

**EPFL**

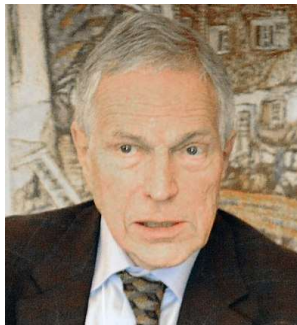
- **Definition**
- A model for innovation
- Two labs – innovation as an economic discovery
- Institutions and values in the economic lab: *something happened strange!*

Diapositive 1

FD1 Foray Dominique; 04/05/2023

What is innovation?

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The creation of **new products or services** – which generate **economic value** for **ordinary people**

Economic value?

Functional improvements for better products

New products/services

Differentiation

Costs

The innovation translates in a so high decrease of costs that it changes the world! (Ridley)

Measuring value: consumer surplus and profit

If economic value is generated, adoption occurs and large scale transformations happen

If the new idea is not adopted on the market, it is not an innovation (even if the technology works) – Phelps

Stratégies de Spécialisation Intelligente

Innovation in the GDP framework

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$$Y/N = Y/H \times H/N$$

Output per capita or standard of living by definition equals productivity or output per hour times hours per capita

with

Y: GDP –value of all goods produced in a given year in the economy (measure of the economy's total output)

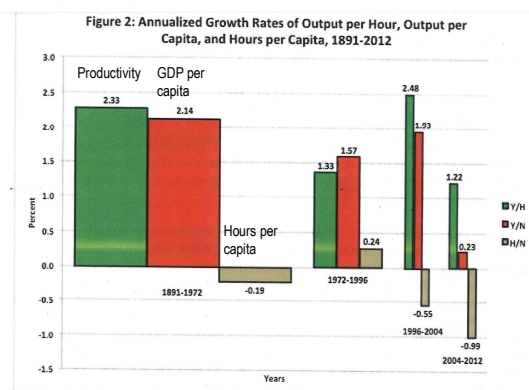
N : total population

Y/N – GDP per capita - measure of the wealth of the economy – determines the standard of living

H: hours of work in the economy,

Y/H : labour productivity - ratio between total output and the quantity of labour (person-hour); measure of the efficiency of the economy

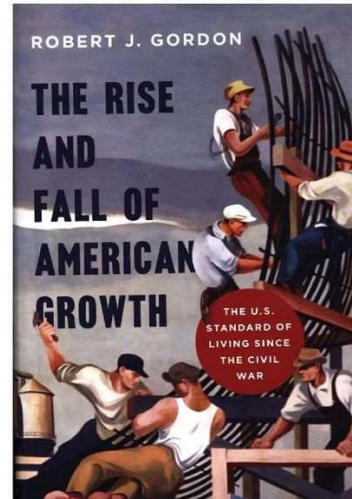
H/N : hours of work per capita



GDP growth and innovation have tremendous effects – qualitative

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- "Think of daily life around 1850 made of painful manual labor, household drudgery, isolation, and early death. **Only one hundred years later, daily life had changed beyond recognition.** Manual outdoor jobs were replaced by work in air-conditioned environments, housework was increasingly performed by electric appliances ; darkness was replaced by light, and isolation was replaced not just by travel, but also by color television images bringing the world into the living room. Most important, a newborn infant could expect to live not to age forty-five, but to age seventy-two. The economic revolution of 1870 to 1970 was unique in human history.."



Quantitative – productivity and GDP/Capita improvements 1870 - 1979

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Country	Growth in real GDP per capita % (wealth)	Growth in real GDP per person-hour% (productivity)
UK	325.0	585.0
Switzerland	472.0	830.0
United States	691.0	1,080.0
Italy	493.0	1,220.0
Germany	1,396.0	1,510.0
France	694.0	1,590.0
Finland	1,016.0	1,710.0
Sweden	1,084.0	2,060.0
Japan	1,653.0	2,480.0

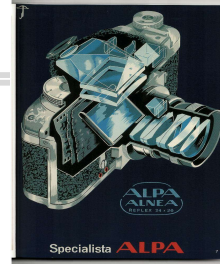
Output per labor hour increased from 585% in the UK to 2480% in Japan (second column) after no substantial increase for at least 15 centuries!
This rise in productivity was sufficient to permit a rise in output per capita of more than 300% in the UK to more than 1,600% in Japan

For ordinary people?

The creation of **new products or services** – which generate **economic value** for **ordinary people**

Innovation generates value for the **mass** of people under the form of huge surplus

Two exceptions
Luxury industry
Watch industry



Industry targeting
professional performance
Alpa

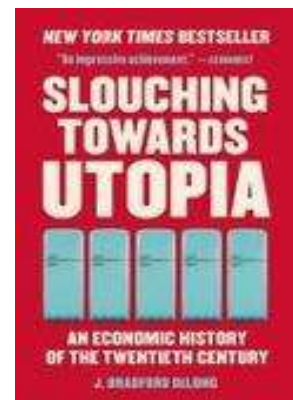
Innovation
but
smaller
surplus



For ordinary people ?

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- "Many technological innovations of the past century have transformed experiences that were rare and valued luxuries – only available to a rich few at great expense – into features of modern life that we take so much for granted that they would not make the top twenty or even the top hundred in an ordered list of what we think our wealth consists of. [...] We today – even the richest of us – rarely see ourselves as so extraordinarily lucky and fortunate and happy, even though, for the first time in human history, there is more than enough.
- There are more than enough calories produced in the world, so it is not necessary for anybody to be hungry.
- There is more than enough shelter on the globe, so it is not necessary for anybody to be wet
- There is more than enough clothing in our warehouses, so it is not necessary for anybody to be cold
- And there is more than enough stuff lying around and being produced daily, so nobody feel the lack of something necessary"



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- Definition
- A model for business innovation
- Two labs – innovation as an economic discovery
- Institutions and values in the economic lab – *something happened strange!*

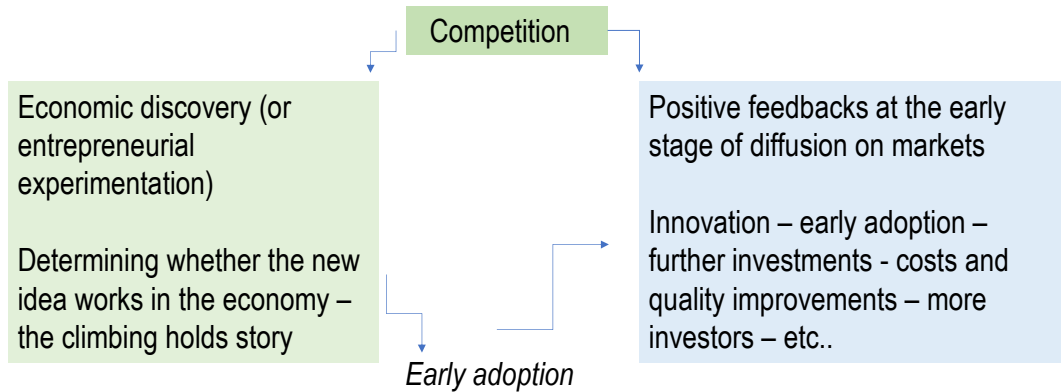
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A hand holding a black and red EPFL-branded robotic bird against a background of autumn trees. The bird has a black body with red wings and tail. The EPFL logo is visible on the side of the body. The background shows trees with yellow and orange leaves, suggesting an autumn setting.

Don't confuse invention and innovation

A new technology works **technologically** – it reproduces effectively the technical operations for which it has been invented and developed...
..but a new technology becomes an innovation if **it works also economically**. It must grip to the economy – finding strong climbing holds – **economic discovery**

Three components



Economic discovery (component 1)

- **A new idea** – a new technological knowledge or an invention...
- ..but a new idea which **is materialized** under the form of a new (or improved) product, process, business (or social) model..
- ..AND which is tested and **experimented in the economy** – economic discovery
- Innovation implies adoption by consumers or professional users and adoption requires that the potential innovation generates economic/social values (meet consumer preferences, at affordable costs, is potentially profitable) – e.g. **grips firmly to the economy**

Finding the climbing holds

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- **Demand side**
- Potential market size
- Consumers & customers preference – willingness to pay – salience: the buyer's perception of immediate benefits
- Diffusion not impeded by exogenous factors – durability of assets, existing installed base, regulatory framework

Finding the climbing holds

EPFL



- **Supply side**
- Cost of innovation – fixed costs, per-unit production cost, per-unit sales costs - and scalability
- Technological opportunities

Finding the climbing holds

EPFL



- **Market operations**
- Externalities of the competing technologies (are they priced?)
– bad *versus* healthy foods
- Path-dependence (the existing product or technology is better than the innovation simply because it has accumulated a lot of capital and knowledge - see below)
- Funding – external *versus* internal finance
- Profit (conditional to all previous climb holds and appropriability issues – eg spillovers, exclusivity)

Economic discovery

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Supply

Fixed costs, per unit operation and sales costs (scalability)
Tech opportunities



Demand

Potential market size
Consumer preference & willingness to pay
Uncertainty versus salience
Obstacles to diffusion

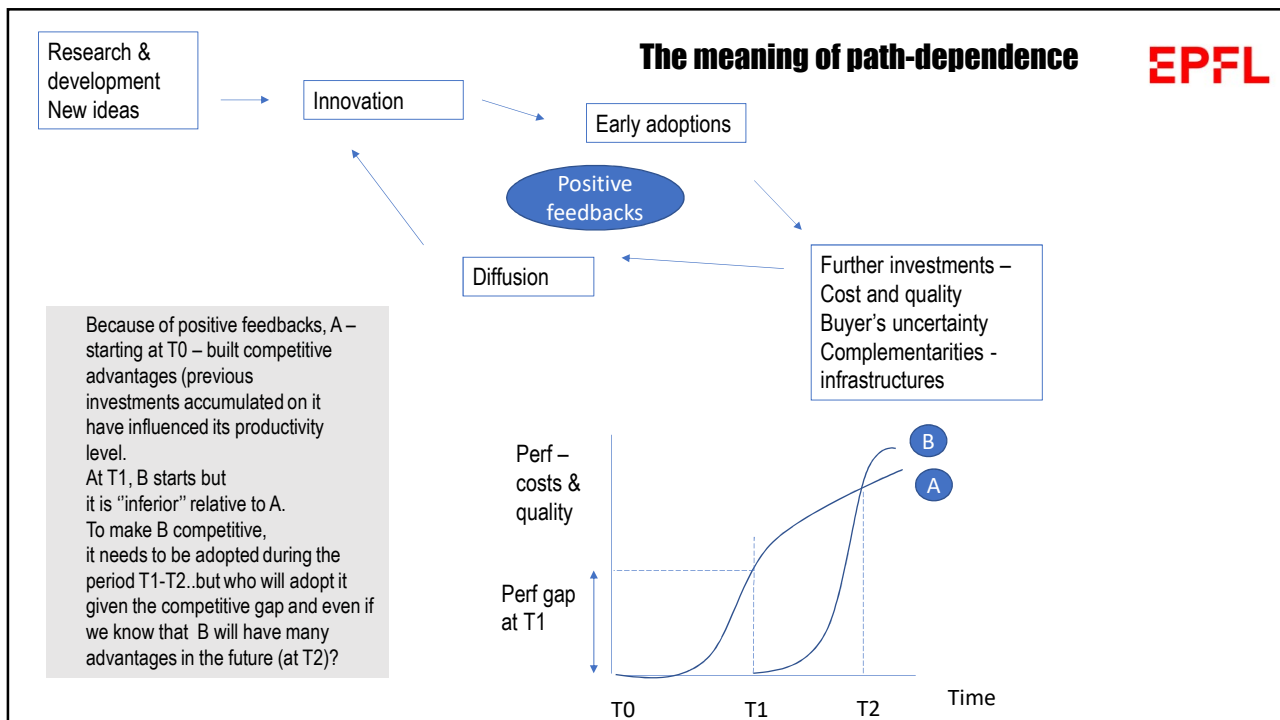
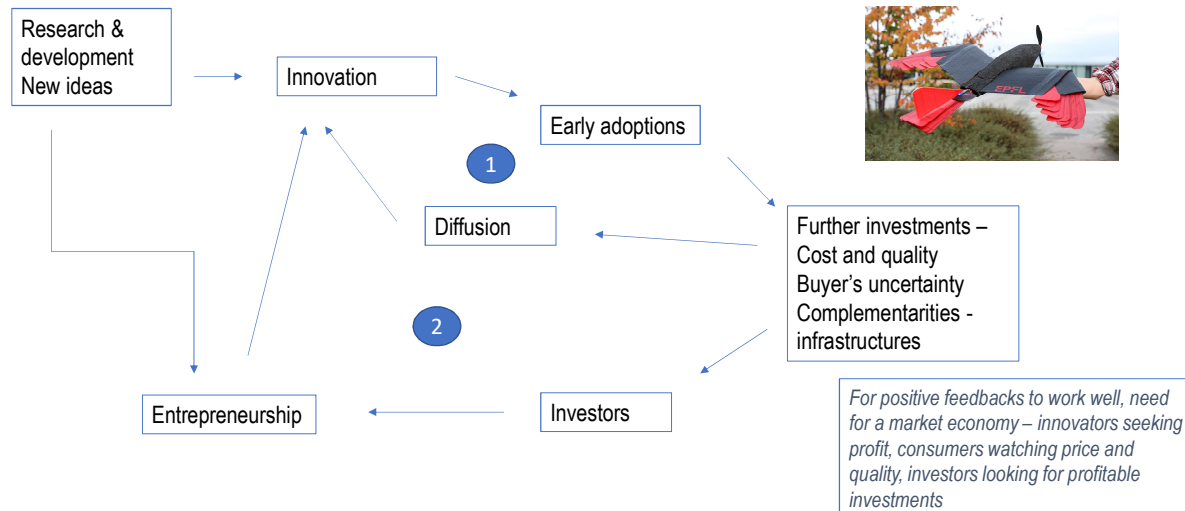
Market operation

Negative externalities are priced
Path-dependence
Cost of external finance
Appropriability condition (profit)

A new idea or technology which grips firmly to the economy is: attractive for consumers, at an acceptable cost, allows innovator to capture a part of its value (profit), has competitiveness not harmed by unpriced externalities and path-dependency, etc.. In such case: it is widely adopted and has a huge impact

Systems of positive feedback on markets for innovation (component 2)

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Competition (component 3)

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Economic discovery (or entrepreneurial experimentation)

Innovation is a way to get out of competition by offering something unique and so making profit

Competition at multiple stages

Positive feedbacks at the early stage of diffusion on markets

This sequence involves the entry of new investors and new innovators

Early adoption

"A distinctive feature of the life science innovation system is the pervasiveness of competition at multiple levels of analysis. This competition occurs in many dimensions and throughout the value value chain – the domain of basic research; the market for technology; the product market. This complex and multifaceted competition has a powerful influence on innovation and increases the amount of diversity and experimentations within the community of inventors and firms"

A case of a technology which has found strong climbing holds to become an innovation and enjoyed powerful positive feedbacks

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THE HOME JOURNAL February, 1933

Frigidaire keeps food fresh regardless of every change in weather

WINTER weather is never a substitute for refrigeration. Outdoor temperatures change from day to day to day. In cold days, no cold for proper food preservation, are often followed by warm, more dependable, and more days to add the touch of all kinds of food to your table.

With Frigidaire Electric Refrigeration in your home you will be protected against every change in weather. Day and night, and day after day, year.

Food will be kept at low, even temperatures—fresh, pure and wholesome, retaining all of their original flavor. You will enjoy the better, more economical refrigeration that is now being enjoyed by more than 750,000 Frigidaire users.

New low prices have made the value of Frigidaire greater than ever before. Meat cabinet models are priced as low as \$225—and mechanical units for its installation in the standard makes of cabinets as low as \$170. (All prices f.o.b. Syracuse.) The General Motors deferred payment plan affords the most convenient and economical way to buy.

Visit the nearest Frigidaire Sales Office and see Frigidaire in actual operation. Or mail the coupon below for a copy of the Frigidaire Catalog.

Frigidaire
PRODUCTS OF GENERAL MOTORS

FRIGIDAIRE CORPORATION
Dept. 511
A large card or a copy of the Frigidaire Catalog
Name _____
Address _____

- The price was still rather high, the refrigerator costing \$900..in 1923, there were 20,000 refrigerators in the US ; in 1933, 850,000. How the curve rises sharply : 1936, two millions ; 1941, three and half million..the mechanical refrigerator becomes popular as soon as its price is standardized and maintained at a minimum
- Its impact on daily life was immense
- Measuring value (chapter 3 & course by Nina Boogen)

Ω = consumer surplus [wtp – price]
 μ = profit [price – costs]
 $\Omega + \mu$ = social surplus

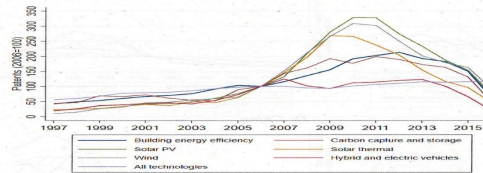
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Clean energy – climb holds too weak around 2011

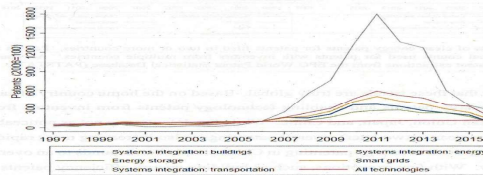
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Around 2011, the climb holds were not strong enough: consumers, costs, competitiveness (externalities)

A. Clean Energy Technologies



B. Enabling Energy Technologies



Patents are used as an indicator for innovation outputs – it is imperfect but useful

Problems with the climbing holds

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- (a) - People would like to have clean energy but no clear willingness to pay for that.
 - Electricity is a commodity market
 - For a long time consumers want just light to go on when they flip a switch
 - They do not care about the source of the energy and are unwilling to pay a premium for clean energy
- (b) – Innovation must deal with an established installed base (issues of tech inter-relatedness) – diffusion is slow because assets are durable
- (c) Cost features are not favourable –
 - Enormous fixed cost of experimentation and high per-unit production cost because a new technology starts as more expensive than the alternatives which are already in place (because cost improvements happen essentially during the early phases of adoptions and operations)
- (d) – All externalities not priced – which put the new technology (with better environmental performance) in competitive disadvantage
- (e) - (a) + (b) + (c) + (d) means poor profit expectations – no attraction for investors (or only social investors)
- No climbing holds: no business cases
- Goals of innovation policy: to get the things started through various types of instruments

- If the potential innovation finds strong climbing holds – adoption starts and positive feedback system starts as well – then it will be widely adopted and will have a great transformative power
 - *The innovation translates in a so high decrease of costs that it changes the world!*
- Invention is an engineering achievement – innovation is an economic achievement
- **Economic discovery** – experimentations with the climbing holds – and **positive feedbacks on the market for innovation** are the essence of business innovation

Ideas or technologies which don't become innovation

Economic discovery (or entrepreneurial experimentation)

Determining whether the new idea works in the economy – the climbing holds story

Competition

Positive feedbacks at the early stage of diffusion on markets

Innovation – early adoption – further investments - costs and quality improvements – more investors – etc..

Early adoption

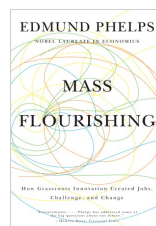
Economic discovery fails
Google glass
The new idea is inadequate (could not pass the "economic exam") and so even doesn't try economic discovery
Concorde, Apollo

In all these cases negligible effects on growth and wealth

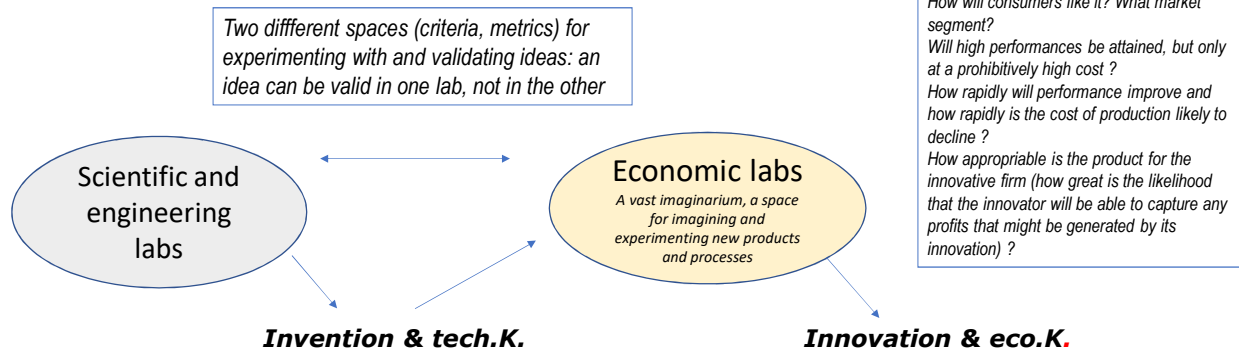
Positive feedbacks don't start
The idea is good and useful but markets don't work well yet
Case of new agricultural methods or tools in the Middle Age

- Definition
- A model for business innovations
- Two labs – innovation as an economic discovery
- Institutions and values in the economic lab – *something happened strange*

Discovery procedure : « *the term refers to the process of determining whether the imagined product or method can be developed and, if developed, determining whether it will be adopted. Through internal trials and market tests, a modern economy adds to its **knowledge of what can be produced and what methods work**, and to its knowledge of what is **not** accepted and what does **not** work* » Phelps



Two laboratories in the great knowledge factory!



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Economic discovery is an abstract concept
It has various forms depending upon who is at stake

Large companies
Start ups
Individuals (inventors, artists,...)

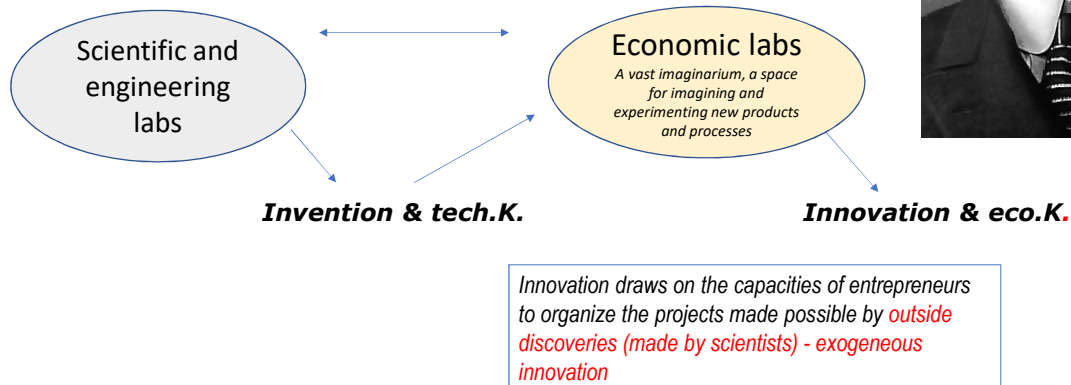
One feature of economic discovery is its huge uncertainty:
*Consumers themselves have little idea about how much they will like the new product
*The entrepreneur does not know really the commercial value of her product – she has to try and experiment in the real economy to discover this value
*Investors are not really good in assessing success probability of projects at early stage (correlation between initial score and real performance after 5 years: 0.1)
Uncertainty is very important for access to external capital, investments decisions, etc..

The phenomenon of double-selection

Market is the ultimate decider (the final selection process)

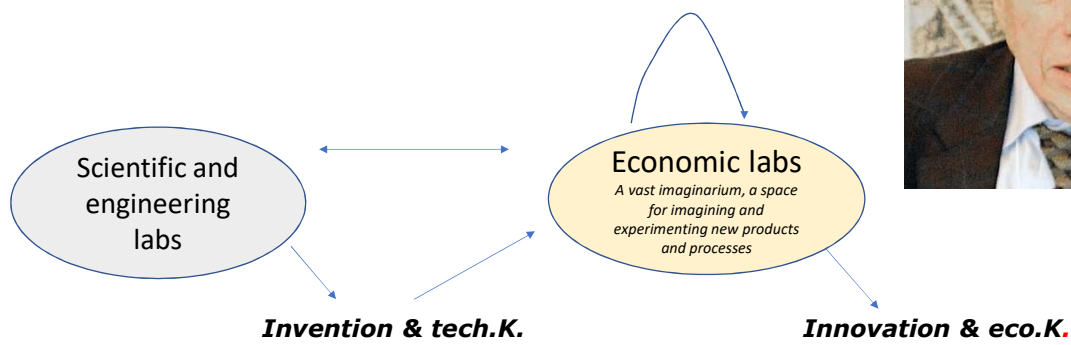
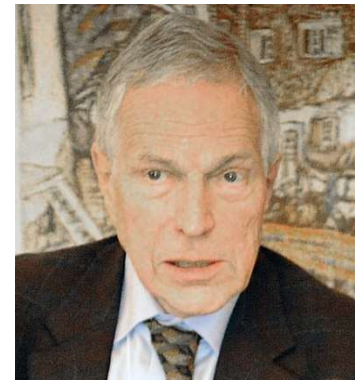
A preliminary selection can happen through:
large firm internal process
venture capital
Intermediaries in creative industries (publishing houses, film producers)

Schumpeterian innovation



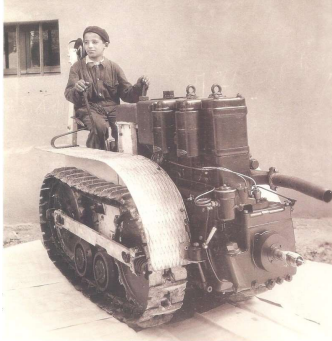
Phelps innovation

While some innovations come from science, some others are *indigenous* – they spring directly from people working in the economy



« My book argues that, although some innovations were the results of the various sorts of discoveries outside the economy, the phenomenon of sustained innovation in a country – its indigenous innovation – has generally derived from a desire among the people to innovate – typically, people already engaged in the economy

Exogeneous (technological) and indigenous innovations



Exogeneous innovations

Some countries have acquired some elixir boosting performance that is absent in others, putting them at risk of bad performance in all more aspects

What is the composition of this elixir?

A certain mix of science driven (exogeneous) and business made (indigenous) innovations?



WE RENT EQUIPMENT!

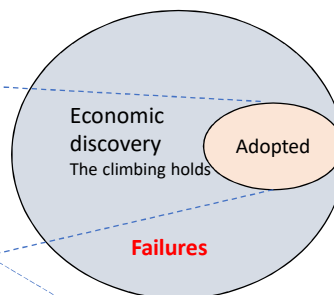
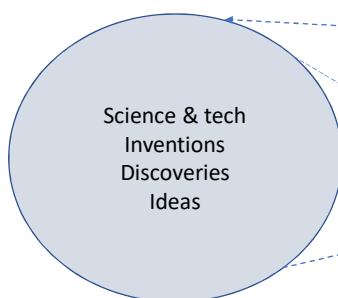
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Indigenous innovations

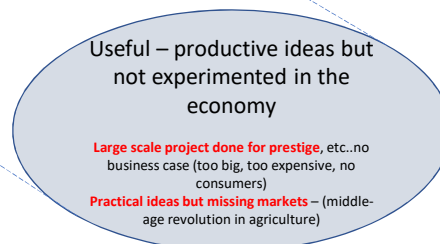


The funnel effect



Innovation and its
economic effects
– surplus, profit

Economic
knowledge



Only a fraction of 'ideas' will generate **technological innovations** (other inventions will not enter the economy or they will not be adopted - economic discovery fails)

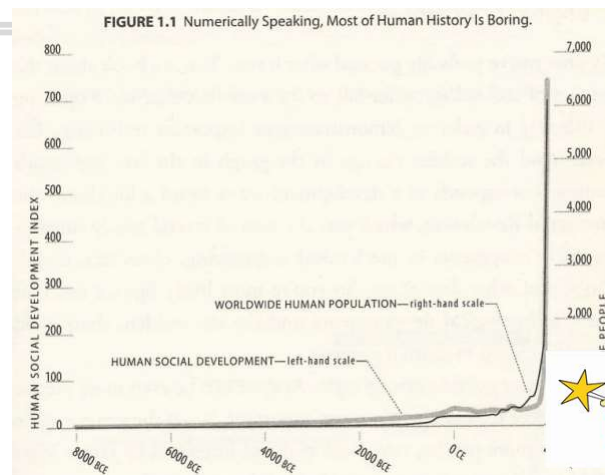
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The big picture

Brilliant technologies but impact on productivity was from negligible to 0 (or negative) – « *output per worker did not increase AT ALL between 1500 and 1800* »

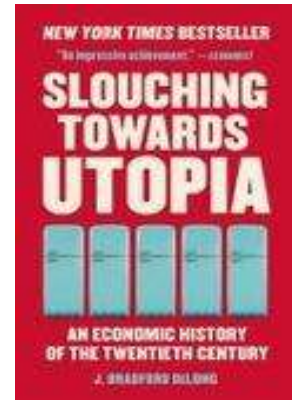
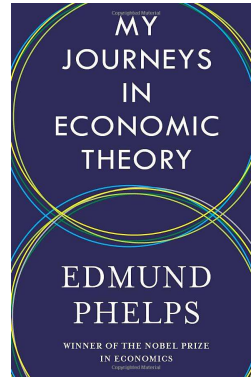
“Something happened that was strange for its time, something that would change everything: exploding innovation and economic knowledge” Phelps
But why did not the innovation explosion happen earlier?
Remember McCloskey



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What is an innovative economy based on our XX^e century experiences? **EPFL**

- « An innovative economy: private-ownership systems characterized by, first, their openness to new commercial ideas – the ideas of entrepreneurs for new products and new methods – and, second, their decentralized mechanisms for selecting the ideas to finance and providing the needed capital and incentives ». Phelps
- « Things changed starting around 1870. Then we got the institutions for organization and research and the technologies – we got full globalization, the industrial research laboratory, and the modern corporation. These were the keys. These unlocked the gate that had previously kept humanity in dire poverty » DeLong



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Institutions to support economic discovery and innovation **EPFL**

Funding mechanisms:

VC, start ups and stock markets
Large firms
Institutional (social) investors
The State

Laws and legislation to:

Limit the liability of investors
Provide for easy marketability of ownership shares
Establish stock markets which were essential for the achievement of ready marketability
Reduce risk by the technique of insurance
Define the obligation within principal-agents relationships

Intellectual property:

Experimenting in the economy increases risk of imitation and piracy

Maintain freedom, limit risks, provide funding and increase the prospect for large financial rewards

Competition :

Free entry, freedom to try and propose new things (against corporations, privileges, regulations which protect incumbents)

Autonomy of innovators vis-à-vis government and freedom to experiment:

Freedom from arbitrary and interventions from authorities, liberalism

Decentralization

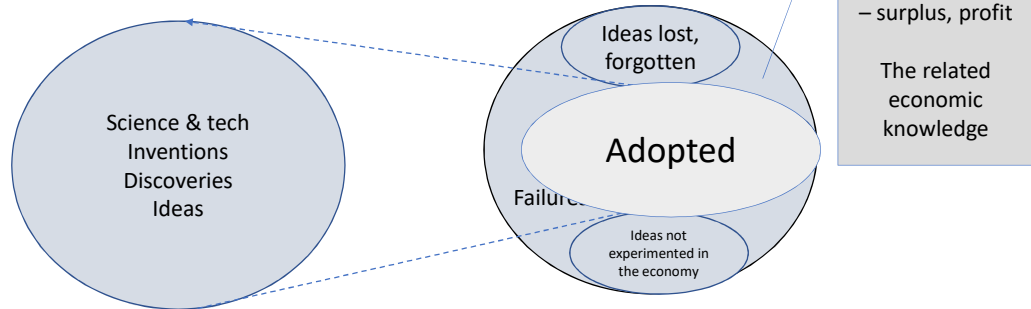
Inability of the incumbents to prevent entry and new experiment and of the experimenters to influence the outcome of market evaluation of the new product

A great change vis-à-vis former periods where arbitrary interventions from governments were the rule!

« Capitalism is unique not in invention but in innovation »

Challenging the funnel effect

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Only a fraction of 'ideas' will generate **innovations** (other inventions/ideas will not enter the economy or they will not be adopted - economic discovery fails)

Innovism = an economic regime (modern capitalism) in which more new ideas become innovation (the economic labs works better than ever) – are put in productive use

