Class
Innovation and SMEs

IPS
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- Many models in industrial economics are static: choice of the price level at a certain point in time, concentration level which maximises social welfare, etc.
- Industries – productive sectors – should also be analysed from a dynamic perspective: evolution through time, factors for development and decline, etc.
- From a dynamic perspective a fundamental element is innovation, technical progress.
- In industrial economics, the study of innovation has led to the development of a new approach, almost a new theory: the evolutionary theory, that has brought many new insights to innovation policy, which is part of industrial policy

- The evolutionary theory focuses attention on the importance of technological progress and derives a new approach to the analysis of economic processes.
- Main hypotheses of neoclassical theory:

- Characteristics of demand (given)
- Given technology
- Firms as black boxes
- Unit of analysis = exchange
- Knowledge = information

1. Concepts and definition

- Technical progress and growth

Abramovitz (1956), Solow (1957)

Use different methods, different time periods, they measure output differently,

But same conclusion:

Not more than 15% of US GDP growth between 1900 and 1950 is due to the growth in the K and L factors

(neoclassical theory: g = f(K, L))

⇒ Hence 85% of growth results from same quantity of K and L that give higher output thanks to technical progress and learning

(improvement in productive techniques which allow to produce more with the sane quantity of factors)

⇒ TP and growth are intimately linked

⇒ TP = technological development, innovation

⇒ It is therefore important to study the determinants of TP at firm and territorial levels in order to understand the determinants of industrial development

⇒ The evolutionary theory focuses attention on these issues

⇒ While the neoclassical theory of innovation focuses attention on the effect of innovation and technical progress on market structure.

Concepts:

Technology = set of knowledge on the techniques and routines necessary to produce a given good or service

The existing technology limits how much can be produced with a given quantity of productive factors

TP = changes in the technology

E.g. New methods to produce existing goods

new forms of organisation, new marketing methods, etc.

New products which satisfy new needs

Innovation = creation of knowledge

Freeman (1982) distinguishes between invention and innovation

Invention = idea, project or model

Innovation = first commercial transaction of the new good or process

Process innovation = invention or commercialisation of a new production process (e.g. Mass => flexible production system)

Product innovation = new product or improvement in an existing product

Three phases of the innovative activity:

1. Basic research (leads to new discoveries without any commercial aim)
2. Applied research

   = aimed at enhancing technological knowledge with a specific commercial aim

3. Experimental development

   includes all research activities aimed at applying technological knowledge to new processes or products

2. Analysis in the neoclassical theory

Neoclassical theory considers only a part of the phenomenon related to TP, due to the restrictive assumptions made.

The most restrictive hypothesis is that:

knowledge = information

Knowledge in fact comprises both tacit knowledge (embodied in things and persons, communicated through the relationship between a master and a pupil) or implicit knowledge

And codified (or explicit) knowledge which can be formalised in language, books or manuals and therefore perfectly communicable = information

Consequences of hypo knowledge = information?

Then knowledge has the characteristics of information which is to be a public good:

Non excludable: difficult to impede someone from consuming the good

Non rivalry: the consumption of the good by one individual does not reduce the quantity available to other individuals

=> The “market for ideas” (for information) is characterised by various market failures which justify public intervention

4 major failures:

1. Appropriability: the firm must invest in R&D in order to innovate but it is not sure to take the returns from this investment if the new knowledge is easily known and copied

=> Low incentives to innovate

2. Positive externalities: spill-overs

   The R&D activity of a firm has effects on other firms (high when new knoweldge is easily communicated)

3. Risk and uncertainty: R&D investments are high while the probability to innovate is low => high risk

   3 types of uncertainty:

   - technology: is it possible to do what we would like to do?

   - market: will the new product have a market?

   - competition: rivals will invent something better before us?

4. Non convexity (economies of scale in the use)

   given that MC of information diffusion is zero

$\Rightarrow$ Public policy problem:

we want to maximise the diffusion of ideas, because MC of diffusion = 0

but

if diffusion is maximised then returns to innovation are nil

Hence **Trade-off between diffusion and incentives to innovate**

and

The private gains from R&D and innovation are always lower than the social gains

	Rate of return (%)	
Innovation	Social	Private
New type of metal that reduced cost of appliances	17	18
Machine tool innovation — new computer controls	83	35
Component for control system	29	7
Construction material — reduce cost of building	96	9
Drilling material — reduce cost of drilling wells	54	16
Industrial equipment — new type of drafting	92	47
New paper product that cuts cost of users	82	42
New type of thread that cut costs of garment makers	307	27
New mechanism for doors	27	37

Figure: Social and private rates of return from investment in seventeen innovations - Part I. Source: Mansfield et al. (1977).

Solution?

Essentially 4

1. Innovation subsidies (to reduce R&D costs)
2. Patents (in order to avoid too rapid diffusion and give time to the innovator to take the returns from its investment)
3. Public procurement
4. R&D collaboration (programmes of R&D collaboration between firms, between firms and universities, etc., in order to reduce risk and uncertainty)

3. Technology and market structure

Important policy issue regarding innovation and SMEs:

Are competitive markets more innovative? (Arrow hypothesis)

Or monopolies innovate more because they have the financial resources to invest in R&D? (Schumpeter hypothesis)

If Schumpeter is right, better be a large firm to be able to innovate!

Schumpeter: there is a positive correlation between quantity of resources invested in R&D, monopolistic power and profit

Why?

1. High profits allow to have resources to invest in R&D
2. Monopolies are more risk-taking
3. Monopoly means barriers to entry hence limited imitation

Arrow (1962): opposite thesis

The incentive to innovate is lower in monopoly relative to competition

In both cases incentives are lower than socially optimal level, because there are market failures in the market for ideas

(For Arrow, knowledge = information)

Model with drastic innovation and non drastic innovation: the drastic innovation is, the higher the cost reduction induced by the innovation

The incentive to innovate is measured by the difference in profit before and after innovation.

In this conditions, Arrow shows that the incentive to innovate is always higher in competition relative to monopoly

Arrow Model: it is the ex-post market structure which influences the incentive to innovate

Firms integrate ex-ante the various cases that may arise according to the decision they choose.

Simple model to illustrate: Gilbert & Newberry (1982)

Show how ex ante competition influences the structure of incentives

Duopoly:

Firm 1 = monopoly

Firm 2 = potential entrant

In this case the incentive to innovate of the monopoly depends not only on the expected profit, but also on the competitive threat (threat of entry)

Hence the monopoly decides taking account not only of expected profits but also of what happens if the potential entrant enters the market.

Assume there exists a new technology that firms can adopt

For firm i, adoption allows to reduce production costs from c_i to $c'_i < c_i$

then:

The incentive for the monopolist to adopt the innovation in case of no competitive threat is: $\Pi_1(c') - \Pi_1(c)$

With competitive threat: $\Pi_1(c'_1) - \Pi_1(c_1, c'_2) > \Pi_1(c') - \Pi_1(c)$

⇒The presence of competitive threat explains why leaders often spend more on R&D than competitors: to maintain their dominance through time

(this is one factor, not the only one)

General results regarding firm size and innovation

High-technology SMEs have a key role in developing and exploiting new technologies (hence development of new sectors)

In fact large firms are look for external sourcing of new technologies and high-technology SMEs are one of the external sources which they aim to access.

About 75% of R&D expenditures in the EU are accounted for by large firms (> 500 employees).

Hence 25% of R&D is performed by SMEs (< 250 employees), against 14 % in the USA and 7% in Japan.

SMEs also have a lower innovation intensity than large firms (share of turnover from innovative products)

➔Is Schumpeter right?

Arguments in favour of large firms innovating more than SMEs:

- R&D projects typically involve large fixed costs and these can only be covered if sales are sufficiently large;
- there are scale and scope economies in the production of innovations;

Other arguments:

Large firms can undertake many projects at a time and hence spread the risks of R&D;

Large firms have better access to external finance and firms with greater market power are better able to finance R&D from own profits and more easily appropriate the returns from innovations.

EMPIRICAL EVIDENCE?

Many empirical analyses have been carried out:

NO SIGNIFICANT RESULT ON EFFECT OF FIRM SIZE ON INNOVATION

(e.g. Simeonidis (2006) for a review)

WHY? The effect depends on the sector, and averages across sectors often rule out these differences

Examples: role of innovative SMEs in the biotech sector, in instruments, while other sectors have strong role of large firms in innovation: e.g. chemicals.

The issue therefore is not whether firm size is conducive to innovation, but rather which market and technology characteristics favour large and/or small firms.

e.g. concentration, technological opportunities, the stage of the technology life cycle, scope for diversification; problem of access to finance is particularly important for SMEs

In addition, taking all SMEs together limits the insights one can get:

SMEs are heterogenous also in the innovation dimension:

- The vast majority of SMEs undertake no or little R&D (Basic SMEs)

- Most SMEs have a low innovative profile, but regularly acquire, adapt, apply technology new to the firm (Adopting SMEs)

- Other SMEs are innovative as technology user, developing or combining existing technology to develop innovations that are not only new to the firm, but also new to the market (Leading SMEs)

- Among leading SMEs, a few are involved in leading-edge high level research, leading to drastic innovations. These pioneering SMEs are often young start-up companies (Young Innovative SMEs)

Nowadays some innovative startups reach valuation greater than $ 1 bn = unicorn

UNICORNS

Survey of HBR (2016) found that

Startups founded between 2012 and 2015 were growing in valuation twice as fast as companies from startups founded between 2000 and 2013!

= signs of big disruption

= signs we are indeed in the midst of an industrial revolution!

Note: unicorns can be a good topic of essays

Innovative SMEs often collaborate with other firms in the innovation process

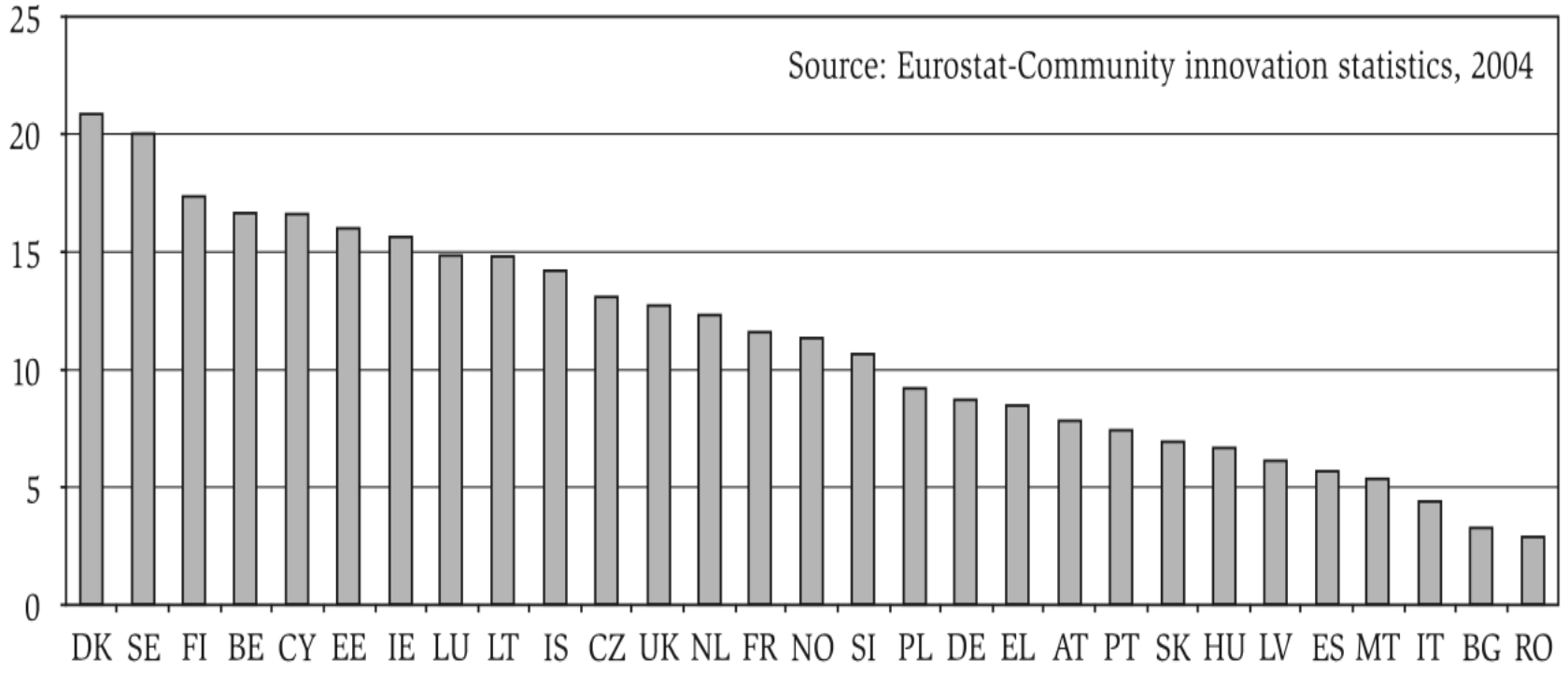


Figure 6. Innovative SMEs co-operating with others (as % of all SMEs); By country.

Source: Eurostat, Statistics in Focus, 116-2007, CIS 4 results.

Importance of SMEs in the population of innovative firms

SMEs account on average for 90% of innovative firms (OECD / Eurostat data, 2018)

(Importance of indicators!!!)

Other evidence from the Community Innovation Survey (Eurostat)

SMEs play a key role in shifting innovation models by adapting supply to different contexts or user needs and responding to new or niche demand

Innovative start-ups bring new ideas into the market by tapping into knowledge generated but not commercialised by existing firms (Acs et al., 2009)

SMEs also have a competitive edge due to their higher risk acceptance, greater flexibility, greater ability to integrate complex sets of information and technologies, more agile and adaptive organisational culture, as well as greater cohesion and sense of collective purpose, that help them overcome their size-related disadvantages.

SMEs play a key role in new and strategic sectors: software, nanotechnology, biotechnology and clean technologies.

Generally,

- SMEs are more engaged in new organisational or marketing practices than large firms
- SMEs have good performance in launching new products and processes
- SMEs introduce mainly non-technological innovations (Most SMEs are in the service sector where innovation is more incremental and non-technological)

SMEs and innovations related to the fourth industrial revolution?

- Many SME managers remain unaware of the potential offered by the new technologies to their business (particularly, digital technologies)
- ICTs have been major disruptors of business practices: internet is now used for operational matters, including ordering, selling, marketing or online banking, and for interacting with business partners and public authorities
- ICTs also change consumer behaviour: demand becomes more sophisticated and better informed, implying shortening of innovation cycles and time to market.

SMEs can take advantage of:

- The IoT and big data analytics can help enhance customer behaviour analysis and create new knowledge for product differentiation and customisation, for better anticipating user expectations and for improving customer experience
- 3D printing is possibly another main driver of mass customisation and the range of applications is likely to further expand as the technology matures

➔ Examples of disruption abound

Disruption in the retail sector (= sector dominated by SMEs)

The NikeID platform enables customers to design and shop personalised sportswear online

The Dash Replenishment Service of Amazon allows measuring product usage at home and automatically reorder through connected devices

Physical shops are also changing a lot:

- Shopping assistant robots provide in-store services, check stocks and collect data on customer behaviours (e.g. Walmart, USA; SoftBank Mobile, Japan).
- Smart fitting rooms equipped with virtual augmented reality mirrors and sensors enable customers to create an outfit, try it without underdressing and share for comments on social media via their mobile phone (e.g. Van Heusen, USA).

Can you think / collect information on other examples?

Problem of protecting innovation for SMEs

Patent law assumes that a higher protection provides higher incentives to innovate: if the potential inventors know that they will be able to protect their inventions, then they will invest in R&D, because they will be sure to get the returns from their investment

Patent (In)effectiveness

Cohen et al. (2000): 1994 survey of more than a thousand managers of manufacturing industry R&D laboratories on methods used to protect income flows generated by intellectual assets. Managers ranked the effectiveness of patent protection

-lead time that comes from first innovation secrecy

Patent (In)effectiveness

-possession of complementary manufacturing facilities and know-how legal protections other than patents.

-In protecting their competitive advantage from innovations during the three years preceding the survey.

Patent (In)effectiveness

Product innovations	%	Process innovations	%
Lead time	52.76	Secrecy	50.59
Secrecy	51.00	Complementary manufacturing facilities and know-how	43.00
Complementary manufacturing facilities and know-how	45.61	Lead time	38.43
Complementary sales and service	42.74	Complementary sales and service	30.73
Patents	34.83	Patents	23.30
Other legal mechanisms	20.71	Other legal mechanisms	15.39

Figure: Mean percentage of innovations for which appropriability mechanism is considered effective (Cohen et al. 2000).

Product innovations	Medical equipment	Drugs	Special purpose machinery, nec	Autoparts	Computers
Lead time	58.06	50.10	59.69	64.35	61.40
Patents	54.70	50.20	48.83	44.35	41.00
Complementary sales and service	52.31	33.37	46.33	44.84	40.20
Secrecy	50.97	53.57	45.08	50.83	44.20
Complementary manufacturing facilities and know-how	49.25	49.39	51.09	53.06	38.00
Other legal mechanisms	29.03	20.82	23.05	15.65	27.20

Figure: Mean percentage of product innovations for which appropriability mechanism is considered effective, 5 industry groups. Source: Cohen et al. (2000, Tabie 1). "nec" indicates "not elsewhere classified."

Intellectual Property Rights

Most important reasons firms decided not to patent:

- difficulty in demonstrating to the patent office that the innovation was in fact novel
- ease of inventing around a patent
- the amount of information that had to be disclosed to obtain a patent.

Patent (In)effectiveness

Reasons to patent	Product innovations	Process innovations
Prevent copying	95.8	77.6
Blocking rivals' attempts to patent a related invention	81.8	63.6
Prevent infringement suits	58.8	46.5
Enhance reputation	47.9	34.0
Use in negotiations	47.4	37.0
Licensing revenue	28.3	23.3
Measure internal performance of own technology personnel	5.8	5.0

Figure: Per cent of respondents by reason, 765 product innovations, 674 process innovations. Source: Cohen et al. (2000, Figure 7, Figure 8).

SMEs generally use patenting less than large firms (only 28% of patent applications at the EPO are by SMEs and individual inventors)

They prefer other modes of protection, such as trade secrets.

Trade secrecy is confidential business information that can cover new manufacturing processes, improved recipes, business plans or commercial information on whom to buy from and whom to sell to (e.g. customer list). Unlike patents, trade secrets are protected by law on confidential information, e.g. confidentiality agreement, or non-disclosure or covenant-not-compete clauses.

However, trade secret law is more difficult to enforce than a patent; it does not protect from fair discovery or reverse engineering and the secret is lost when disclosed + is set within national legal frameworks limiting transnational knowledge transfers.

- Digitalisation and the revolution in data codification, storage and exchange (i.e. cloud computing, emails, USB drives) imply rise in trade secret infringements.
- Increasing value given to IP (and de facto its misappropriation), staff mobility and changing work culture and relationships (e.g. temporary contracts, outplacement, teleworking) or the fragmentation of global value chains (with more foreign parties involved within more diverse legal frameworks and uneven enforcement conditions) also contribute to increase exposure and risk of disclosure
- However, new technologies can also favour protection of IP: particularly through the blockchain

Innovation: the importance of collaboration

Clusters

Open innovation

Innovation systems

INNOVATIVE CLUSTERS

1. **What are clusters?**
2. **Evidence on their effect on a territory's economic growth and development?**

1. Definition of clusters

According to report from expert group for the European Commission,

Cluster = “geographically closed groups of interconnected companies and associated institutions in a particular field, linked by common technologies and skills. They normally exist within a geographic area where ease of communication, logistics and personal interaction is possible. Clusters are normally concentrated in regions and sometimes in single towns”

Policies for clusters are a part of industrial policy

Characteristics of clusters:

- Dense economic and social relationships;
- Located in a local context which is homogenous and cohesive from a cultural point of view;
- High social capital;
- Intensive knowledge exchange and collective knowledge creation

Effects:

- Low transaction and communication costs
- External economies (collective efficiency)
- Learning and innovation

Cluster are in which sectors?

Clusters can be found in all sectors, except sectors where economies of scale are very high (e.g. steel) :

- Traditional sectors: Made-in-Italy districts, productive districts of developing countries
- Sectors with medium technological intensity: automobile, shipbuilding, etc. some clusters, essentially supplier networks of larger firms
- New sectors (*high tech*): pharmaceutical, biomedical, software, etc.

$\Rightarrow$ Some famous clusters: Silicon Valley

Clusters are general created from private initiative, not from public policy aimed at creating a cluster.

However, the success of some clusters has led governments to get interested in them.

Since interest is mainly on high tech clusters in the EU, let's look at them.

2. Evidence on effect of clusters on economic development and growth?

There is no systematic evidence (data on clusters at national level)

Only anecdotal evidence exist, namely studies of specific cases.

Examples:

USA: Hollywood, Wall Street, Detroit, Silicon Valley, Route 128

Switzerland: watch industry

Italy: Prato, Carpi, Sassuolo, Mirandola, Montebelluna, etc.

France: Grenoble (Nanotechnologies), Toulouse (Airbus), Lyon (biotechnologies), etc.

=> Case studies outline factors of their emergence and factors for their performance

Factors for the creation of clusters?

The literature is wide on this issue: from Marshall (1920) to Krugman (1991)

Factors include:

- Presence of natural resources;
- Economies of scale in production or procurement;
- Specialised labour markets;
- Specialised local supply;
- Shared infrastructure;
- Localised externalities.

Why emergence of clusters in specific sectors?

Why Prato is in Prato and not in another Italian town?

Why Mirandola is there and not in Bologna?

No definitive answer to this.

Porter (1990) brings some elements of explanation:

- Demand and production factor conditions;
- Presence of industries with complementary activities;
- Structure and competition in the local context.

Factors:

- Natural resources: Carrara (marble); Solingen (Germany) (cluster producing knives close to iron and wood resources); silk industry in Japan; film industry in Holywood (natural resources linked to climate: generally sunny, also low cost land, proximity to varied landscapes);
- Territorial concentration of specific competencies: electronics in San Francisco Bay; optical industry in Wetzlar (Germany);
- Specific local demand: was a factor for the development of the packaging cluster near Bologna; industry for automation equipment near Turin, silk industry in Japan;
- Spinoff from other activities: synthetic fiber cluster close to silk cluster in Japan.

So we can highlight various factors for the emergence of clusters, but no unified model (theory) exist

Cases are so varied

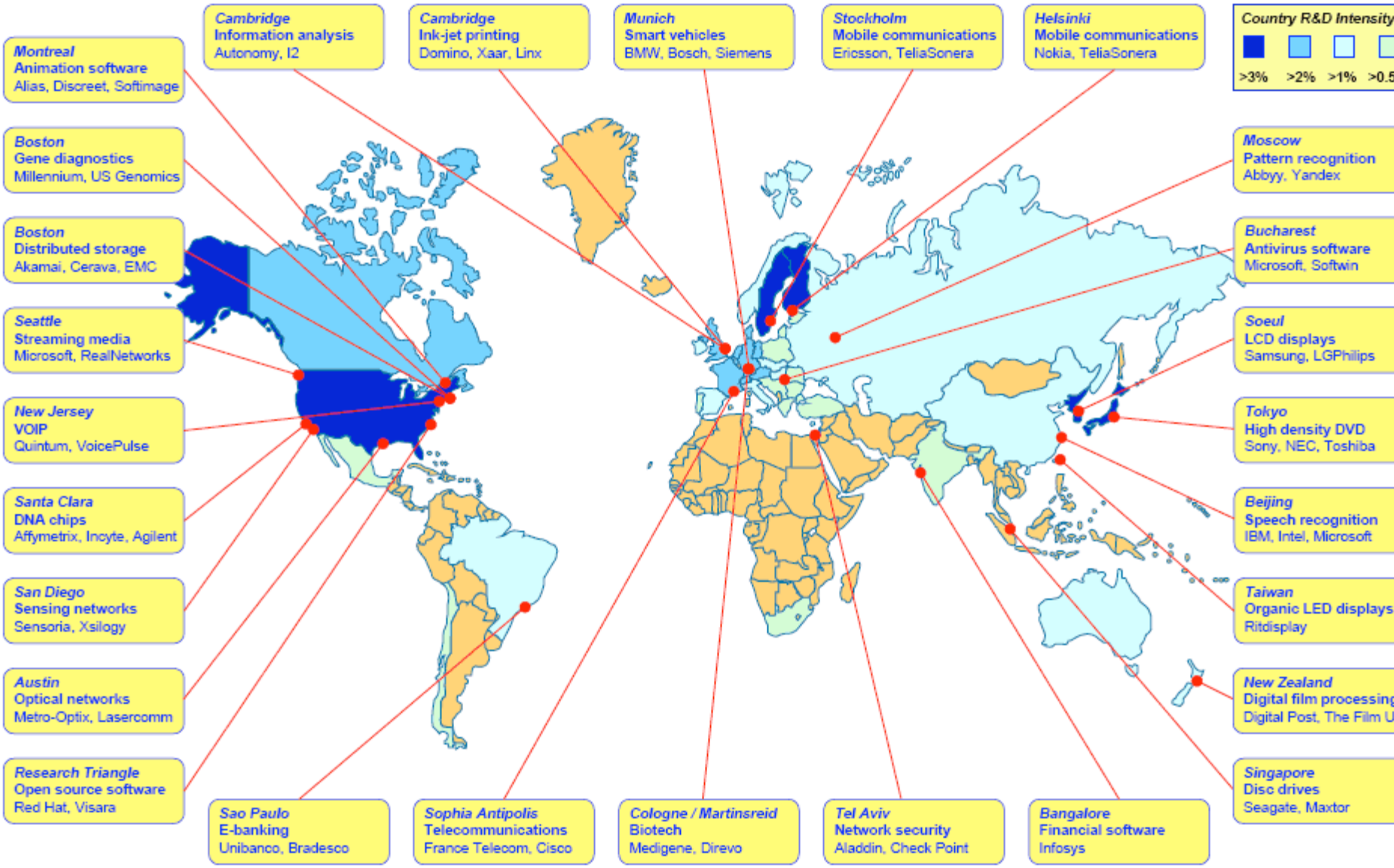
$\Rightarrow$ Policy implication: policy-makers can implement policies to favour the emergence of clusters but we are not sure that clusters will effectively emerge

$\Rightarrow$ Unless policy is really interventionist, like in Styria (Austria) (see below)

Evidence in the literature however is that new industries or regional development often arises out of the emergence of clusters

Recently particularly important have been innovative clusters

Global innovation clusters, core technologies and key companies



Sources: Technology Review, DTI, Red Herring, Business 2.0, OECD, MIT

Example of a cluster: Silicon Valley (Santa Clara County)

- **Silicon Valley** between San Jose and San Francisco in California is the classic cluster
- Centre of the US (and world) **computer industry-** and other high tech industries such as **biotechnology and clean technology**
- Grew out of electronics expertise in Stanford University, and US military spending on electronics
- Proliferation of **Start-ups** (e.g. Intel and Apple) with innovation culture and innovation strategy
- "**network firms**"
- Risk and venture capital resources

Silicon Valley

What is in Silicon Valley?

Universities

Venture Capital

5 airports

Clusters

- Alfred Marshall (1890) talked about '**industrial districts**':
  - A local pool of specialized labour
  - Firms specializing in intermediate stages of production
  - Knowledge spillovers

- Interest in clusters revived in 1980s with '**new industrial districts**' and new work identifies the importance of:

  - supportive socio-cultural attributes that create an innovative culture (**way of doing things in the locality, tacit knowledge**)
  - a network of public and private institutions supporting firms in the locality
  - an intense set of backward, forward and horizontal linkages between firms based on non-market as well as market exchanges

- '**Clusters**' (the rebranded term) became a popular concept for innovation studies following the work of Porter (1990) and Krugman (1991)

What is a cluster?
A spectrum of Definitions

Phenomenon	Richness of Cluster	Difficulty of Measurement
Informal Knowledge Exchange	Rich	Hard
Explicit Collaboration		
Labour Mobility		
Marshallian Externalities		
Network Firms		
Companies Interdependent in a Value Chain		
Co-Location and Superior Performance		
Co-Location and Technological Proximity		
Co-Location	Shallow	Easy

What Characterizes Innovation Clusters?

- Geographical Concentration
- High Degree of Specialization
- Large Number of Start-ups and Small Firms
- Ease of Entry and Exit
- High Rate of Innovation

Share some examples of clusters in your region/country

- What cluster is it? In which industry?
- Size of the firms?
- Relationships among the firms?
- Performance of firms within the cluster?
- Why do firms cluster?

Why do companies cluster?
Advantages and Disadvantages

	Demand Side	Supply Side
Advantages	• Strong local customers • Reduced consumer search costs • Market share gains from clustering (Hotelling) • Reduced transaction costs • Information externalities	• Strong local suppliers • Pool of specialised labour and other specialised inputs • Shared Infrastructure • Reduced transaction costs • Information externalities and knowledge spillovers • Facilitates Innovation
Disadvantages	• Competition in output markets	• Competition in input markets (real estate, labour) – 'overheating' • Local infrastructure over-stretched • Congestion (e.g. in transportation) • Cartels • "New ideas need new space"

Statistical /econometric evidence

- Companies located in strong clusters often **grow faster** than average
- Strong clusters attract disproportionate amounts of **new firm entry** (“start-ups”)
- In high-tech industries (e.g. biotech), **proximity of the science base** (e.g. major university) attracts entry
- Strong clusters generate disproportionate amounts of **innovation and patenting**

Clusters and Innovation

- Innovation stems from division of labour
  (depth: **specialisation**)
- Innovation stems from combination of diverse knowledge
  (breadth: **diversity**)

➔ Both of these mechanisms can work better in the cluster than in isolation

How Do Clusters Facilitate Innovation?

- Division of labour, specialization
- Networking
- Ease of entry and exit
- Resource mobility

1. Division of Labour and Specialization

- A large number of firms in the same industry allows firms to specialize in what they are good at
- They can provide specialist goods and services and cluster firms can draw on a range of specialised suppliers
- These will include specialised firms that support innovation in the cluster (patent agents, venture capital firms etc.)

Why are companies in clusters more specialised?

- **Transactions costs are lower in clusters**
  -Reduced costs of coordinating inputs with company requirements
  -Reduced costs of communication with suppliers
  -Reduced risk of opportunistic behaviour

- If transactions costs are low it makes sense to outsource to specialist supplier who enjoys economies of scale

- Companies that **specialise enjoy economies of scale**
  Therefore: companies tend to specialise in part of the vertical chain and outsource the rest

Why are companies in clusters more specialised?

- "The Division of Labour is limited by the Extent of the Market" (Adam Smith)

- As we move from dispersed production serving a small area to clustered production serving a large area, **the extent of the market is increased**

- And thus a greater division of labour emerges

How Do Clusters Facilitate Innovation?

- Division of labour
- **Networking**
- Ease of entry and exit
- Resource mobility

How Do Clusters Facilitate Innovation?
2. Networking

- Innovation does not happen in isolation but draws on other firms for ideas, knowledge and services- **innovation is a multiplayer game, not a solo act.**

- Tight-knit groups of people working in the same field but within a number of different firms located in close proximity can facilitate networking within the cluster- **a knowledge community**

- Cluster firms know a lot about what their competitors are doing

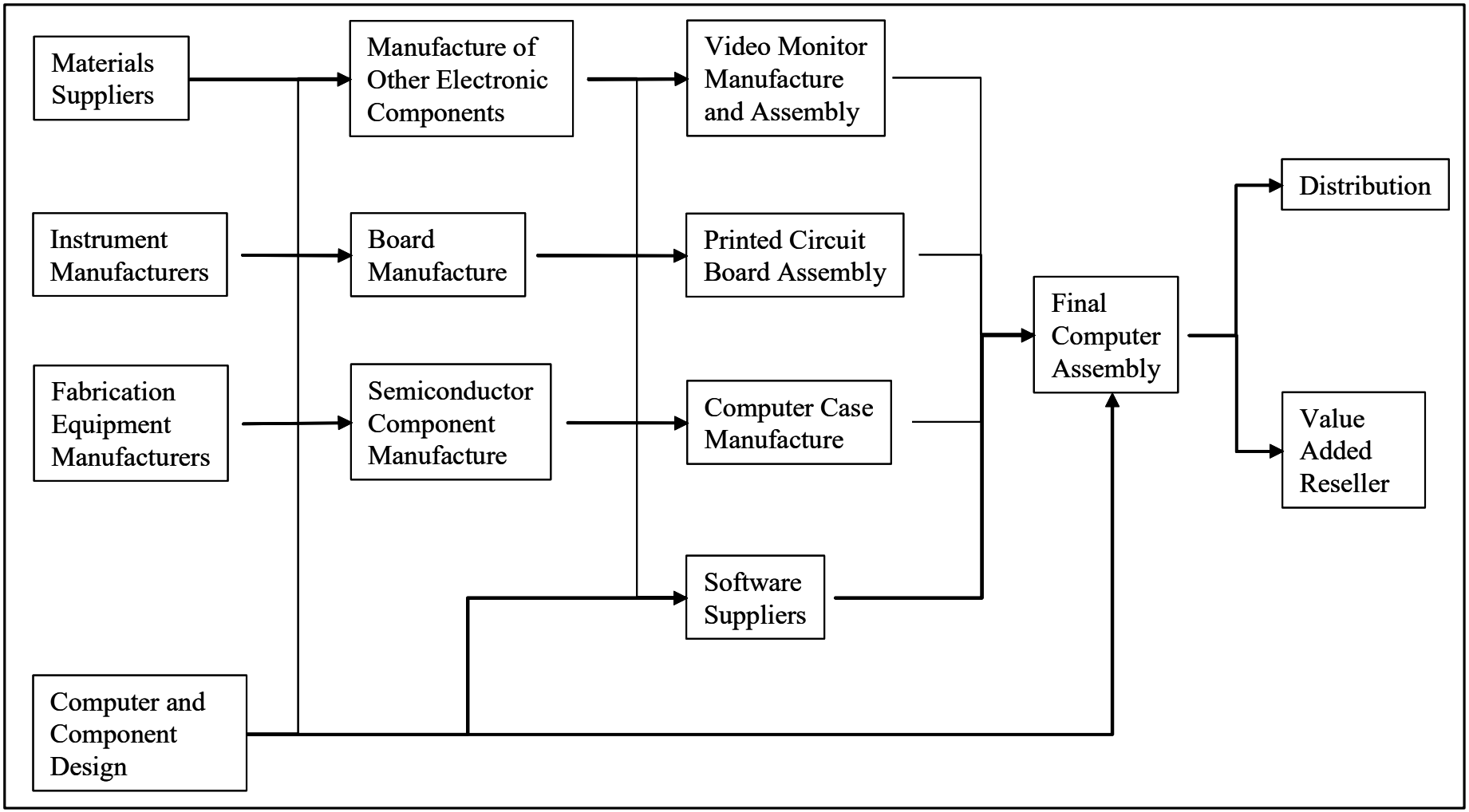
Exploiting networks in a cluster

- Networks are about linkages and connections bringing together suppliers, customers, collaborators, research centres to produce innovations

- Networks consists of firms with complementary capabilities and resources

- Networks come with their own challenges:
  - How to manage beyond firm boundaries?
  - Self interest vs. system interests?
  - Trust? Free riders?

Division of Labour in Computer Manufacture



Vertical Integration (1960s) in Computer Industry

- In early 1960s, IBM dominated the computer industry
- IBM had a high degree of vertical integration, and made almost all the components of its computers "**in house**"
- This included the semiconductor components, peripherals (disk drives, tapes etc.), software, operating systems, and assembly

Network Firms (1980s onwards) in Computer Industry

- Contrast this with the history of Apple, one of the pioneers in the PC market
- Apple, founded in Silicon Valley, was at that time just a design company - designing computers
- Apple produced no components and did almost no assembly - all that was **outsourced** to other companies, *many of which were also in Silicon Valley*
- Apple was once described as the ultimate ***network firm***

How Do Clusters Facilitate Innovation?

- Division of labour
- Networking
- **Ease of entry and exit**
- Resource mobility

How Do Clusters Facilitate Innovation?
3. Ease of Entry and Exit

- A tradition of start-ups: small and young companies
- Lower sunk costs for entrepreneur scientists
- ‘OK to fail’ culture

How Do Clusters Facilitate Innovation?
4. Resource Mobility (especially labour)

- If people move between companies, so do ideas.
- Movement encourages an active market for ‘skills’.
- Firms well aware of what other cluster firms are doing.

Case Study

- Procter and Gamble is a multinational company well known for its wide range of consumer products, covering everything from snacks to hygiene products and detergents.
- Employs 7500 scientists and spends $5 million on Research and Development annually.
- Until the year 2000, they operated with the '**invented here**' model doing their innovations in house.
- In 2000, they moved to a new strategy '**connect and develop**' to exploit the ideas and innovations of external partners such as universities and other companies.
- Every year P&G produces a 'top 10 needs' based on consumer research and reach out to their broad network with the 'problem' and search for technology providers.
- Once a technology provider is identified, they negotiate the terms of licensing the technology and often undertake product development in-house.

Questions

1) What are the advantages and disadvantages of the ‘connect and develop’ model over the ‘invented here’ model from P&G’s perspective?

2) What is the role of P&G in this network? What capabilities are required to perform this role well?

3) Why are technology providers (these may be universities or companies) willing to take part in such a network?

4) P&G does not only work with a local network but a global one that includes firms all around the world. What are the advantages and disadvantages of global networks?

Importance of firms' external relationships in order to innovate:

- **Open innovation model (Chesbrough, 2003)**

- **Innovation systems: at national, regional or local levels**

Firms' innovation depends on density of relationships both within and outside the firm

Outside: relations with other firms, research centres, universities, and other organisations

Chesbrough has outlined the importance of external relations in his open innovation model (firms cannot innovate without openness to and interactions with outside actors)

The literature on innovation systems (from end-1980s) outlines the importance of external relationships. Implications are discussed for POLICY: innovation policy should aim at strengthening the innovation system, namely the network between innovation actors as well as the capabilities of actors (knowledge base, resources for R&D, etc.)

Implications in terms of technological policy

Technological policies (i.e. Policies aimed at favouring innovation and technological diffusion) implemented at regional, national and European levels have changed in the last 20 years:

New instruments and objectives have been added

Thanks to the results of evolutionary theory

Let's have a look at them starting from instruments derived from neoclassical theory and new instruments added when considering the broader perspective of the evolutionary theory

a) Neoclassical theory and technological policy: the market for ideas

The traditional justification for technological policy results from the market failures in the market for ideas

Innovation is knowledge creation and knowledge are assumed to be information, namely codified knowledge and hence communicable at zero cost.

4 market failures in the market for ideas:

1) Spillovers = positive externalities: the more an idea diffuse, the higher the benefits for society but the inventor looses the exclusivity of his ideas and does not get all returns.
2) Risk and uncertainty: R&D expenditure are high (hence risk) and it is not sure to innovate and find a market (uncertainty)
3) Non convexity: (increasing returns) R&D expenditure are high, hence there are scale economies in the use of ideas, while the marginal costs of diffusion are nil; there are also scope economies in the use of ideas, since the same idea can be used in various contexts

4) Appropriability problem: getting the return from investment in R&D when imitation is easy

- Evaluation: it is difficult to value an idea before knowing it, but once one knows the idea, there is no point in buying it!

  => tendency to undervalue ideas

  => low returns for the inventor

  => low incentives to innovate

- Competition: social returns to R&D are higher than private returns

$\Rightarrow$ Policy problem: we want maximum diffusion to use the idea at most but maximum diffusion means low return to the inventor

$\Rightarrow$ Trade-off: diffusion / incentives to innovate

Policy instruments to resolve failures in the market for ideas:

1. Subsidy: the inventor receives a subsidy in order to lower innovation costs; diffusion is guaranteed

   Problem: difficult to check whether the firm would have spent in R&D even without the subsidy: additionality problem whereby the subsidy may substitute the spending the firm would in any case have done

2. Public research: incentives to innovate exists even without any return; problem is additionality (public research substitute private research) and objectives of research which may result from lobby pressures rather than maximisation of welfare

3. patent: protect inventions for a specific duration (20 to 30 years). However, diffusion is lowered.

=> These instruments are used in the EU both at national and European levels; also in other countries in the world (research subsidies, public research in universities or in international R&D centres such as European Space Agency; a European patent has been created in 2004 only).

b) Critics to the neoclassical theory and new instruments:

The above policy recommendations derive from 2 essential hypotheses:

1. All knowledge is information
2. All exchange takes place in perfectly competitive markets

These two assumptions can be criticised:

First hypo: knowledge = info

- Restrictive assumption because a great part of knowledge is tacit

Machlup (1982), Scotchmer (1991) argue that the more and individual invents, the more likely he is to invent again (cumulative)

The return to invention are in fact both increasing and decreasing: increasing the number of researchers does not necessarily imply increasing innovation

- The MC of knowledge communication is not zero not only because a part of knowledge is tacit, but also because acquiring knowledge is costly: requires investments in learning, trial, understanding, etc.

The evolutionary theory argues that the cost of acquisition of new knowledge increases with the distance between the new knowledge and the existing knowledge base: e.g. Biotechnology completely change medicine production, hence high cost of acquisition of this new technology (new knowledge)

Second hypo: all interactions arise in competitive markets

Competitive markets: large number of buyers and consumers who do not know each other; no transaction costs, no information asymmetries, etc.

However the transactions between agents involved in the innovation process do not only arise on markets:

- Bilateral contracts are possible
- Knowledge diffusion can arise without a transaction, for instance during a conversation between individuals (researcher and manager) at a public event or other circumstances

$\Rightarrow$ Evolutionary theory stresses the importance of the role of institutions and of proximity in the diffusion of knowledge and innovation processes

$\Rightarrow$ Technological policies recommended change:

1. besides R&D subsidies, patents, public research

2. most of all favour interactions between all agents involved in the innovation process (firms, universities, local and national governments, research centres, etc.) :

- links university - industry

- scientific parks (cluster)

⇔ Emphasis in Europe in the last 20 years, both at national (and regional) and supranational levels

Innovation actors (firms, public and private research centres, public authorities, etc.) and their relationships constitute **systems**:

- National level: national innovation system
- Regional level: regional innovation system

=> Technological policy must by systemic in order to be effective.

Example: innovation policy in the Emilia-Romagna Region

Objective: create and develop the regional innovation system

Instruments:

- Aster, organisation which favours interactions between firms, research centres (especially universities) and local authorities (now ART-ER)
- Support to cooperation between innovative firms
- Support to the creation of firms from innovation (spinoff)

$\Rightarrow$ To promote research and innovation in the region and get maximum value of the research done in the region

Innovation policy is one element of industrial policy

Given the results outlined in this lecture, innovation policy also includes specific measures for SMEs:

Access to financing for R&D

Favouring clustering of SMEs

Access to skills

etc.

➔ WE NOW HAVE ENOUGH BACKGROUND KNOWLEDGE TO DISCUSS INDUSTRIAL POLICY FOR SMEs. (next classes)