The Effects of Network Structure Upon Venture Capital Fundraising

CS 442
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ABSTRACT

There is a common saying among businessmen that success has less to do with what you know, and more to do with who you know. In this paper, we investigate the effects of implicit relationships among startup founders and investors as they relate to the amount of venture capital a startup can raise. We ultimately conclude that network position does not have a positive bearing on a startup's tendency or ability to raise funding.

1. INTRODUCTION

In the late 90's, the technology industry (specifically, web-based companies) experienced what is known as the "Dot-Com Bubble" – a period of very high venture capital funding for businesses that proved to be insolvent and unsustainable.

This leads us to suspect that there were certain indices of influence besides an objective evaluation of the startup's business model that affected investment firms' tendencies to trust high-risk ventures with large amounts of capital. Specifically, we hypothesize that if a startup has a favorable position in the broader technology network, it would be prone to raising higher amounts of capital than startups who have less favorable positions. The reason is because a startup with a favorable position in the network might be able to take advantage of its potential access to experienced mentorship, valuable employees, or industry alliances. This sort of knowledge has been demonstrated to peak in tightly connected, small world networks, which, presumably, startups with good positions in the network occupy. [1]. In addition, firms in networks with high reach and high clustering have been shown to have greater innovative output. [2] Presumably, these indices, in addition to a startup's business model and traditional profit metrics, might factor into an investment firm's consideration and make it appear less risky and likelier to provide a larger return on investment.

2. METHODS

2.1 DATA

We scraped all of the data from Crunchbase (www.crunchbase.com). Crunchbase is an online encyclopedia of startups, founders, investment firms, and investors. It is a very robust dataset and just about every notable entity in the startup world has a listing on Crunchbase, as well as the relationships that entity has with other entities. For example, we might see a profile for Founder W, who has founded Company X, which was funded by Firm Y, in which Investor Z is a partner. From this data, we built two graphs - the first, a bi-partite, directional graph where nodes are either Investment Firms or Startups, with weighted edges representing the amount of money a Firm has invested into a Startup. We treat angel investors as Firms, and we allow edges between Startups and Startups (where a larger company invests in, but does not buy, a smaller one. There may be semantic disagreements here - for example, few would consider a companies like Intel or Facebook to be startups. This is irrelevant for the purposes of the graph).
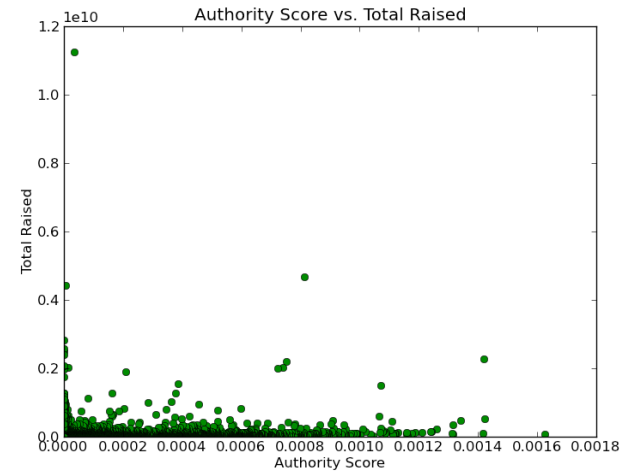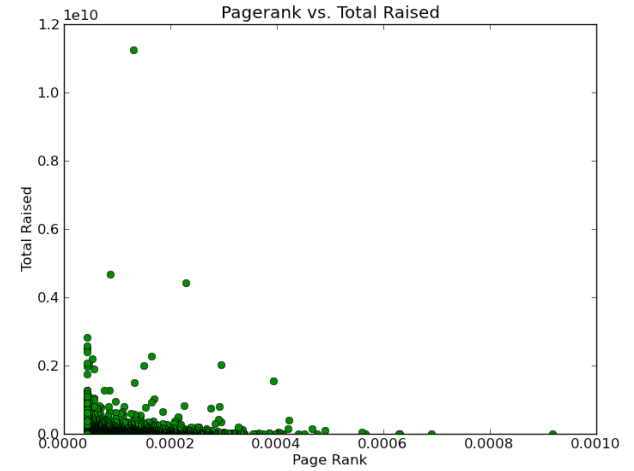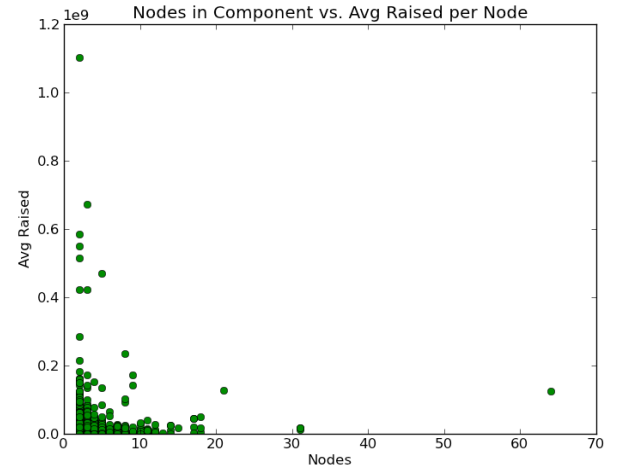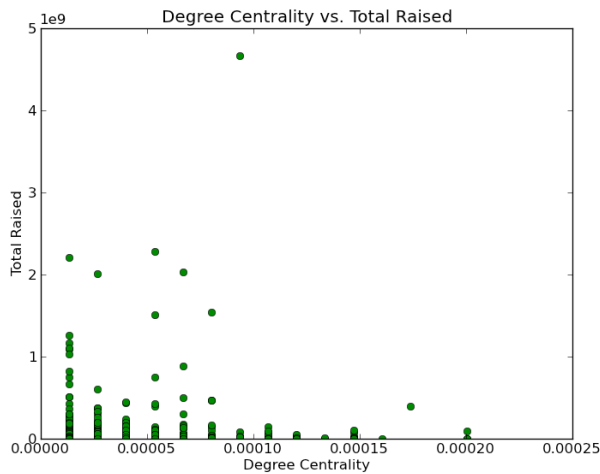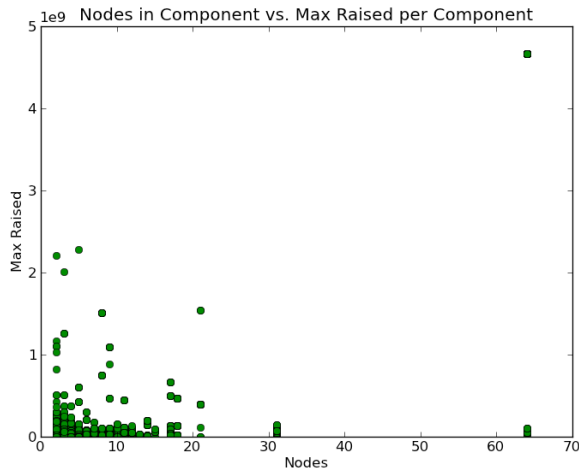
2.2 ANALYSES

The analyses revolved around visualizing the relationships between a startup's various link analysis scores against the total amount of money it raised. We define a higher score in all of the following algorithms as being indicative of a "favorable position within the network." For the bi-partite investments graph, the algorithms included PageRank and the Kleinberg HITS; for the latter, the authority scores were graphed against the total amount raised per startup.

These two algorithms are relevant because they measure the amount of importance the venture capital community as a whole ascribes to any given startup. We note that a startup who is funded by a prominent firm will have a higher PageRank and authority score, and this should signal to other investment firms that the startup is indeed valuable, according to the authoritative nodes. This should

induce less authoritative nodes to invest in these companies as well, driving up the total amount raised per startup.

For the shared founders graph, the graph was measured as follows: the nodes in a component vs. the average raised per node, the nodes in a component vs. the max amount raised per component, and the degree centrality of a node vs. the total amount raised. Degree centrality is calculated by the fraction of total nodes any given node is connected to. Presumably, nodes with shared founders have greater access to the value implicit in the network, because the shared founder will be able to use his/her own personal network to the benefit of all the companies he/she started - and the more companies any given founder is involved in, the likelier it is to be that this personal network is very valuable.

Nodes in Component vs. Max Raised per Component

Degree Centrality vs. Total Raised

Nodes in Component vs. Avg Raised per Node

Pagerank vs. Total Raised

Authority Score vs. Total Raised

3. RESULTS

We expect an upward trend in each case, which would support our hypothesis. Startups with higher PageRank and authority scores presumably have

more favorable positions in the network and should thus be likelier to be funded larger amounts. In addition, we stipulate that startups within larger components of the shared founder network have access to more network resources and so should appear more valuable to investors. In these cases, the max raised per component, as well as the average raised per node, should increase with component size. The same should hold for a startup with a high degree centrality.

On the contrary, we see that every single graphed measure trends downward. As authority and PageRank scores increase, the total amount raised decreases, and the same generally holds for all other measures.

4. CONCLUSIONS AND FUTURE WORK

The results seem to indicate that an investment firm considers much more than a startup's network status when deciding to invest, and that startups with better positions in the network actually appear less valuable. However, they could also indicate the opposite: that a startup with a favorable position in the network does not seek as much funding as startups with a lesser positions. This could be because these startups with better positions are effectively utilizing their network's resources. Perhaps startups with less favorable positions in the network cannot compete with the value implicit in this except by aggressively raising venture capital funding.

Of course, the amount of funding a startup acquires is no real measure of success. It would very interesting to see if we defined "success" for a company as a measure of its growth, profit, or consumer perception, and see if these vectors increase with a startup's better positions in the network.

5. REFERENCES

[1] Robin Cowan, Nicolas Jonard.
Network structure and the diffusion of knowledge, Journal of Economic Dynamics & Control 28 (2004)
[2] Melissa Schilling and Corey Phelps. Interfirm Collaboration Networks: The Impact of Large-Scale Network Structure on Firm Innovation. Management Science (2007)