Entrepreneurship and Wealth-Generation in Socially Structured Economies

An Overview

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Introduction

"[T]here is hardly any part of economics that would not be advanced by a further analysis of specialisation."

—Hendrik Houthakker (1956, p. 182)

"Static models provided by neoclassical equilibrium theory do nothing to explain the most central concept in economic development: the entrepreneur."

—Coase and Wang (2012, p. 1)

- We present theoretical and empirical considerations in the field of entrepreneurship by investigating the interaction between *institutions*, *socio-economic networks* and the *social division of labour*.

Fundamental thesis

- The act of entrepreneurship is expressed through a crucial development of the social division of labour.
- This is reflected in a major modification of institutional environments and networked interaction infrastructures.
- We investigate the conjecture that entrepreneurial activities by individuals and coalitions lead to new specialisations, *socio-economic roles* and, as a consequence, unique positions in the economy.
  - Entrepreneurial positions are *uncontested* such that they can lead to exploitation.
  - However, they are also wealth-generating positions, facilitating deeper divisions of labour and the connection of communities that would otherwise be disconnected.

Dissertation structure

- The analysis of entrepreneurship within a network-institutional—or *relational*—perspective is partitioned into three consecutive Parts:

Part I. Develops a theory of economic interaction, wealth-generation and entrepreneurship within a *socially structured economy*.

Part II. Investigates entrepreneurial activity and positional power in an economy consisting of a horizontal division of labour.

Part III. Investigates entrepreneurial activity and positional power in with more complex interaction structures and a vertical division of labour.

- Throughout we complement theory with empirical examples, including:
  a. The network of elite Florentine families; and
  b. The evolving directorate network of New York City during the early Twentieth Century.

Aim and objectives

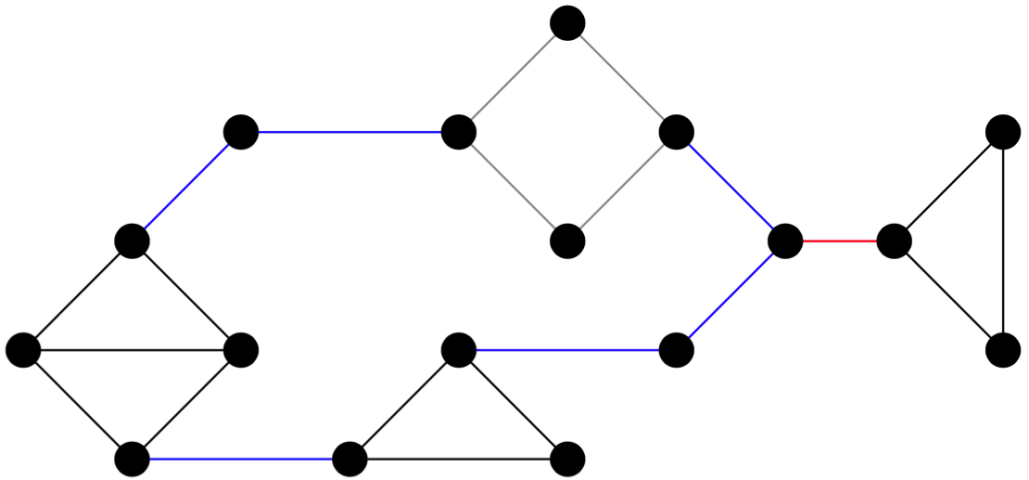
- **Aim:** To develop a theory of entrepreneurship and the entrepreneurial function within network-institutional economies.
- This aim is realised through four objectives:
  1. Develop a model of economic activity based on a population of specialised economic agents that form a functional social division of labour.
  2. Illustrate the role of the entrepreneur within the relational perspective and highlight the impact that entrepreneurship has on the evolution
  3. Provide a distinction between the act of entrepreneurship and the entrepreneurial function of the economy.
  4. Complement our theoretical discussion of the relational perspective and entrepreneurship with empirical analyses of entrepreneurial activities. This involves creating a set of tools that allows us to analyse data in a pragmatic way.

Related literature

- The thesis draws from three main strands of economic literature.

1. On the (social) division of labour:
   - Like Ricardo (1817), Plato (c. 427–347BC) and Xenophon (c. 430–354BC) claim that the division of labour emerges from heterogeneities in agents abilities (Silvermintz, 2010). Their discussions of the city appeals to a *horizontal division of labour*.
   - Hume (1739, 1740), Turgot (1774) and Smith (1776) suggest that a social division of labour can emerge even in an economy of equals. Insights contribute to the *vertical division of labour*.
   - Young (1928), von Hayek (1945), Stigler (1951, 1976), Becker (1985), and Yang (1988, 2001, 2003) provide the most recent insights; concentrating on the modelling of increasing returns to specialisation, the depth of the division of labour, and the *Smith-Young Theorem*.

2. On entrepreneurship and institutions:
   - Knight (1921, 1935) the notions of entrepreneurship and supernormal profit do not coincide with conventional equilibrium theory. Requires activity out of equilibrium.
   - Schumpeter (1912, 1934, 1942) suggests that the entrepreneur forces a dramatic deviation from equilibrium through the distribution of innovative product and/or processes.
   - Baumol (1990) claims that entrepreneurial incentives regarding rent-seeking versus profit-generating activities depend on the institutions of the economy.
   - Mainly building on Buchanan (1980) and Acemoglu (1995), Henrekson and Sanandaji (2011) investigate how entrepreneurs abide by, evade, or alter their institutional environment.



- From mathematical sociology, Burt (1992, 2005, 2010, 2014) suggests that entrepreneurial agents are those that have superior social capital in that they have access to more diverse sources of information.
- Entrepreneurs hold local and/or global bridge relations that connect communities that would otherwise be disconnected. Their social position provides them sources of diverse information they can exploit for economic benefits (Granovetter, 1972; 1985; 2005)

3. Algorithmic and strategic generation of socio-economic networks:
   - Watts and Strogatz (1998), Watts et al. (1999), Barabasi (1999; 2000), and Jackson and Rogers (2007) provide models for the algorithmic generation of small-world and scale-free networks.
   - Jackson and Wolinsky (1996) define the *pairwise stability* concept of network formation based on consent between agents.
   - Corominas-Bosch (1999, 2004) and Polanski (2007) discuss models of bilateral bargaining and trade between a set of producers and consumers in a bipartite graph.
   - Blume et al. (2009) and Gilles and Diamantaris (2013) extend these models with the introduction of *traders* that broker economic relationships between producers and consumers.

- We combine these strands of literature in developing a *relational perspective* of social and economic activity.

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Part I overview

- Part I develops, from an axiomatic basis, a set of fundamental notions that inform the relational perspective. From this we define the entrepreneur and entrepreneurial activity.
- Part I results in:
  1. Formal definition of *socially structured economies* given a relational perspective of social and economic activity.
  2. Development of consumer-producers, socio-economic roles, and the social division of labour.
  3. Clarity regarding the definition and impact of entrepreneurship and the entrepreneurial function within this framework.
- This is expressed over three chapters.

Chapter 1: Toward a relational perspective

- This chapter debates the fundamental modelling axioms and hypotheses required to develop the relational perspective.

Axiom I. **Bounded rationality:** Limited cognitive abilities to compute the consequences of their own and others actions. This results into fundamental perceived uncertainty in the economy.

Axiom II. **Harmonisation of production and consumption:** Economic agents are bearers of consumptive needs as well as productive abilities.

Axiom III. **Homogenous agents:** Throughout we assume that agents are identical with respect to production and utility functions.

- The following notions are derived from these axioms: (1) Economic agents as consumer-producers; (2) Socio-economic roles and specialisations; (3) Embeddedness, governance systems, and institutions; and (4) Interaction infrastructures as networks.

Modelling consumer-producers

- Every economic agent $i \in N$ is a *consumer-producer* represented by the tuple $(u_i, \mathcal{P}_i)$, where u_i refers to the *utility function* of agent i and $\mathcal{P}_i$ refers to the *production abilities* of i.
- Let there be $\ell \geqslant 2$ economic goods such that each good is denoted by k. $x_k \geqslant 0$ is the quantity of economic good k consumed.
- Consumption space:

$$\mathcal{C} = \mathbb{R}^{\ell}_{+} \equiv \{x = (x_1, \ldots, x_\ell) \mid x_k \geqslant 0 \text{ for all } k = 1, \ldots, \ell\} \ .$$

- Throughout we use a *Stone-Geary* utility function when modelling consumer-producers, which takes the form:

$$u\left(x_1, \ldots, x_\ell\right) = \prod_{k=1}^{\ell} \left(x_k + \gamma_k\right)^{\alpha_k} \ ,$$

where $\gamma_k, \alpha_k > 0$.

- Every economic agent $i \in N$ is endowed with an individual production set $\mathcal{P}_i \subset \mathcal{C}$ representing the agents productive abilities such that the following properties hold:

  1. For agent i the production set $\mathcal{P}_i$ is represented using an individual production function $F_i : \mathcal{C} \to \mathbb{R}$, which is strictly monotone, and a parameter $W_i > F_i(0)$ with

  $$\mathcal{P}_i = \{x \in \mathcal{C} \mid F_i(x) \leqslant W_i\} \ .$$

  Therefore, for every agent $i \in N$, the individual production set $\mathcal{P}_i$ is assumed to be a compact set with $0 \in \mathcal{P}_i$.

  2. The production set $\mathcal{P}_i$ is subject to weakly increasing returns to scale represented by the property that the production function F_i is weakly quasi-concave in the sense that

  $$F_i(x) \leqslant F_i(y) \leqslant W_i \text{ implies that } F_i\left(\lambda x + (1-\lambda)y\right) \geqslant F_i(x) \ ,$$

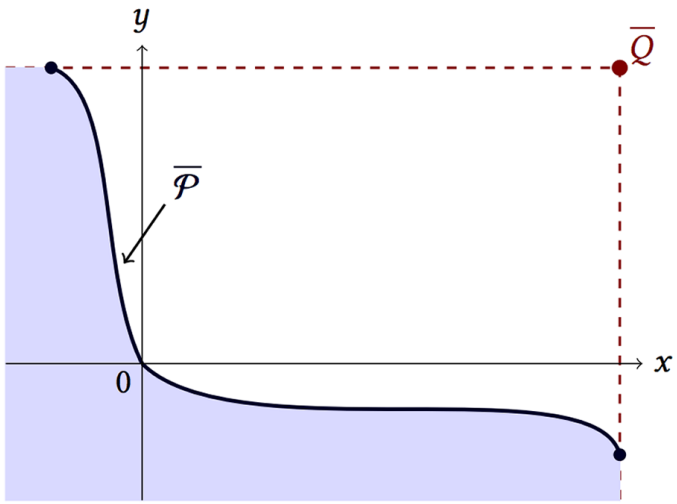
  for all $x, y \in \mathcal{C}$ and $0 \leqslant \lambda \leqslant 1$.

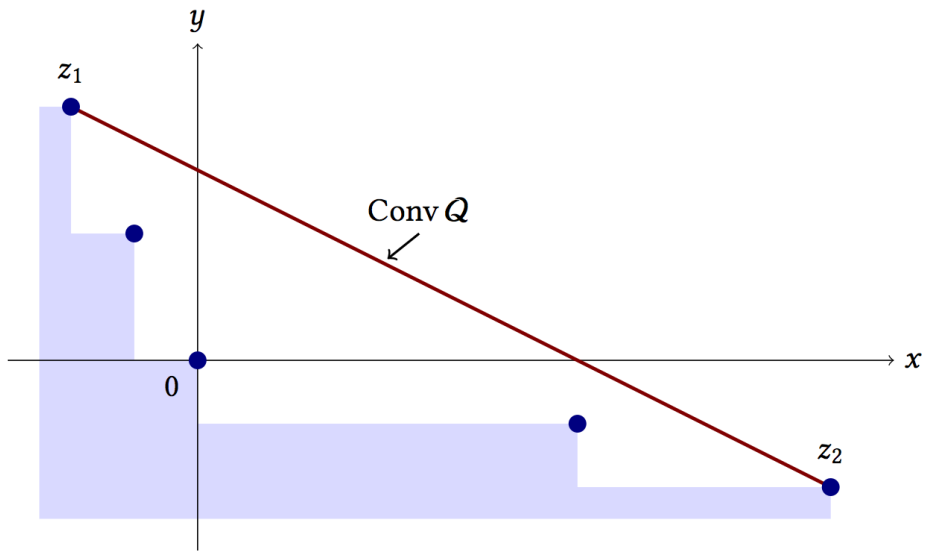
3. Finally, the production set $\mathcal{P}_i$ reflects increasing returns to specialisation, represented by the property that for all bundles $x, y \in \mathcal{C}$ and every $0 < \lambda < 1$:

$$F_i(x) = F_i(y) = W_i \text{ with } x \in \partial\mathcal{C} \text{ and } y \gg 0$$
$$\text{implies that } F_i(\lambda x + (1-\lambda)y) > W_i$$

where $\partial\mathcal{C} = \{x \in \mathcal{C} \mid x_k = 0 \text{ for at least some } k\}$ is the boundary of the consumption space $\mathcal{C}$.

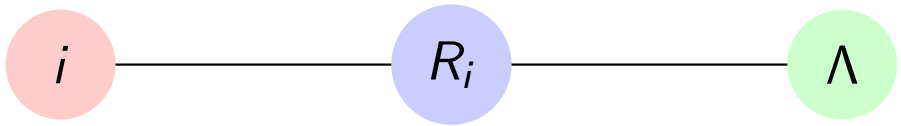
- A distinction is made between weak increasing returns to specialisation (WIRS) and strict increasing returns to specialisation (SIRS).



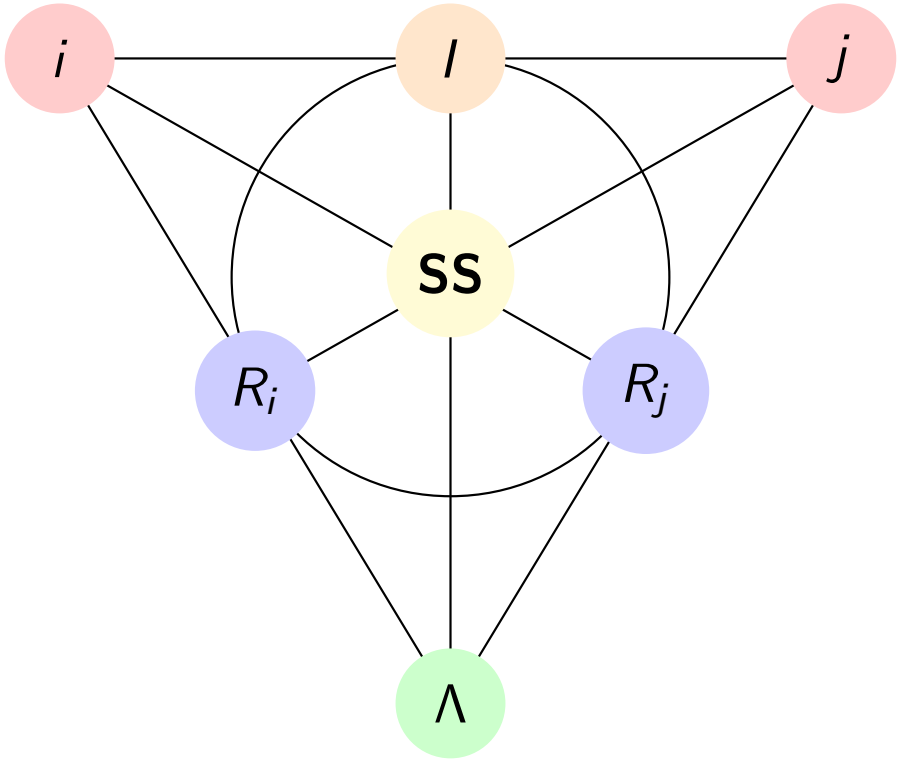


- The hypothesis of SIRS leads to the theorem that, given a population of > 1 economic agents and no interaction inefficienies, each agent always has an incentive to specialise.

- To engage in functional wealth-generating interaction each agent adopts a specialisation and with it a *socio-economic role*.
- A socio-economic role expresses an agents *embeddedness* in a well-defined governance system.



- A socio-economic role is a reflection of the governance system (Λ) that an agent exists within.
  - Includes behavioural rules, cultural norms, media that are associated with specialisations.
- Economic agents adopt a socio-economic role through either *adaptive specialisation* or *objective specialisation*.

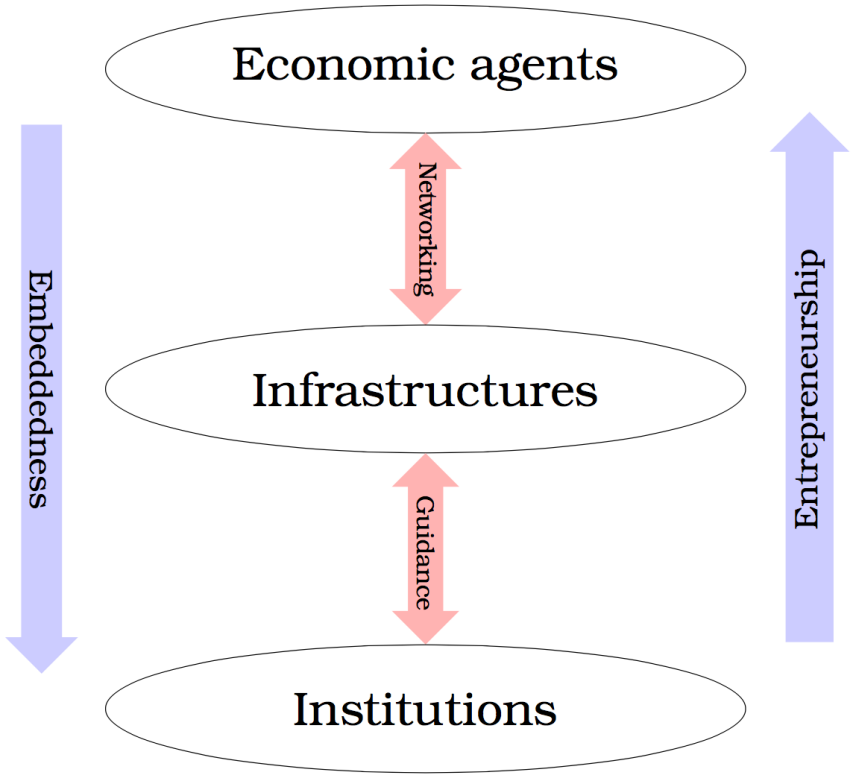


- Due to the problem of the Core economic agents are considered as centrifugal forces and the governance system as a centripetal force.
- The fundamental problem of the Core needs to be resolved through the use of institutional mechanisms.

- The formation of economic relationships leads to a global social structure termed as an **interaction infrastructure**.
- An interaction infrastructure refers to a tuple consisting of:
  1. A population of consumer-producers; and
  2. A set of functional bilateral economic interactions and relationships formed between the population of consumer-producers.
- Interaction infrastructures are represented as *networks*.
- Leads to the modelling Lemma regarding the positional attributes of economic agents:
  - Economic agents have a relational position within an interaction infrastructure. These positional attributes are derived from the economic interactions they form with others.

Chapter 2: Growth & development of the socio-economic space

- All economic relationships and interactions are socially embedded and exist within some well-defined *space*.
  - We term this interaction space as a **socio-economic space**.
  - Refers to a given set of economic agents engaged in a well-described collection of general economic interactions that operate under a well-defined collection of media and institutions.
  - As such, the socio-economic space contains economic agents, interaction infrastructures, and a governance system guiding the formation of these relationships.
- This Chapter provides an overview of the socio-economic space and, with it, an analysis and simulation of its growth and development through adaptive specialisation.



- There exists a two-way relationship between the population of economic agents, their relational position within the economy and the set of institutions in the governance system.

- The socio-economic space is defined in a formal manner as a mathematical concept.
- A socio-economic space can be represented by a pair $(N, \mathcal{G})$ where $N = \{1, \ldots, n\}$ is a given set of economic agents and

$$\mathcal{G} \subset \mathcal{S}(N) \cup \mathcal{H}(N)$$

is a given collection of **general economic interactions** on N, where

$$\mathcal{S}(N) = \{S \mid S \subset N \text{ and } S \neq \varnothing\}$$

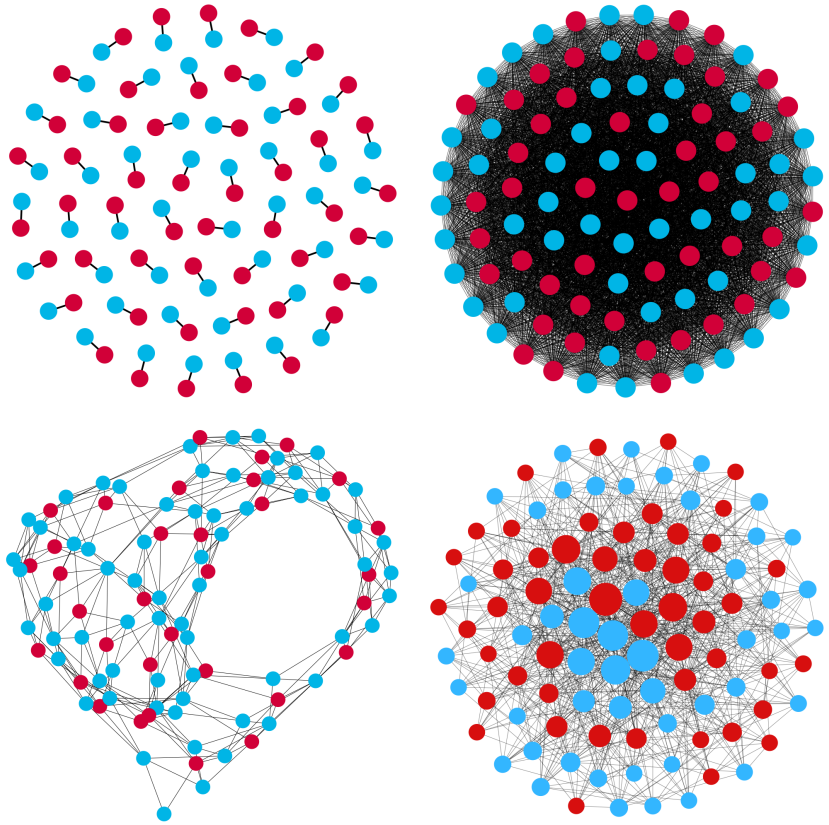
is the family of non-empty coalitions in the population N, representing **lateral** economic interactions on N, and

$$\mathcal{H}(N) = \bigcup_{k=2}^{\infty} N^k$$

is the class of all finite ordered sequences of economic agents, representing **hierarchical** economic interactions in N.

- Whilst discussing the evolution of the socio-economic space we distinguish the notions of growth and development.
  - **Growth:** Refers to a change in some fundamental or pre-existing parameters that define the socio-economic space such that the aggregate utility of all economic agents increases.
  - **Development:** Refers to a productive change in the elements of the governance system and its derived structure such that the new institutional mechanisms, for example, produces an increase in aggregate utility.
- At this point we make the connection between *the development of the socio-economic space and productive entrepreneurial activity* under the relational perspective.
- Further, we make a note that **decline** and **regression** are polar notions to growth and development.

- The growth of the socio-economic space is simulated through the process of adaptive specialisation.
- A number of simulations are provided (written in Matlab). Each simulation differs in a number of factors:
  1. The relative production technologies/abilities of the economic agents in the outputs considered; and
  2. The exchange mechanisms considered that characterise the socio-economic space.
- Simulations define two environments within which economic agents operate. These environments are informed through different exchange mechanisms:
  1. Egalitarian exchange economy: Supply-side only; and
  2. Cournot-Nash exchange economy: Prices are determined through demand and supply-side pressures.



- The institutional mechanisms dictate the resulting structure of the network, the positions of economic agents, and aggregate welfare within the socio-economic space.

Chapter 3: Entrepreneurship & the entrepreneurial function

- If the division of labour is at the centre of the relational perspective, then its evolution is of major importance in our discussion.
- We have discussed many of the attributes the socio-economic space:
  - **The fundamental elements:** Consumer-producers, governance system, and interaction infrastructures; and
  - **The fundamental forces:** Guidance, networking and embeddedness.
- We have still yet to talk about the final force: entrepreneurship and the entrepreneurial function.
- Its definition and illustration is the purpose of this Chapter.

- Consider a socio-economic space with a population of economic agents and a governance system of institutions.
  - An **entrepreneur** is an economic agent who, through her actions, engages in entrepreneurship.
  - **Entrepreneurship** refers to actions that modify in a major way elements of the governance system and the underlying interaction infrastructure in the socio-economic space, thus directly or indirectly impacting the population of the socio-economic space.
  - The **entrepreneurial function** refers to actions that modify in a minor way elements of the socio-economic space, thus directly impacting the individual economic agent and her local environment.
- Entrepreneurship is considered as a "higher form" of adaptive specialisation, leading to new roles that become embedded and thus subject to objective specialisation.

- This definition of entrepreneurship is related to established theoretical perspectives, but does not fit traditional models of 'ocupational choice'.
  - Schumpeter (1912, 1935, 1942): New product and process innovations faciliate the emergence of new specialisations and roles.
  - Baumol (1990): Entrepreneurship can be either 'productive', 'unproductive' or 'destructive'. Depends on institutional environment.
  - Henrekson and Sanandaji (2011): Entrepreneurs can abide by, evade or alter institutions.
  - Burt (1992, 2004, 2010): Entrepreneurs possess and exploit superior social capital through the leveraging of information.

- Given the definition of the entrepreneur and the simulations in the previous Chapter we make the following conjecture:
  - Through a process of entrepreneurship an economic agent creates a new socio-economic role.
  - This role carries unique positional attributes within the interaction infrastructure it exist within.
- This conjecture is central to subsequent formal analysis regarding the relationship between entrepreneurship and the interaction infrastructure of the socio-economic space.

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Part II overview

- Part I developed the relational perspective and noted the impact the entrepreneurs have on the institutional environment. Part II analyses the relationship between entrepreneurs, network position, and power.

- This Part results in:

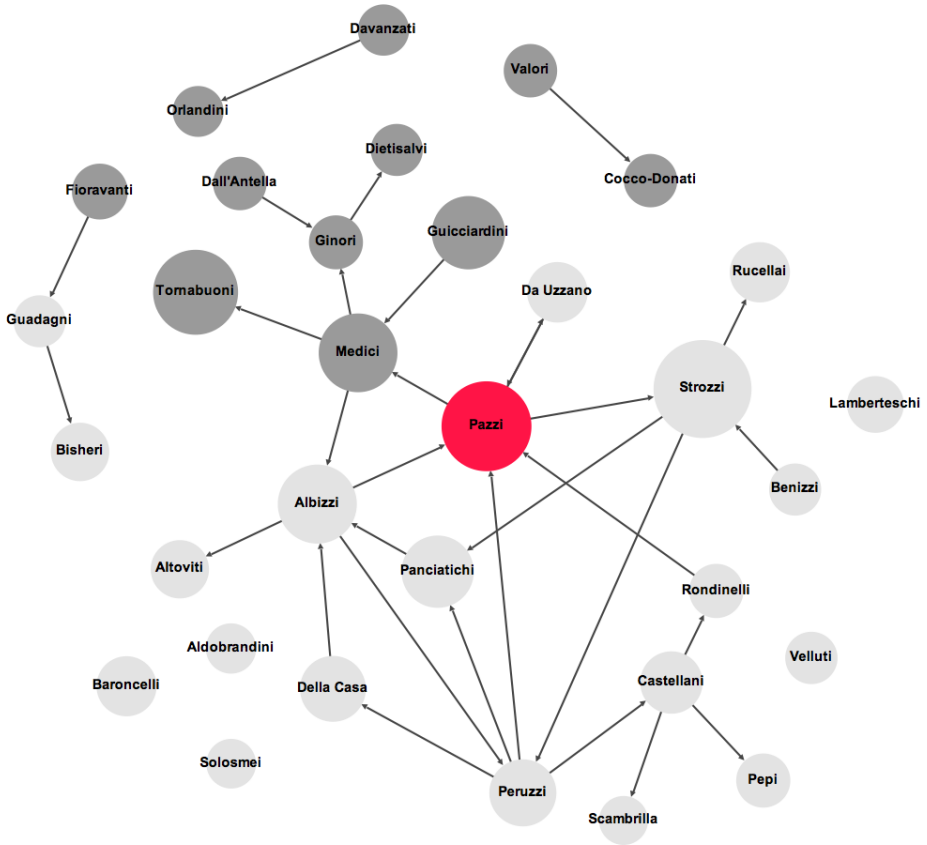
  1. A set of tools in which to measure entrepreneurial power in networks. This is based on the agents unique position and the connectivity of their environment.
  2. A game theoretic model in which to understand entrepreneurship as a coalitional act.
  3. Application of these tools to empirical examples; in particular the elite Florentine marriage and exchange network.

- This is expressed over two chapters.

Chapter 4: Middlemen as entrepreneurs

- Entrepreneurial agents possess unique positions within an interaction infrastructure.
- Centrality tools have been developed to look at nodes that are in "the thick of things" (Freeman, 1977). These concentrate on the links that nodes have in the network, the eigenvector of the network, the geodesic paths that they exist on, etc.
- These tools do not highlight the unique positions of entrepreneurial agents. We develop a set of measures that to measure the power of a agent through:
  a. The inability for other agents to *contest* the entrepreneurs position;
  b. The walks that the entrepreneurial agent can *exploit*; and
  c. The *robustness* of their unique position.

- All analysis is generalised to directed graphs and therefore the tools developed have no specific application to economic scenarios *per se*.
- Can be used in sociology or information theory to investigate the transfer of knowledge or flow and potential manipulation of information.
- We apply these measures of power and robustness to the marriage network of elite Florentine families and to Krackhardt's managerial advice network.
- The rise of the Medici can be attributed to their unique position in their social network; in particular, their ability to broker relationships between opposing factions in Florence.
- However, their position is not robust relative to other powerful elite families, such as the Pazzi.



- With the tools developed we highlight the powerful brokerage opportunities, which the Medici took advantage of.

Chapter 5: The formation of extractive structures in networks

- The tools developed in the previous chapter relate to the positional power of individual entrepreneurial agents. It does not consider the network as a structure that can evolve out of strategic decision-making.
- The insights in the previous chapter are generalised to consider coalitions of agents that can attain entrepreneurial power within a given network structure.
- Agents can effectively manipulate the interaction infrastructure in a major way in an effort to reduce their contestability and/or increase their robustness.
- We use game theory in conjunction with graph theory to provide a measurement of entrepreneurial power from group activity.

- Again, we apply these measures to empirical examples of two evolving networks:
  1. The marriage network of elite Florentine families; and
  2. The network of 9/11 terrorists from 1999–2001.
- **Appendix:** The algorithmic solution to the 'blocking problem' discussed in this Chapter is applied to problems of vaccination and network decompartmentalisation.

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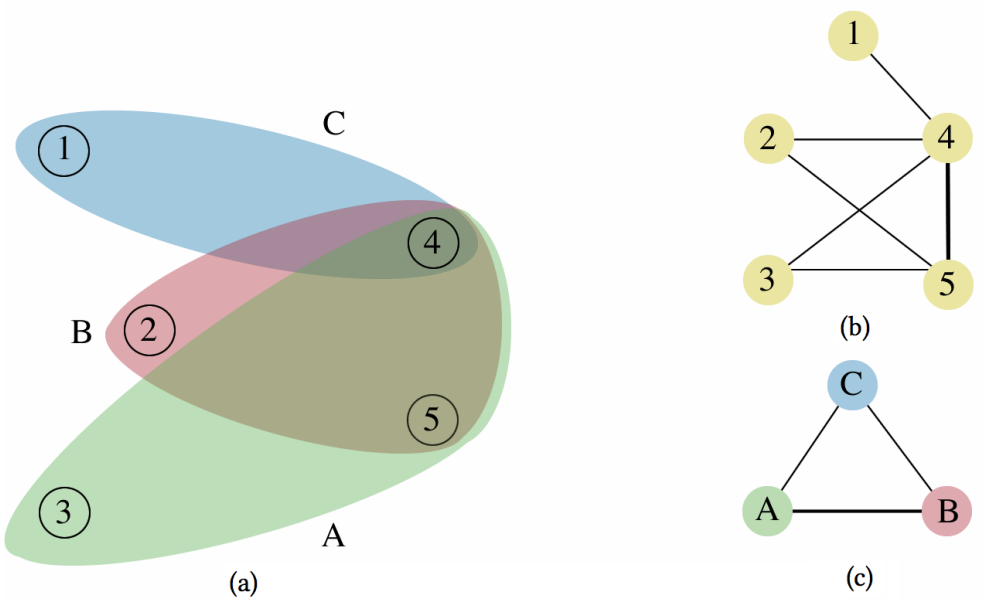
Part III overview

- Part III considers entrepreneurship and power more complex interaction infrastructures. This infrastructure illustrates a vertical division of labour and is represented in terms of a hypergraph: a generalisation of a network.
- This Part results in:
  1. Tools that provide an analysis of power and influence of individuals and affiliations within a hypergraph setting.
  2. An analysis of the corporate directorate of New York City during the early Twentieth Century.
  3. Investigate into the relationship between the topological structure of the economy and the institutional environment.
- This is expressed over two chapters.

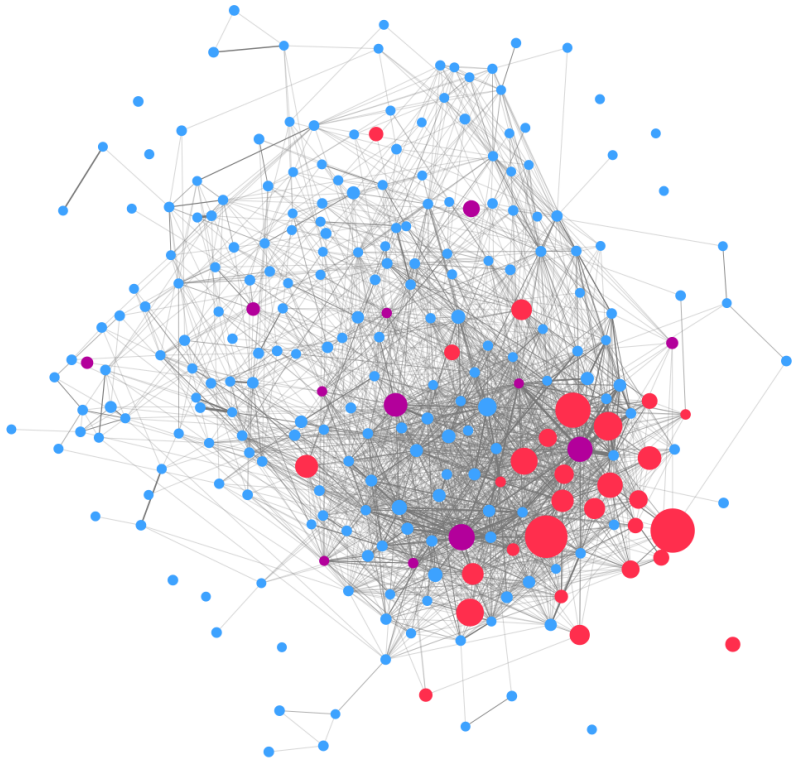
Chapter 6: Measuring control in hyperhraphs



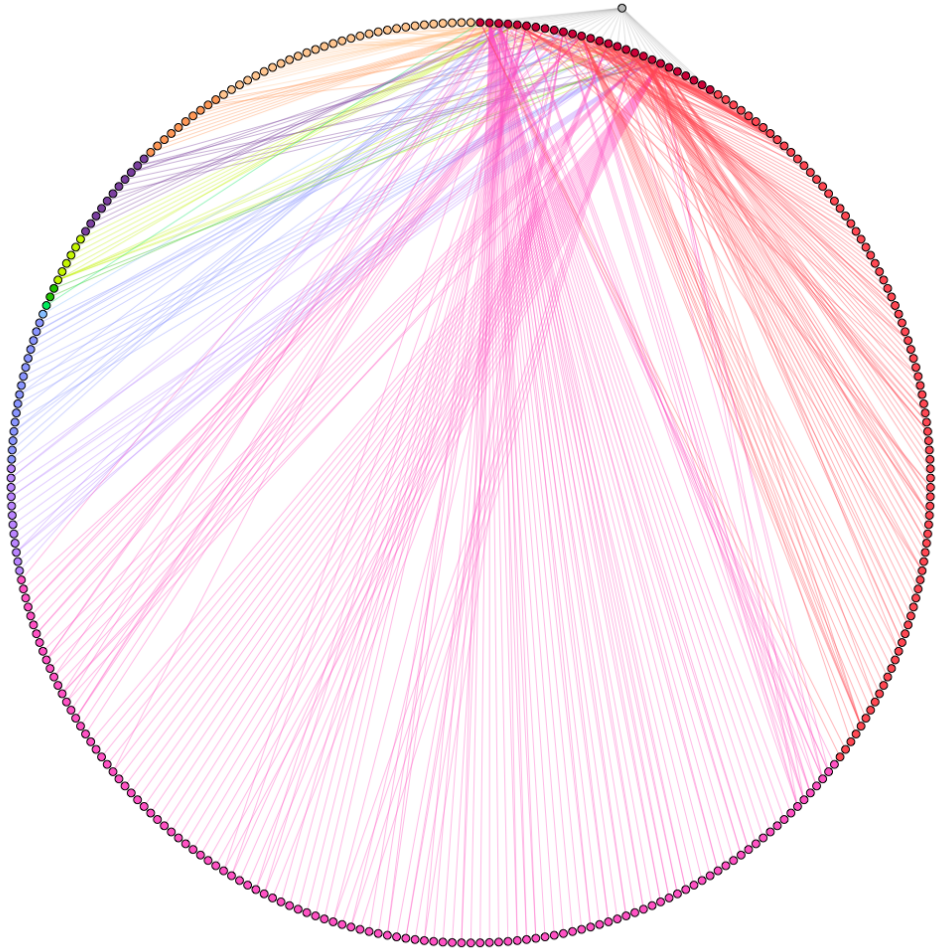
- We consider the **influence** that individual agents and affiliations have in a weighted hypergraph.

- The measurement of influence is derived from the β-measure (van den Brink and Gilles, 2000) and we prove that it is, in fact, a generalisation of the standard degree measure for networks.
- We also allow affiliations of a hypergraph to be allocated to different **aspects**; which relate to groups of socio-economic roles.
- A population of **elites** are derived from the aspectual nature of hypergraphs. These are agents that exist in all aspects of the hypergraph.
- Particular application is applied to indicating important agents in directorate networks.

Chapter 7: Control in the Platform economy: The case of New York City



- We consider the influence of individuals and firms in the directorate network of NYC.



- We consider the influence that individual agents and affiliations have in a weighted hypergraph.