

How Industry Assesses Areas for R&D Investment

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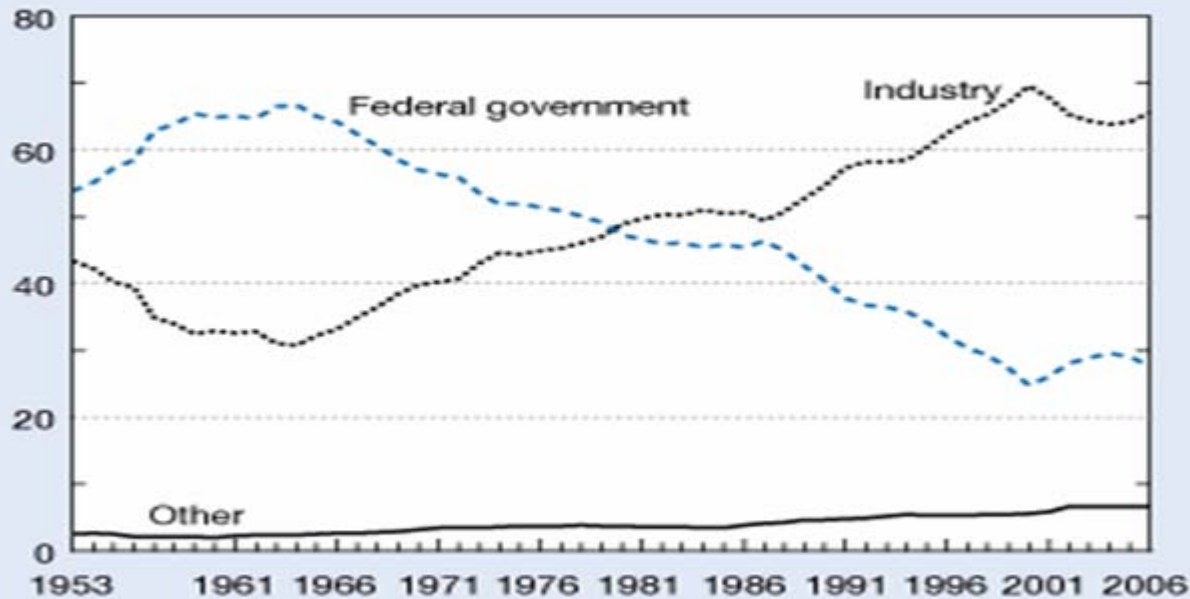
Topics

- Relative R&D Investments
- Evolution of R&D in the US
 - Leveraging the Federal Investment
- Why Companies Do R&D
 - The Need for Competitive Advantage
 - Balancing Risk and Reward
- Industry Variants
- Where Companies Do R&D

US R&D Funding: Government vs. Industry

Figure 4-3
**National R&D expenditures, by funding sector:
1953–2006**

Percent



SOURCE: National Science Foundation, Division of Science Resources Statistics, National Patterns of R&D Resources (annual series). See appendix table 4-5.

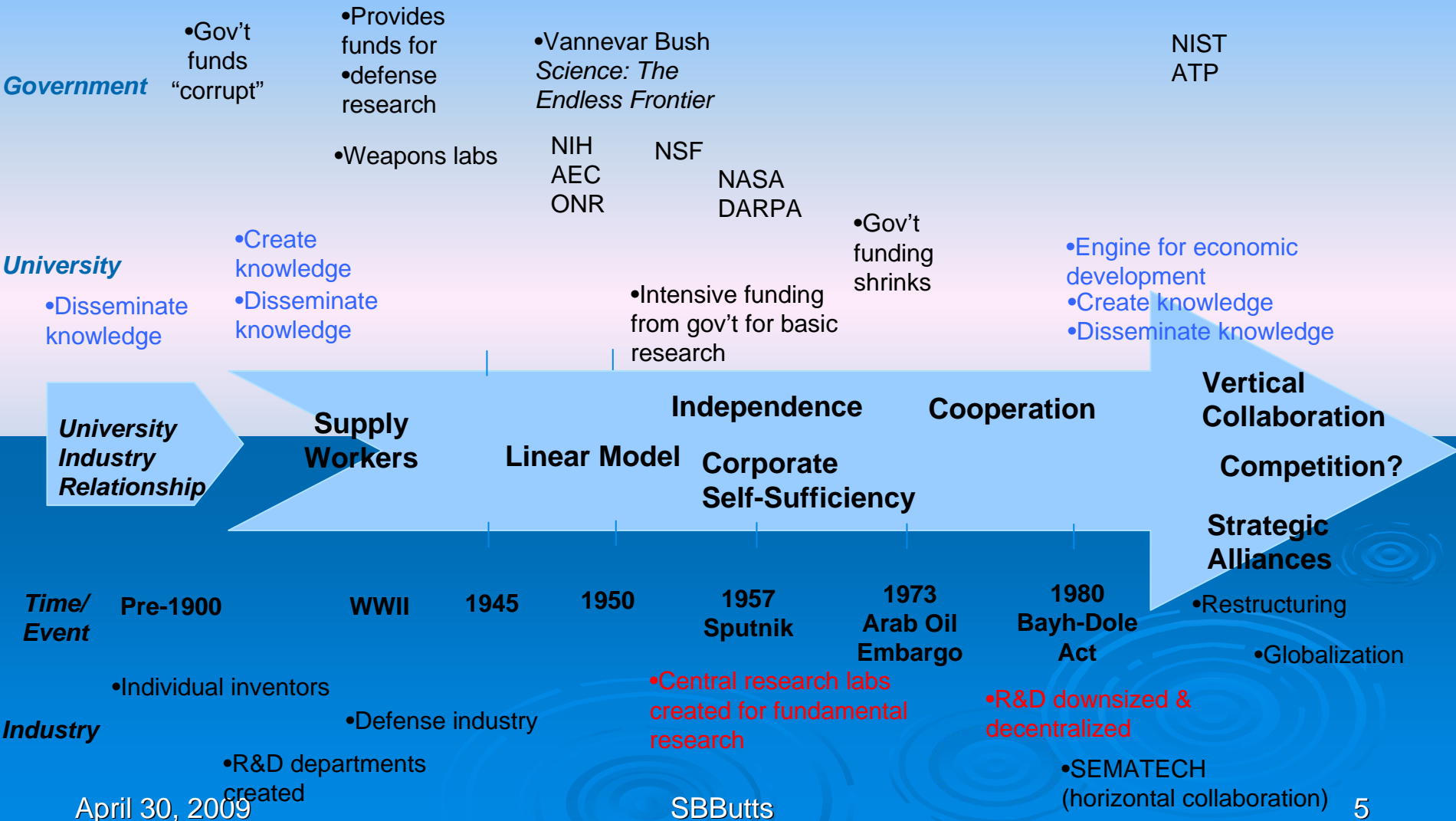
Science and Engineering Indicators 2008

How Much Is Spent on R&D?

- **Figures for 2006: Funding / Performing**
 - World
 - ~\$1T (estimated from 2002 data)
 - US-Located Companies (primarily from product sales)
 - \$192B / \$209B
 - US Federal Government (tax dollars)
 - \$81B / \$32B
 - US Universities (primarily from Federal Government)
 - \$8B / \$40B

Evolution of R&D in the US

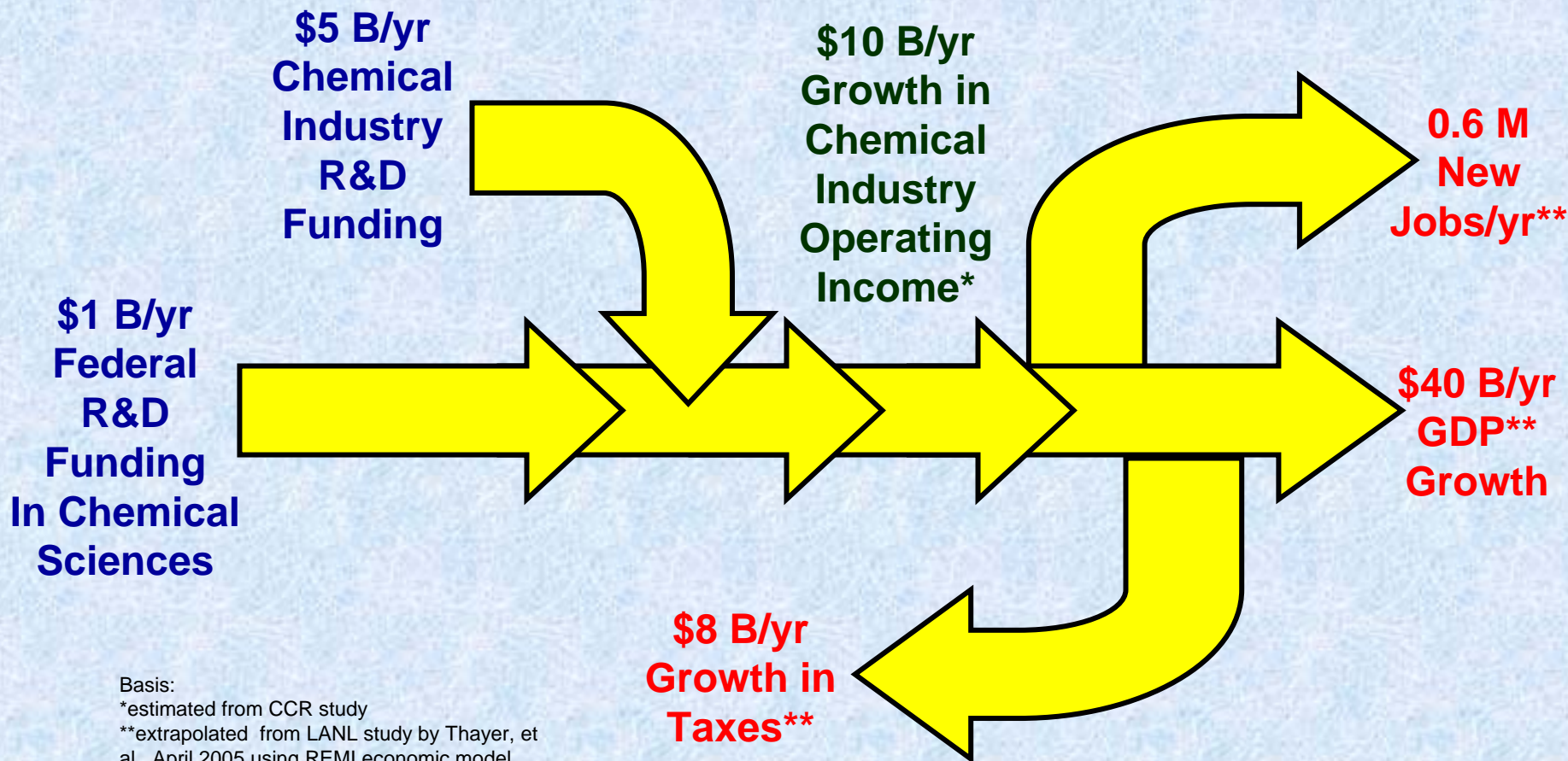
Derived From: C.T. Hill, "Partnerships in Research: The Evolution of Expectations," in Research Teams and Partnerships: Trends in the Chemical Sciences, Board on Chemical Sciences, National Research Council, 1999, pp 21-27.





CCR

Growth from Chemical Sciences R&D



Basis:

*estimated from CCR study

**extrapolated from LANL study by Thayer, et al., April 2005 using REMI economic model

Overarching Mission For Industry

What: Maximize Long-Term Shareholder Return

How:

- **Invest to create most value through making/selling products or services**
- **Balance short-term viability against long-term value**
- **Avoid destroying value**

Balancing Risk & Reward

■ Minimize Risk

- Technical risk
- Financial risk
- Commercial risk
- Legal risk/liability

■ Maximize Reward

- Competitive advantage
- Sales & profits
- Market position
- Product performance

Why and How Companies Do R&D

- Do R&D to create a competitive advantage in the market
- Try to place smart bets - invest R&D and capital dollars (manufacturing assets) on those technologies that have
 - The best chance of success in the market
 - The greatest return - sales volume/profit margin
- The winners have to cover the cost of the losers

R&D Investment Choices

- Trade offs in R&D investment decisions – balancing upfront costs against potential returns
 - Create new value (long term, high risk, high return)
 - Discover and develop new products
 - Preserve existing value (short term, low risk, moderate return)
 - Extend or expand current products
 - Avoid destroying value (long term, variable risk, negative return; also cost of not doing R&D)
 - Loss of competition advantage
 - Replacement or disruptive technology

Why Good Science May Not Successfully Commercialize

- Technology is not reproducible
- Technology does not scale up from lab to plant
- Cost or quality problems in manufacturing
- Insufficient market demand
 - Consumers don't want/need the product
 - Poor timing
 - Poor path to market

Why a “Good” Product May Fail Even if There is Market Demand

Probability of Commercial Success Depends on Characteristics of New Product

Lower Cost	Marginal	High
Higher Cost	Low	Marginal
	Poorer Performance	Better Performance

Industry Variants

Impact R&D Decisions

- Large company vs. small company
- Multiple products vs. single product
- R&D intensive vs. technology insensitive
- Differing business models for competitive advantage in the market (e.g., Pharmaceutical industry vs. Information Technology industry)
 - Nature of products
 - Time to commercialization
 - Product lifetime
 - Use of intellectual property
 - Profit margins

Promoting Industry R&D Investments

- Federal funding for high risk breakthrough research and demonstrations in areas of national interest
- Consortia for development of pre-competitive technology
- R&D tax credits

Where in the World to Invest in R&D

- Deciding where to locate R&D is quite complex and influenced by many factors, most importantly:
 - Access to product markets
 - Quality of R&D personnel
 - University collaboration
 - Intellectual property protection

Thursby & Thursby, *Here or There? A Survey of Factors Multinational R&D Location*, National Academies Press, 2006