Policy and Innovation

References

- References

  - Edler, J., & Fagerberg, J. (2017). Innovation policy: what, why, and how. *Oxford Review of Economic Policy*, *33*(1), 2-23.
  - Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research policy*, *15*(6), 285-305.

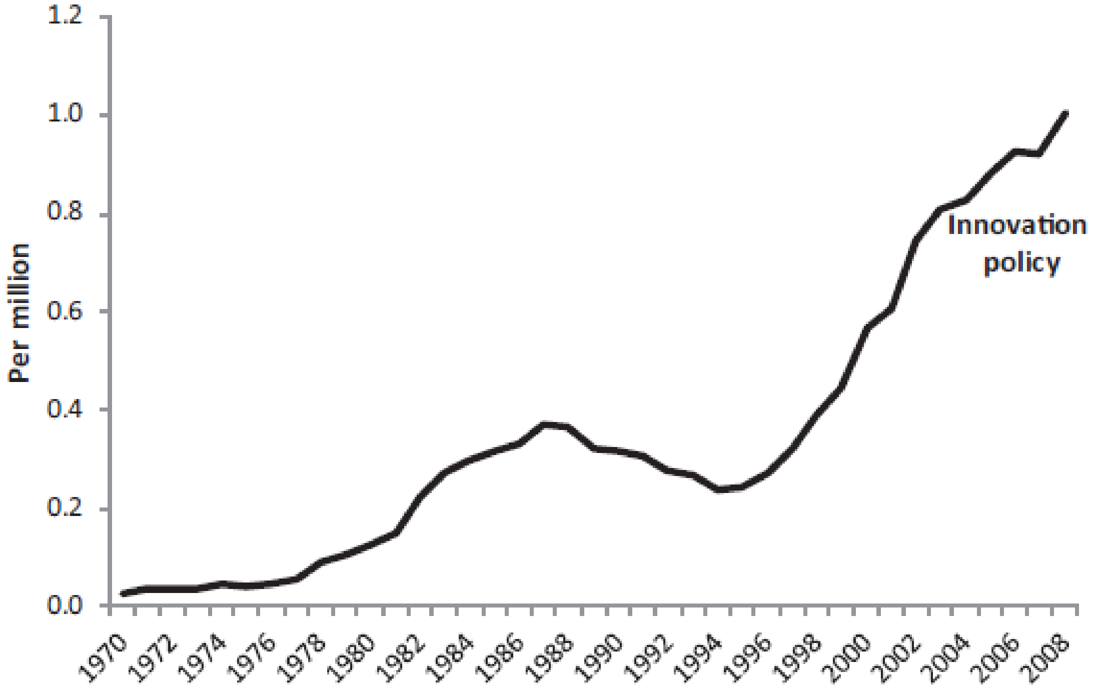
Innovation policy

- Public policy realm
- Innovation gained central role in the economic growth
- **Can/should policy have a role in supporting innovation?**
- Definition, design, implementation, and governance of innovation policy

How long have innovation policy existed?

- What is innovation policy?
- What is innovation?

Figure 1: The frequency of the term 'Innovation Policy' according to Google



Source: Own calculation based on information from https://books.google.com/ngrams, consulted on 31 May 2016.

Schumpeter and beyond

- Introduced the distinction between invention (a novel idea for how to do things) and innovation (carrying it out into practice)
- two aspects of innovation **novelty** and **implementation**
- novelty may not necessarily mean ‘new to the world’, it can also refer to something that is new to those that produce or use the innovation
- novelty does not have to be of the radical kind, offering new functionalities and/or disrupting existing practices
- For Schumpeter, a main reason for his distinction between invention and innovation was the realization that **what matters economically and societally** is not the idea itself but its **exploitation in the economic and social system**.

Rosemberg

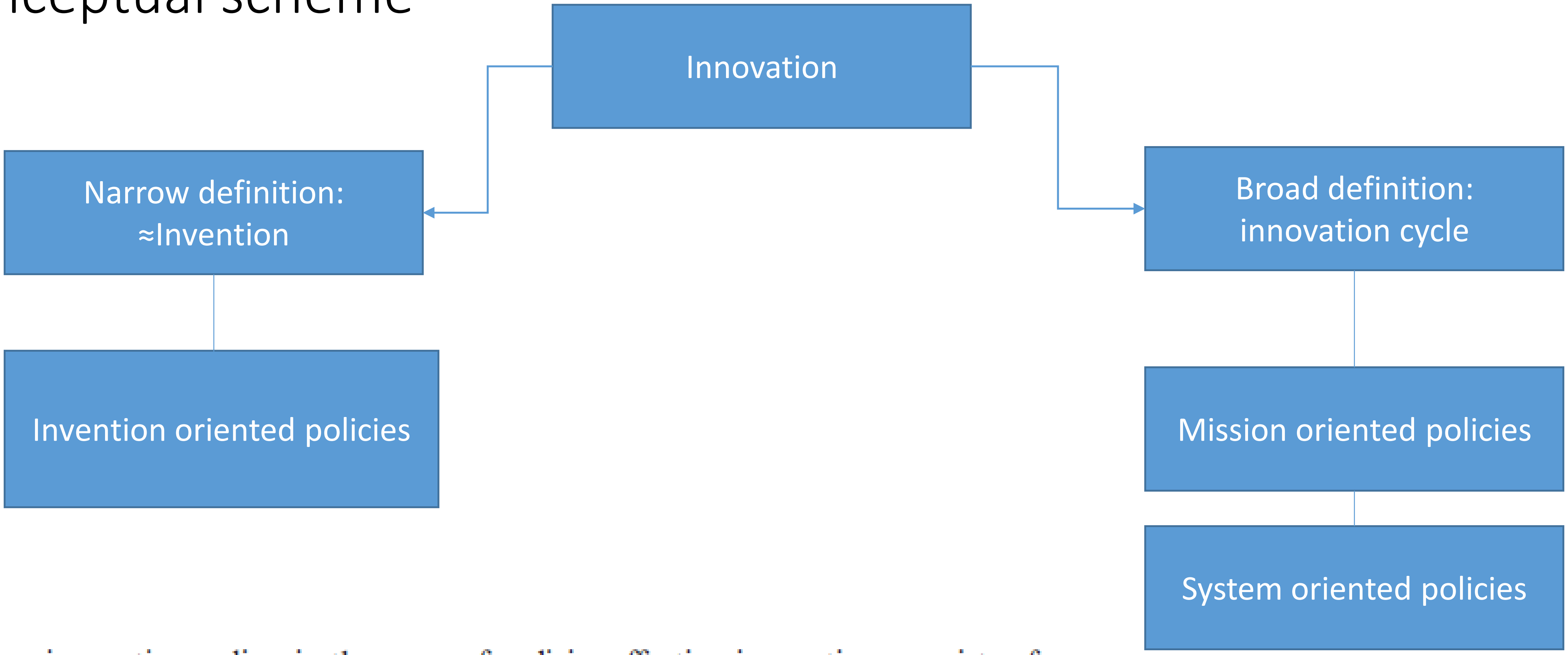
most important innovations go through drastic changes in their lifetimes—changes that may, and often do, totally transform their economic significance. The subsequent improvements in an invention after its first introduction may be vastly more important, economically, than the initial availability of the invention in its original form. (Kline and Rosenberg, 1986, p. 283).

- Improvements occur more often in the diffusion phase
- Innovation policy needs to focus both on the creation of new solutions and their exploitation and diffusion
- ≠ perspectives on innovation (narrow, broad)→ ≠ implication for policies
- Should limit the analysis to policies designed with the explicit intent of influencing innovation, or also take into account policies primarily created for other purposes, but which may have a significant impact on innovation activity?

Innovation Policies

- *Mission-oriented policies* (Ergas, 1986) are aimed at providing new solutions to specific challenges that are on the political agenda.
- *Invention-oriented policies* concentrate on the R&D/invention phase, and leave the possible exploitation and diffusion of the invention to the market.
- *System-oriented policies* focus on system-level features, such as the degree of interaction between different parts of the system (e.g. Research Voucher Scheme, Netherlands) [What are innovation vouchers?]

A conceptual scheme



Thus, innovation policy, in the sense of policies affecting innovation, consists of a range of different policies (and policy instruments) that have been introduced at various points in time, with different motivations, and using a variety of labels, including, increasingly, innovation policy. Some of this may have to do with terminological shifts (Lundvall and Borras, 2004; Boekholt, 2010). For example, much of what is called innovation policy today may previously have gone under labels such as industrial policy, science policy, research policy, or technology policy.[3]

Interaction with
other policies…

Why innovation needs policy?

- Market failure approach
- Innovation system approach
- Path dependency

Market failure approach

- if the pay-offs are so large, why don’t private firms undertake the investments themselves?
- Firms cannot fully appropriate the gains from their investment→underprovision of knowledge with respect to social optimum
- This justifies three instruments:
  - Public production of knowledge
  - Subsidies to R&D in private firms
  - IPRs

Critics to the market failure approach

- Goveranance failure risk: policy advice can turn out to be «vague» and worsen the situation
- Accessibility to knowledge: each person/firm cannot appropriate of all the knowledge
- Capabilities/ appropriability: knowledge spillovers are not enough, capabilities are needed to handle knowledge

Innovation system approach to innovation policy

- Late 1970's economic slowdown→ increasing worries on how to switch growth trends
- Innovation seen as key→how and if policy can contribute to innvation activity
- National System of Innovation approach (NIS) as a framework to respond to these challenges
- How the environment can fuction as a resource for firm level innovation and how policy can contribute to it

Weaknesses of this innovation systems

- if the system does not sufficiently provide demand for innovation access to complementary knowledge and skills, or supply of finance—we may speak of a ‘system failure’ hampering innovation activity
- the state should not limit itself to provide funding for basic knowledge and help to protect innovation through implementation of IPRs, as the market failure perspective would suggest, **but also identify and rectify such systemic problems**
- **Holistic approach** to policy: consider not only innovation and industrial aspects but also other aspects (e.g. environmental policy)

Path dependency

VS

- **Variety-creation** is the source of long-run growth, selection processes, by eliminating the least promising solutions, contribute to much-needed efficiency
- **Selection** may give raise to path-dependency, namely the course of tech. change is linked to the development of some innovation wrt another
- Path dependencies are difficult to change course at a later stage
- **Technology lock-in** is a form of economic path dependence whereby the market selects a technological standard and because of network effects the market gets locked-in or stuck with that standard even though market participants may be better off with an alternative

Innovation policies in practice

- Factors of influence:
  - Understanding of the matter
  - Practice
  - Stakeholder involved

Table 1: Taxonomy of innovation policy instruments

	Overall orientation		Goals						
Innovation policy instruments	**Supply**	**Demand**	**Increase R&D**	**Skills**	**Access to expertise**	**Improve systemic capability, complementarity**	**Enhance demand for innovation**	**Improve framework**	**Improve discourse**
1 Fiscal incentives for R&D	●●●		●●●	●○○					
2 Direct support to firm R&D and innovation	●●●		●●●						
3 Policies for training and skills	●●●			●●●					
4 Entrepreneurship policy	●●●				●●●				
5 Technical services and advice	●●●				●●●				
6 Cluster policy	●●●					●●●			
7 Policies to support collaboration	●●●		●○○		●○○	●●●			
8 Innovation network policies	●●●					●●●			
9 Private demand for innovation		●●●					●●●		
10 Public procurement policies		●●●	●●○				●●●		
11 Pre-commercial procurement	●○○	●●●	●●○				●●●		
12 Innovation inducement prizes	●●○	●●○	●●○				●●○		
13 Standards	●●○	●●○					●○○	●●●	
14 Regulation	●●○	●●○					●○○	●●●	
15 Technology foresight	●●○	●●○							●●●

Notes: ●●● = major relevance, ●●○ = moderate relevance, and ●○○ = minor relevance to the overall orientation and stated innovation policy goals of the listed innovation policy instruments.
Source: Adapted from Edler *et al.* (2016*b*, p. 11).

Policy impact

- Long lags between implementation and effect + difficult to measure output in terms of innovation
- Interaction of different policy instrument + effect depends on the innovation system itself

Innovation Policy in the EU and US

- https://ec.europa.eu/growth/industry/innovation/policy_en
- https://www.innovationpolicyplatform.org/content/united-states

An important aspect the policymaker might consider: Innovators and Profitability

- Teece (1986): offers a framework to explain why full appropriability of profits from innovation can be difficult.
  - **RQ: why innovators cannot appropriate of all the benefits of their innovation**?
- Focus on the **innovators**: those firms which are first to commercialize a new product or process in the market

	Innovator	Follower-Imitator
Win	1 • Pilkington (Float Glass) • G.D. Searle (NutraSweet) • Dupont (Teflon)	2 • IBM (Personal Computer) • Matsushita (VHS video recorders) • Seiko (quartz watch)
Lose	4 • RC Cola (diet cola) • EMI (scanner) • Bowmar (pocket calculator) • Xerox (office computer) • DeHavilland (Comet)	3 • Kodak (instant photography) • Northrup (F20) • DEC (personal computer)

Fig. 2. Taxonomy of outcomes from the innovation process.

What determines profitability of an innovation?

- Appropriability regime
- Complementary assets
- Dominant design

Regime of appropriability

- Factors that govern innovators' ability to capture profits from innovation
  - Nature of technology
  - legal protection

echnological innovation

exposed to industrial espionage and the like. T

Design

- A new design emerge: a class of design emerges as the most promising after extensive trial and errors (e.g Ford T). Competition is on the design (Who is the innovator?)
- The the design get established: competition shifts towards price because the cost of uncertainty is now lower

The existence of a dominant design watershed is of great significance to the distribution of profits between innovator and follower. The innovator may have been responsible for the fundamental scientific breakthroughs as well as the basic design of the new product. However, if imitation is relatively easy, imitators may enter the fray, modifying the product in important ways, yet relying on the fundamental designs pioneered by the innovator. When the game of musical chairs stops, and a dominant design emerges, the innovator might well end up positioned disadvantageously relative to a follower. Hence, when imitation is possible and occurs coupled with design modification before the emergence of a dominant design, followers have a good chance of having their modified product annointed as the industry standard, often to the great disadvantage of the innovator.

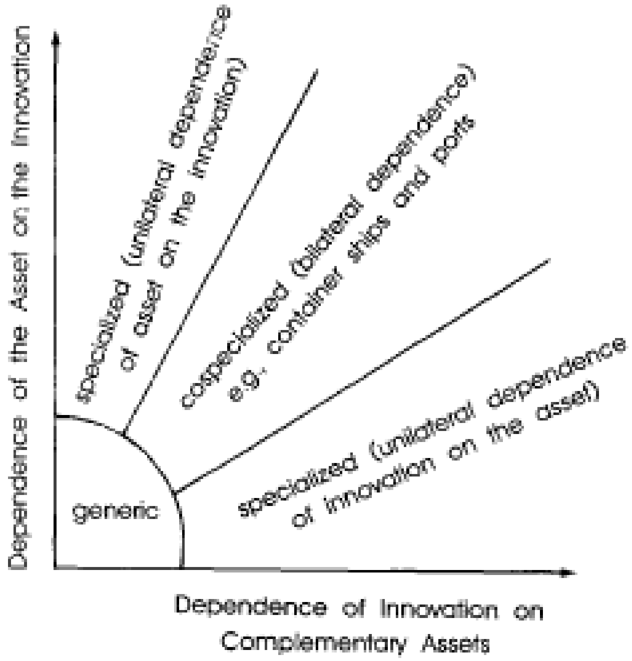
Complementary assets

Let the unit of analysis be an innovation. An innovation consists of certain technical knowledge about how to do things better than the existing state of the art. Assume that the know-how in question is partly codified and partly tacit. In order for such know-how to generate profits, it must be sold or utilized in some fashion in the market.

In almost all cases, the successful commercialization of an innovation requires that the know-how in question be utilized in conjunction with other capabilities or assets. Services such as marketing, competitive manufacturing, and after-sales support are almost always needed. These services are often obtained from complementary assets which are specialized. For example, the commercialization of a new drug is likely to require the dissemi-

- Generic: do not need to be tailored on the innovation
- Specilized: unilateral dependence between innovation and assets
- Cospecialized: bilateral dependence

Different degree of specialization are associated with different costs



Implications for Policy

Appropriability regimes

tight

- Ensures the innovator the needed time to improve adjust or further develop the design of the product without beign eclipsed by the imitators
- Ensures enough time to access the complementary assets:
  - Specialized asset: costly and valueless if the relation breaks down

weak

Turn to business strategy to keep imitators at bay

New design

The cost of prototyping is relatively low

The firm is tightly couplet with the market

Established design

Need for specialized and cospecialized assets

The CAT scanner

EMI

The scanner which EMI developed was of a technical sophistication much higher than would normally be found in a hospital, requiring a high level of training, support, and servicing. EMI had none of these capabilities, could not easily contract for them, and was slow to realize their importance. It most pro

strategic error compounded by the very limited intellectual property protection which the law afforded the scanner. Although subsequent court decisions have upheld some of EMI's patent

tures copied. Two competitors, GE and Technicare, already possessed the complementary capabilities that the scanner required, and they were also technologically capable. In addition, both were experienced marketers of medical equipment, and had reputations for quality, reliability and service. GE and Technicare were thus able to commit their R&D resources to developing a competitive scanner, borrowing ideas from EMI's scanner, which they undoubtedly had access to through cooperative hospitals, and improving on it where they could while they rushed to market. GE began taking orders in 1976 and soon after made inroads on EMI. In 1977 concern for rising health

The CAT scanner

- EMI had the knowledge but was barely able to handle it
- IPRs regime where lax
- Competitors had:
  - Knowledge
  - Complementary assets but also <u>RELATIONS</u>
  - More competitive when certificate of need where introduced
- By 1978 EMI lost market share leadership to competitors
- Even though the inventor of the CAT won the nobel prize, EMI failed to appropriate the lion's share of profits from their innovation

Lessons from the world's best-known fast-follower: Samsung [Full article from London Business School here]

- Samsung didn’t invent the mobile phone – that honour goes to Motorola – but it took a transformative new technology and ran with it

  - growing and innovating since 1938, when it started out as a food exporter shipping dried fish and flour from Korea to China
  - In the 1950s it got into life insurance and textiles
  - Samsung Electronics was founded in 1969. In the early 1990s Samsung started producing processors and hard drives for PCs, exporting them to companies including today’s smartphone rivals Apple
  - In 1983, when Motorola launched the Motorola 8000, Samsung was still proudly making black-and-white TVs
  - has become a dominant force in consumer electronics. It introduced its first Android phone, the Galaxy S, in 2010
  - the Motorola brand name has all but vanished: only the “Moto” product name is left as a small reminder of what was once a pioneering company at the forefront of innovation

How has it achieved its success?

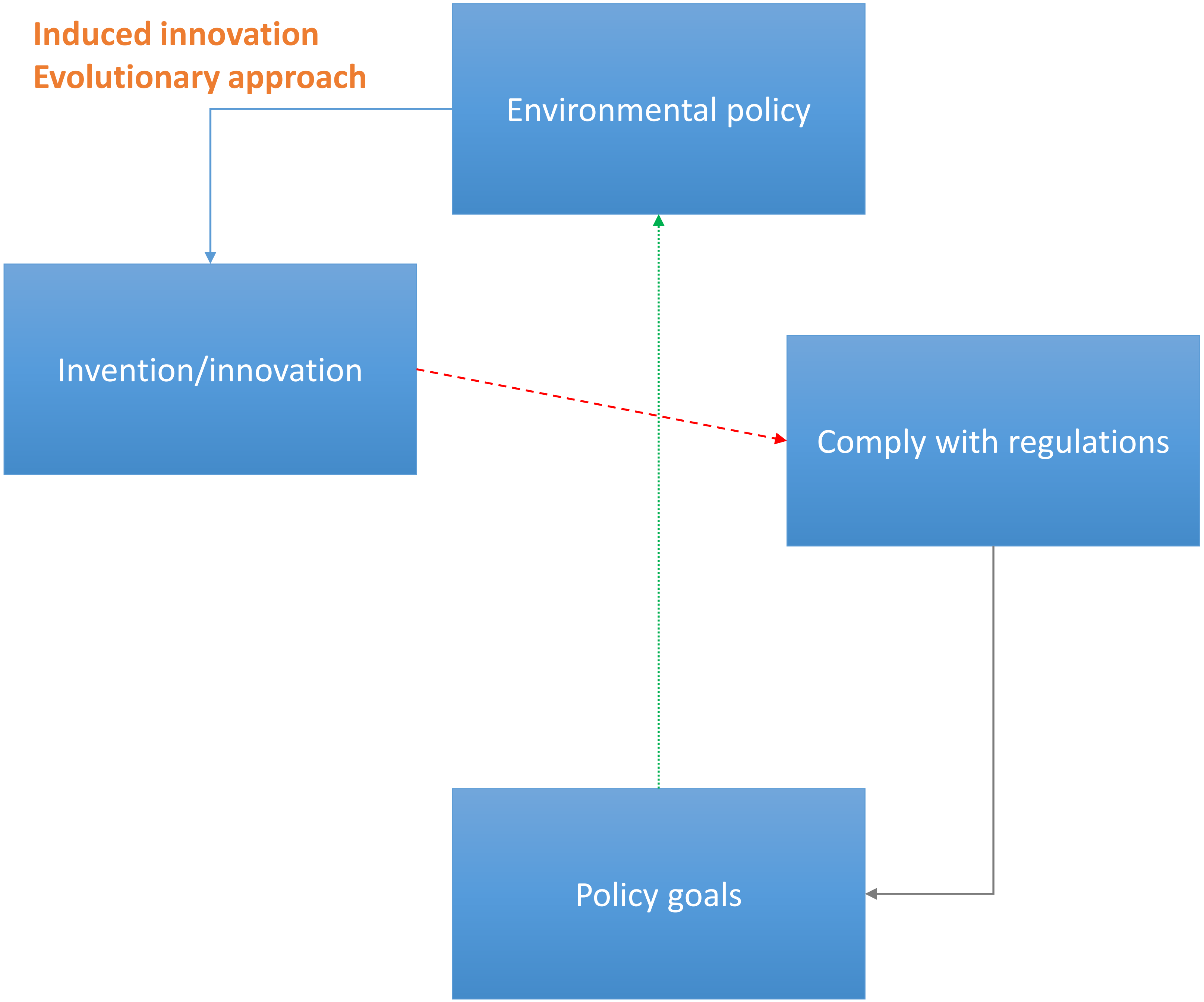
- Samsung is the classic fast follower: they're attuned to what competitors are doing and what other people are bringing to market first. They watch like a hawk as others gain traction and then very rapidly come up with their own version. (design→price competition)
- Remember too that Samsung is a company with a **vast amount of technological expertise**. They make about 50% of the world's microprocessors in some sections of the market.
- They're one of Apple's biggest **suppliers**, providing memory chips, touchscreen glass and other components. The reason they're able to move so fast is because they already have so many other **general-purpose technologies** that underlie consumer electronics. So **moving quickly is about bundling together new and existing technologies**. (complementary assets)

Innovation & Environmental Policy

References

- Jaffe, A. B., Newell, R. G., & Stavins, R. N. (2002). Environmental policy and technological change. *Environmental and resource economics*, *22*(1-2), 41-70.
- Examines critical aspects of the process of technological change.
- Reviews some of the theories concerning innovation and environmental policy

- **Induced innovation**
- **Evolutionary approach**



1. Induced innovation

- Investment in R&D:
  - Produce profitable new knowledge
  - Maximize the value of the investment
- Issues
  1. Very low probability of success + very high value outcome
  2. Specialized, sunk, intangible
  3. Not fully exclusive

Why should R&D respond to environmental policy?

1. Uncertainty + intangible outcome + spillovers= significant underinvestment by private firms in R&D, w.r.t. social optimum.
2. **R&D→profit motivated; the rate and direction of tech. Change can be influenced by changes in realtive prices**

➢ Policy can implicilty or explicitly raise the costs of inputs.

- Induced Innovation Hyp. suggest pathways for the interaction of env policy and technology

Environmental policy

Market based instruments:encourage good behavior through the use of market signals rather than dictate standards or maximum pollution

Examples: taxes, subsidies, emission trading

- Allows to choose the most efficient technological solution for the firm
- It is always convenient for the firm to reduce pollution if an efficent solution can be found (reduces/do not increase the cost of production)

Command and control: forcing companies to take charge of the same level of pollution, regardless of cost

Can be:

Technology standard: establish which technology the firm will use to comply with the regualtion

Or:

Performance standard:impose a performance target but allow firms to choose ho to comply

2. The evolutionary perspective

- Uncertainties in R&D→ difficult to optimize R&D investments
- Boundedly rational firms (Nelson & Winter, 1982): satisficing rather than optimizing behaviour
- Rules of thumbs and routines are used to determine the investment in R&D
- Enviromental constraint= imposition of an external constraint

The Porter Hypothesis (PH)

- [*Properly designed*]Environmental policy forces the satisficing firm to rethink its stategy→ can discover a new way of production which is more profitable
- Win-win situation: pollution is reduced-firm is more competitive
- This is a key theory , more on this later…

Th. of the effects of environmental policy on technological change

- Besides all, it is recognized that alternative types of environmental policy instruments can have significantly different effects on the rate and direction of technological change
- It is not possible to identify and unambiguos ranking of policy instruments.
- Success depends also on the innovator

Command and Control instruments

- Standards must be unambitious because of the risk of being utimately unachivable, leading to political and economic disruption
- Since there is no financial incentives for firm to exceed the target the adoption of newer technology is discouraged

Market based intruments

- Taxes, susidies, tradable permits… **indirect instruments**
- Put a price on pollution
- Can encourage firms to undertake pollution control efforts (= innovation) that are in their own interest + meet policy goals
- It pays for the firm to clean up a bit more, if a sufficiently low-cost technology or process for doing so can be identified

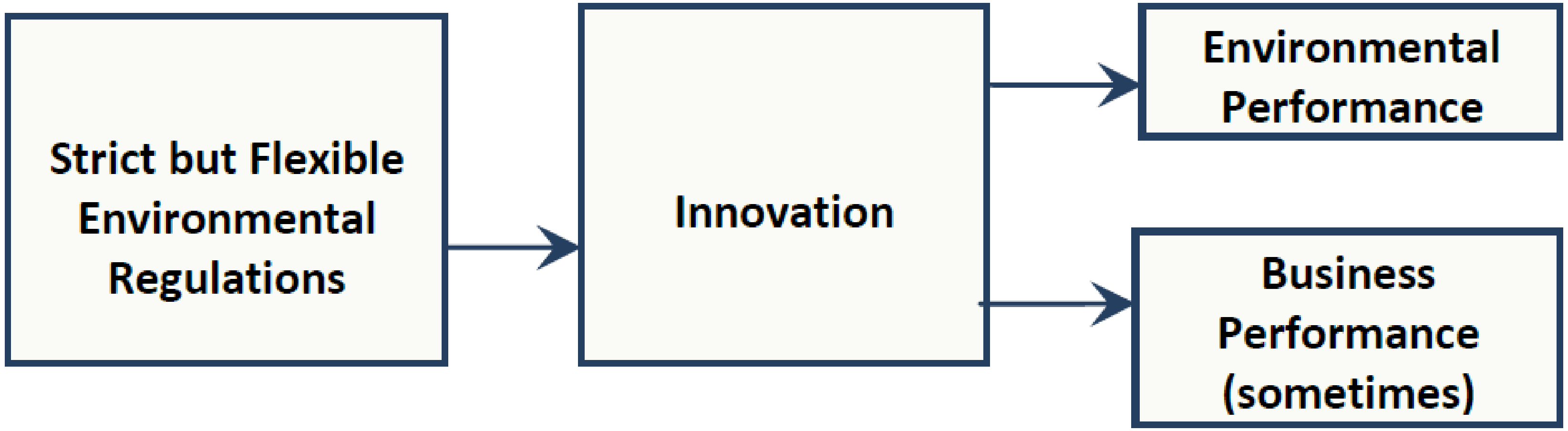
Porter Hypothesis

- References:

  - Porter, M. E., & Van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *The journal of economic perspectives*,*9*(4), 97-118.
  - Lanoie, P., Ambec, S., Cohen, M. A., & Elgie, S. (2010). The Porter Hypothesis at 20: Can Environmental Regulation Enhance Innovation and Competitiveness?. *CIRANO-Scientific Publications 2010s-29*.

Porter Hypothesis

- Traditional view →environmental policy imposes an additional cost on firms:
  - Reduces the choice of technology/input
  - Emissions were once free
- Porter Hypothesis (PH) 1995:
  - Case studies
  - Pollution= waste of resorces
  - Pollution reduction= improvement of productivity of resources



«More stringent put properly designed environmental regulation can trigger innovation that may partially or more than partially offset the cost of complying with them»

- Reasons that properly crafted regualtions may lead to this outcomes:
  - Is a signal to companies
  - Information gathering
  - Reduces uncertainty
  - Creates pressure
  - Favours diffusion
- Creates win-win situation→ environment protection+enhance competitiveness

Th three PHs

1. Weak PH→properly designed environmental regulation may spur innovation
2. Strong PH→innovation often more than offset any additional regulatory cost
3. Narrow PH→flexible regualtory policies gives firms better inentives to innovate and are thus better than prescriptive forms of regualtion

Well designed environmental regulation

- maximise innovation giving freedom on the technological approach to follow;
- encourage continuous improvement;
- Leave little rooms for uncerainty
- To attain these objectives, policy should:
  - Signal a non-efficient use of resources;
  - Raise firms’ awareness through inofrmation diffusion;
  - Reduce uncertainties concerni environmental R&D;
  - Incentive innovation adoption and diffusion;
  - Speed up *innovation offset*.

Beyond the distinction

- **Flexibility**: do not constrain production and allow the continued introduction of innovation
- **Stringency**: how ambitious is the policy objective w.r.t. the present standard.
- **Stability**: reduced uncertainty thus favouring R&D investments
- **Incidence**: measurement of the externality
- **Depth**: goes over the objectives of the regualtio

Critics to PH

- Not in line with profit maximizing assumption
- Rest on the idea of myopic firms
- Do regulators know better which are the «hanging fruits»?
- What is PH actually saying?