Solvay Business School

Assessing the Effectiveness of Science and Technology Policies

What can we learn from quantitative and qualitative evaluation ?

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Today's Menu :

- **S&T policy challenges**
- **The Main instruments**
- **Quantitative evaluations : OECD area**
- **Qualitative evaluation : R&D Tax Credit**
- **Concluding remarks**

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The Policy Challenge

- **To reduce "market failures"**
  - Imperfect Appropriability: **Arrow (1962)**
    - **Social Return > Private Return**
  - Uncertainty: **requires high risk premium**
  - Financial constraints: **SME's and start-up**

- **Contributing to basic knowledge and economic growth**

The policy challenge

- Since the 80 ’s : implementation and acceleration of **evaluation processes**.
  - Economic crisis (2 Oil shocks); end of the golden sixties; unemployment => Technological innovation fuels welfare and economic growth.
  - Government budget deficits =>

    Needs of efficient actions and resources allocation profiles.

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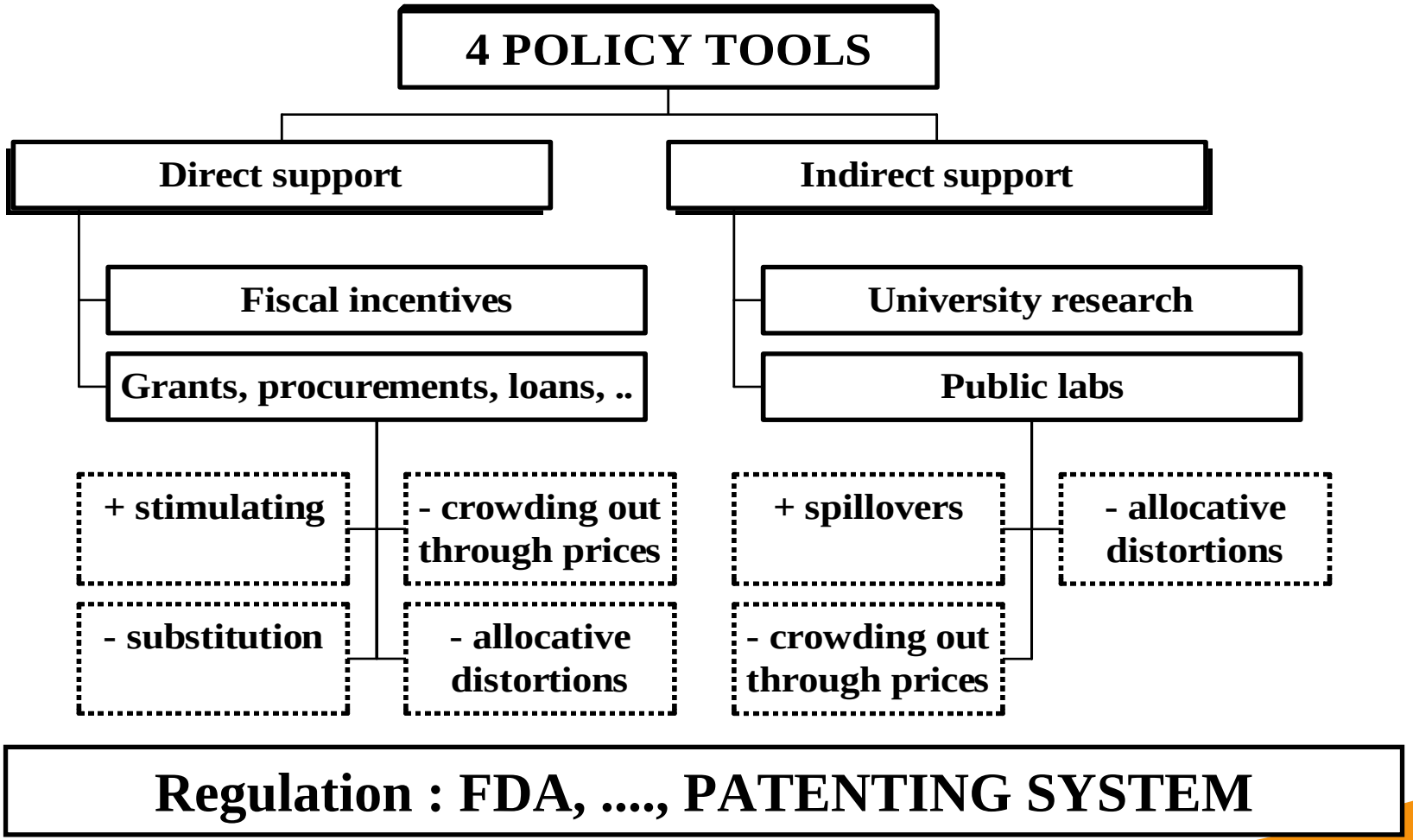
Four main instruments

- **Government funding of business-performed R&D**
- **Fiscal incentives**
- **Publicly-performed research**
  Public labs
  Higher Education

S&T Policy Instruments : the net impact is unpredictable



What can we learn from Evaluations ?

- **Do the positive effects dominate the negative effects?**
- **Do the various policy instruments interact with each other?**
- **What are the country-specific features?**

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Two Macroeconomic Models

- **1: Impact on Business R&D investment**

$$\Delta RP_{i,t} = \lambda \Delta RP_{i,t-1} + \beta_{VA} \Delta VA_{i,t} + \beta_{RG} \Delta RG_{i,t-1} + \beta_{B} \Delta B_{i,t-1} + \beta_{GOV} \Delta GOV_{i,t-1} + \beta_{HE} \Delta HE_{i,t-1} + \tau_t + e_{i,t}$$

- **2: Impact on MFP growth**

$$MFP_{it} = \exp\left[\phi_i + \varphi_t + \mu_{it}\right] \; SRP_{it-1}^{\beta_{rp}} \cdot \; SFR_{it-1}^{\beta_{fr}} \cdot SRHEGOV_{it-2}^{\beta_{hegov}} \cdot \; U_{it}^{\sigma_U} \; \cdot G^{\sigma_G}$$

Empirical Implementation

- A panel of 16 OECD Member countries
- Data sources: OECD National accounts, R&D data.
- Control for the business cycle, country and time dummies, German unification.
- Error correction model (ECM)
- Estimation method: 3SLS

Caveats

- **All results are *averages* over time and countries**

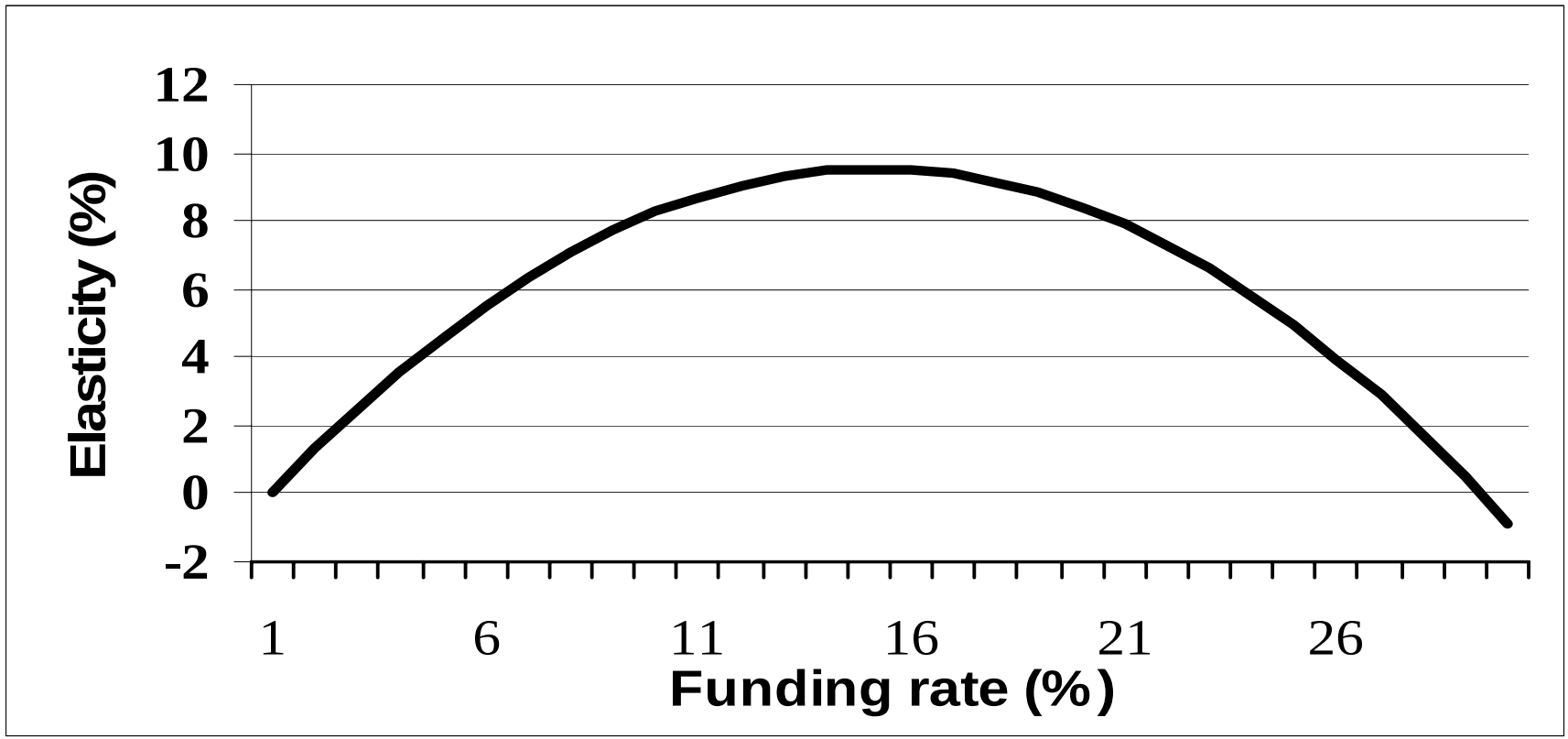
- **All policy conclusions are *tentative* (need the support of case studies)**

Main Results (1)

- Equation 1: **Determinants of Business R&D**

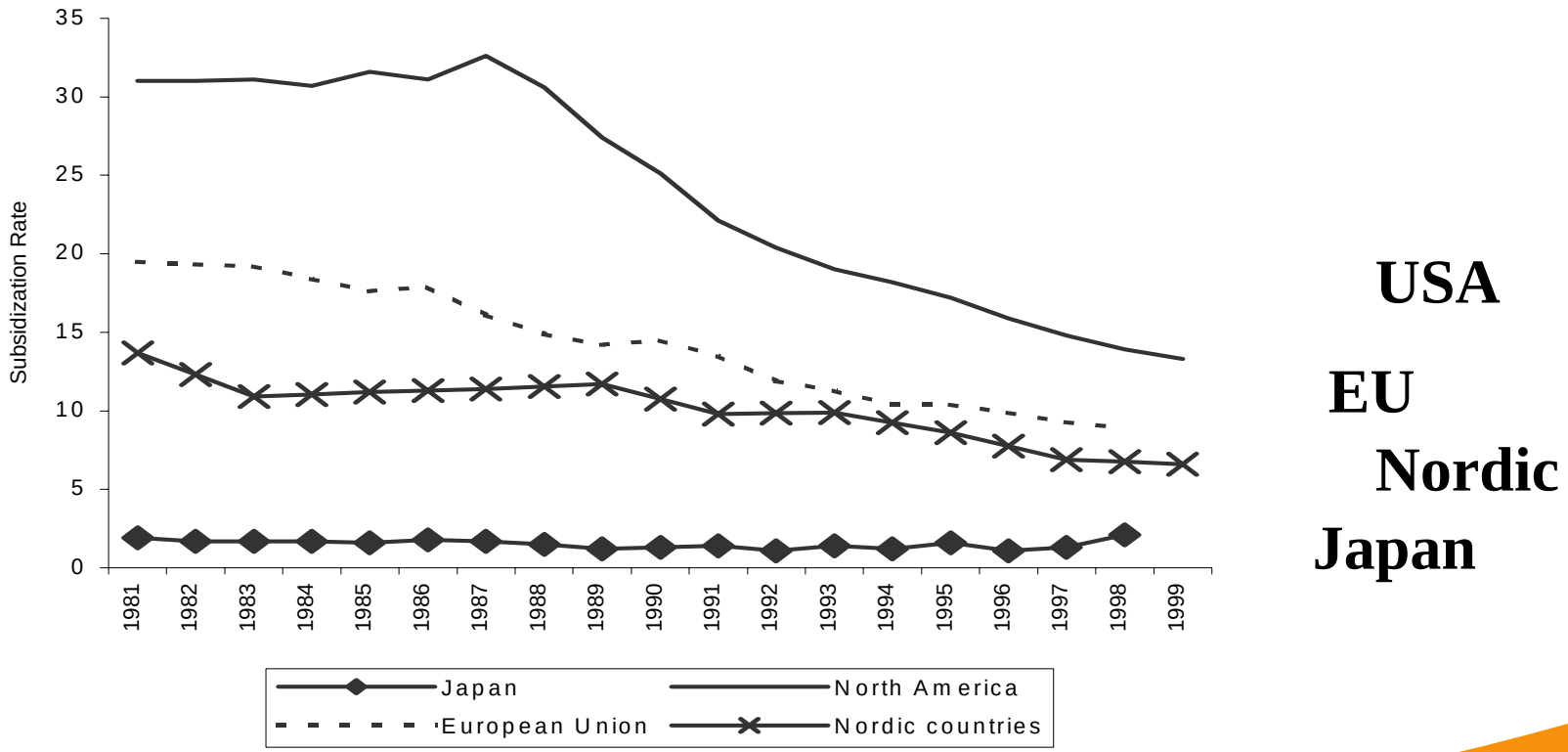
	Value added (VA)	Subs. (RG)	Fiscal incent. (B)	Public R&D (GOV)	Univ. R&D (HE)
Long-term elasticities	**1.54*** **	**0.08*** **	***-0.33*** **	**-0.08*** **	**0.00**

Increasing and decreasing returns to subsidies …



Public support to business R&D stimulates privately funded R&D

Percentage of BERD financed by government



USA

EU

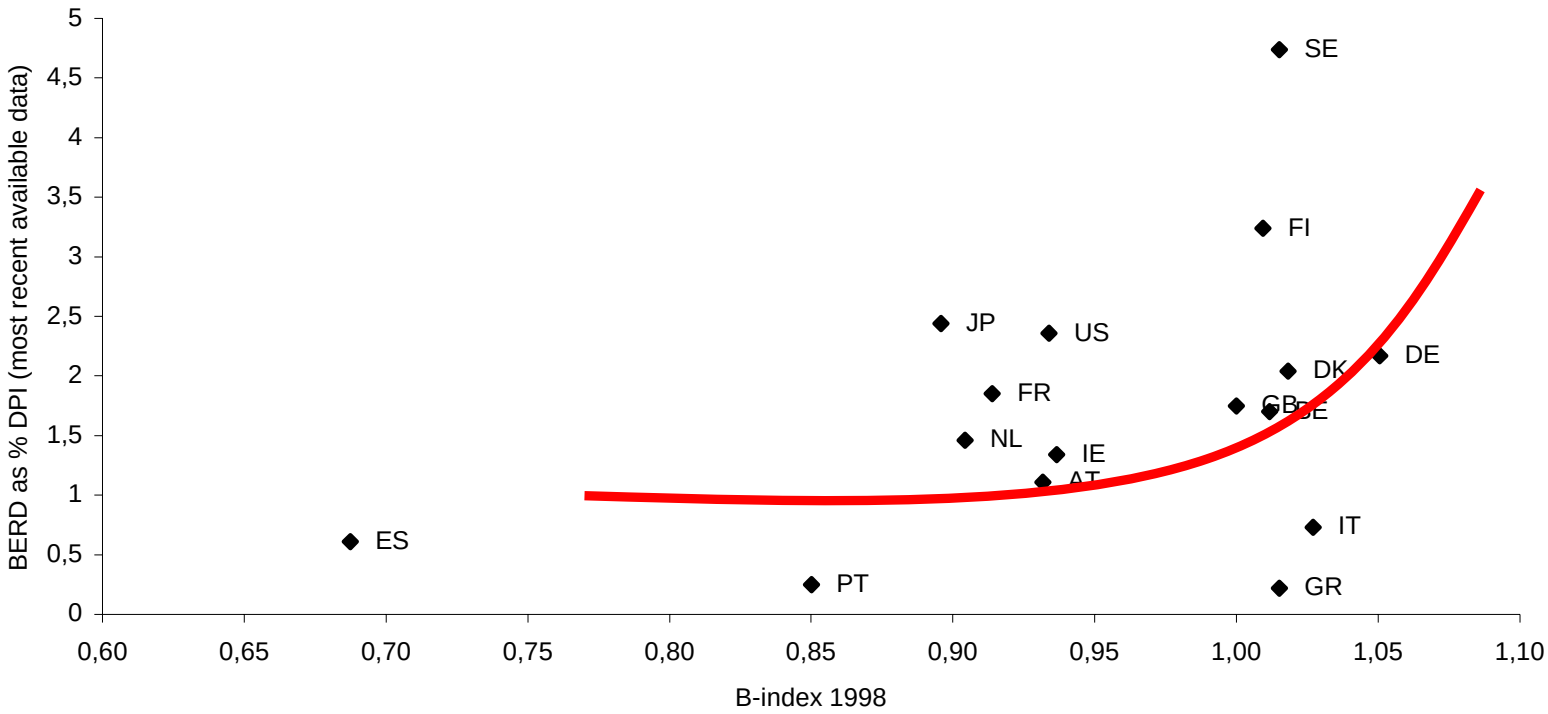
Nordic

Japan

(source: OECD, MSTI)

R&D tax credits stimulate business R&D

B-index and business R&D intensity



(source: OECD, MSTI)

Direct subsidies and fiscal incentives

- **Are not complementary**
- **Are more efficient when stable**
- **The former has a longer term impact**

Defence-related subsidies *(Procurement vs. Grant)*

- **Reduce the stimulating effect of subsidies**
- **Induce a negative effect of Higher Education R&D activities**
- **Are the main factor explaining the crowding-out effect of public research**

R&D and Growth Since R. Solow (1957)…

- **The share GNP growth attributable to capital and labor is relatively small.**
- **The *RESIDUAL* is therefore a measure of technical progress…**
- **…. or of our ignorance.**

- **How much of it can be explained by a measure of our knowledge?**

Three main sources of knowledge:

- **Business R&D** generates new products and processes: it increases directly productivity.
- **Public R&D:** for public missions (no *direct* effect or no *measured* effect); for basic research that induces new technological opportunities.
- **Foreign R&D**: new products and processes have a direct effect on productivity when implemented in the country (FDI, licences, imitation); an indirect effect through pecuniary externalities; a source of knowledge for national R&D.

Main Results (2)

- **Equation 2: R&D and Growth**

	Business R&D stock	Foreign R&D stock	Public R&D stock
Long-term elasticities	0.132*	0.459*	0.171*

Business R&D and growth

- 1% more in business R&D generates 0.13% in productivity
- The effect has increased since 1980
- The effect is larger in R&D intensive countries (absorptive capability)
- The effect is lower where the share subsidies is larger ..
- This negative effect is due to defence-related R&D

Foreign R&D and growth

- 1% more in foreign R&D generates 0.45% in productivity
- The effect has been stable since 1980
- The effect is larger in R&D intensive countries...
- The effect is larger in small countries

Public R&D and growth

- 1% more in public R&D generates 0. 17% in productivity
- The effect has **decreased** since 1980
- The effect is larger in countries where the share of **universities** (as opposed to govt labs) is higher
- The effect is larger in **R&D intensive** countries
- The effect is larger when the share of **defence** is lower
- The effect is larger when the share of **private funding of University R&D** is lower

Policy Implications for growth

- Doing R&D is important for productivity and economic growth – two faces of R&D.
- Government may review the mechanisms through which they provide funds for R&D to firms
- Government should improve the reactivity of the public research system.
- Government should support basic research performed in the higher education sector
- Government should ensure the openness of the economy to foreign sources of knowledge

Policy Implications for business R&D

- Both fiscal incentives and direct funding stimulate business R&D investment...
- … but avoid “too much of a good thing”
- Stability improves the effectiveness of S&T policies
- Although defense-related R&D funding does not aim to stimulate private R&D expenditure, be aware of its crowding-out effect on business R&D.
- There are strong interactions between the various policy tools : need for coordination

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Subsidies vs. Fiscal Incentives

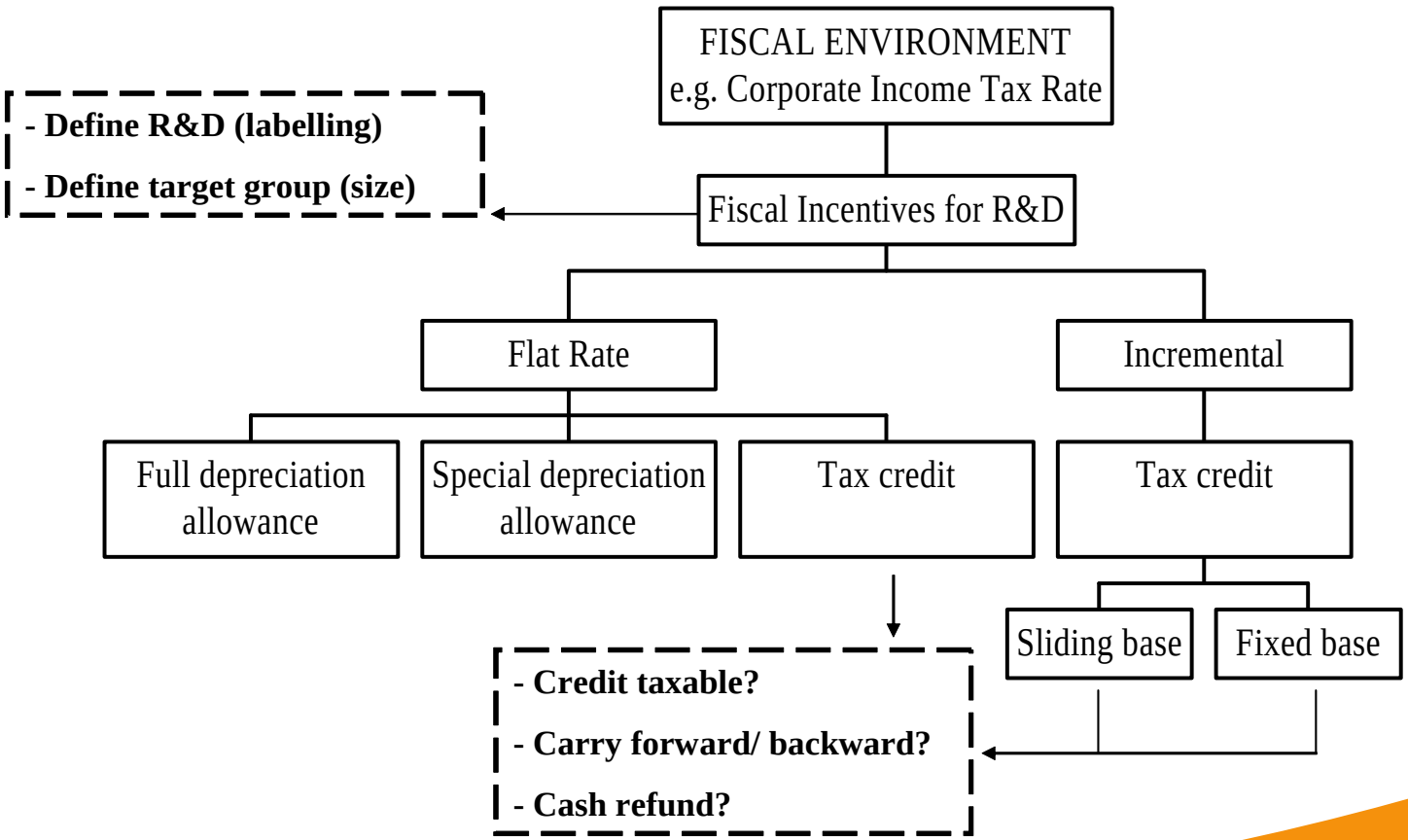
Most important advantages of each policy:

R&D Subisidies	Vs.	Fiscal Incentives
More targeted		**More neutral**
- Social return >>> Private return		- Business knows better - Avoid picking winners - Market friendly
Better budget control for gov.		**More accessible**
		More predictable for Cies

Drawbacks of fiscal incentives

1. It might reward R&D expenditure that would have taken place even without the incentive (like subsidies….)
2. It is harder for the government to predict the total loss of tax revenue and its impact
3. Tax incentives are less effective to support specific governmental priorities (subsidies more effective)
4. It often applies only to companies in profit, and thus no effect in case of downturn (depends on its design)
5. Tax incentives are difficult to design and might add too much complexity (but can be avoided)

The basic framework of fiscal policies to business R&D



Design Issues

1. Volume vs. Incremental
2. Definition of R&D
3. Eligible R&D expenditure
4. Carry back / Carry forward provisions
5. Target group
6. Claiming the tax credit

Disadvantages of volume and incremental (Design Issues)

	Business Perspective	Governmental Perspective
Volume		•More costly •Awards business as usual
Rolling Incr.	•More complicated •Higher application costs •Distortive in dynamic env. •Nil when high but stable	•More complicated •Higher admin costs •Marginal impact
Fixed Incr.	•Even more complicated •Even higher applic. costs	•Even more complicated •Even higher admin costs •Marginal impact

Definition of Research and Development (Design Issues)

In general based on Frascati (OECD, 1993):

- **Three activities: Basic, Applied and Devel.**
- **Element of novelty**
- **Resolution of scientific/technological uncertainty**

Eligible R&D expenditure (Design Issues)

- **Typically *current* expenditure**
  1. **Wages**
  2. **Consumables**
  3. **Contract research**
- **Sometimes *capital* expenditure**
- **Innovative / special clauses**
  - **University outsourcing**
  - **Wages only**
  - **Patent enforcement**

What with unused credits? (Design Issues)

Important issue for SME's

- **General solution: *carry forward***
- **Sometimes *carry back***
- **Innovative/special solutions**
  - **Cash refund**
  - **Credit with Treasury/transferable as guarantee**
  - **Tradability of unused credit**

Target group (Design Issues)

- **Main dilemma: All companies vs. SME's**
  - Limit eligible companies by definition
  - Use maximum/minimum thresholds
  - Flexible provisions for unused credits
- **Claiming the credit: beforehand vs. afterwards?**
  - Certainty vs. flexibility

Recommendations of the E.C. task force

- Basic criteria of good practices:
  - **simplicity,**
  - **low administrative and compliance costs,**
  - **reliability, and**
  - **long term stability.**
- **Volume based** schemes are more simple, more generous and less distortive

Recommendations of the E.C. task force

- Improve the **visibility** and **transparency** of fiscal incentives
- A **clear definition** of R&D is essential
- There is a need for **formal evaluation** practices (**relevant databases**)
- There is a need for an **optimal policy mix** regarding business R&D
- There is a need for an **effective coordination** mechanism between the public institutions involved

The current policy in Belgium

1. Bénéfices immunisés en cas d'embauche

- **Incremental:** For each *additional* researcher
- **Rolling base:** Compared to number of employees *last year*
- **Fixed Allowance:** Exemption from corporate income tax of 11.510 € or 23.030 €
- **Weak stimuli:** +- 12% of the total incremental R&D expenditure and strong distortive effects

The current policy in Belgium

Most firms are aware of existing incentives …

BUT:

- Few use them
- Support almost never seen as “R&D stimulator”

Why?

1. **Administrative cost too high**
   (time-consuming, bureaucratic, not transparent)

2. **Unpredictable and unstable policy in the l.r.**

3. **Not substantial enough to generate a change in the R&D policy**

Perceived advantage of the Dutch system

- **Research *directly* seen as cheaper**
- **Increased *competitiveness* with centres abroad**
- **Visibility of the policy**
- **No uncertainty**

However: "project-based" policy not appealing

Perceived advantage of the UK system

- **No prior application needed**
- **Eligibility of outsourced research**
- **Transparency**
- **Flexibility**
- **Climate of « trust » between companies and the administration**

For the industry
Ideal model: combination of both *Dutch* and *UK* models

Belgian Policy Evaluation

- Only relates to the first year of recruitment
- Too small amount to be stimulating
- In order to secure the exemption,
  - **deliver an attestation each subsequent year**
  - **the researcher has to remain on a full time basis in the research department of the same company**

Belgian Policy Evaluation

- **The tax credit is nominative**
- **The conditions for highly qualified researchers are too severe**
- **The definition of R&D is too vague**
- **There is a need for better integration of the different governmental departments**

Recommendations - Discussion

- **Level tax credit of 25% on all R&D expenses (total expenses)**
- **Restrict to the definition of the Frascati manual**
- **Allow patent-related expenses to be deducted**
- **Allow R&D expenditure from outsourced or subcontracted activities to the university**
- **Reduce most of the complexity associated with the current policy**
- **Put a consistent policy in place**

Recommendations - Discussion

- **Increase the coordination between the various government institutions and ministries involved**
- **Allow cash refunds for loss-making SME's and**
- **Carry back and forward provisions for large firms**
- **Eliminate the requirement that R&D has to be technically new from a societal point of view**
- **Offer the facility to apply beforehand as well as afterward for the tax incentive**

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Concluding remarks

Quantitative and qualitative evaluations are very useful

The issue is not whether or not a policy tool has to be implemented

But HOW it must be implemented.

Concluding remarks

How ? : What matters is the design…

- **Funding mechanisms (procurement vs. grant)**
- **Improve reactivity of public institutions**
- **… avoid “too much of a good thing”**
- **Look for stability and predictability**
- **Be aware of negative indirect effects**
- **Take into account interaction between policies**

Question time

References :

Dominique GUELLEC and Bruno VAN POTTELSBERGHE ;

- OECD Economic Review, 1999 and 2001
- Economics of Innovation and New Technologies, 2003
- Working Paper, 2002

Download : www.ulb.ac.be/cours/solvay/vanpottelsberghe