The Economics of R&D Tax Credits

Professor Bronwyn H. Hall
University of California at Berkeley
Oxford University

Outline

1. Economic rationale for government support of private R&D.
2. Trends in government support of private R&D: direct spending and tax incentives.
3. Structure of existing R&D credit.
4. Effectiveness of existing R&D credit.
5. Comparison of U.S. taxation of R&D with other major industrial countries.
6. Policy issues

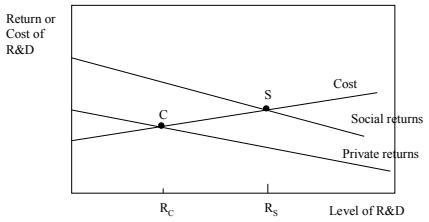
1. Why do Governments Have R&D and Innovation Policies?

- Social return to R&D>Private return => private sector underprovision. Some reasons for this:
  - Difficult to evaluate and fund some kinds of research.
    - External finance means revealing ideas.
    - Benefits so diffuse recipients hard to organize or identify.
    - Need large organization for implementation/commercialization but such organizations not necessarily good innovators.
    - Standards-related R&D - public goods nature of standards.
  - National security and/or strategic industries
    - "ripe" for technical advance.
    - closely linked to other industries.
    - enables progress in many other industries (e.g., semiconductors).

1. Why do Governments Have R&D and Innovation Policies? (cont.)

- Education/human capital and imperfect capital markets.
  - Individuals face differing financial constraints in investing in human capital - equality of opportunity argues in favor of education subsidies.
  - Externalities for society from human capital formation by individuals (assuming they do not capture all the benefits in their wages).

1. Private and Social Returns to R&D - Simple Graph



1. Determinants of the Wedge between Social and Private Returns to R&D

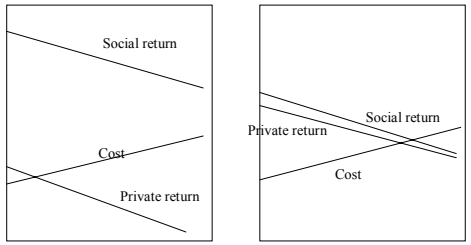
- Magnitude varies by country, industry, technology type.
- Ordering of projects may differ using the two criteria. Examples:
  - Cures for developing country diseases (malaria) versus developed country diseases.
  - Products with marginal improvements that take the whole market – e.g., "me too" drugs

1. Determinants of the Wedge between Social and Private Returns to R&D

Types of research vary greatly in returns:

1. "Pure" science:
   - Bohr - quantum mechanics
   - basic genome mapping.
2. Goal-oriented applied research:
   - Edison - light bulb/ phonograph
   - New electric batteries.
3. Scientific discoveries from solving practical problems:
   - Pasteur - bacteriology via wine research
   - Mathematics via encryption research.

1.Variation in the Wedge between Social and Private Returns



1. Economists' Solutions to Market Failures

- Internalize the externality:
  - Research joint ventures between firms
  - Create a property right (patents or other IPR)

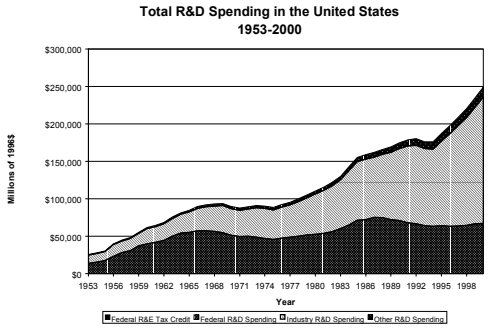
  Problem: may give monopoly power, reduce output.
- Subsidize the activity; reduce its cost.
- Tax the activity (in this case, a credit)
- Regulation (not very effective in this case)?
  - Price controls (wage controls on S&E?)
  - Quotas - mandating R&D performance

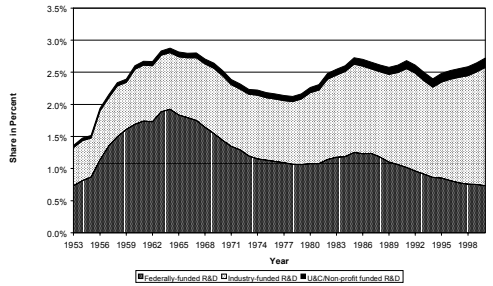
1. Subsidizing R&D

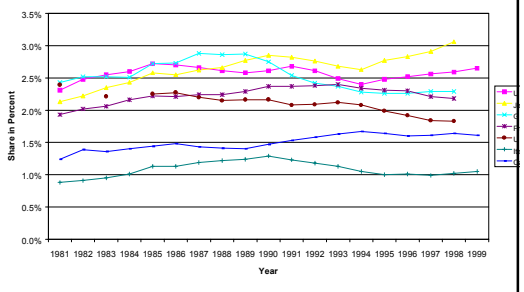
- Direct government subsidy:
  - science/basic research
  - education
  - defense/space
  - health
- Tax policy:
  - R&D is expensed - faster than economic depreciation.
  - R&E tax credit (federal and some states) – *focus today*.
  - Returns to foreign R&D repatriated at low tax rates.

1. The Tradeoff

- Who chooses projects better, government or industry? *targeted subsidies vs. broad credits.*
- Who performs projects better, government or industry? *direct spending vs. subsidy or credit*
- Politics?
  - Which part of the budget?
  - Which congressional district benefits?







3. R&E Tax Credit

- Introduced in July 1981; continuously tinkered with and renewed through 2004, with the exception of one year in 1995-96, when it lapsed.
- Components:
  1) Regular credit (20% of incremental spending) OR
  Alternative incremental R&E credit (lower base, lower rate)
  2) Basic research credit
- Reduced by the corporate tax rate (recaptured on expensed R&D) – implies actual credit ~ 65% of computed credit.

3. Regular R&E Tax Credit

As of July 1996, the R&D tax credit is generally computed based on the following formula:

*20% x (**QRE - BA**) + 20% x (**Basic**)*

The *Base Amount (**BA**)* is the *Fixed Base Percentage (**FB**)* times average annual gross receipts for the preceding 4 tax years.

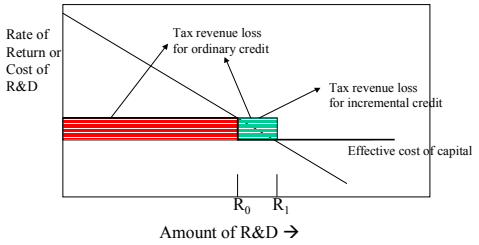
BA cannot be less than 50% of the taxpayer's *Qualified Research Expenses (**QRE**)* for the current tax year.

FB is the ratio of the taxpayer's ***QRE*** for the base period of 1984 through 1988 to gross receipts for the same period. This percentage may not exceed 16%. For start-up companies (as specially defined for the credit), ***FB*** is generally 3%.

3. Regular R&E Tax Credit

- ***Qualified research expenditure*** – "research in the laboratory or for experimental purposes, undertaken for discovering information, technological in nature, application is intended to be useful in the development of a new or improved business component for the taxpayer, whether carried on by the taxpayer or on behalf of the taxpayer by a third party."
  - In practice, ***QRE*** is about 62-65% of R&D spending – definition is the source of substantial IRS auditing headaches.
  - Credit is 65% of amounts paid to a third party, increased to 75% if third party a qualified research consortium.
  - Excludes software development for internal use by the firm.
- ***Basic research*** - "original investigation for the advancement of scientific knowledge not having a specific commercial objective."

3. Why an Incremental Credit?



3. Marginal Cost of R&D

Sample computation for 1981 through 1989

Tax price = $1 - (TI) \cdot \tau \cdot (1+r)^{-J} - \varphi$

$\varphi = \rho\,((1+r)^{s} Z - (1/3)\,[(1+r)^{-(1+J(+1))}(Z_{+1}>0.5) + [(1+r)^{-(2+J(+2))}(Z_{+2}>0.5) + [(1+r)^{-(3+J(+3))}(Z_{+3}>0.5)]$

where

TI = whether firm has taxable income

τ = corporate tax rate φ = effective credit rate

r = interest rate ρ = statutory credit rate

Z = 0,1,2, depending on *QRE* rel. to *FB*

J = number of years until loss carryforward exhausted (usually zero)

s = +/- number of years credit carried forward or back

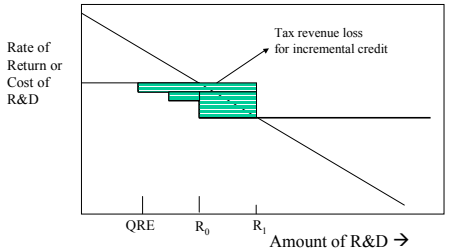
3. Distribution of the Effective Marginal Tax Rate across U.S. Firms

3. Alternative R&E Tax Credit (AIRC)

- The alternative credit has a lower base and also a lower rate of credit:

QRE to 4-yr average sales	Alternative credit rate
1.0-1.5 %	2.65%
1.5-2.0%	3.20%
>2.0%	3.75%

3. Analysis of AIRC



3. Typical AIRC Users

- Defense contractors (because defense spending for R&D has fallen since the 1980s).
- Companies whose sales are growing more rapidly than R&D because
  - less R&D-intensive lines of business are growing faster than other lines of business
  - a blockbuster product was discovered during or after the base period.
- Companies that have achieved large productivity increases in their R&D activities due to new technology.
- Companies that have reduced R&D budgets to cut costs.

Source: Peter Merrill, private communication.

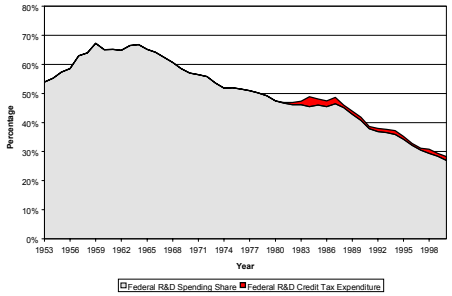
4. Effectiveness of existing R&D credit.

- How to evaluate?
  - Difficult if not impossible:
    - Was the gap closed? private = social return at optimal level of social R&D.
  - Usual method:
    - Benefit (increased industrial R&D) = Cost (loss of tax revenue).
  - Compare to subsidy "effects" on private R&D spending.

4. Sampling of Major Studies

- Mansfield (fairly early, 1984) – found little effect on firm R&D using surveys and small sample.
- Baily and Lawrence (1992, time series/cross industry) – unit elasticity. 1 percent R&D increase per 1 percent fall in cost.
- Hall (1993) – first properly done firm-level study – elasticity>1; revenue loss<induced R&D.
- Bloom, Griffith, Van Reenen (1997) – cross-country study finds elasticity about 1.
- Hall and Van Reenen (RP 2000) – survey of results, including other countries.

4. Federal Share of Total R&D (U. S.)



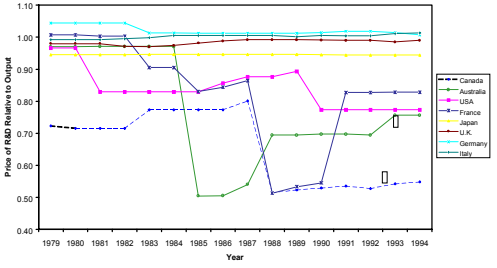
5. Comparison of U.S. taxation of R&D with other major industrial countries

Country (Date Enacted)	R&D Deprec. Rate	Tax Credit Rate	Base for Inc. Tax Credit	Carryback and Carryforward	Credit Taxable?	Foreign R&D by by Domestic Firms
Canada	100%	20%	0	3 yr CB	yes	expense
(1960s)				10 yr CF		no ITC, etc.
France	100%	50%	(R(-1)+R(-2))/2	5-yr CF; 5 yr for OL	no	no accel dep
(1983)	or 5 yr amort.		(real)	TC refunded	recapture	no credit
Germany	100%	none	NA	1/5 yrs	NA	
	amort. if acq.					
Italy	100%	none	NA	NA	?	NA
	or 5 yr amort.					
Japan	100%	20% (max at	max R since 66	5-yr usual but	no	6% credit for coop
(1966)	or 5 yr amort.	10% tax liab.)		credit limited to 10%		w ith foreign labs
UK	100%	none	NA	5-yr CF	NA	
US	100%	20%	avg of 84-88 R	3/15 yrs	yes	not eligible
(July 1981)	or 5 yr amort.			changed to 1/20 in 97		

5. Comparison of U.S. taxation of R&D with other major industrial countries

- All countries allow expensing; fast depreciation of R&D capital equipment.
  - US, Canada, Japan, and France have a tax credit in addition.
  - in most cases it can be carried back at least 3 years and forward at least 5 years.
  - US, France, and Canada require recapture of expense deduction.
- Foreign R&D done by domestic firms usually not eligible for the credit – incoming royalties generally taxed by host country at between 0 and 10%.
- Domestic R&D done by foreign firms – outgoing royalties generally taxed at between 0 and 10%.

5. After-tax Cost of $1 of R&D



Source: Hall and Van Reenen (2001)

6. Some Open Policy Issues

- Permanence – is 5 years permanent for a biotech firm?
- "Relabeling" – it may happen, but how much of the increase is due to that effect?
- Definition of "qualified" expenditure – administrative and IRS audit costs.
- Software costs (internal vs. external)