

MEASUREMENT OF INNOVATION: WHERE DO WE STAND?

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- Introduction
- Definition of innovation
- Identification of innovation
- Measurement of innovation
- Conclusions

- Innovation is pervasive in the media, in business and in politics.
- Innovation is also popular in the scientific literature. But this popularity is relatively recent.

| | 1960-1969 | 1970-1979 | 1980-1989 | 1990-1999 | 2000-2009 | 2010-2015 | 1960-2015 |
|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Articles | 271 | 844 | 2087 | 4112 | 11615 | 17015 | 33411 |
| Books | 0 | 0 | 24 | 14 | 315 | 594 | 947 |

TABLE: Occurrences of the word "innovation" in the title of scientific articles and books (Scopus database)

- There is a consensus in the theoretical literature to consider that innovation is a source of income growth (Romer 1990, Helpman and Grossman 1991, and Aghion and Howitt 1992).
- The empirical evidence is lagging behind because empirical studies use different indicators of innovation and have a hard time to pinpoint the right measure of innovation.
- Most studies use proxies such as R&D expenditures or patent data to estimate the economic impact of innovation.

- This paper does not propose a new way of identifying and measuring innovation.
- Explore the reasons why innovation is not easy to observe and, hence, to measure.
- In this presentation I will not review all measurement indicators used in the scientific literature. This section is covered in the paper.

- In empirical analyses, there are observables and unobservables. Innovation is clearly an unobservable economic variable.
- Although unobservable, it is necessary to define innovation to be able to identify it theoretically and find its most suitable proxy(-ies).
- But trying to define it leads to a first difficulty: everybody talks about innovation but what is an innovation?

- If we assume that firms are the main innovators, when does a firm innovate?
- First possibility: everything that a firm produces is an innovation. So firms innovate constantly and their supply is only composed of innovations.
- Second possibility: not everything that a firm produces is an innovation. Then, there are innovating and non-innovating firms or firms that innovate more than others.
- The first possibility would simplify the problem but would render the concept of innovation economically meaningless.

- In this paper, I will use the definition by Greenhalgh and Rogers (2010), which adopts the second possibility:
"Innovation can be defined as the application of new ideas to the products, processes, or other aspects of the activities of a firm that lead to increased value"
- In other words, a firm innovates to **increase** value for its B2C clients (higher utility) or its B2B clients (higher profit) in order to increase value for itself (higher profit).
- If the value turns out to be negative, the innovation is a failure.

- The second possibility (definition of Greenhalgh and Rogers (2010)) necessarily implies a difficulty in identifying innovations in firms' activities.
- Since firms do not report in their annual accounts what they consider as innovations in their productive activities, we must infer them from their growth data.
- The supply of a firm can change in two ways: quantitatively and qualitatively. Innovation is precisely a qualitative change in the supply of a firm.
- From firms' data, it is impossible to distinguish quantitative (non-innovative production) and qualitative (innovative production) changes.

- There are two problems: what is the frontier between a qualitative and a quantitative change in reality? And who can identify this frontier?
- To the first question, the OECD (Oslo Manual 2005) provides a vague answer: "a significant degree of novelty" or "a significant improvement"
- To the second question, the OECD (Oslo Manual 2005) answers: the firm itself.
- The frontiers of innovation are subjective!

Suppose that we identify innovations correctly. How to measure their economic value?

- A first observation: innovation creates but also destroys economic value (Schumpeter (1942): "creative destruction").
- Consequence: value of an innovation \neq economic effect of an innovation (even within a firm sometimes).
- Value of an innovation = sales - costs. Both terms are unobservable.
- But knowing the value of innovation would not be sufficient to measure the economic effect of an innovation.

- The economic effect of an innovation is the net value between the value created and the value destroyed by the innovation.
- This net value should come out in firms' profit: profit per worker should increase if the net value is positive.
- The two sources of an increase in profit per worker are: increase in labor productivity or/and an increase in market power.
- Problem: other variables than innovation can affect labor productivity and market power.

- The last problem: how to measure labor productivity due to innovation?
- When statisticians measure changes in labor productivity over time, they have to take into account the change in prices of the goods. If prices are overestimated, then labor productivity will be underestimated and *vice versa*.
- When the quality of the goods changes over time, the statisticians have no other choice to "make up" initial prices for the innovative goods because they did not exist before. Of course, the choice of these initial prices will affect the measure of labor productivity changes in the case of innovations.
- As a result: labor productivity changes due to innovations are imperfectly measured.

- My talk might seem depressing! So many problems surround the measurement of innovation.
- My message is not: too many difficulties, we should give up.
- My message is: let's be aware of these difficulties to find appropriate proxies.
- New technology could alleviate these problems: big data for instance.