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. 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

   ![Diagram showing social return, private return, and cost for basic research and development]

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. Regular R&E Tax Credit

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

\[ \text{Credit} = 0.20 \times (\text{QRE} - \text{BA}) + 0.20 \times \text{Basic} \]

The \text{Base Amount (BA)} is the \text{Fixed Base Percentage (FB)} times average annual gross receipts for the preceding 4 tax years. \text{BA} cannot be less than 50% of the taxpayer’s \text{Qualified Research Expenses (QRE)} for the current tax year. \text{FB} is the ratio of the taxpayer’s \text{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), \text{FB} is generally 3%.

3. Why an Incremental 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, \text{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. Marginal Cost of R&D

Sample computation for 1981 through 1989

\[ \tau = \frac{1}{1 + \rho} \left\{ (1+\tau)^\left( Z \right) - (1+\tau)^\left( J+1 \right) \right\} - \left\{ (1+\rho)^\left( Z \right) - (1+\rho)^\left( J+1 \right) \right\} \]

where

\( \tau = \frac{1}{1 + \rho} \left\{ (1+\tau)^\left( Z \right) - (1+\tau)^\left( J+1 \right) \right\} - \left\{ (1+\rho)^\left( Z \right) - (1+\rho)^\left( J+1 \right) \right\} \]

\( J = \text{number of years until loss carryforward exhausted} \) (usually zero)

\( s = \pm \text{number of years credit carried forward or back} \)

\( Z = 0,1,2, \) depending on \( QRE \) rel. to \( FB \)

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:

<table>
<thead>
<tr>
<th>QRE to 4-yr average sales</th>
<th>Alternative credit rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0-1.5%</td>
<td>2.65%</td>
</tr>
<tr>
<td>1.5-2.0%</td>
<td>3.20%</td>
</tr>
<tr>
<td>&gt;2.0%</td>
<td>3.75%</td>
</tr>
</tbody>
</table>

3. Type 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 \( \rightarrow \) social return at optimal level of social R&D.
  - Usual method:
    - Benefit (increased industrial R&D) \( \rightarrow \) 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.
- Hall and Van Reenen (RP 2000) – survey of results, including other countries.

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

<table>
<thead>
<tr>
<th>Country</th>
<th>R&amp;D Deprec. Tax Credit Base for Carryback and Credit</th>
<th>Foreign R&amp;D by Domestic Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>100% 20%</td>
<td>yes</td>
</tr>
<tr>
<td>France</td>
<td>100% 50% (R(-1)+R(-2))/2 5-yr CF; 5 yr for OL</td>
<td>no, no accel dep</td>
</tr>
<tr>
<td>Germany</td>
<td>100% none</td>
<td>NA</td>
</tr>
<tr>
<td>Italy</td>
<td>100% none</td>
<td>NA, with 5 yr amort.</td>
</tr>
<tr>
<td>Japan</td>
<td>100% 20% (max at max R since 66 5-yr usual)</td>
<td>limited to 10% with foreign labs</td>
</tr>
<tr>
<td>UK</td>
<td>100% none</td>
<td>NA</td>
</tr>
</tbody>
</table>

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)