



Who brings investments?

Venture Capital through Reputation, Networks, and Influence

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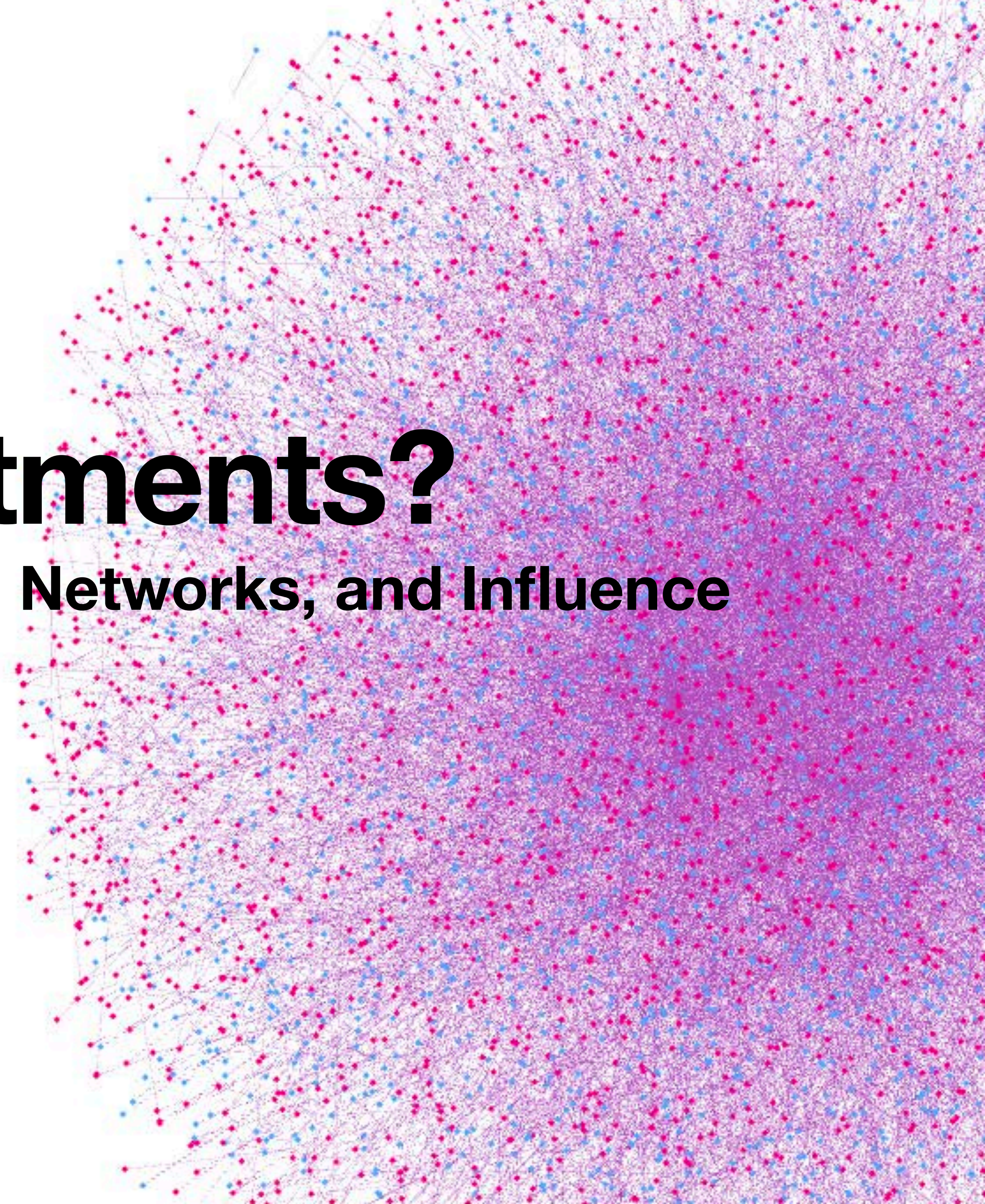
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PRE-PRINT



Quality in startups is elusive

theranos



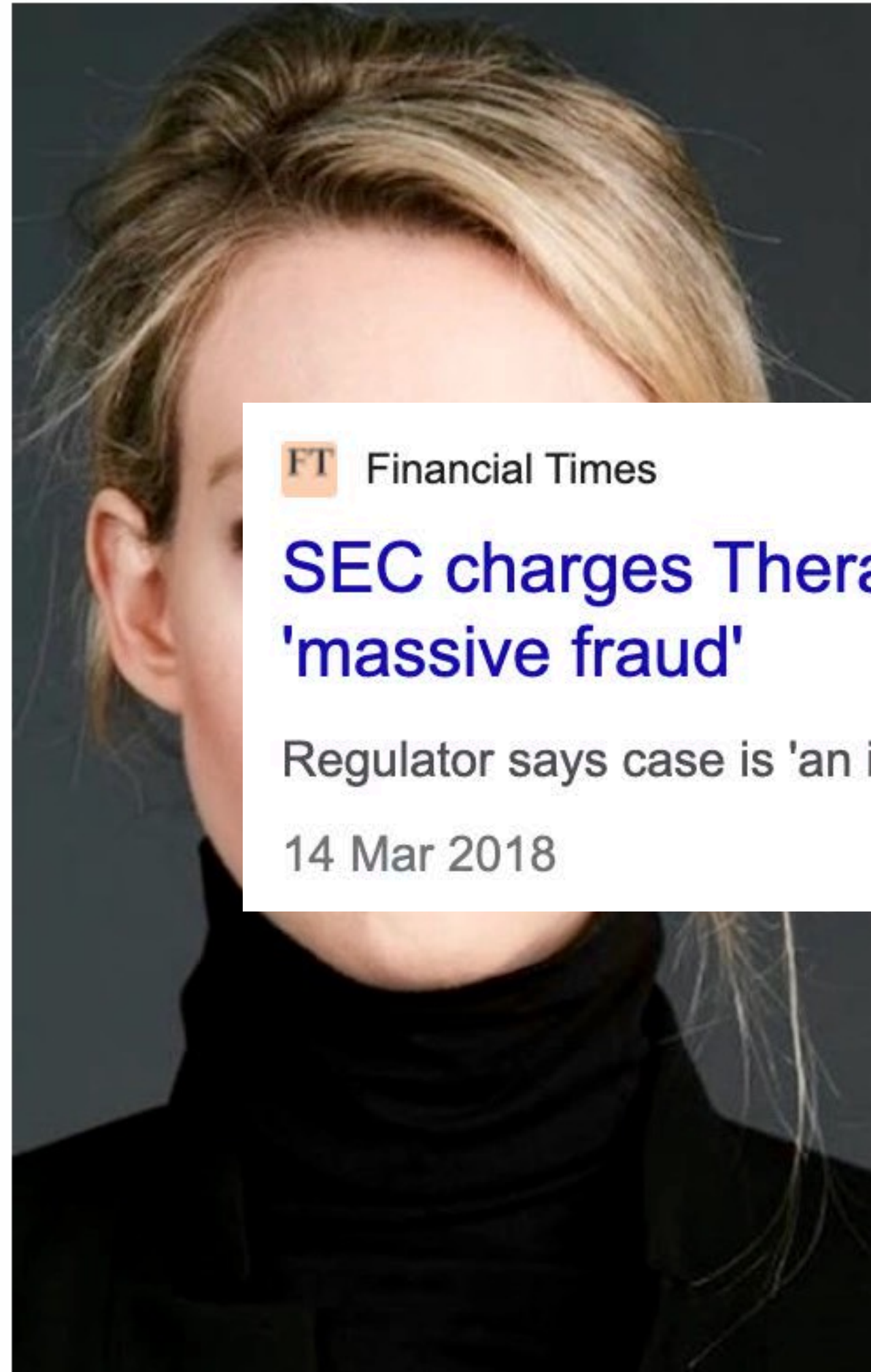
- raised more than \$500 million
- valued \$9 billion

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Quality in startups is elusive

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Quality in startups is elusive

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Outcome
HEALTH

FRANK.

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10.1126/science.aau7224 (2018).

Quantifying reputation and success in art

Samuel P. Fraiberger^{1,2}, Roberta Sinatra^{3,1,4,5}, Magnus Resch^{6,7}, Christoph Riedl^{1,2*}, Albert-László Barabási^{1,3,8,9*}

*“In areas where quality is difficult to quantify objectively, **reputation** and **networks of influence** play a key role in determining access to resources and rewards.”*

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Agenda

Networks of Influence in VC

Research Question

Selection vs Outcome

Score Construction

Meth pt1: Dynamic Bipartite Network

Meth pt2: Funding Attraction Score

Meth pt3: Transitive Fitness Model

Data

How much do networks matter?

Access to Following Round

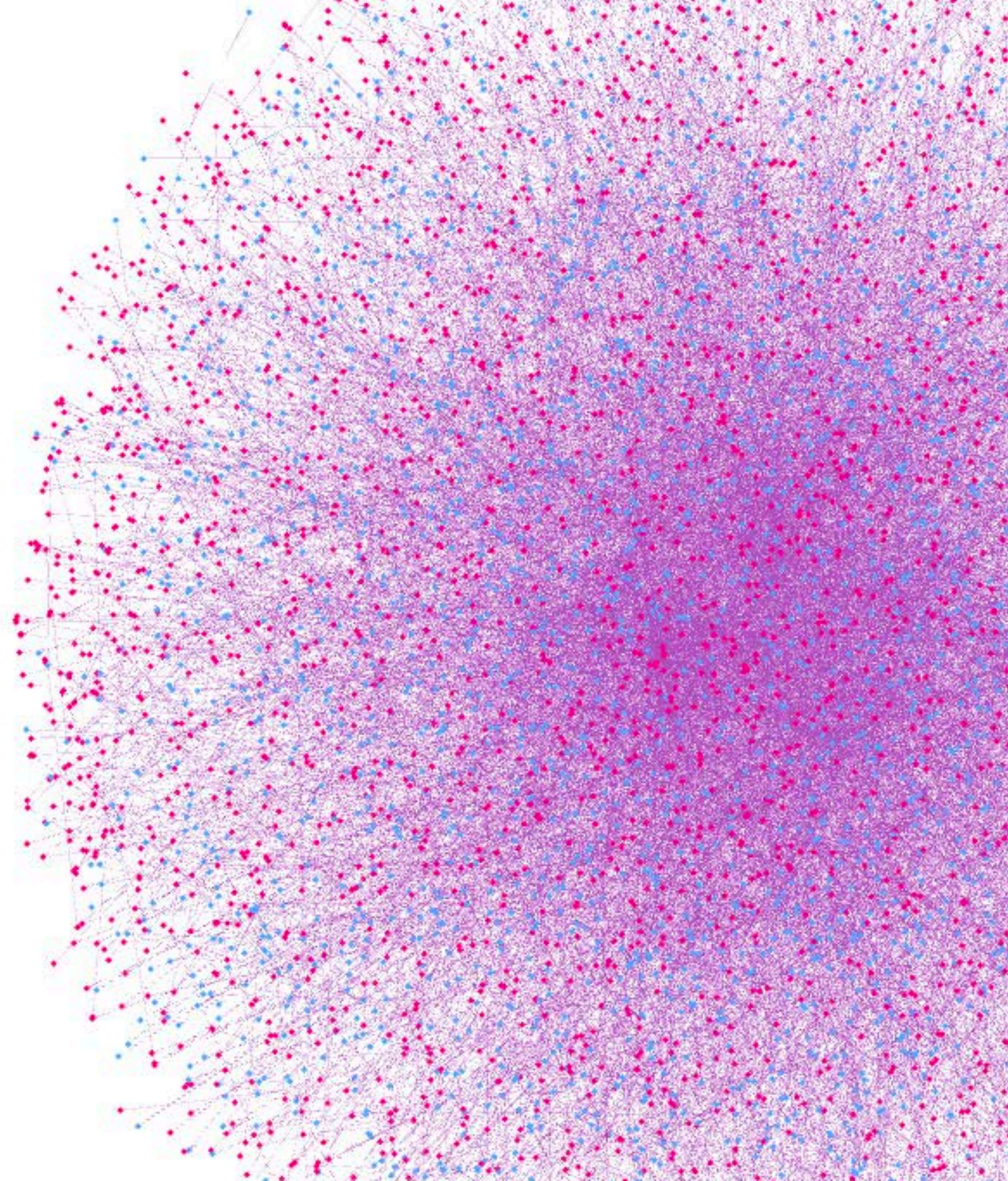
Money Raised

Robustness



Findings Preview

- 1) VCs' Networks of Influence matter the most at the beginning of a companies' business life
- 2) Their influence in amount of money raised keeps constant
- 3) VCs' influence changes over time



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Networks of Influence



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1) Is it the case in VC?

Company Side:

- VC reputation increases IPO valuation and post IPO performance (Lee, Pollock, Jin, 2011)
- Companies are willing to offer reputable investors a 10-14% price discount for their affiliation (Hsu, 2007)

Investor Side:

- More connected VCs enjoy higher success (Hockberg et al., 2007, 2011); mature and high status VCs benefit less from network cohesion (Bellavitis et al., 2017)
- Deals are sourced in great part by the VCs' network (Gompers et al., 2016)

2) If yes, how do we define and quantify a networks of influence?

Funding attraction index

ability of a VC to bring other VCs in funding what you invested in at a later stage



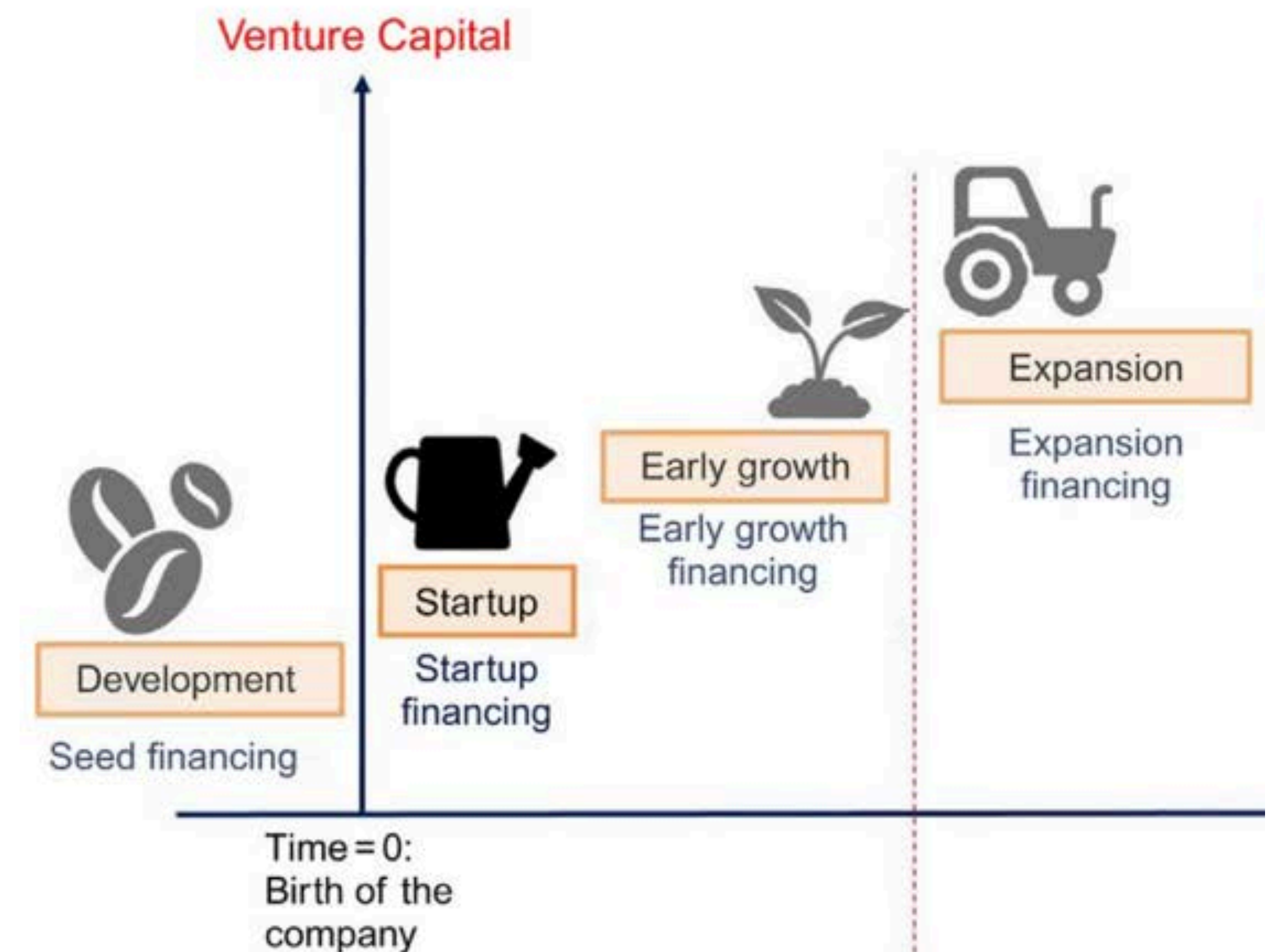
How do companies move forward in business life?

Are influential investors more successful than others in making the companies they back move forward in business life?

Success = access to the following funding round (Werth and Böert, 2011)

Companies backed by investors with a high funding attraction factor are

- (1) more likely to raise follow on funding, but the mechanism fades in its importance as the quality of the company becomes clearer, and
- (2) more likely to raise higher amounts of capital in the follow-on round.



(2018, Caselli & Negri)



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First the quality or the VC?



Are influential VCs simply better at selecting in which companies to invest in or is the company's better performance a consequence of their influence?

Sorensen-Heckman approach (Bottazzi et al. 2008 and 2016)

unit of observation = the potential (realized and unrealized) matches between an individual company and an individual investor

The model estimates:

- a **selection** equation (does the VC invest in the company?)
- an **outcome** equation (is the company successful?)





Selection vs. Outcome

Does the VC invest in the company?

Seed stage selection equation:

$$\begin{aligned} dealhappened_{seed} = & \beta_0 + \beta_1 ZFAI_{seed} + \beta_2 \underline{TotalExperience}_i \\ & + \beta_3 \underline{IndustryExperience}_i + \beta_4 \underline{NumberOfEmployees}_c \\ & + \beta_5 \underline{EstimatedRevenueRange}_c + \beta_6 \underline{Industry}_c + \beta_7 \underline{DealYear} + \epsilon_{c,t} \end{aligned}$$

Series A stage selection equation:

$$\begin{aligned} dealhappened_{seriesA} = & \beta_0 + \beta_1 ZFAI_{seed} + \beta_2 \underline{InverseMillsRatio}_{seed} \\ & + \beta_3 \underline{TotalExperience}_i + \beta_4 \underline{IndustryExperience}_i \\ & + \beta_5 \underline{NumberOfEmployees}_c + \beta_6 \underline{EstimatedRevenueRange}_c \\ & + \beta_7 \underline{Industry}_c + \beta_8 \underline{DealYear} + \epsilon_{c,t} \end{aligned}$$

Is the company successful?

Access to the following round outcome equation:

$$\begin{aligned} dealhappened_{seriesA} = & \beta_0 + \beta_1 ZFAI_{seed} + \beta_2 \underline{InverseMillsRatio}_{seed} \\ & + \beta_5 \underline{NumberOfEmployees}_c + \beta_6 \underline{EstimatedRevenueRange}_c \\ & + \beta_7 \underline{Industry}_c + \beta_8 \underline{DealYear} \\ & + \beta_4 \underline{LogSeedMoneyRaised}_{c,t} + \beta_5 \underline{NumberOfSeedInvestors}_{c,t} \\ & + \beta_5 \underline{NumberOfFundingRounds}_{c,t} + \epsilon_{c,t} \end{aligned}$$

Money Raised in the following round outcome equation:

$$\begin{aligned} moneyraised_{seriesA} = & \beta_0 + \beta_1 ZFAI_{seed} + \beta_2 \underline{InverseMillsRatio}_{seed} \\ & + \beta_2 \underline{InverseMillsRatio}_{seriesA} \\ & + \beta_5 \underline{NumberOfEmployees}_c + \beta_6 \underline{EstimatedRevenueRange}_c \\ & + \beta_7 \underline{Industry}_c + \beta_8 \underline{DealYear} \\ & + \beta_4 \underline{LogSeedMoneyRaised}_{c,t} + \beta_5 \underline{NumberOfSeedInvestors}_{c,t} \\ & + \beta_5 \underline{NumberOfFundingRounds}_{c,t} + \epsilon_{c,t} \end{aligned}$$

Sorensen-Heckman approach (Bottazzi et al. 2008 and 2016), but sequential



Funding Attraction Index

3 methodological STEPS

Dynamic Bipartite Network

Novel Funding Attraction Score

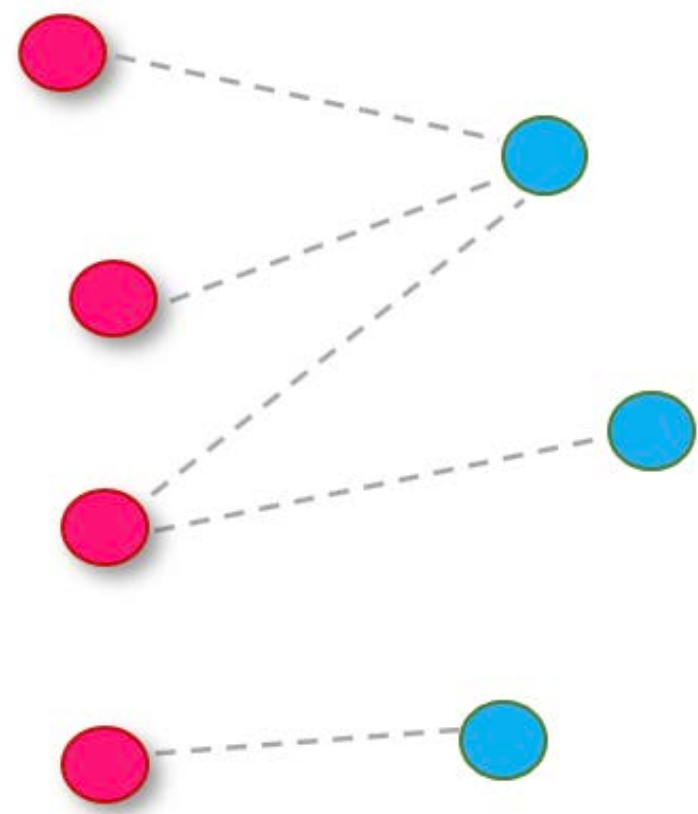
Transitive Fitness Model

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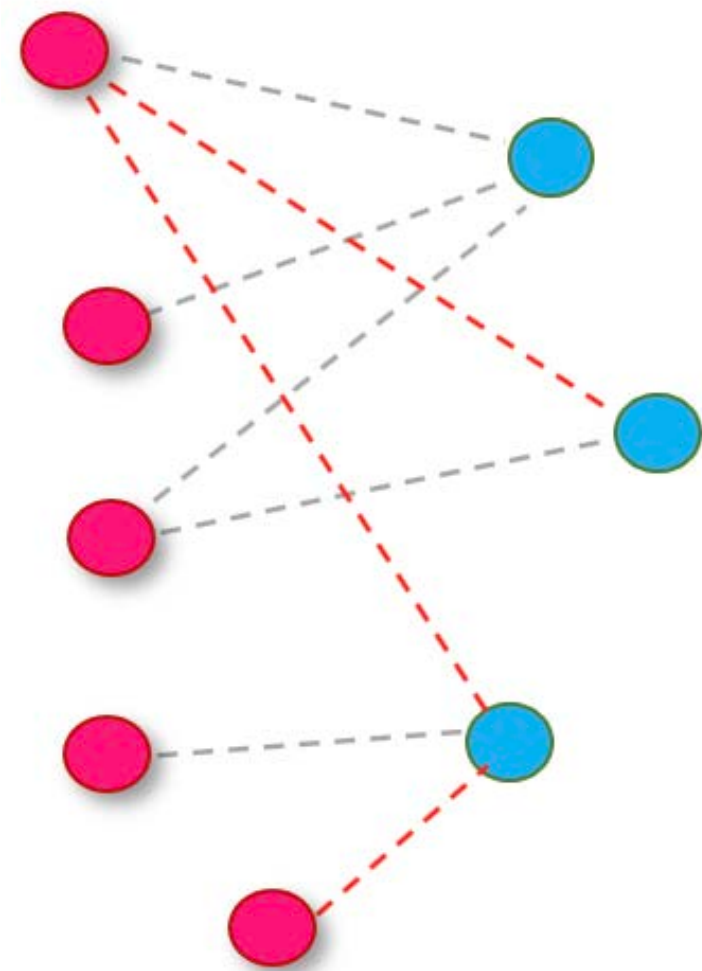


Step 1. Dynamic Bipartite Network

Round 1



Round 1+2



Nodes:

● Investor

● Company

Investment ties

--- Round 1

- - - Round 2

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- Early-stage investments ecosystem
- Bipartite graph of funding interactions between investors and startups
- Dynamic: the network grows from 2010 to 2021
- Each company receives investments in 2 moments in time (seeding and series A)
- Investors can invest as many times as they like

Why? Burstiness, memory & non-stationarity



Step 2. Novel network measure

$$T_i = \frac{1}{n} \sum_j^n \frac{C_{ij}}{\min(k_i^{[1]}, k_j^{[2]})}$$

$$M_i = \frac{\sum_j^n C_{ij}}{k_i^{[1]}}$$

Jointly introduced the bipartite, the temporal and the communal dimensions to the topological overlap matrix (2002, Albert et al.)

Formulated the novel **funding attraction index** (M_i): quantifies the number of times that the investments of a investor at round 1 have been replicated by other investors at round 2.

C_{ij} =number of companies to which both investors i and j are connected at round 1

$k^{[1]}$ =node degree at round 1

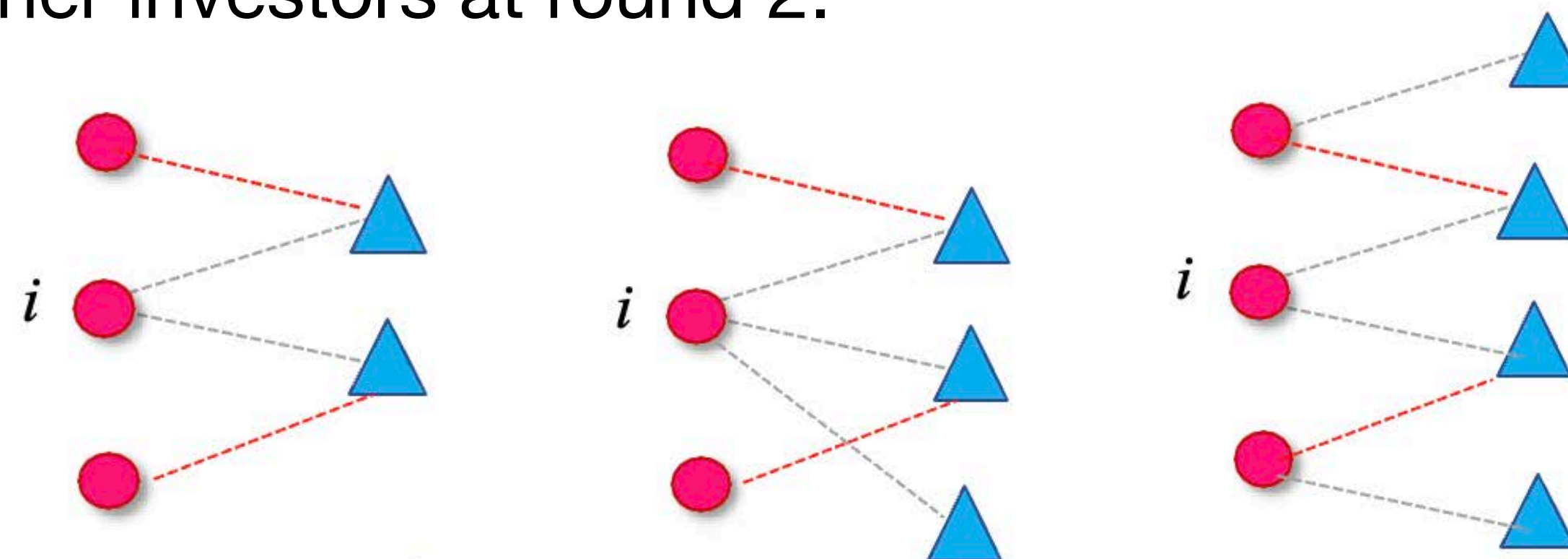
$k^{[2]}$ =node degree at round 2

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Funding attraction index

ability to drag other VCs in funding what you invested in



$$M_i = 1$$

$$T_i = 1$$

$$M_i = 0.66$$

$$T_i = 1$$

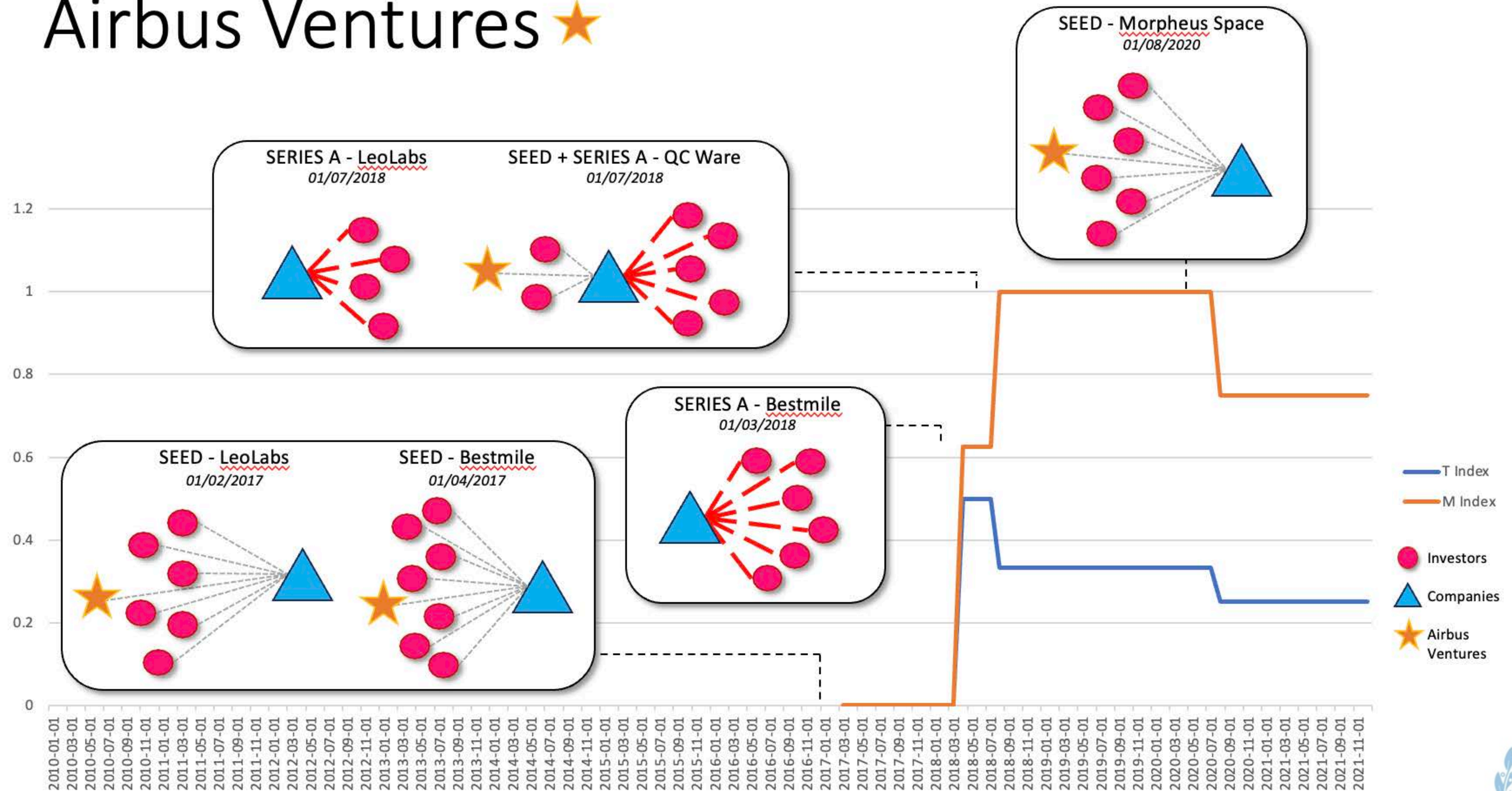
$$M_i = 1$$

$$T_i = 0.5$$



Funding Attraction Score Development

Airbus Ventures ★



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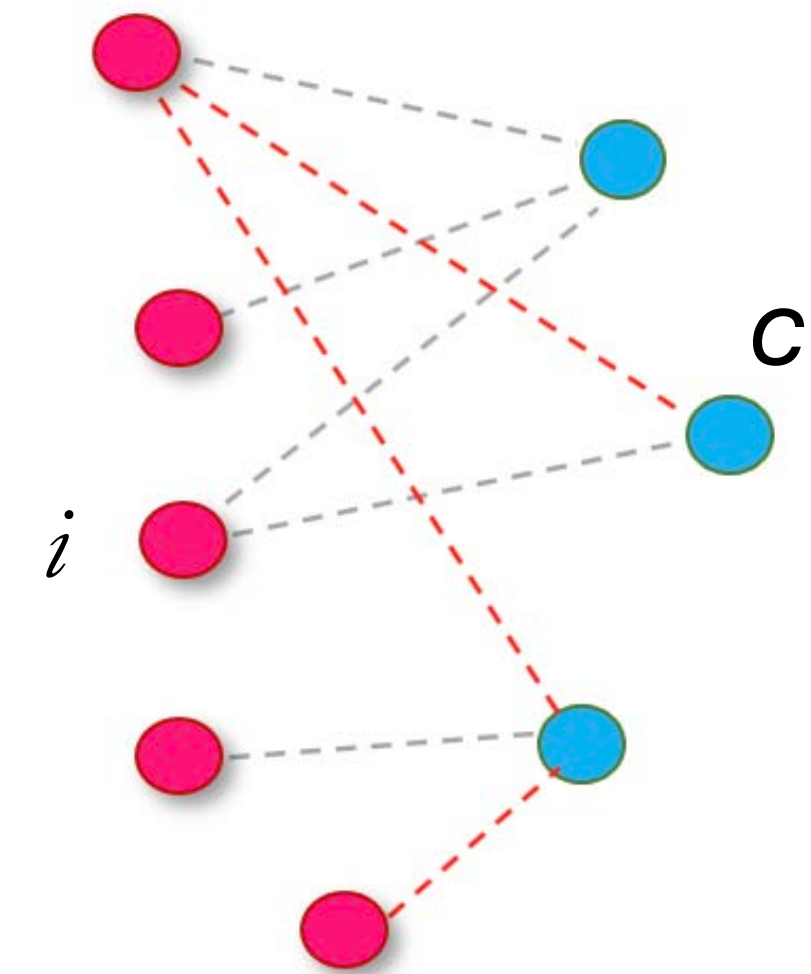
Step 3. Transitive Fitness Model

We introduce a novelty in fitness models (Caldarelli et al., 2002) by determining the fitness measure (Z) of a node c through the characteristics of the nodes i to which c was connected at the previous point in time

i takes the value of the *funding attraction score*

To compare the newly developed index, i (in different specifications) takes value of:

- Network measures (eigenvector, betweenness, degree centrality)
- Traditional VC literature metrics (quantifying success rate and experience)
- Industry reputation (Forbes' Midas list)



$$Z_c = f(M_{i,t-1})$$

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The Dataset

California: all rounds 2010-2021, related to companies founded 2010-2017

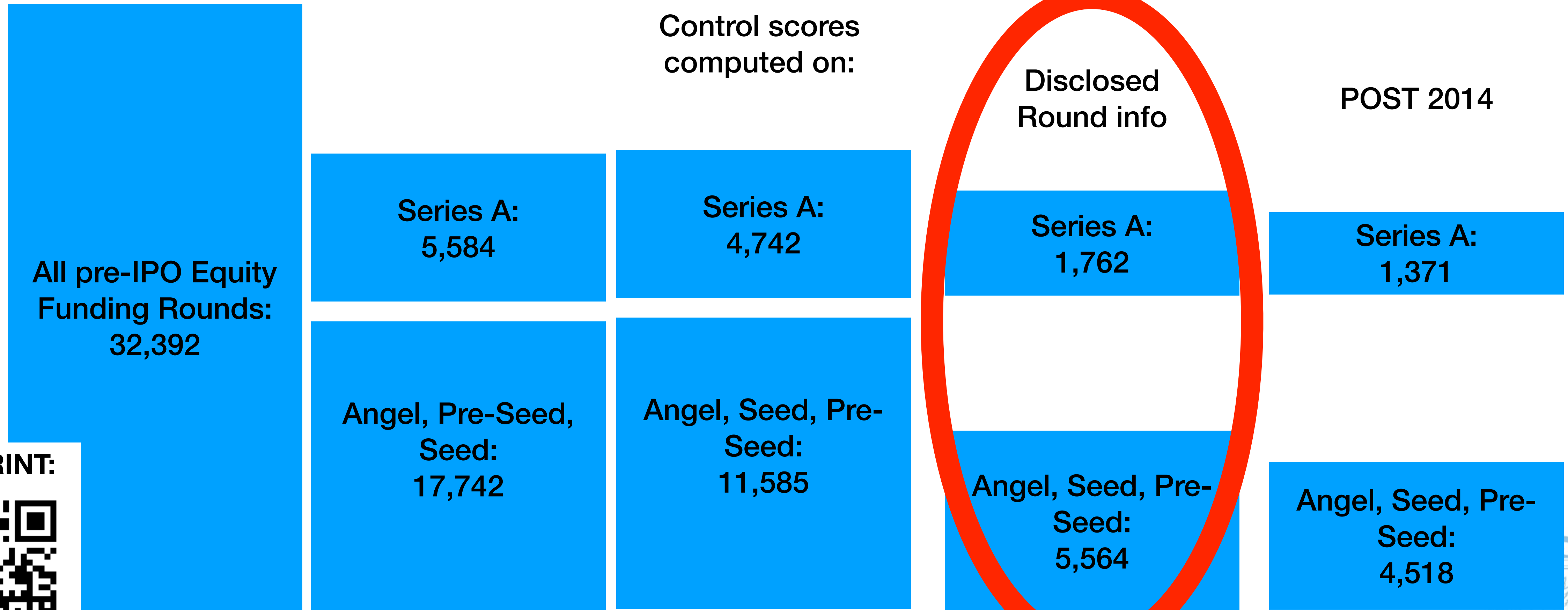
Scores computed on:

Control scores
computed on:

Disclosed
Round info

POST 2014

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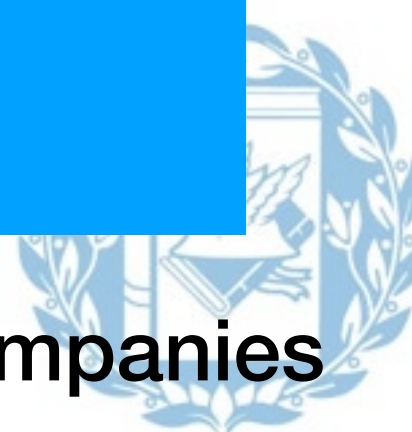
No. of Rounds

No. of Rounds

No. Unique Companies

No. Unique Companies

No. Unique Companies



Investments Networks

Angel, Pre-Seed,
and Seed Rounds

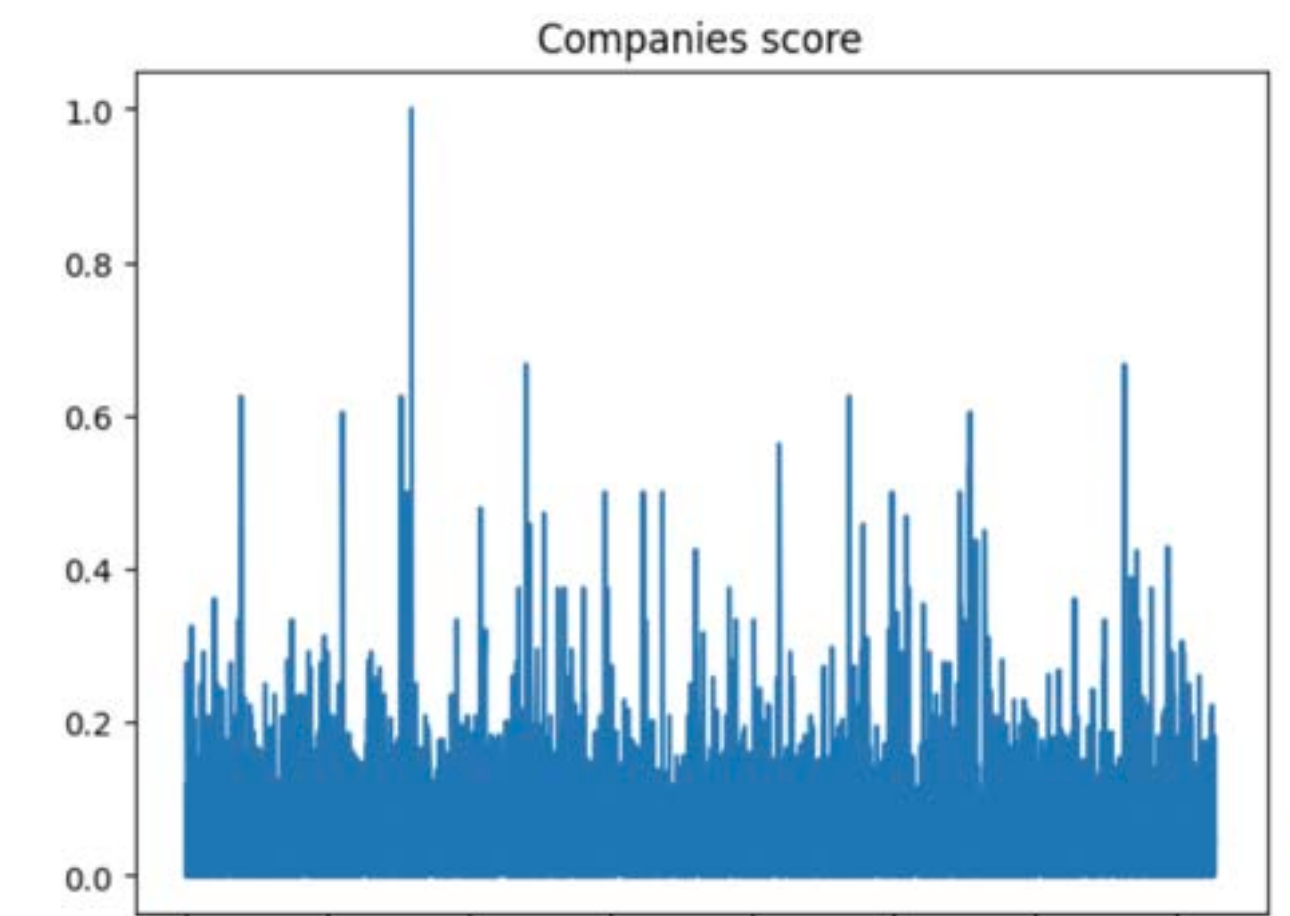
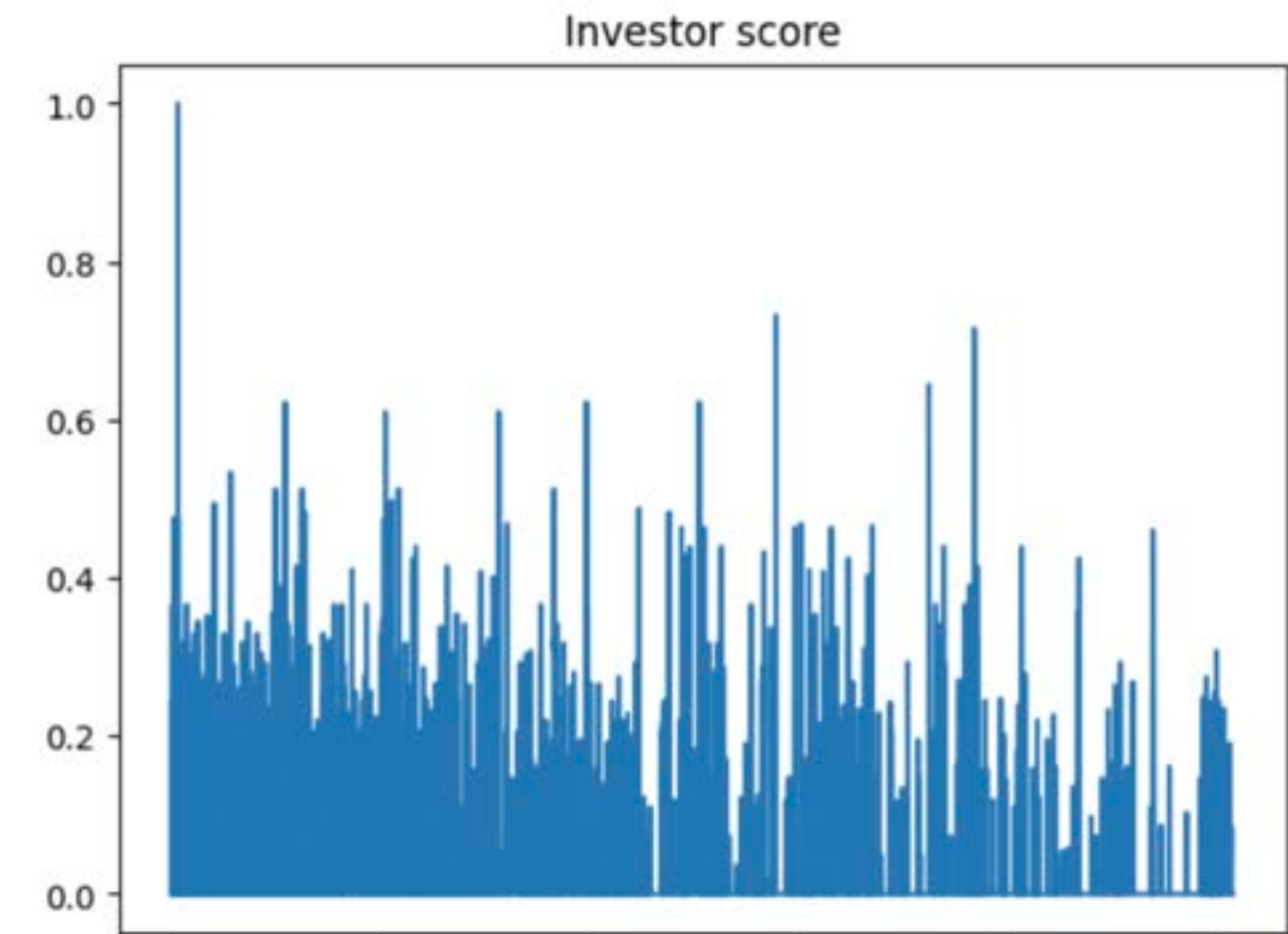
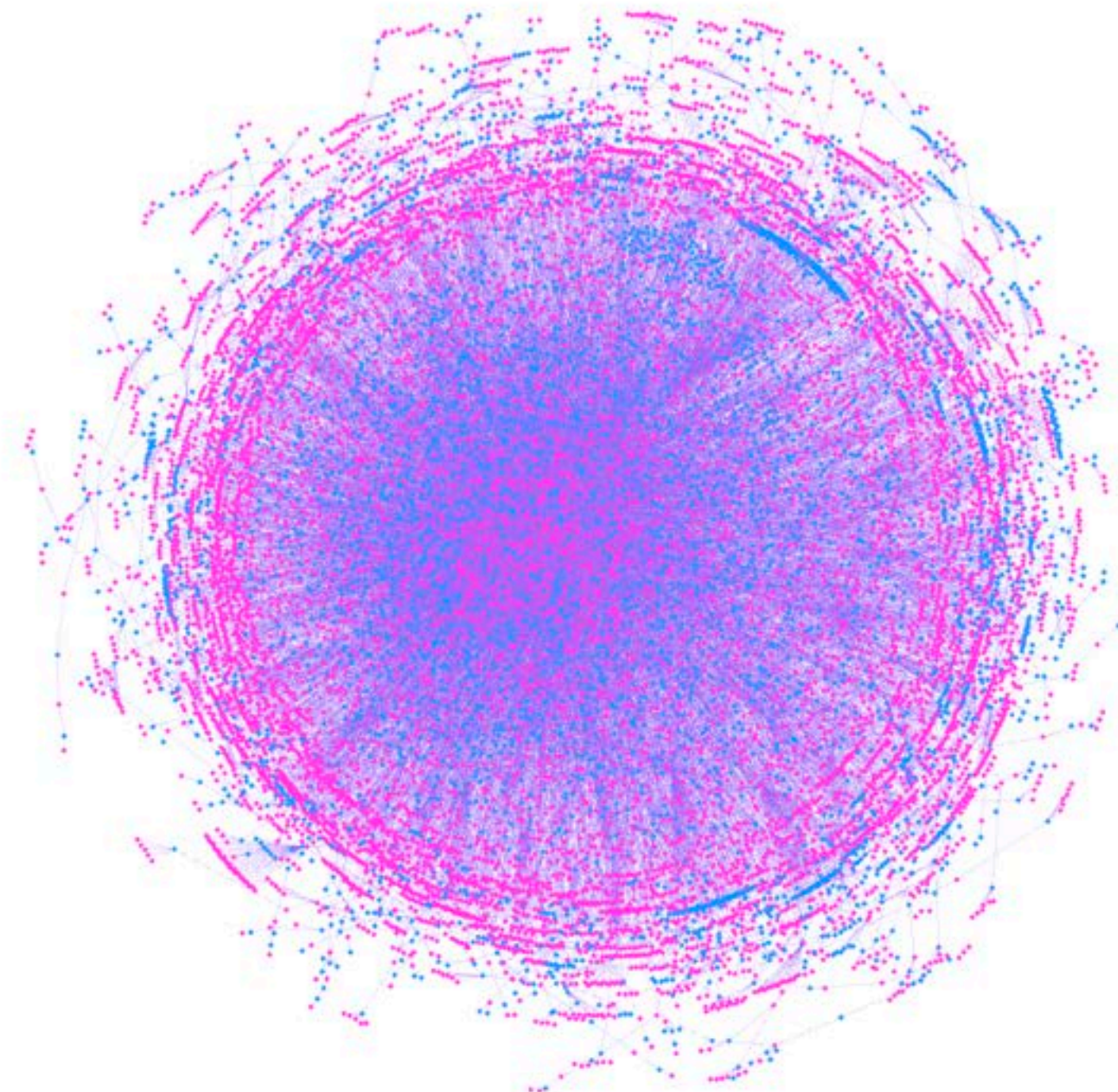
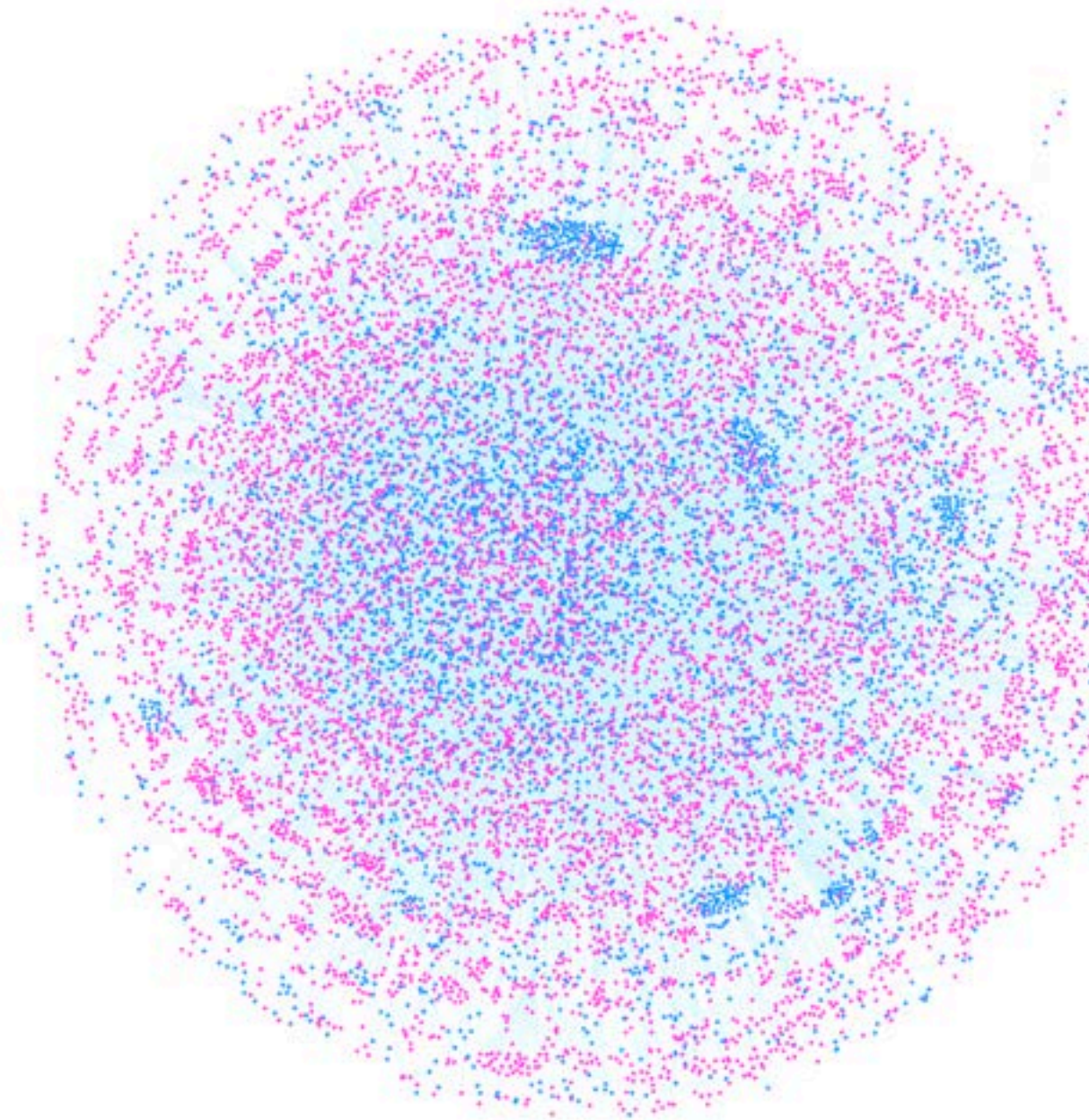
+ Series A

5,564 companies

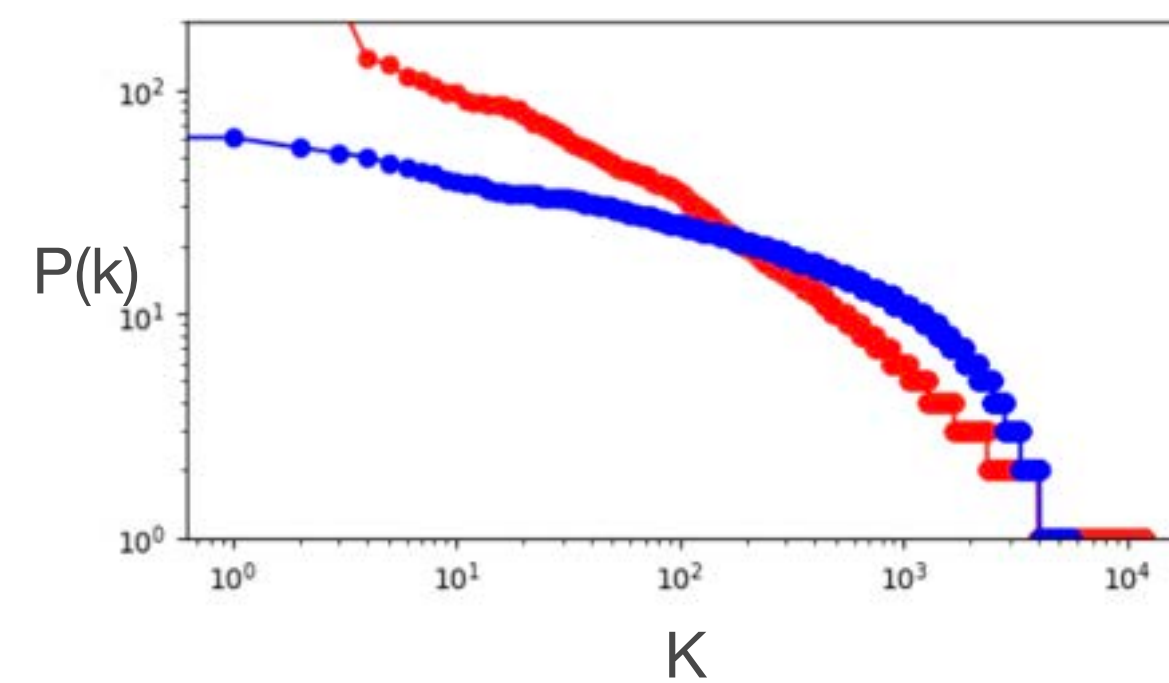
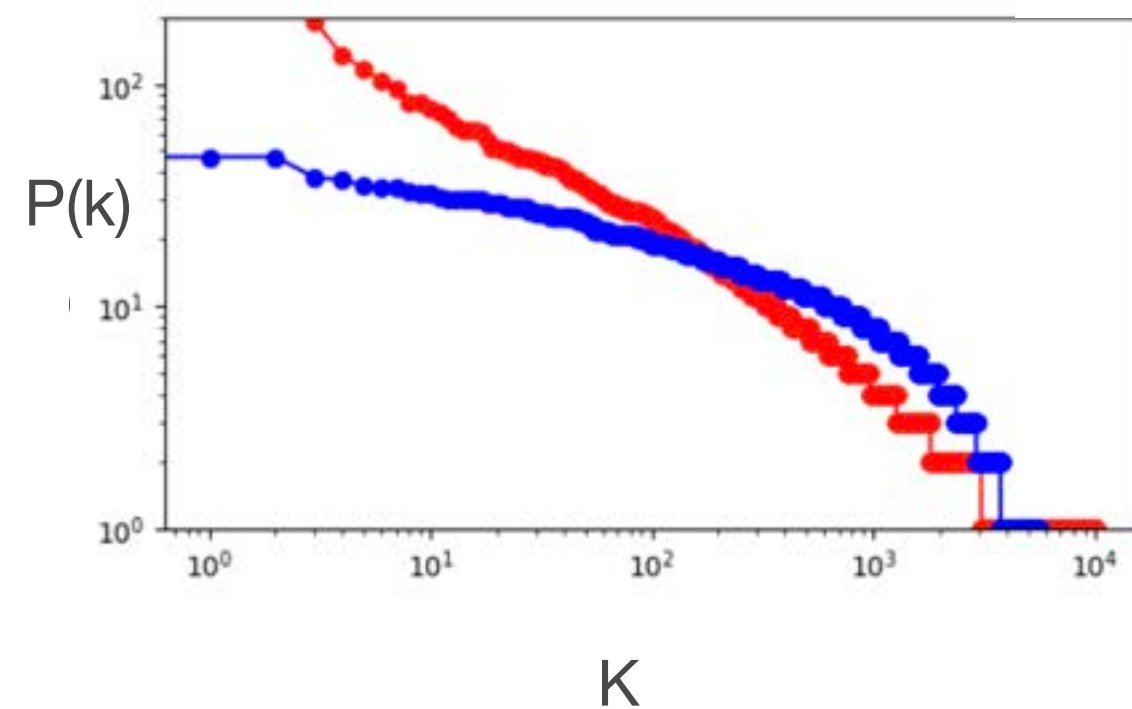
10,167 to 11,988 investors

9,016 to 10,778 funding rounds

25,391 to 33,712 links



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Moving Forward in Business Life

	Selection Probit	Outcome Probit	Selection Probit	Outcome Probit	Selection Probit	Outcome Probit
	(1)	(2)	(3)	(4)	(5)	(6)
Access to Round:	Seed	Series A	Series A	Series B	Series B	Series C
Funding Attraction Index (FAI)	0.0653*** (0.002)	0.1216*** (0.015)	0.0533*** (0.003)	0.0700*** (0.013)	0.0128* (0.008)	-0.0682* (0.040)
Inverse Mills Ratio		1.3174 (0.533)		0.5835** (0.239)		-2.9237 (1.855)
Total Experience	0.0113*** (0.0001)		0.0107*** (0.0001)		0.0390*** (0.0390)	
Experience Industry	-0.0041*** (0.001)		-0.0025*** (0.000)		-0.0223*** (0.004)	
Controls:						
Year (Previous Round)	Yes	Yes	Yes	Yes	Yes	Yes
Industry Group	Yes	Yes	Yes	Yes	Yes	Yes
Estimated Revenue Range	Yes	Yes	Yes	Yes	Yes	Yes
Number of Employees	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-3.3052 (0.024)	-0.6095 (0.119)	-3.3612 (0.017)	-1.3165 (0.113)	-2.9796 (0.030)	-0.0483 (0.130)
Observation Number	30,267,644	18,791	56,390,336	23,585	5,544,965	7,762
R squared	3.886%	27.98%	3.842%	28.04%	4.647%	20.82%
* or ** or *** indicate statistical significance at the 10%, 5% or 1% level, respectively						

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Moving Forward in Business Life - Full Model

	Outcome Probit	Outcome Probit	Outcome Probit
	(1)	(2)	(3)
Access to Round:	Series A	Series B	Series C
Funding Attraction Index (FAI)	0.1218** (0.042)	0.0842** (0.041)	0.0229* (0.091)
Inverse Mills Ratio	1.0579 (1.495)	0.9215 (0.881)	-0.5710 (5.887)
Controls:			
Year Seed	Yes	Yes	Yes
Industry Group	Yes	Yes	Yes
Estimated Revenue Range	Yes	Yes	Yes
No. Investors (Previous Round)	Yes	Yes	Yes
Money Raised (Previous Round)	Yes	Yes	Yes
Number of Rounds	Yes	Yes	Yes
Number of Employees	Yes	Yes	Yes
Constant	-1.5057 (0.413)	-2.5285 (0.425)	-0.4816 (0.330)
Observation Number	2,635	2,633	1,358
R squared	38.92%	36.76%	25.84%
* or ** or *** indicate statistical significance at the 10%, 5% or 1% level, respectively			

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Raising Higher Amounts of Capital

Multivariate Regression			
	(1)	(2)	(3)
Money Raised in:	Series A	Series B	Series C
Funding Attraction Index (FAI)	0.0646*** (0.024)	0.0427* (0.014)	0.0312** (0.034)
Inverse Mills Ratio 2	-0.9569** (0.395)	0.0886* (0.092)	0.0180 (0.806)
Controls:			
Year Seed	Yes	Yes	Yes
Industry Group	Yes	Yes	Yes
Estimated Revenue Range	Yes	Yes	Yes
No. Investors (previous rounds)	Yes	Yes	Yes
Money Raised (previous rounds)	Yes	Yes	Yes
Number of Rounds	Yes	Yes	Yes
Number of Employees	Yes	Yes	Yes
Constant	16.7608 (0.307)	16.1207 (0.242)	16.8252 (0.673)
Observation Number	935	935	523
R squared	26.3%	25.9%	35.9%
Adjusted R squared	23.4%	23.0%	31.1%
* or ** or *** indicate statistical significance at the 10%, 5% or 1% level, respectively			

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Robustness

Idea

Company fixed effects

Novel data structure - all deals are included in the same regression: seed to series A, series A to series B, series B to C.

Preferential Access

Applied 3 different types of controls:

- Top 10% funding attraction index
- Top 10% success rate
- Midas

Pre-money valuation

Very few deals disclosed the pre-money valuation

The dataset drops consistently

Geographical Bias

Novel dataset: analysis repeated on New York sample

Results are consistent but, similarly to the European industry, the Newyorkese industry is lagged in terms of stages





Ways Forward

Weightening Ties

Amount of capital invested

Issue: disclosure.

While the total amount of capital per deal is disclosed, we do not know how much each investor put (and for how much equity stake)

Effects of influence on Success

Success defined as:

- Exit (IPO, Being Acquired)
- Unicorn
- Make Acquisition

Patents

Does investor influence change in the presence of patents?

Do they favor the patent registration?



Conclusions

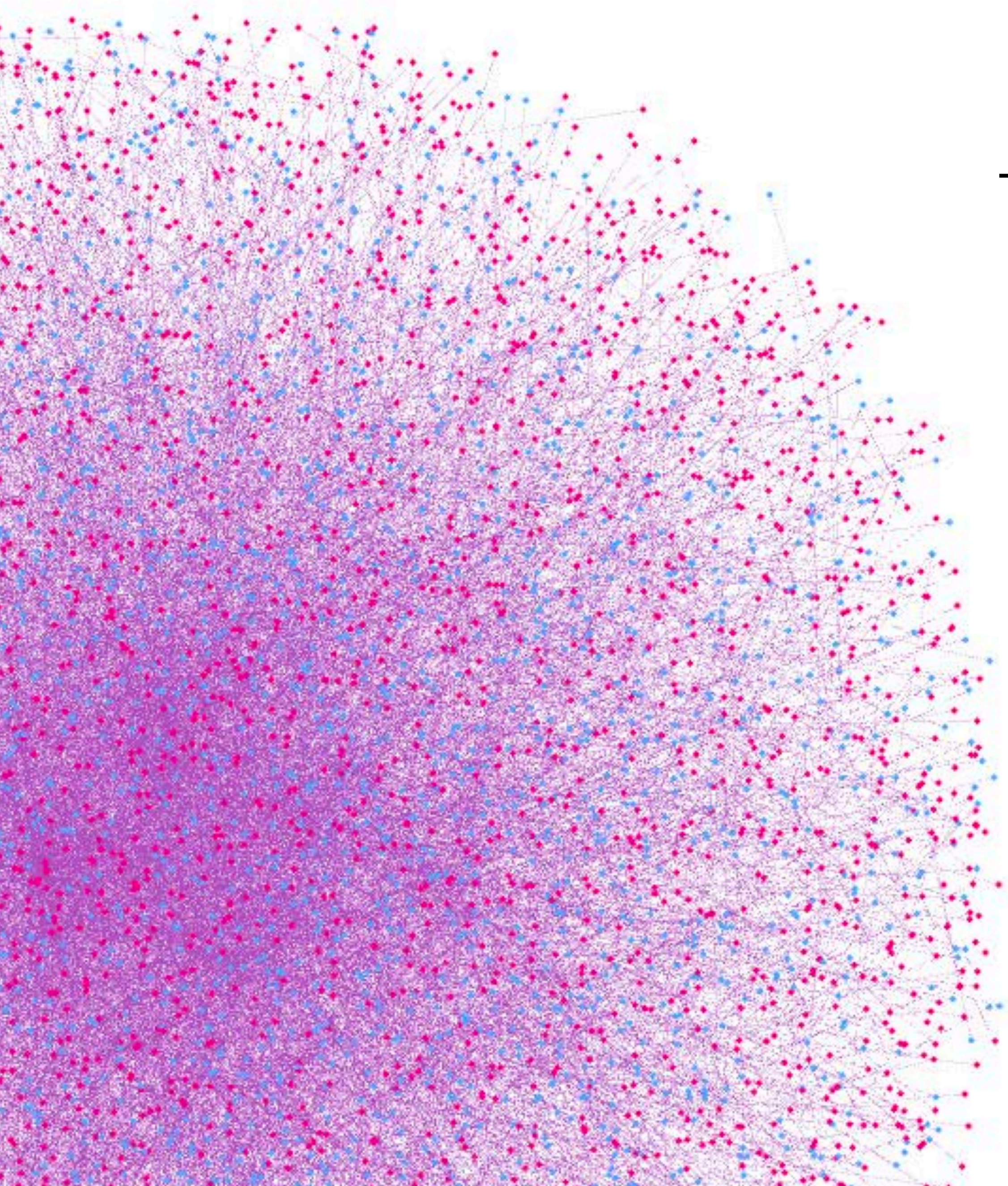
The earliest investors are the ones that influence a new venture the most, as they determine the chance of the firm to move forward in business life. At later funding stages, the influence fades.

Investors' ability to attract other investors is time-specific and relies on their recent funding history.

Novel:
Funding Attraction Index
Transitive Fitness Model

Shed a light on the early-investments ecosystem
Unveiled one of the mechanisms ruling it
Novel model of startup funding

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THANK YOU!



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