




A Social Network Analysis of Venture Capital

Anuj Menta, Aneri Dalal,
Cole Smith, Nivedita Ganesh



Hypothesis

- Corporate VC firms invest heavily in startups working on industries aligned with their parent company as compared to VC firms
- The **effective size** of Corporate VC firms in a social network of Venture Capitalists is higher than the effective size of VC firms
- A social network of VC firms **is more closely knit** as compared to a social network of Corporate VC firms
- The bipartite social network formed by VC firms and startups **obey the power law** (rich get richer phenomena)
- The bipartite social network formed by VC firms and startups has a **very high network density** (>0.5)
- The network of Corporate VC firms follows **Strong Triadic Closure** more than the network of VC firms

Refutability

- Corporate VC firms invest heavily in startups working on industries aligned with their parent company as compared to VC firms
 - Calculate diversity coefficient
- The effective size of Corporate VC firms in a social network of Venture Capitalists is higher than the effective size of VC firms
 - Calculate effective size of every node and compare
- A social network of VC firms is more closely knit as compared to a social network of Corporate VC firms
 - Compare network densities

Refutability

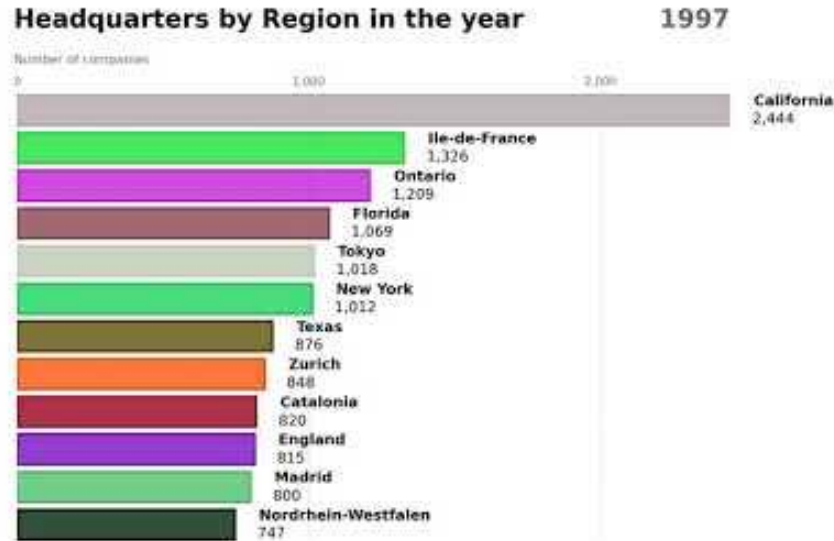
- The bipartite social network formed by VC firms and startups obey the power law (rich get richer phenomena)
 - Plot in-degree and out-degree and check if they resemble the power law plot
- The bipartite social network formed by VC firms and startups has a very high network density (>0.5)
 - Calculate network density
- The network of Corporate VC firms follows Strong Triadic Closure more than the network of VC firms
 - Calculate transitivity of networks of CVC and VC separately



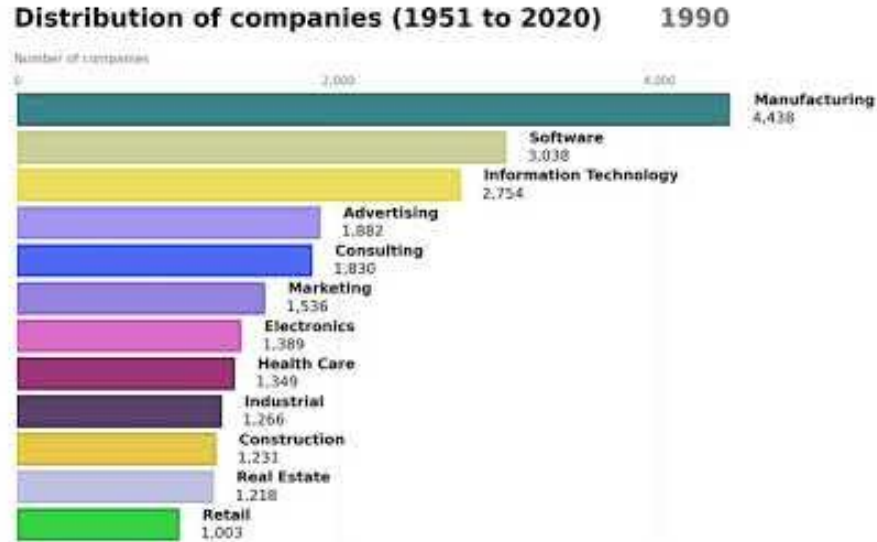
Visualizations



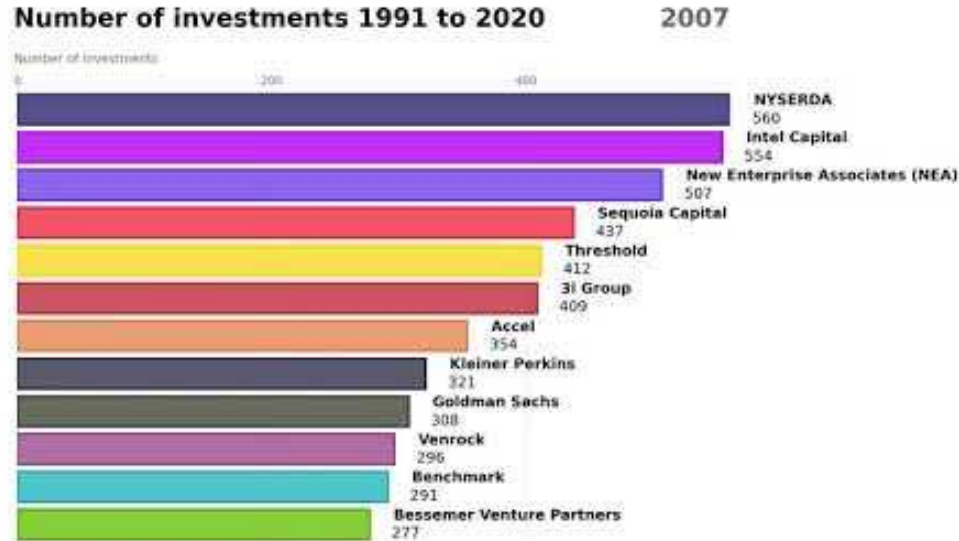
Distribution of Companies Founded by Location



Distribution of Companies by Type Over Time



Number of Investments Made by VC Firms Over Time



Dataset attributes

Attribute	Value
Number of VC Firms	17,034
Number of CVCs	725
Number of companies	787,545
Number of investments	287,436
Compute time (total)	~40hrs
Source	Crunchbase

Diversity Coefficient

The diversity coefficient is structured to quantify the diversity of the type of companies a VC firm invests in. The higher the diversity coefficient, the less spread out the investments are. The diversity coefficient is defined as:

the Standard Deviation of the frequency distribution of types of companies a VC firm has invested in.

Example:

Software	40
Healthcare	35
Fintech	31
Blockchain	16

Diversity Coefficient

Hypothesis: Corporate VC firms invest heavily in startups working on industries aligned with their parent company as compared to VC firms

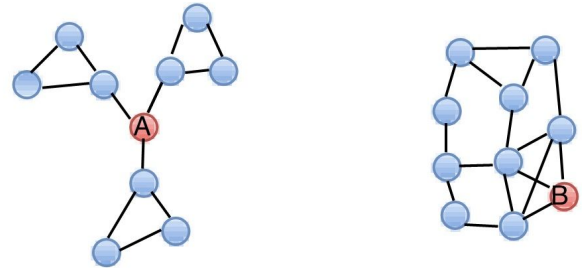
Total Number of VC firms	17,034
Mean diversity coefficient of all VC firms	0.37
Mean diversity coefficient of CVC firms	6.30

Network Effective Size

The **effective size** of a network, from a given node, is the **number of non-redundant contacts** among its immediate contacts. Bert's Formula:

$$\text{Effective size of } i\text{'s network} = \sum_j \left[1 - \sum_{q \neq i, j} p_{iq} m_{jq} \right],$$

The summation indicates the *redundancy* of connections for each of i 's contact j . This is related to **structural holes**, which are influential nodes that link larger networks. They act as **information liaisons**.



Effective size of the network (for every VC firm):

Definition of our network: We plot a graph where a node V is a VC and an edge E exists between two VC firms if they have ever made an investment in the same company at any point in time. For every edge in this graph, we calculate the effective size of the network for every node.

Hypothesis: The effective size of Corporate VC firms in a social network of Venture Capitalists is higher than the effective size of VC firms

Another interpretation of the Hypothesis is that Corporate VC firms act as structural holes in a social network of VCs

Top 10 VCs

Venture Capital	Effective Size
Wavemaker Partners	986.54
Vertex Ventures	949.82
Highland Capital Partners	945.25
Matrix Partners	945.13
IDG Capital	944.30
U.S. Venture Partners (USVP)	913.95
Trinity Ventures	906.66
BDC Venture Capital	847.05
Tech Coast Angels	842.92
Bpifrance	828.23

Top CVCs

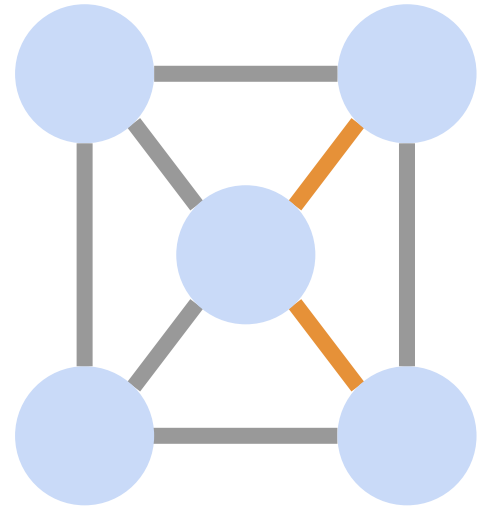
Corporate Venture Capital	Effective size
Intel Capital	2872.49
Salesforce Ventures	1565.54
Tencent Holdings	1523.37
Qualcomm Ventures	1322.19
Bain Capital Ventures	1070.52
Wayra	707.72
Brand Capital	339.44

**Corporate VC firms acts as
structure holes in the network**

Network Density

The network density indicates how tightly knit the entire network is. The density is defined as the number of edges in the network over the total number of possible edges. So, the higher the density, the more compact the network is.

The network density of the network of all VCs as previously defined is 0.00044. Meaning, **only 0.044% of the possible connections exist.**



Density =

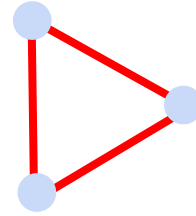
$$\frac{\text{Orange}}{\text{Gray} + \text{Orange}}$$

Transitivity

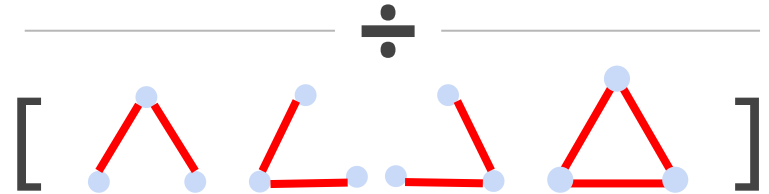
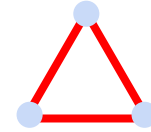
Transitivity is the ratio of all triangles over all possible triangles. A possible triangle exists when one person (Fox) knows two people (Fell and Whitehead). So transitivity, like density, expresses **how interconnected a graph is in terms of a ratio of actual over possible connections.**

The transitivity for the graph previously defined is **0.1089**.

Triadic Closure:



Clustering Coefficient:



Transitivity (CVC vs. VC)

We plotted networks by isolating the nodes which are Corporate VC firms and VC firms. The following are the transivities of each of the networks

We notice that the network of Corporate Venture firms follows the Strong Triadic Closure property **more** than the network of VC firms.

Hypothesis: The network of Corporate VC firms follows **Strong Triadic Closure** more than the network of VC firms

Network of Corporate VC	Network of VC
0.2025	0.1544

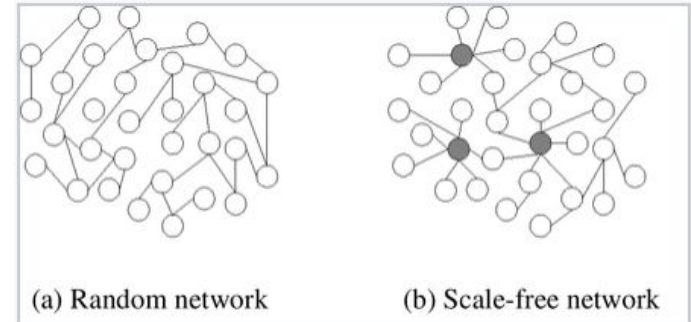
Power Law in Social Networks

Also known as the **'Rich get richer phenomena'**

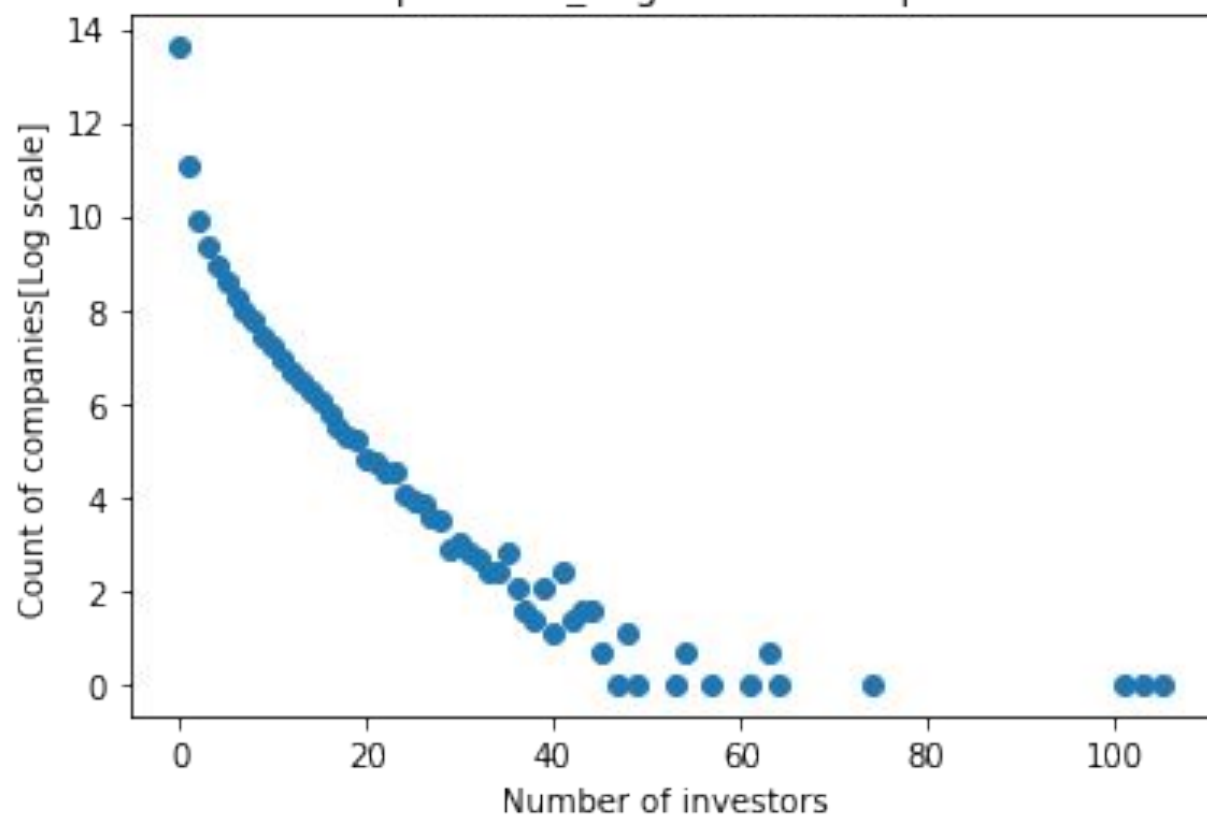
We say that a social network follows the power law if the fraction $P(k)$ of nodes in the network having k connections to other nodes goes for large values of k as

$$P(k) \sim k^{-\gamma}$$

A network that follows the power law is also called a scale-free network. A scale-free network has what we can call 'hubs' which are often the highest-degree nodes



plot of in_degree of startups



Results

- Corporate VC firms invest heavily in startups working on industries aligned with their parent company as compared to general VC firms
- The effective size of Corporate VC firms in a social network of Venture Capitalists is higher than the effective size of generic VC firms
- A social network of VC firms is more closely knit as compared to a social network of Corporate VC firms
- The bipartite social network formed by VC firms and startups obey the power law (rich get richer phenomena)
- The bipartite social network formed by VC firms and startups has a very high network density (>0.5)
- The network of Corporate VC firms follow Strong Triadic Closure more than the network of VC firms



Thank You!



Plot of out_degree for investors

