When Do Networks Create Value?

Bonding Social Capital and Centrality

S. Santoni[1,2]

[1]Bayes Business School

[2]Soundcloud

MSc in Business Analytics, 2022/23

Outline

Session 2 Wrap Up

When Do Networks Create Value?

Bonding Social Capital and Value Creation

Measuring Density

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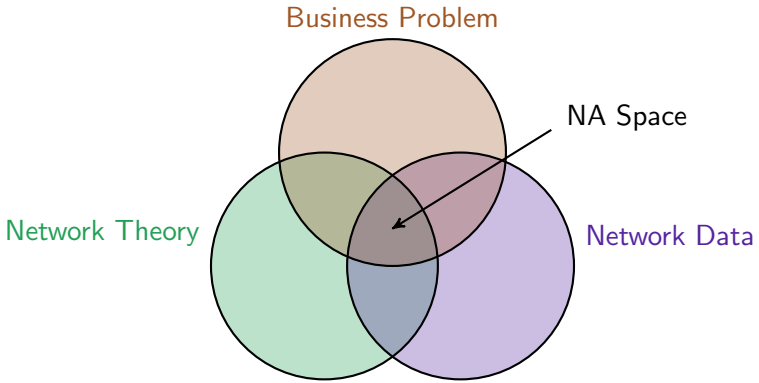
Where Does a Network Analytics Project Stand?



Real World Problem Statements I Worked With

"Our data say employees have not come up with fresh ideas for quite a while. We need to find out."

— The innovation platform manager of a global public utility.

"The people in the [R&D] department do not part-take in the decision making process regarding the selection of the future projects. Shall they?"

— The Head of Reserch of a big pharma company.

"Engineers want more autonomy in forming a new product development team. What are the pros and cons?"

— The CTO of a global semiconductor company.

Mapping Business Problems on Objective Functions and Domains

	Domain			
Objective function	**Employee**	**Project**	**Organization**	**Inter-orgs**
Creativity	•	•		
Knowledge sharing	•	•		
Task performance	•	•		
Coordination	•	•	•	•
Innovation	•	•	•	•
Econ performance			•	

Notes. — The table shows common associations between business problems' objective functions (what clients want to achieve in essence) and domains (the level at which the problem should be addressed). Dots denote the existence of common associations.

Forms of Networks

It is socially accepted to distinguish networks between

- Directed Vs undirected
- Weighted Vs unweighted
- One Vs two-mode

!! Pay attention !!

These categories are not mutually exclusive. E.g., a network can be both directed and weighted.

The Goals of Network Theory

Mainly, network theory aims to explain

1. Why some nodes or groups achieve more (the social capital tradition)
2. Why some nodes or networks are more similar to each other (the social homogeneity tradition)

Network Theory's Network Views

Network theories mirror two different views of networks

- The first view — known as the 'network flow model' — emphasizes the information, resources, or artefacts that flow through the network and possibly accrue to the individual nodes
  - *Sample proposition*: central nodes have an information advantage over peripheral ones
- The second view — known as the 'network architecture model' — highlights the connection between network structure and individual or organizational outcomes
  - *Sample proposition*: decentralized organizational structures are more suited in high-tech industries than low-tech companies

Groups of Network Theories

Underlying model	**Social capital**	**Social homogeneity**
Network flow	Capitalization (value creation)	Contagion
Network architecture	Coordination	Adaptation (network change)

Source is [1, page 47]

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Groups of Network Theories

Underlying model	**Social capital**	**Social homogeneity**
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Source is [1, page 47]

The Leading Question

When do networks create value?

Theories on Networks and Value Creation

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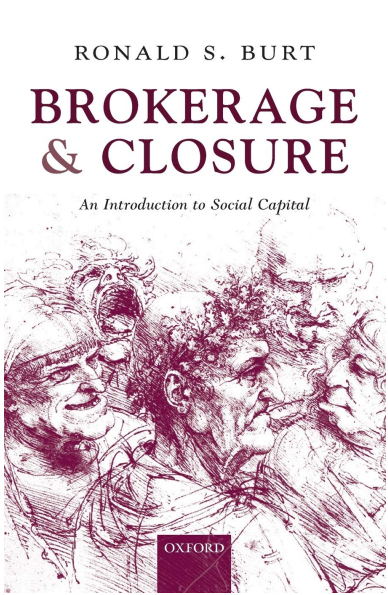
Mainly, the various theories on the influence of networks on value creation can be grouped into two categories:

- **Bridging** social capital theories, whose key tenet is that sparse networks bring value to individuals and groups by facilitating fresh courses of action and new ideas — a process called **network brokerage**
- **Bonding** social capital theories, whose key tenet is that dense networks bring value to individuals and groups by fostering cooperation and trust — a process called **network closure**



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Today's Class Focus

Networks and Value Creation

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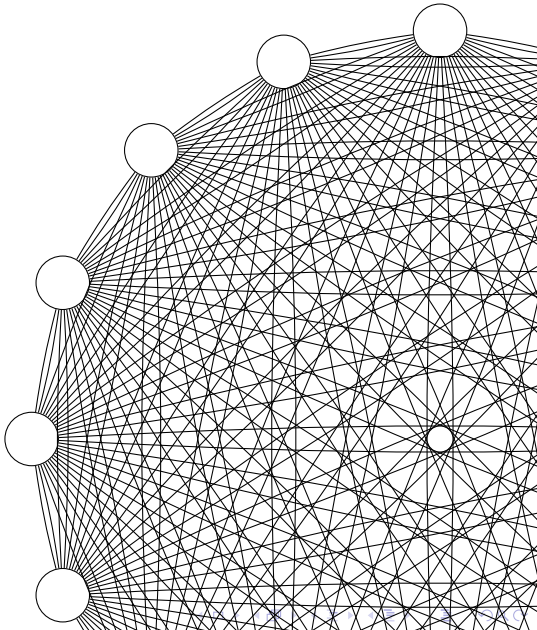
The attention revolves around the topic of bonding social capital and the closure mechanism



What is Network Density?

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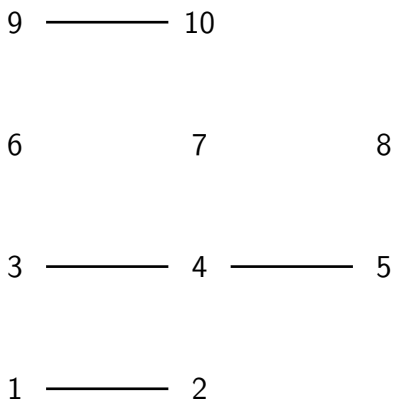
∼ Definition 1 — Density ∼

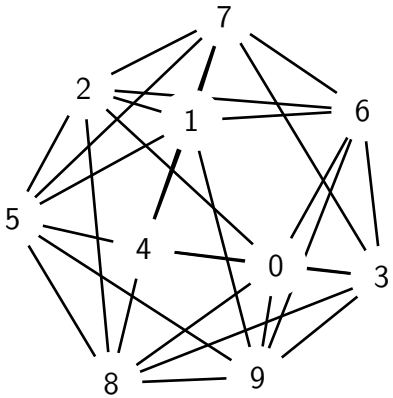
The tendency of a network to present direct ties between pairs of nodes.

Two Networks with Different Levels of Density

A sparse network



A dense network



What Is the Outcome of Dense Networks?

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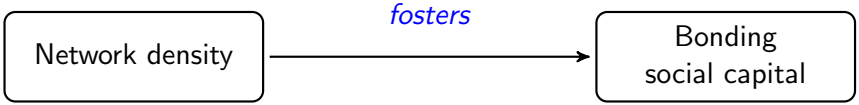

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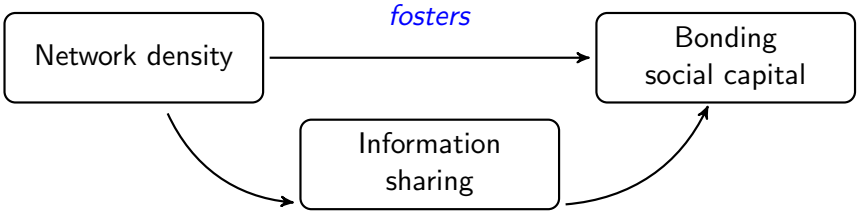

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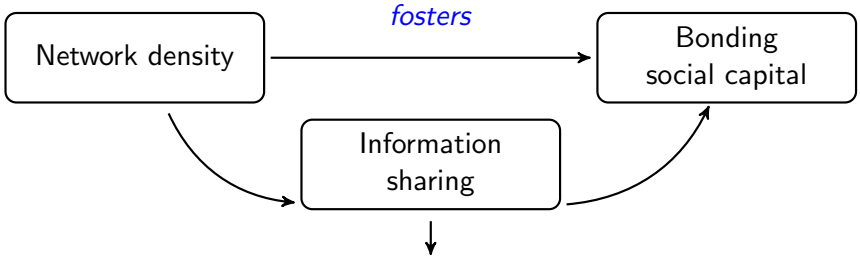

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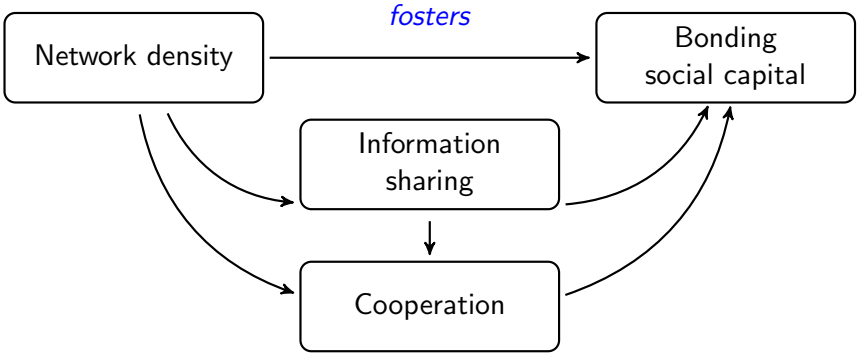

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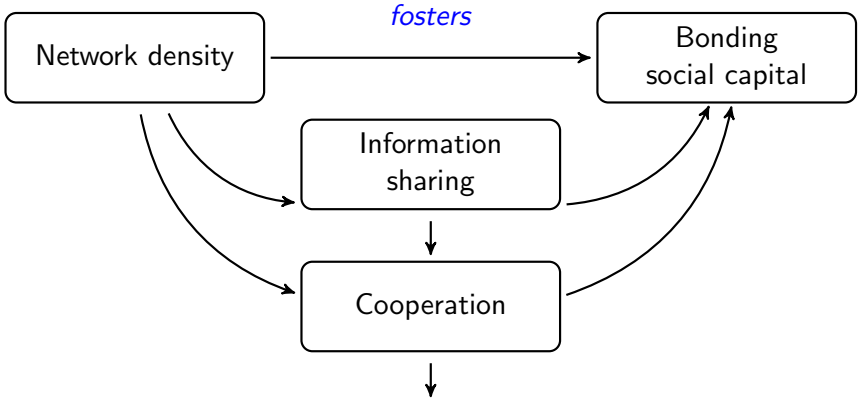

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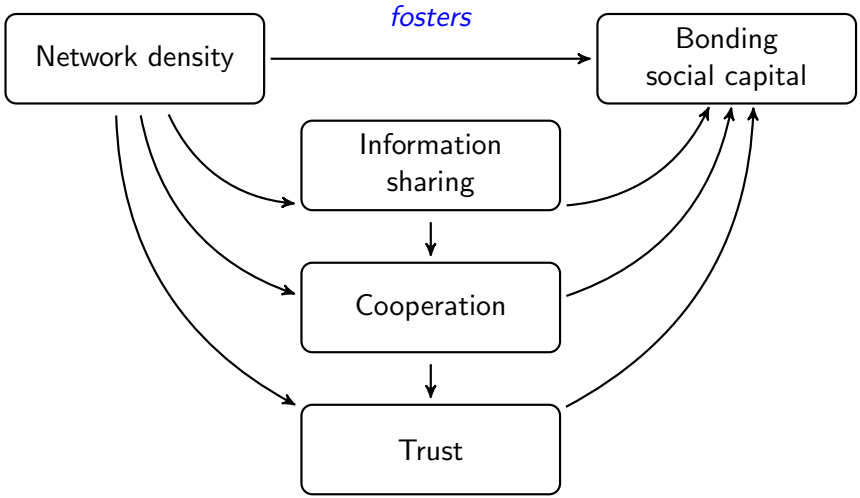

Network Density → Information Sharing

A pricing problem: setup

Let us consider the following pricing problem:

- The potential transaction includes a buyer B and a seller S
- The market is not regulated and there is no perfect information on the vector of prices in the market
- S already produced the good and sustained a unitary production cost δ
- We take the perspective of S, which 'makes the price' based on the best available information on the reservation price of B and competitors' offering prices $\Phi = \{\phi_1, \phi_2, ..., \phi_i, ..., \phi_N\}$
- The pay-off of S is as follows:

$$\Pi^S = \begin{cases} \hat{\phi} - \delta & \text{if B willing to buy} \\ -\delta & \text{otherwise} \end{cases}$$

- The probability B is willing to buy is expressed as

$$p = f(\phi) \qquad \text{with} \qquad 0 \leq p \leq 1$$

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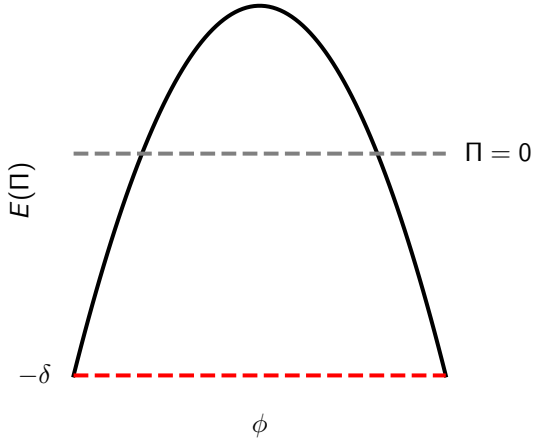
Per the previous slide, the expected pay-off for S is

$$E(\Pi^S) = p * (\phi - \delta) + (1 - p) * (-\delta)$$



Network Density → Information Sharing

What is the fair market price? Scenario A: sparse network

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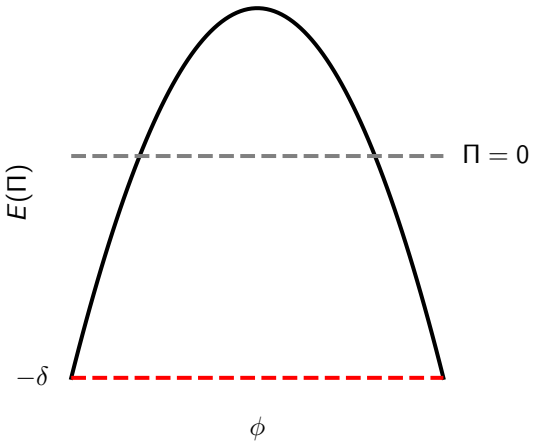
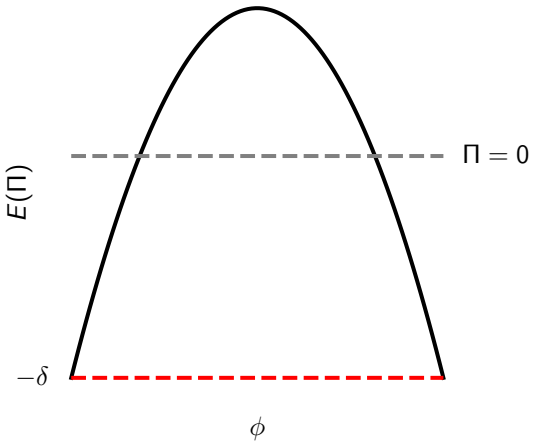
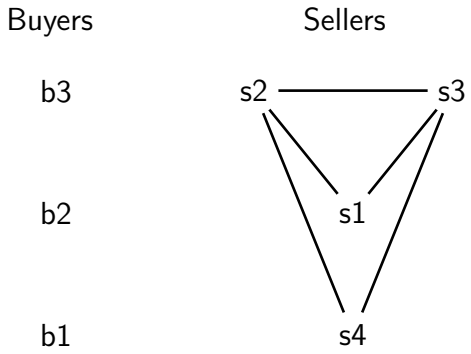


Network Density → Information Sharing

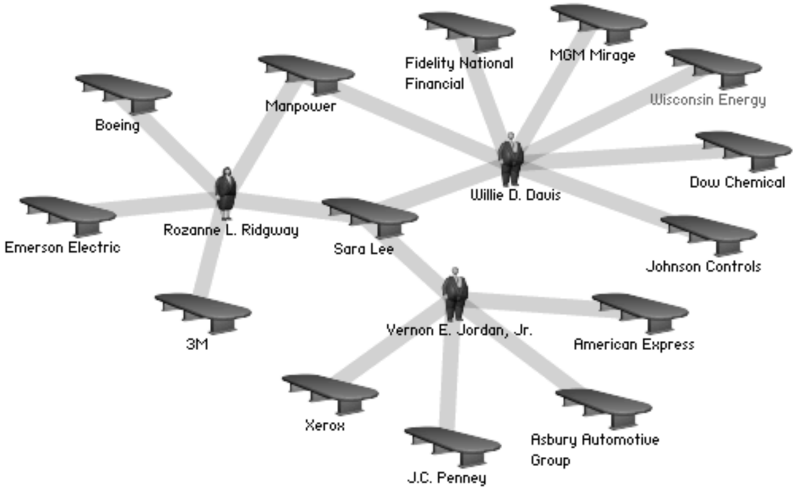
What is the fair market price? Scenario B: dense network





Network Density → Information Sharing

How do sellers know about each other private information?



A portion of the interlocking directorates network connecting US companies. *Notes* — two companies are connected when their at least a boad. Go to the source.

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Here is the setup

- Let us have one seller s serving a market with two buyers $b1$ and $b2$
- Let us also assume that the parties cannot write a complete contract specifying the characteristics of the good s sells, say an industrial machinery to produce jam

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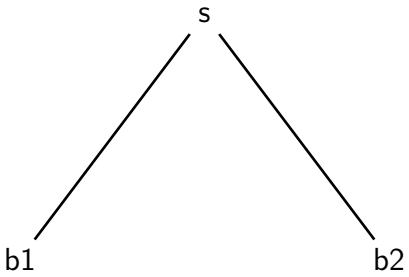
Does *s* behave opportunistically by engaging in moral hazard?
In other words, does *b* receive the good with the agreed features?

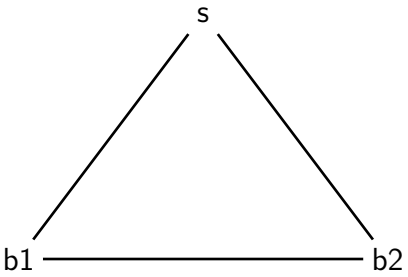
Network theory helps to address this question!

Network Density → Cooperation

Let us play the cooperative game together



Scenario A: open triad—
*b*1 and *b*2 do not exchange information



Scenario B: closed triad—
*b*1 and *b*2 exchange information

Network Density $\rightarrow$ Cooperation

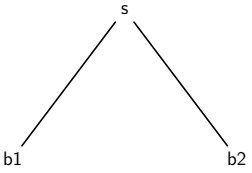
What is the expected pay-off of s in scenario A?

The expected total pay-off of s is the sum of two independent expected pay-offs $E(\Pi^s) = E(\Pi^s_{b1}) + E(\Pi^s_{b2})$, where

$$E(\Pi^S_{b1}) = E(\Pi^S_{b2}) = p * (\phi - \delta) + (1 - p) * (-\delta)$$

The intuition is that $b2$ does not know if s engages in moral hazard and delivers a machinery lacking the agreed features to $b1$. Hence, the willingness to buy of $b2$ is a function of the price s charges but not of the courses of actions of s regarding the transaction with $b1$

$$p_{b2} = f(\phi)$$



$b1$ and $b2$ do not exchange information

Network Density → Cooperation

What is the expected pay-off of s in the two scenarios?

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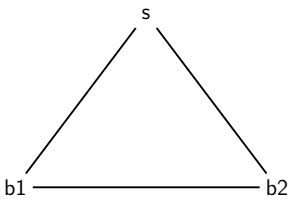
If the transactions between s and $b1$ and s and $b2$ are not contemporaneous (e.g., the $s - b2$ transaction takes place after the $s - b1$ transation), the expected total pay-off of $E(\Pi)^s$ depends on the fact that s engages in moral hazard by not delivering the machinery with all the features $b1$ expects. Specifically, the willingness to buy probabilities will differ across buyers:

$$p_i = \begin{cases} f(\phi) & \text{if } i = b1 \\ f(\phi, \omega) & \text{if } i = b2 \end{cases}$$

where ϕ is the price of the good and ω is the extent of moral hazard of s in the $s - b1$ transaction (the more the machinery deviates from $b1$'s expectations, the larger ω). For example the willingness to buy of $b1$ may be modelled as $p_{b1} = \frac{1}{\phi}$ (with $\phi \geq 1$). Instead, $b2$'s willingness to buy may be modelled as $p_{b2} = \frac{1}{\phi} * \frac{1}{\omega}$ (with $\phi \geq 1$ and $\omega \geq 1$).



$b1$ and $b2$ exchange information

Network Density → Trust

Why do we trust 'places' as well as 'businesses'?

Journal of Trust Research, 2016
Vol. 6, No. 1, 7–36, http://dx.doi.org/10.1080/21515581.2015.1108849

Routledge
Taylor & Francis Group

From interpersonal to interorganisational trust: The role of indirect reciprocity

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(*Received 13 November 2014; accepted 12 October 2015*)

How does interpersonal trust (i.e. between individuals) lead to interorganisational trust (i.e. between groups of individuals)? I build a bottom-up theory in which interorganisational trust arises from individuals and their dispositions, actions and observations. The theory is based on indirect reciprocity, whereby A helps B and then C helps A. Using a simulation model, I analyse (a) whether indirect reciprocity can lead to trust between two organisations even when many people are involved, when the extent of their indirect reciprocation differs, and when helping others is costly; and (b) how the presence of a boundary spanner affects this process. The main findings are that (a) indirect reciprocity can indeed create interorganisational trust under such conditions, and that, in fact, indirect may outperform direct reciprocity. Furthermore, (b) boundary spanners can decrease or increase interorganisational trust: they may decrease it by boosting their own trust at the expense of that of others, and they may increase it by enhancing indirect reciprocity for everyone through four mechanisms: contributing, discriminating, initiating and consolidating.

Keywords: interorganisational trust; interpersonal trust; indirect reciprocity; boundary spanners; simulation

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Density Metrics

!! Pay attention !!

There is no single metric capturing the concept of network density

In practice, we use complementary metrics such as

- Average degree
- Degree distribution
- Connectdeness
- Clustering coefficient

References

[1] John Scott and Peter J Carrington. *The SAGE Handbook of Social Network Analysis*. SAGE publications, 2011.