

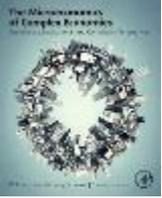
Approaching Real-World Interdependence and Complexity

“ [...] Reducing transaction costs is the main argument for financial deregulation, which is the root of the current financial crisis.”

Ping Chen

“There trend to be a lack of communication and co-operation in the supply chain, and the process is not marked by a great deal of trust.”

Oliver Loebel

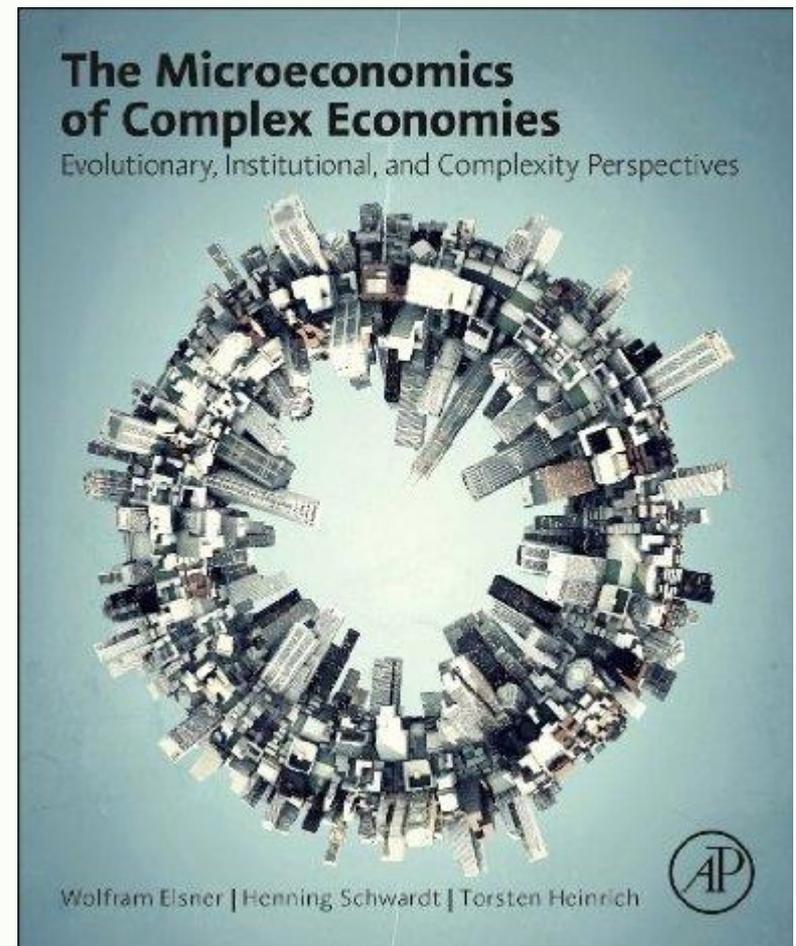


Readings for this lecture

- Mandatory reading this time:

Approaching Real-World Interdependence and Complexity: Empirical Phenomena in the Global Economy, in:
Elsner/Heinrich/Schwardt (2014):
[The Microeconomics of Complex Economies](#), Academic Press, pp. 57-93.

- The lecture and the slides are complements, not substitutes
- An additional reading list can be found at the [companion website](#)





Aims of this lecture

- Characterize real world economic phenomena
- Apply the tools acquired so far to study these phenomena
- Identifying needs for further analyses and related tools, to be developed in the forthcoming parts of the lecture.



Topics

- ▣ The complexity of the real world economy and its implications
 - ▣ How do economics deal with their complex environment?
 - ▣ How should policy makers deal with complex economies?
- ▣ Fragmentation of value added chains (VAC)
- ▣ The increasing role of network-based technologies
- ▣ Spatial clusters and networks as dominating organizational structures



Fragmentation of VACs

- Outsourcing, the delegation of parts of a company's production process (and potentially also employees or assets) to a third party, typically the less productive elements of the VAC, leading to
 - Functional fragmentation
 - Spatial fragmentation along VACs

- Inappropriability of information
 - Inevitable information and knowledge outflow
 - Thus impossibility to maintain a long-term monopoly on technological knowledge or to appropriate potential rents
 - Stimulating in cooperative environments
 - Continuous exchange of positive externalities
 - Harmful in defective environments
 - Free riding and exploitation



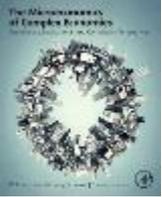
Resulting coordination and dilemma problems

- ❑ Two firms, A and B, in the same VAC
- ❑ What does this mean for their technology choices?
 - ❑ The technologies must be *interoperable*
 - ❑ Coordination problem
- ❑ Continuous exchange of information through product parts
 - ❑ Collective good characteristics of information
- ❑ What does this mean for the firm's decisions to invest into R&D?
 - ❑ There is an incentive to free-ride on the other's expense
 - ❑ Dilemma Problem



Tacit Knowledge

- ▣ Inappropriability of information in business processes affects
 - ▣ Formal technological knowledge, including current research, trade secrets etc. (to a lesser degree)
 - ▣ Knowledge on the organizational structure, etc.
 - ▣ Procedural knowledge on implementation of technologies, work experience, etc. (tacit knowledge)
 - ▣ Tacit knowledge cannot (or hardly) be formally taught or catalogued
 - ▣ It is part of the firm's employees human capital, the firm will lose it when laying off the employees (typically when closing the firm's presence in the region)
 - ▣ It will spread as employees collaborate with others from other parts of the VAC.



- ❑ Outsourcing may lead to the division of
 - ❑ Manufacturing processes and
 - ❑ Service provision
- ❑ Direct interdependence
 - ❑ between the two resulting units
 - ❑ with other units in the VAC and potential costumers
- ❑ Coordination and Cooperation is required to the ends of
 - ❑ Developing tacit knowledge
 - ❑ Joint development
 - ❑ Building trust (including but not only on the management level)
- ❑ Implicit assumption: No power difference among the firms
 - ❑ What if there are some big firms, and many small ones?

Example: Service
Providers and Customers



Network Technologies

- Different agents in an interconnected system
 - VAC, Joint Venture, Communication network
- Compatibility and interoperability required
 - Software, supplier parts
- The users the network has, the bigger its usefulness for the users
 - New users generate positive external effects for the incumbent users
 - New users generate negative external effects for the users of competing networks
- Choice as a path-dependent process involving many actors
- Individualistic maximization becomes nearly irrelevant



Network Technologies

- Technologies that gain their value to the user predominantly from their user base, e.g. telephones, communication equipment, technological and social standards'
 - New users generate positive external effects for the incumbent users
 - Technology choice as a path-dependent process involving many actors
 - Multiple Equilibria; Individualistic maximization has low predictive power as to which equilibrium the system will converge.
- In the context of modern businesses:
 - Different agents in an interconnected system that requires compatibility and interoperability, e.g. VAC, Joint Venture, Communication network
 - E.g. software, communication infrastructure, supplier parts



A Game Theory Example

- Three agents: A, B, C
- Choice among two non-interoperable technologies, T_1 and T_2 with numbers of users $n(T_1)$ and $n(T_2)$ and expected individual payoffs per user Π_1 and Π_2
- At the beginning, agents do not know which technology is superior
- Suppose, in fact, T_1 is superior to T_2

Technology	T_1		T_2
Agent	A	B	C

- Coordination problem
- If a player makes her choice, she produces positive externalities for the other players



Game Theory Example

- Consider

$$\Pi_1 = n(T_1) + 1 \text{ and } \Pi_2 = n(T_2)$$

- Coordinated situation at the inferior technology is superior to all non-coordinated (isolated) situations
- Path dependent process
- The underlying mechanism may easily lead to latent collective blockage of action



Incentive to wait vs. first mover advantage

- ❑ To make the first move in the technological choice model is risky
 - ❑ One might bet on the wrong technology
 - ❑ One might set the standard and receive increased profits
 - ❑ Minimum critical mass required

- ❑ To wait can be profitable as well
 - ❑ Exploitation of the information revealed by prior movers



Information as a collective good

- ❑ Fragmented VACs imply a certain distribution of information
- ❑ The single firm receives less profit from their R&D expenses...
 - ❑ The information inherent to the project cannot be privatized entirely
- ❑ ...but it might also receive benefits from the products of others
- ❑ Potential for mutual exchange of information
- ❑ But individualistic incentive to just exploit the others
- ❑ Need for an institutional structure solving the underlying dilemma

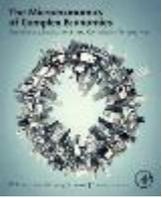


Path Dependence

The development of an economic system depends on past events and is time-dependent

- ▣ External/environmental random events
- ▣ Internal random effects
- ▣ Systemic structural changes
- ▣ Indirect reactions of the system to both exogenous and internal stochastic effects
- ▣ Transitions in the behavior of the system as result of any of the above

For optimizing individuals it is impossible to take all these aspects into account



- ❑ IBM planned to enter the market for personal computer systems and
- ❑ Microsoft was hired to develop a suitable operation system.
- ❑ Microsoft bought Q-DOS, made some minor changes, called it MS-DOS and sold it to IBM
- ❑ The rights on the “new” operation system stayed with Microsoft
- ❑ The program became in spite of a poor performance quite successful.
- ❑ Microsoft went on to dominate the PC sector ever since

The rise of Microsoft



- IT startups at the time faced strong uncertainty and had several options to deal with it, the most important being
 - Radical innovation:
 - Developing a new generation of programs/ operating systems/ etc.
 - First-mover advantage
 - Long-term monopoly revenues
 - Very risky
 - Incremental innovation
 - Developing applied solutions
 - “Wait” for dominating system to emerge
 - Less risky
 - Sell company to major competitor
 - Opportunity of becoming part of the new mother company
 - Without bearing much risk

- What would be the right choice for a maximizing individual?

The rise of Microsoft



The rise of Microsoft

- ❑ Microsoft for instance did not choose a single path and to be prepared for the development of the sector.
 - ❑ Acquiring (and investment in) in DOS
 - ❑ Joint venture with IBM
 - ❑ Negotiations with companies working with UNIX
 - ❑ Collaboration with Apple
 - ❑ Development of a next generation operating system (what would become Windows)
- ❑ Microsoft realized a mixture of the three alternatives presented earlier
- ❑ They benefited heavily from the tacit knowledge then available to them
- ❑ After becoming the standard setter, Microsoft turned to more individualistic strategies
 - ❑ Ending collaboration with some major partners (those who were also competitors) removing compatibility from their products
 - ❑ Aggressively pursuing a strategy of gaining first-mover advantages at the cost of e.g. quality and also revenue (tolerating piracy)



The complexity challenge

- ❑ The economic environment of most economic agents is characterized by
 - ❑ Strong dependence
 - ❑ Uncertainty about the actions of others
 - ❑ Need for cooperation and coordination

- ❑ How do agents react to this complexity challenge?
 - ❑ Individualistic strategies
 - ❑ Collective strategies



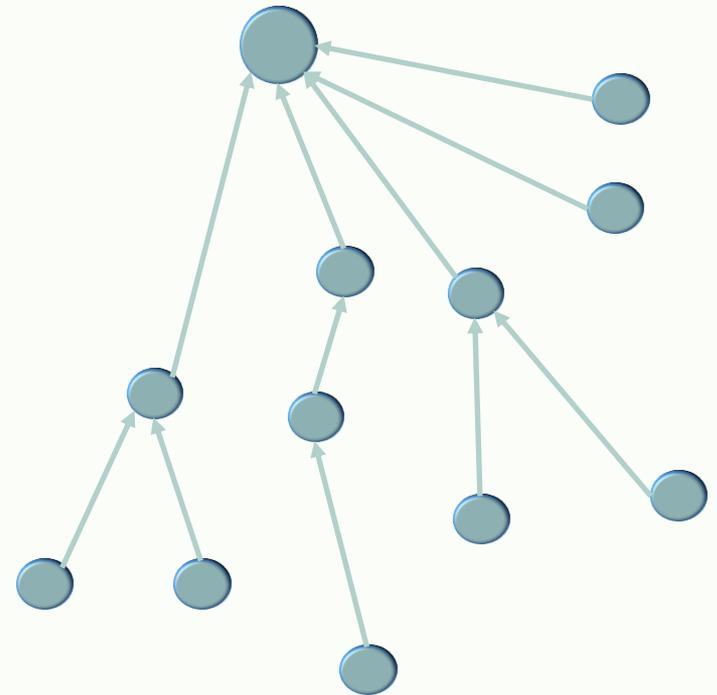
Hierarchy, Power, Collusion

- ❑ Network effects favor the growth of big firms
- ❑ The individual firm or agent cannot change the systemic properties of the economy
- ❑ Big firms often rely on hierarchy to solve the problem of coordination and cooperation under complexity
 - ❑ Helps them to sustain their position
 - ❑ Not favorable for the rest of the economy, i.e. an individualistic response
 - ❑ But it is a system of institutionalized behavior
 - ❑ Includes barriers of entry, mergers and acquisitions, standard setting, lobbying and the use of hub & spoke networks



Hub & Spoke Networks

- ❑ Hub cooperation controls layered sourcing systems
- ❑ Main suppliers as spokes
- ❑ Less profitable steps get outsourced
 - ❑ Hub retains processes with highest value-added, i.e. the most profitable
- ❑ Cheap labor can be exploited
- ❑ Hub retains control over the network
 - ❑ Standard setting





Hub & Spoke Cluster

- Hub & spoke structures established as
 - global sourcing/supplier networks (often with system suppliers supplying several assembler hubs);
 - regional forms of organization in spatial (regional, local) clusters of firms (i.e. firm agglomerations consisting of competitors/ cooperators on a horizontal level and suppliers, customers, service suppliers, infrastructure providers, ...).

- Highly fragile structures:
 - High dependency of firms, employees, and regions worldwide from the central hub and its development; risky and precarious.



Industrial Clusters

- ❑ Local and regional clustering as alternatives to the individualistic responses
- ❑ A cooperation- and qualification-oriented system of independent and even-based small and medium-sized enterprises benefiting from
 - ❑ Spatial proximity (countermeasure against too much fragmentation)
 - ❑ Regional open information flows (tacit knowledge)
- ❑ Characteristics
 - ❑ Interaction density of stakeholders
 - ❑ Proximity of stakeholders
- ❑ Silicon-Valley or Third-Italy type systems

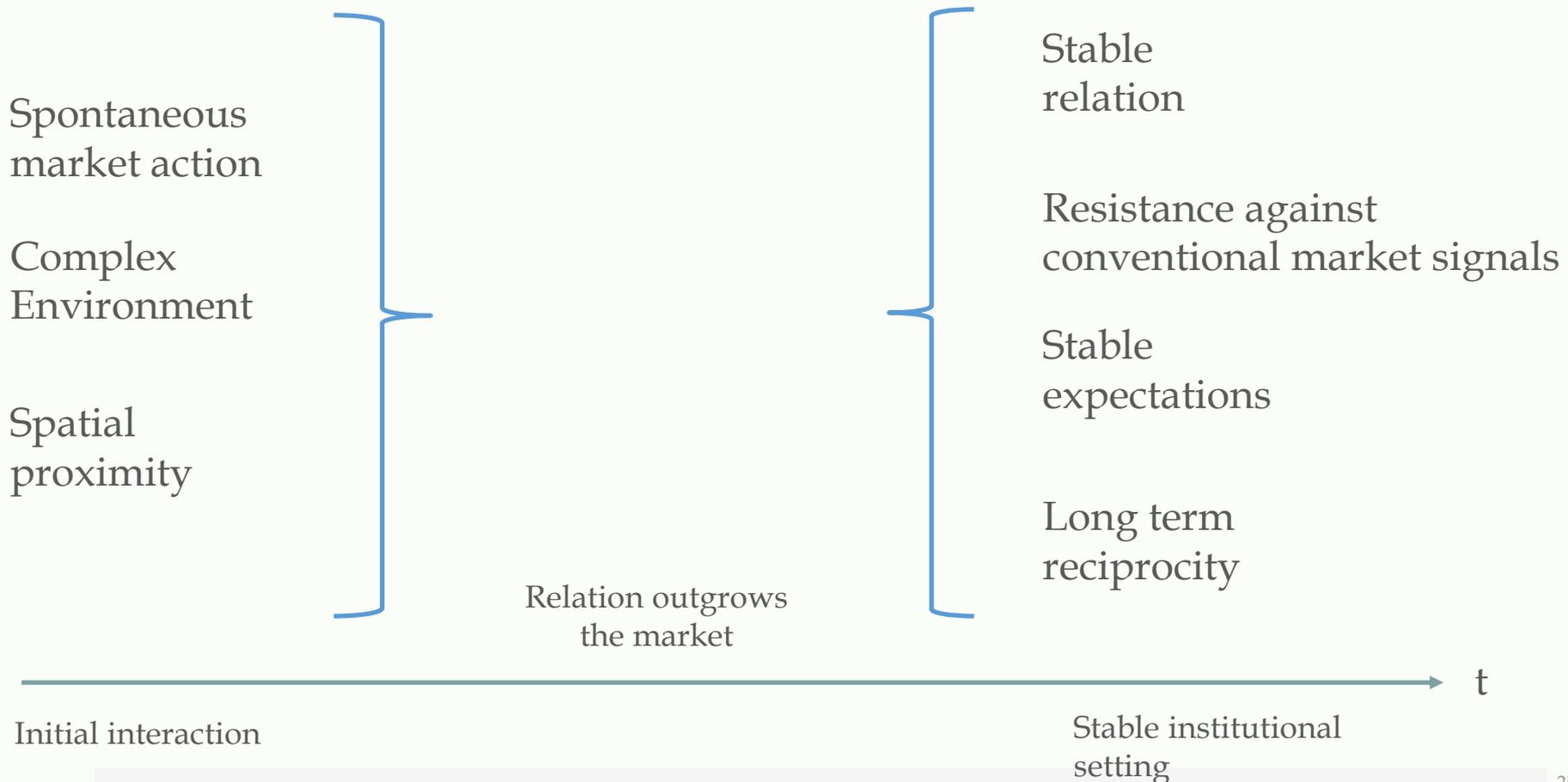


Industrial Clusters

- ❑ Quasi reintegration of parts of the VAC
- ❑ Spatial institutional re-embedding
- ❑ Mixtures of the two reactions are common
 - ❑ Firms may be clustered around Silicon Valley and still outsource parts of their VAC to other parts of the world
- ❑ Determinants for the choice
 - ❑ Recognized interdependence
 - ❑ Degree of uncertainty
 - ❑ ...



Emergence of regional clusters





Industrial clusters and firm networks

- The emergence of industrial clusters often proceeds without formal central planning
- Inside an industrial clusters, more intense relations may be built consciously among a subset of firms
 - Strategic networks
 - Special case: Open-Source Networks



Summary

- Modern Information Economies are characterized by
 - Fragmented VAC
 - Network technologies
- This leads to
 - Need for technological interoperability
 - Direct interdependence among actors
 - Ubiquitous coordination problems and underlying dilemmas
- As a result: A complexity challenge



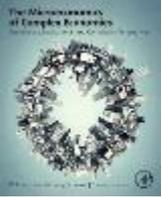
Preliminary conclusions

- ❑ There are different reactions for the agents to cope with the complexity of their environment
- ❑ Big corporations favor to preserve existing power differentials
 - ❑ Individualistic reactions (Hub&Spoke networks, ...)
- ❑ From a societal viewpoint, low power differentials and a cooperative institutional setting would be preferable
 - ❑ Industrial and strategic clusters



Preliminary conclusions for policy

- ❑ Critical time windows for intervention in technological development (standardization and monopolization processes) should be identified
- ❑ Policy should foster non-individualistic reactions to complexity
- ❑ To elaborate the exact functioning and to design adequate policies more concretely, more advanced tools are required
- ❑ Mere deregulation is not sufficient or even harmful
- ❑ Therefore: Understand the theories underlying deregulation and elaborate better alternatives



Readings for the next lecture

▣ Compulsory reading:

The Ideal Neoclassical Market and General Equilibrium, in:
Elsner/Heinrich/Schwardt:
[Microeconomics of Complex Economies](#), pp. 97-128.

▣ For further readings visit the [companion website](#)

