends on backers, goal and duration we plotted percentage of goal pledged versus the number of backers (log, log), goal (log, log) and duration (log, linear) (Figure 3). We can see that the likelihood for success is strongly dependent on the number of backers, and decreases as the goal increases (except for a very few projects with extremely large goal) (Figure 4) and is essentially independent of the duration of the crowdfunding period (30 or 60 days being typical).

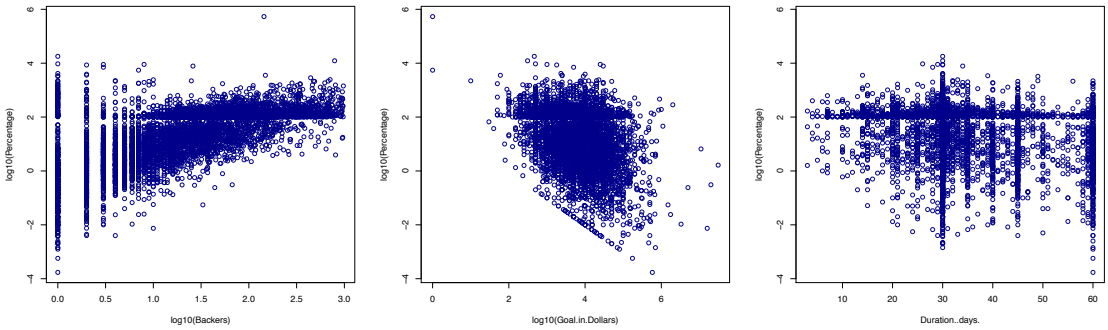

Figure 3: Percentage pledged versus number of backers, goal and duration

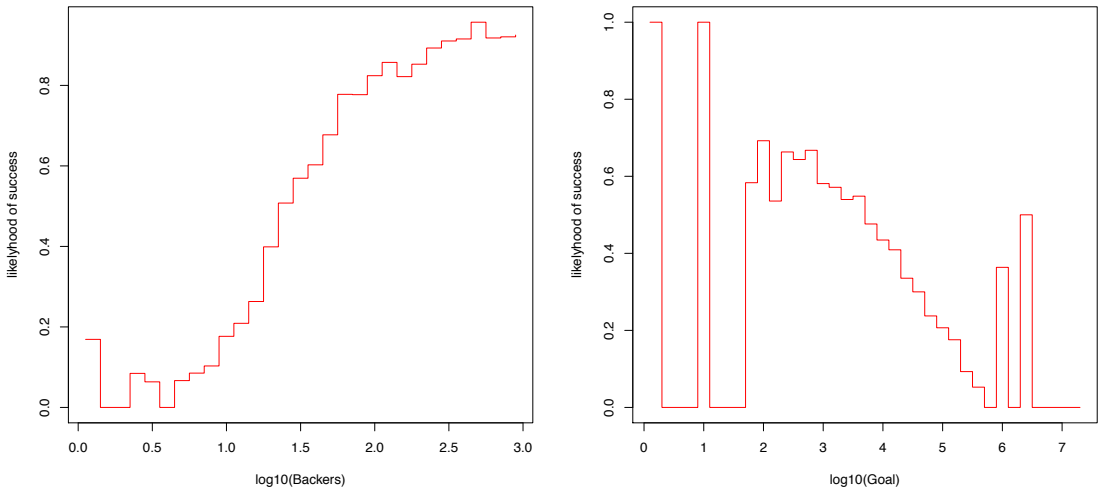

Figure 4: Likelihood of success versus number of backers and goal

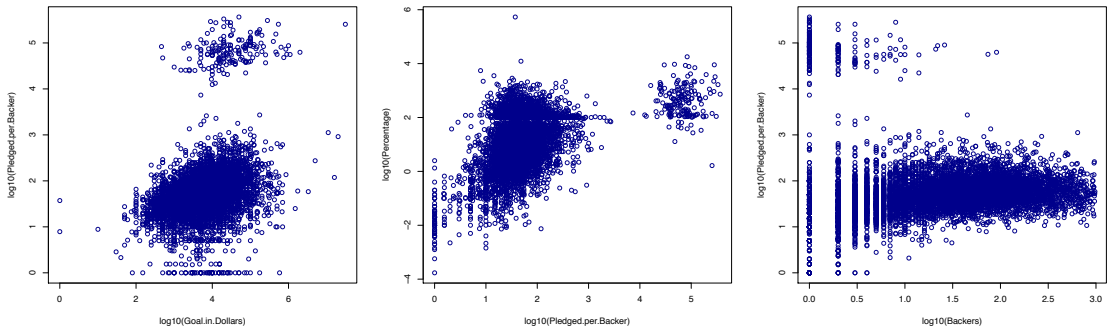

Figure 5: Scatterplots of pledged per backer versus Goal in Dollars, Percentage pledged versus the amount pledged per backer, and amount pledged per backer versus number of backers

The goal amount and the number of backers (Figure 5), the percentage of the goal attained versus pledge per backer (Figure 5), and number of clicks (Figure 6), shows clear differences for the high backers (pledge per backer > $5,000): very few backers (mostly just 1), high goal and very many clicks. The pledge per goal in the low backer case (< $5,000) is correlated with the goal (corr.($\log_{10}$(Pledge/Backer), $\log_{10}$(Goal)= 0.31, 95% conf interval = [0.29, 0.33], regression: $\log_{10}$(Pledge/Backer) = (0.96 +/- 0.03) + (0.195

+/- 0.007) $\log_{10}$(Goal)), residuals: 1st Qu = -0.167, Med = 0.029, 3rd Qu = 0.209, residuals : 1st Qu = -0.22, med= 0.07, 3rd Qu = 0.30)

The number of backers is strongly correlated with the number of clicks (except for the high backers), the strength of the correlation and the precise regression depend on the source of the clicks however (see Table 2). Doing a regression on all of Facebook, Twitter and Miscellaneous clicks gives a regression: $\log_{10}$(Backers) = (0.22 +/- 0.03)$\log_{10}$(FB-Clicks) + (0.101 +/-0.017))$\log_{10}$(Twitter-Clicks) + (0.16 +/- 0.02) $\log_{10}$(Misc.-Clicks) + (1.17 +/- 0.03)(residuals: 1st Qu = -0.22 Med = 0.03 3rd Qu = 0.26)

Table 2: Correlation coefficients and regression of $\log_{10}$(Backers) verus $\log_{10}$(Bitly clicks via<Source>). We always assume we assume Clicks > 5, Backers > 5, and Pledge/Backer < 5000$

Bitly Clicks	**Pearson corr. coeff.**	**95% Conf. Interval**	**Slope**	**Std dev. Slope**	**Intercept**	**Std dev Intercept**
Total	0.67	0.66 - 0.69	0.500	0.007	0.808	0.015
Via Facebook	0.59	0.56 - 0.61	0.513	0.011	0.98	0.02
Via Twitter	0.42	0.38 - 0.45	0.330	0.014	1.46	0.03
Via Miscellaneous	0.51	0.48 - 0.53	0.380	0.010	1.26	0.02

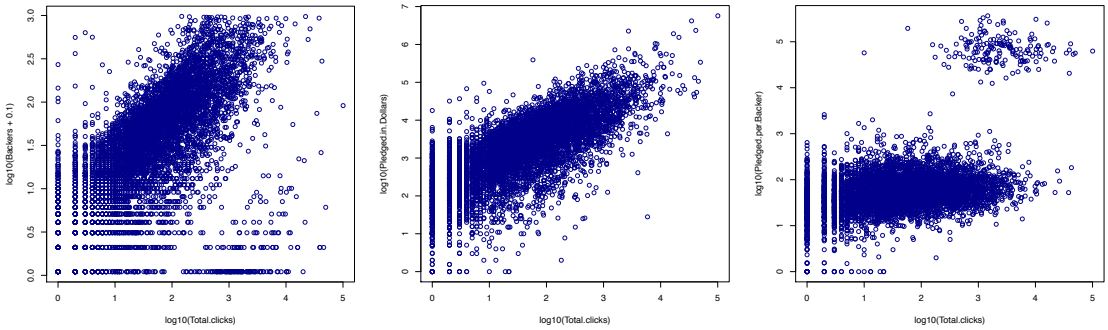

Figure 6: Backers, pledged amount and pledged amount per backer vs total number of clicks

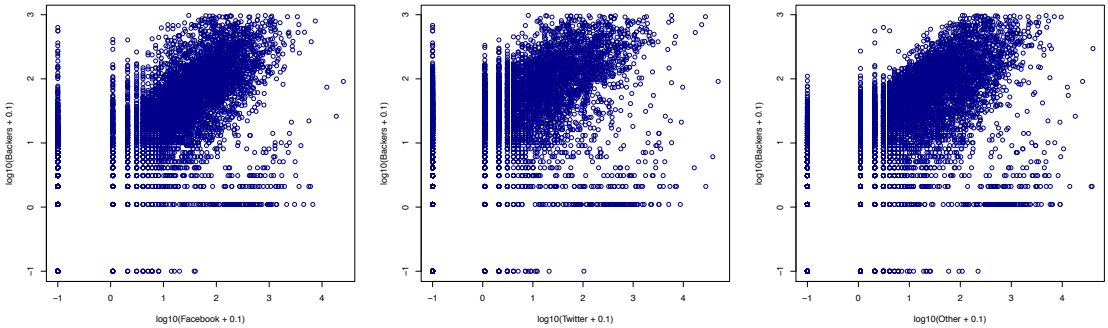

Figure 7: Backers versus number of clicks from Facebook, Twitter and miscellaneous sources

The size of the Facebook network is a much poorer predictor of the success (**Figure 8**, **Figure 9**). There is a small positive correlation with the percentage of the goal raised (see Table 3), assuming normal backers, that the number of backers > 0, and the number of Facebook friends > 5, and. We find essentially no correlation with the amount pledged per backer for the normal backers. Under the same assumptions, we find a small correlation with the number of backers and a corresponding correlation of the amount pledged.

Table 3: Percentage, pledge per backer, number of backers and total amount pledged versus number of Facebook friends assuming Number of Facebook friends > 5, pledged amount > 0 and pledged/backer < $5,000

Quantity	**Pearson corr. coeff.**	**95% Conf. Interval**	**Slope**	**Std dev. Slope**	**Intercept**	**Std dev Intercept**
Percent.	0.21	0.19 - 0.24	0.46	0.03	0.21	0.07
Pledg/Bck	0.08	0.05 - 0.10	0.065	0.012	1.52	0.03
Backers	0.23	0.20 - 0.25	0.34	0.02	0.53	0.06
Pledged	0.21	0.18 - 0.23	0.41	0.03	2.05	0.07

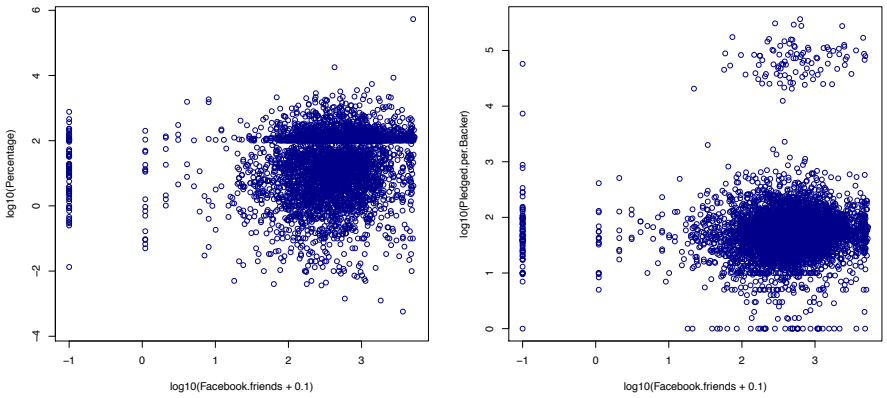

Figure 8: Percentage goal attained and amount pledged per backer vs number of Facebook friends

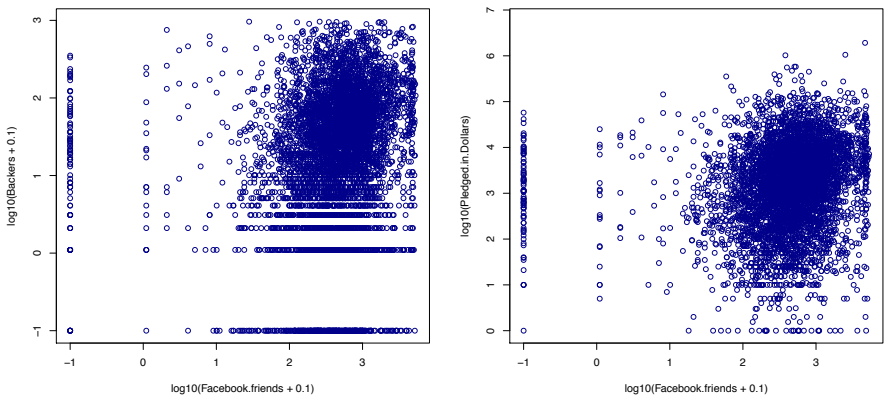

Figure 9: Number of backers and total pledged amount versus number of Facebook friends

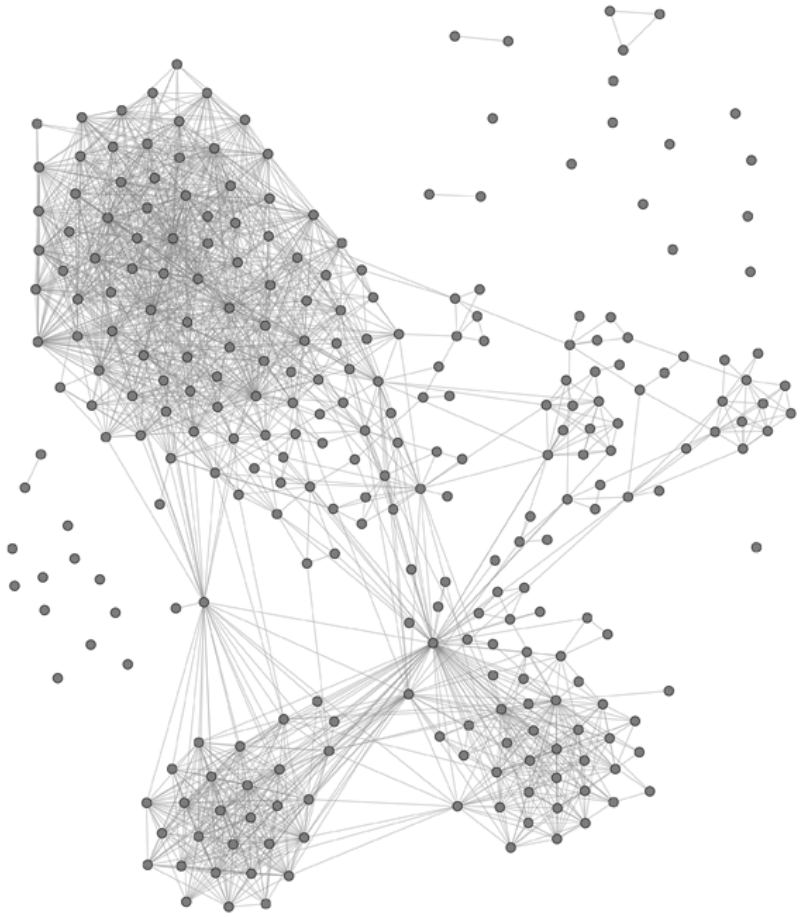

Figure 10: The Social Network Visualization Of An Entrepreneurs Facebook Profile Who Found Sufficient Funding For The Project Number Of Nodes = 276, Number Of Edges = 1,833. Average Degree = 13.3.

Examining the networks (see Table 4) we found that on average successful entrepreneurs have more friends with the exception of the third quartile (Q3) of the number of Facebook friends. However, successful entrepreneurs tend to have less edges (friend relationships) with the exception of Q2. On average, friends of unsuccessful entrepreneurs (with exception of Q1) have more Facebook friends in the network. The network of a successful entrepreneur has a greater diameter, longer path length and more short paths (with exception of Q3). Successful entrepreneurs have a sparser network and a higher modularity was witnessed. The number of communities and weakly connected components gave no conclusive insights.

Table 4: Network metrics of 200 entrepreneurs.

Network metric	Outcome	Q1	Q2	Q3	Q4
Nodes	Successful	150.76	334.92	617.88	1337.8
	Unsuccessful	130.8	317.16	633.12	1258.8
Edges	Successful	843.6	2530.88	8784.96	34807.8
	Unsuccessful	721.08	3090.88	9259.92	35981.75
Average Degree	Successful	9.63	15.14	27.26	46.62
	Unsuccessful	9.21	18.07	28.66	55.09
Diameter	Successful	7.12	8.52	8.96	9.25
	Unsuccessful	6.88	7.88	8.84	8.85
Average path length	Successful	2.84	3.27	3.25	3.05
	Unsuccessful	2.81	3.22	3.10	2.97
Graph density	Successful	.072	.046	.043	.034
	Unsuccessful	.080	.055	.045	.043
Modularity	Successful	.51	.52	.53	.47
	Unsuccessful	.46	.51	.51	.45
Number of communities detected	Successful	23.32	31.56	49.36	76
	Unsuccessful	23.84	29.84	54.44	72.4
Number of weakly connected components	Successful	19.2	25.52	42.12	68.1
	Unsuccessful	20.44	23.88	47.8	64.95

Number of Facebook Friends: Q1 $\leq$ 231, Q2 between 232 and 490, Q3 between 491 and 916, Q4 $\geq$ 917.

8. Conclusions

Our statistical analysis points to two very different strategies to succeed at Kickstarter. In the high backers case (Pledged amount > 5000) we see that one or a very small number of backers come up with the entire sum of money, even though the sums are large by Kickstarter standards (Min = \$7,000, 1st Qu = \$67,220, med = \$107,200, 3rdQu = \$182,900, max = \$5,702,000). These projects also have lots of clicks on the project page. Thus it seems that these projects mainly come to Kickstarter because of the public attention, and feedback, being a successful Kickstarter project creates, which might, in turn, be helpful in raising more capital from other sources.

The other strategy is finding enough backers. The amount pledged per backer increases much slower than the goal amount and can be fitted (within a factor 1.5 either way in half the cases) to

$$\text{Pledge/Backer} = 9 * \text{Goal}^{0.20}$$

The number of backers, on the other hand, is reasonably predicted (within a factor 2 in half the cases) by the number of clicks (assuming Clicks > 5):

$$\text{Backers} = 6.4 * \text{Clicks}^{0.50}$$

Thus, as a rule of the thumb, we can compute the (minimum) number of clicks required to have reasonable chance for a Kickstarter campaign as

$$\text{Clicks for success} = 3*10^{-4}\text{Goal}^{1.6}$$

All things being equal, this scaling law makes it very difficult to raise more than about \$1 million with low backers, which according to our rule of the thumb would require about 1,200,000 clicks (the maximum we found was about 100,000 clicks). A \$5,000 project requires a mere 250, however.

Not all media are equally effective. Assuming the project is interesting enough that it has at least 5 clicks each via Facebook, Twitter and Other sources we find (within a factor 1.8 in half the cases)

$$\text{Backers} = 14.8 * \text{Clicks}_{FB}^{0.22}\text{Clicks}_{Twit}^{0.10}\text{Clicks}_{Misc}^{0.16}$$

We find only a very small correlation with the umber of Facebook friends. It seems that the man benefit from having a large number of Facebook friends is making it as a starting point for consciously bringing the project under the attention of a few hundred to a few thousand people, but without others in the personal network of the initiator picking it up it is unlikely to generate enough attention. This starting point effect might already explain the small correlation with the number of Facebook friends.

We found that crowdfunding is primarily used for projects in the cultural sector. The amounts being raised vary enormously but many are relatively small, (median = $5,000). Actually raised amounts are significantly smaller (med = 1,433). Kickstarter projects only get funding if they raise their requested amount and indeed we see a sharp peak at 100% pledged of the goal amount.

Some projects seem to be backed by one or very few backers which pledge a large sum just to get the attention of being a successful Kickstarter project. The normal low backer success rate increases sharply with the number of backers and decreases sharply with (logarithm of) the goal amount. This can be easily explained by the fact that the pledge/backer increases only slowly with the goal. The number of backers is strongly correlated with the number of clicks the project gets and increases proportional to the square root of the number of clicks. There is only a small (but positive) correlation with the number of Facebook friends which might be explained by the fact that a large network makes it easier to use as a seed for creating more attention.

Examining the results of the social network analysis we could conclude that successful initiators on Kickstarter have more friends but a sparser network. Unsuccessful

entrepreneurs on the other hand have a higher average degree suggesting a denser network. Our analyses suggest that sparse, and thus diverse networks are beneficial for the success of a project. This is in line with De Carolis et al., (2009) who suggest that entrepreneurs draw especially on their weak tie network for bootstrapping activities.

This paper should be relevant to sectors such as the creative industries where the majority of entrepreneurs consist of individuals and small innovating firms. Such individuals and small firms do not have the same financial firepower as larger firms and need to find other solutions to acquire traditional financial capital. Crowdfunding could be one of these solutions but this paper indicates that it is heavily depended on getting enough attention and becomes increasingly more difficult when funding above $10,000 is required because of the scaling law in the number of clicks.

9. References

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