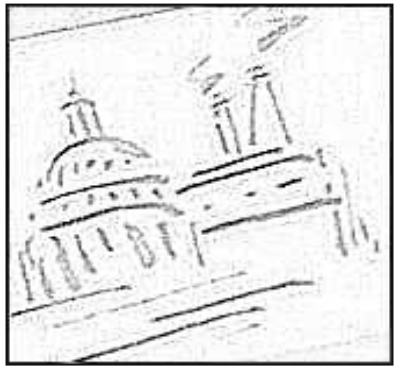

Public/Private Partnerships for Innovation:

Experiences and Perspectives from the U.S.

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Outline of Presentation

- **Policy Background**
  - **Who We Are: The National Academies' Board on Science, Technology, and Economic Policy (STEP)**
  - **R&D Declines and Policy Ambivalence in the U.S.**
- **Role of Small and Medium Enterprises**
- **The Scale and Nature of U.S. Programs**
- **The Relative Size of Early Stage Finance**
- **Optimal Financial Arrangements for Promoting Partnerships**
- **Evaluating Partnerships**
- **Managing Partnerships Effectively**
- **Concluding Remarks**

National Academies' Board on Science, Technology, and Economic Policy

- **A Rare Combination:**
  - **STEP brings together economists, technologists, industrialists, venture capitalists, and policymakers.**
  - **STEP brings business and policymaking experience, analytical rigor, and technical knowledge to issues of public policy.**
- **Established to improve policymakers' understanding of the interconnections among science, technology, and economic policies and their importance to the U.S. economy.**

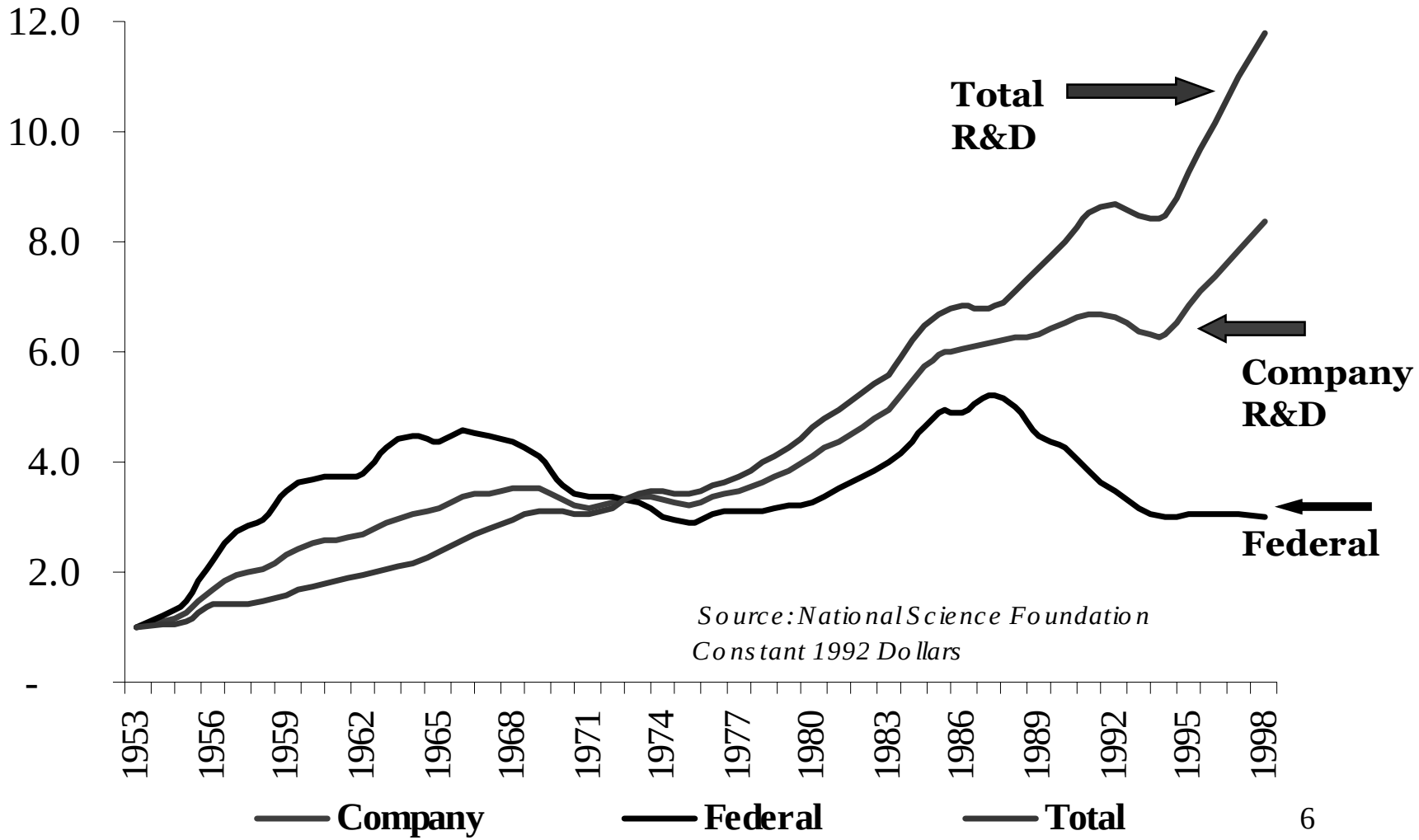
National Academies' Board on Science, Technology, and Economic Policy

STEP Recognizes Challenges to the Innovation Environment

- Post Cold War imbalances in U.S. public and private R&D
- Changing relationships among industry, government, and universities
- Partnerships are increasingly important to bring new technologies to market and capture the benefits of heavy U.S. R&D investments
- Growing recognition of value of partnerships to firms participating in the global economy

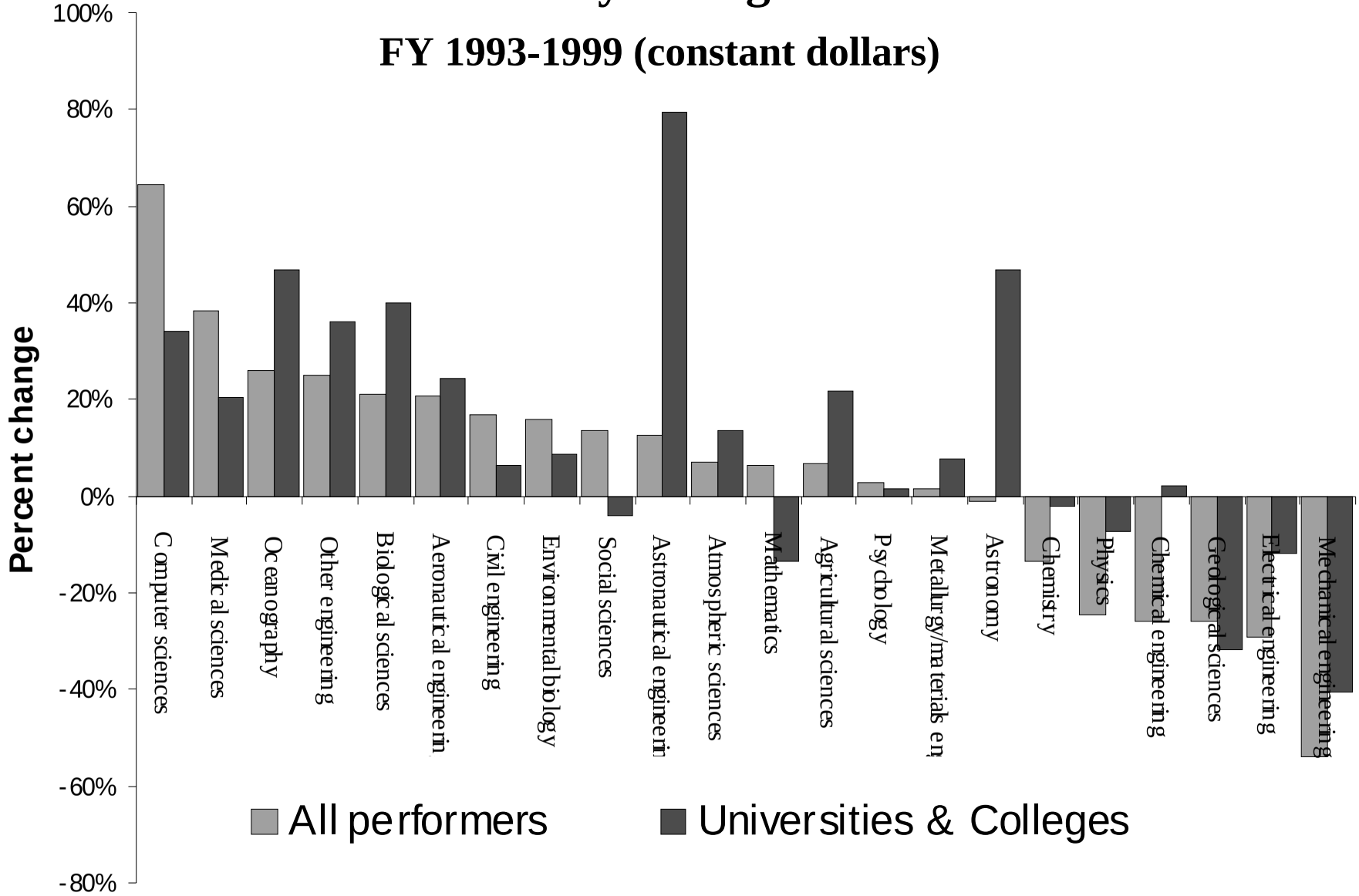
U.S. Policy Context: R&D Declines and Policy Ambivalence

Relative R&D Growth Rates: Index (1953-1998)
Total, Federal, and Company

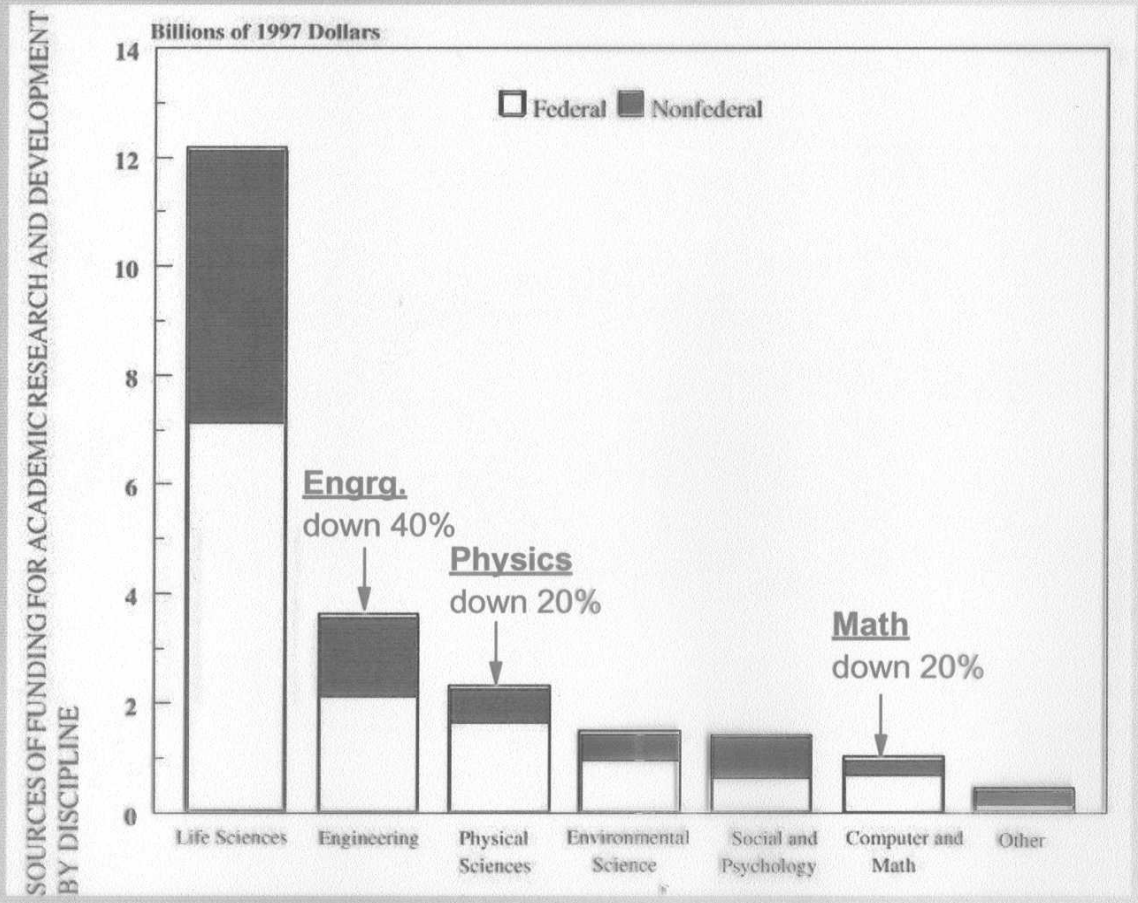


Changes in Federal Research Obligations for All Performers and University/College Performers

FY 1993-1999 (constant dollars)



Academic R&D Sources by Discipline



Source: S. Maynard, SRC

IBM

U.S. Policy Context for Partnerships Analysis: Ambivalence

- The United States is traditionally ambivalent about government support for applied R&D
- Policymakers most comfortable with “linear model” of innovation
  - many believe that government support for basic R&D will transfer seamlessly to the economy at large
- There exists genuine skepticism in Washington about government support for industrial innovation
- This view is frequently held in spite of:
  - numerous examples from U.S. history
  - current U.S. practice
  - current practice elsewhere in the world

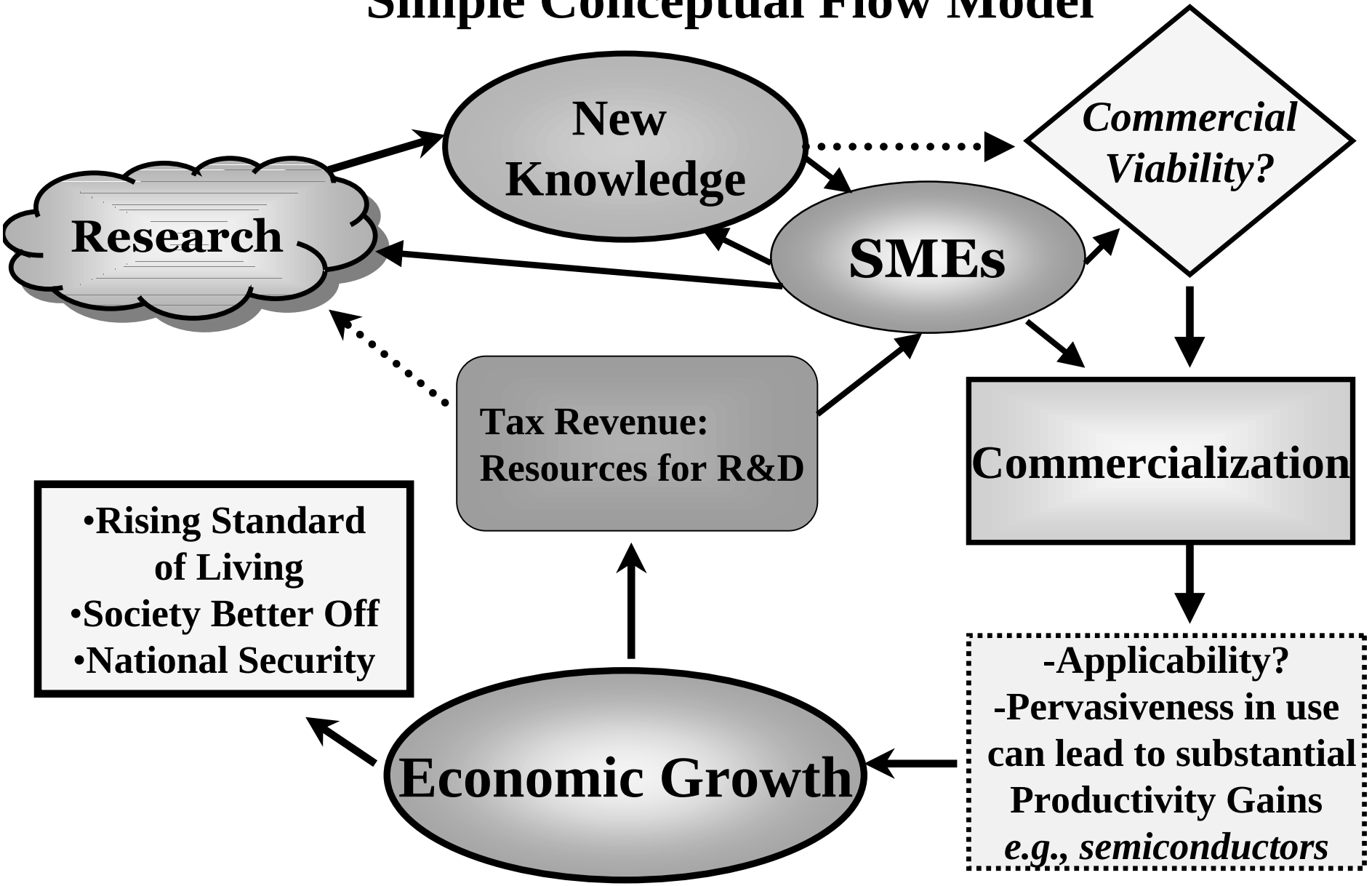
Precedents for Public Role in Science Commercialization

- 1798 - Grant to Eli Whitney to produce muskets with interchangeable parts, founds first machine tool industry
- 1842 - Samuel Morse receives award to demonstrate feasibility of telegraph
- 1919 - RCA founded on initiative of U.S. Navy with commercial and military rationale. Patent pooling, antitrust waiver and equity contributions.
- 1969-1990s - Government investment in forerunners of the Internet (ARPANet)
- Current investments in genomic/biomedical research
  - The issue is how to commercialize innovation

Role of Small and Medium Enterprises

The Role of SMEs

Simple Conceptual Flow Model



Scale and Nature of U.S. Programs

The U.S. Innovation Ladder

Scale and Nature of U.S. Programs

Support to New Technology Development on the U.S. Innovation Ladder

- **The Basis for Growth: Sustained Support for University Research**
- **Private Funding**
  - Friends, Family, and Fools
  - Angels
  - Foundations: Support for socially valuable innovation
- **Early phase development: SBIR ($1.2 billion annually)**
  - Phase I is a $100,000 grant
  - Phase II is a $750,000 grant
  - Phase III involves no direct federal award
- **Mid-range development: ATP ($217 million annually)**
  - Focus on technologies with broad social benefits
  - Sizeable but limited awards: 1-5 million dollars

Scale and Nature of U.S. Programs

Government Procurement of New Technologies

Focus by agencies on *mission related* technologies

Increased emphasis on commercial technologies or dual-use

CRADA (Cooperative Research and Development Agreements)

Cooperative research carried out with national laboratories and individual firms or consortia (sometimes involving foreign firms, e.g., the EUV consortium)

What is *not* a major U.S. Program?

U.S. R&D tax credit

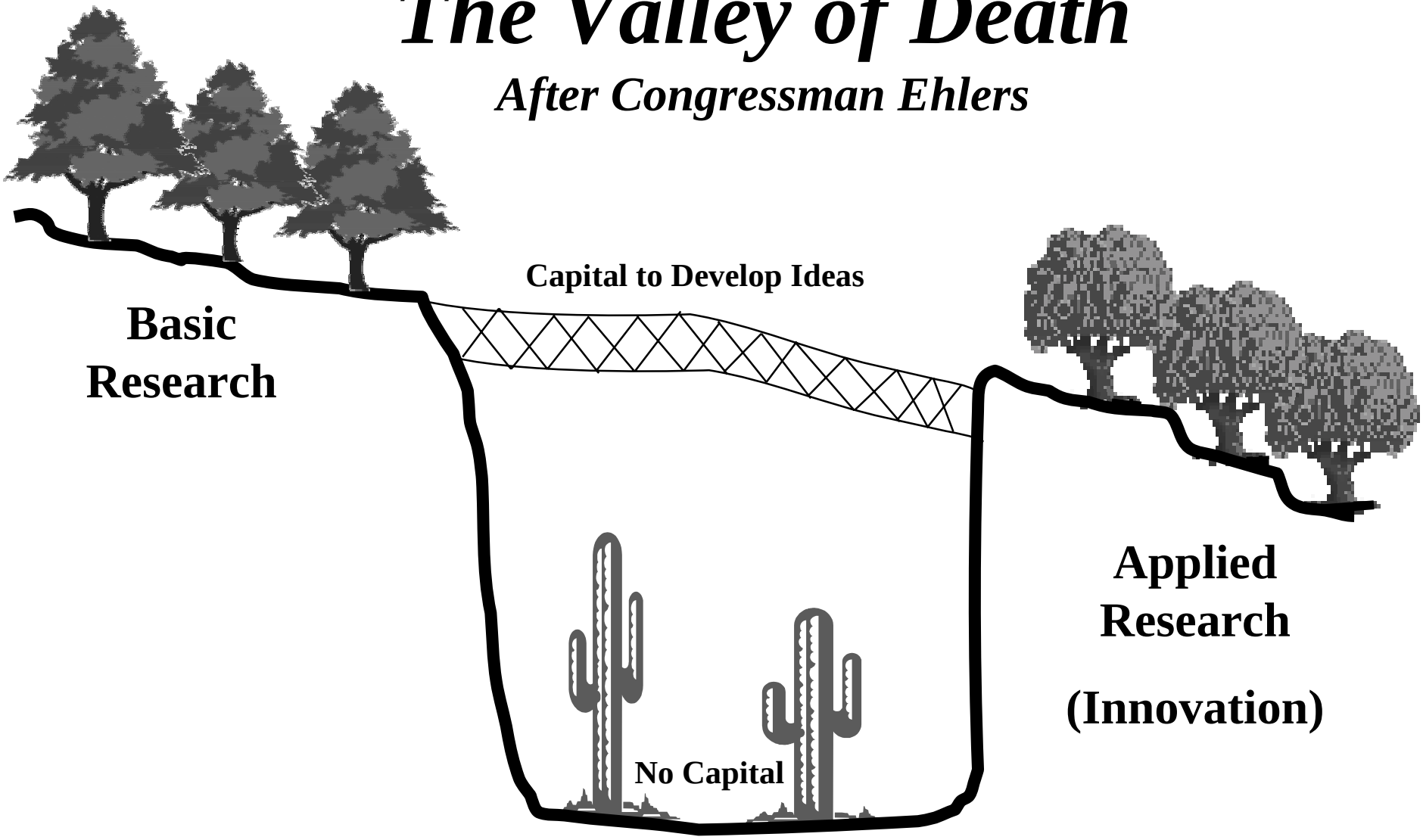
- mainly benefits large business
- is not focused on startup firms
- most new firms are characterized by limited revenues

Early Stage Finance:
Crossing the Valley of Death and Swimming the Darwinian Sea

The Role of Partnerships

The Valley of Death

After Congressman Ehlers



“Valley of Death”

Branscomb's Darwinian Sea

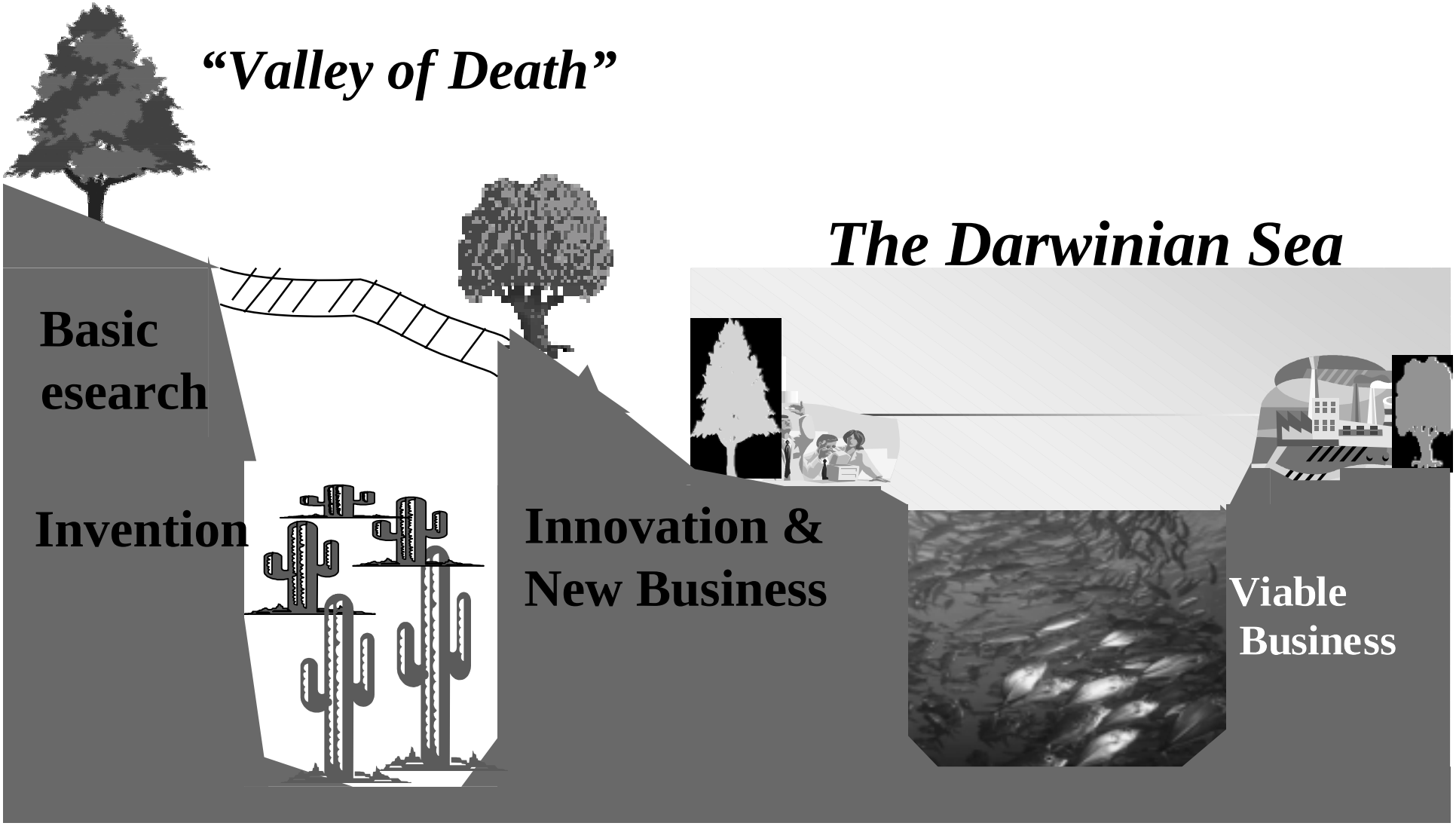
The Struggle of Inventions to Become Innovations

Research & Invention

Innovation & new business

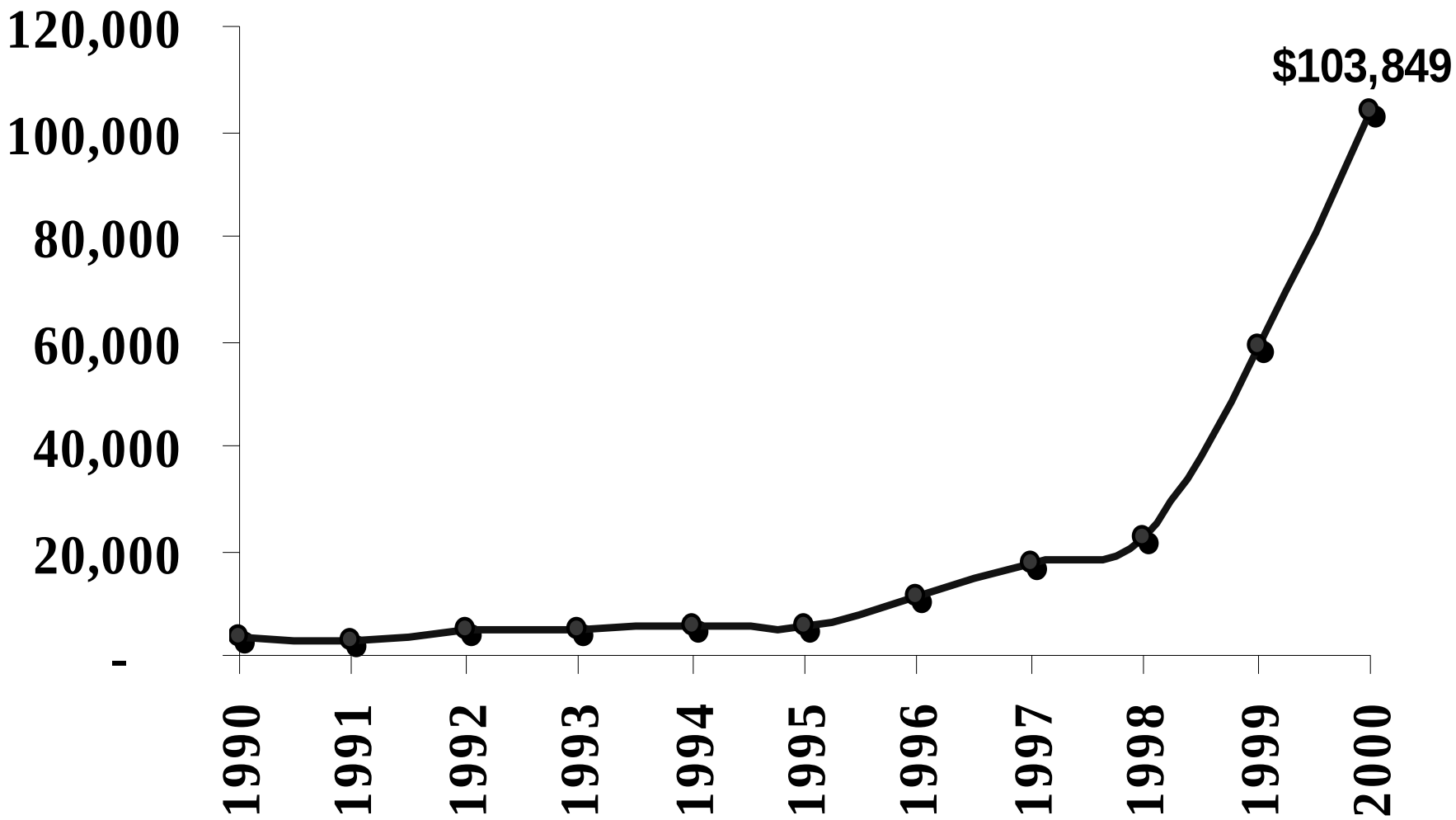
"Struggle for Life"in a Sea of Technical and Entrepreneurship Risks

Crossing the *Valley of Death* only to Arrive in the Waters of the *Darwinian Sea*



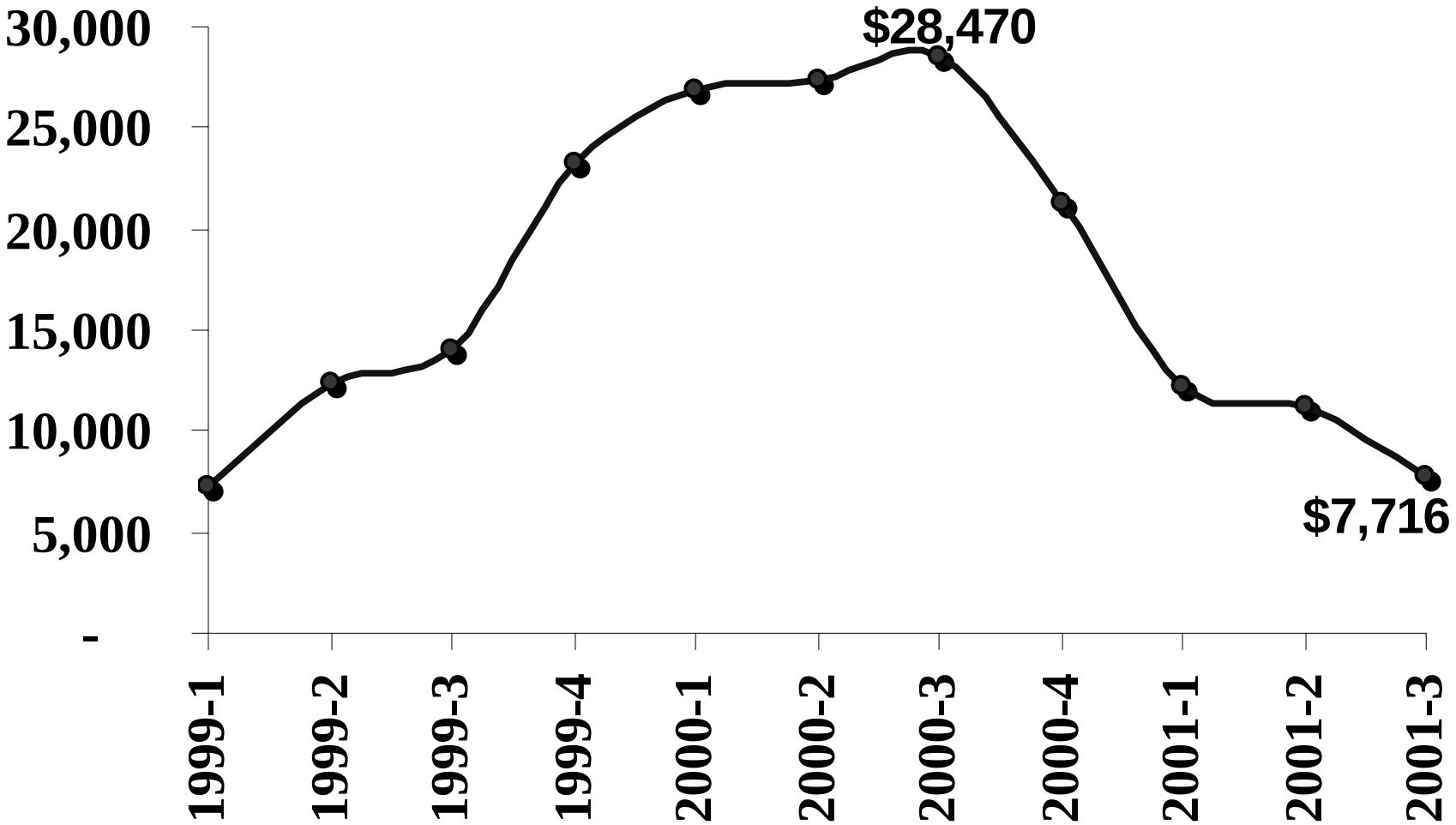
Crossing the Valley

Venture Capital Investment (Millions)



Source: National Venture Capital Association

Venture Capital Investment *by Quarter*
(Millions)



Source: National Venture Capital Association

Composition of Venture Capital Investment (millions)

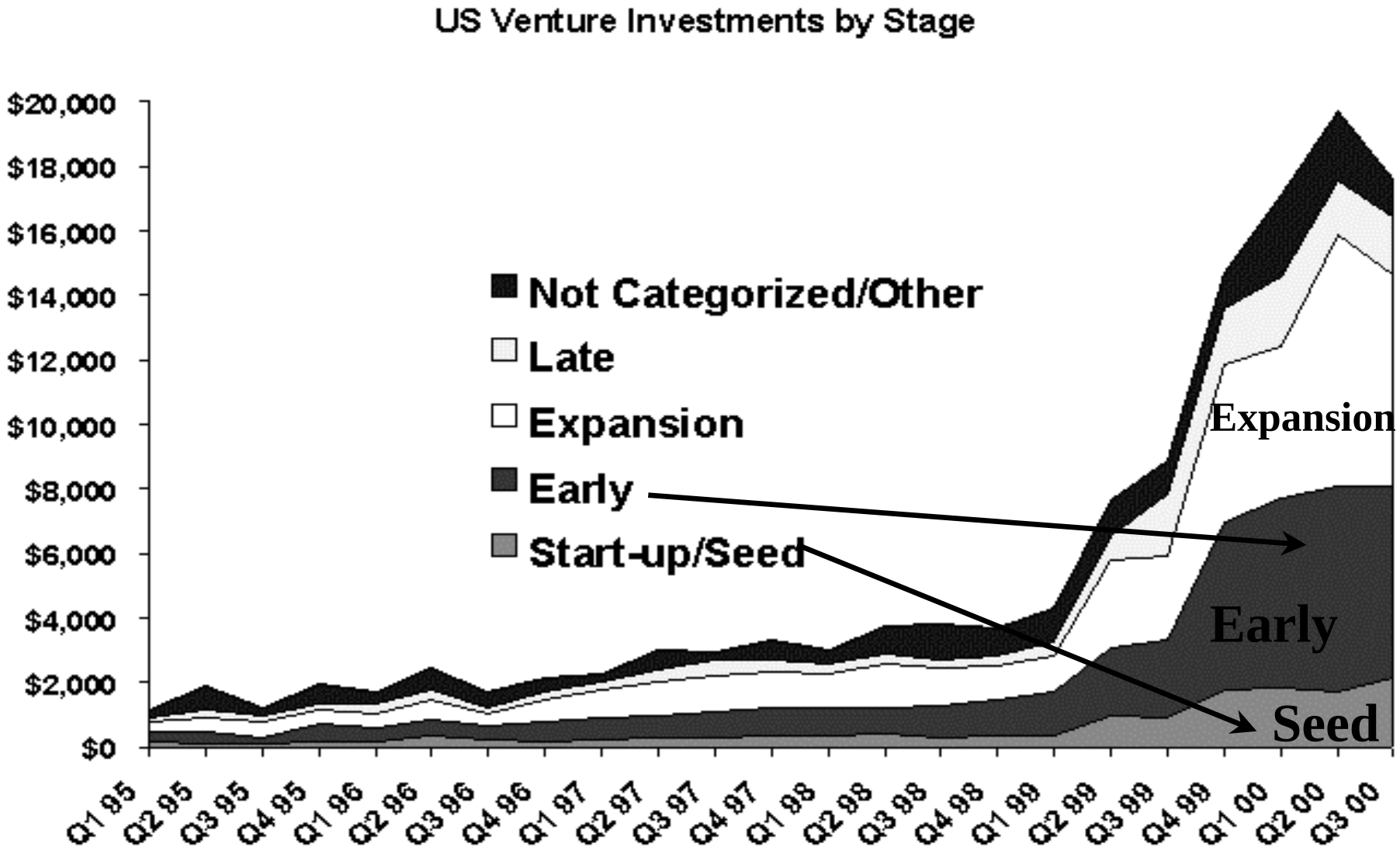


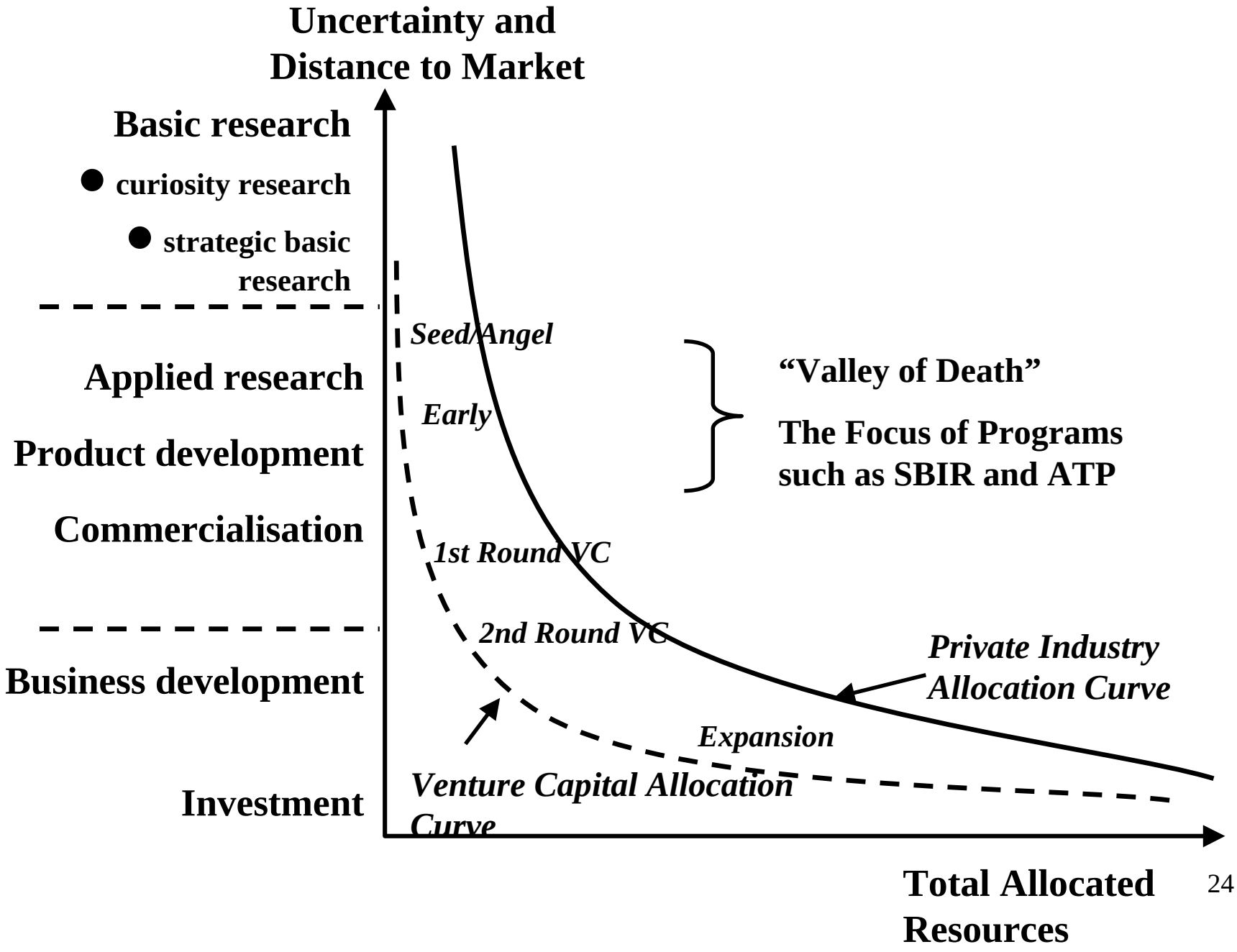
Chart is adapted from: http://www.velocityholdings.com/PV-web.nsf/pages/nationalstatistics

Definition of Venture Capital Stages

- ***Seed financing***-usually involves a small amount of capital provided to an inventor or entrepreneur to prove a concept.
- ***Startup financing***-provides funds to companies for use in product development and initial marketing.
- ***Other early-stage financing***-provides funds to companies that have exhausted their initial capital and need funds to initiate commercial manufacturing and sales.
- ***Expansion financing***-includes working capital for the initial expansion of a company or for major growth expansion, and financing for a company expecting to go public within six months to a year.
- ***Leveraged buyout financing***-includes funds to acquire a product line or business from either a public or private company, utilizing a significant amount of debt and little or no equity .
- ***Acquisition financing***-provides financing to obtain control, possession or ownership of a private portfolio company.

The first three may be referred to as "early stage financing" and the remaining three as "later stage financing." Source: **NSF**

The Allocation of Resources for Research



Optimal Arrangements for Promoting Partnerships

Optimal Financial Arrangements for Promoting Partnerships:

Countries use a variety of instruments to support particular firms or an entire industry by using:

- Short Term Awards to Develop New Technologies
- Direct grants to Companies
- Preferential Loans
- Government guarantees for loans
- Equity Capital Infusions by Government or Government Controlled Banks
- Targeted Tax Concessions for specific sectors and/or regions

Optimal Financial Arrangements for Promoting Partnerships:

- Technology promotion in the U.S. relies on awards, often with the prospect of procurement
- Preferred options are awards which are:
  - **Small in Size**
    - **allows more diversity in selection**
    - **encourages initial innovation**
  - **Limited in Duration**
    - **Avoid Political Capture**
  - **Require in-kind or direct cost sharing**

Partnerships for Encouraging Technological Development and Commercialization

Encouraging Technological Development or Commercialization
The ATP Approach

- Relatively Large Awards
- Leveragability
    - Halo Effect (Awards help attract other capital)
- Explicit Cost Sharing
- Awards are limited in time
- No repeat awards—"One-Off" Approach
- Joint ventures preferred to encourage diffusion

Evaluating Partnerships

Evaluation of Partnerships

- Evaluation Must be an Integral Part of Program Design
- Risk of Political Capture
  - "Friends of the Minister" problem
  - Preferred Sectors
- Risk of Misallocation
  - sustained financing to preferred firms
  - sustained support can sap small firm vitality
- The Danger of Discrediting Technology Support
- But, the hard question is:
  - *What are the Proper Metrics*?

How Should a Program be Evaluated?

- **Q**uality of R&D? What's the Measure of Quality?
  - •Publications
  - •Patents
  - •Patent Citations
  - •Number of Innovations – Sometimes Unreported
- **C**ommercialization Rates
  - •Sales
  - •Licensing
  - •Sale of technologies
  - •Sale of firm
- Magnitude of Spillovers: Indirect path of acquired knowledge

How Should the Program be Evaluated?

- **Firm Performance measured by**:
  - number and type of jobs generated
  - higher wages
  - higher sales
  - higher survival rates
- **Another Measure can be Mission Based: Management and Integration of New Technologies into Agency Programs and Missions, from Environment to Defense**
  - DoD or NASA acquisition
  - NSF and NIH are sometimes harder to measure

Measurement Issues in Evaluation

- **D**evelopmental Impacts: e.g., Are Jobs Created as a result of the Program?
- **D**o more *productive firms win awards or do awards make firms more productive*?
- **W**hat is the Return on Investment (ROI): social return?
- **C**an we study the "reject" firms, as well as analyze *firm performance* before the SBIR grant, to discern the program's effects
    - Issue: No data currently available on firm performance before first award is granted
- **I**s there Crowding out of Private R&D?
    - Are firms which would have received private sector R&D, seeking "free" or supplemental funds from government?

The Efficient Management of Partnerships

Management of Partnerships

- Government plays a decisive role in the development of new programs or focus areas, e.g., to meet emerging societal needs and address “excessive” risk and uncertainty
- Industry should propose specific research areas, identify technological opportunities, and be responsible for exploiting the results, e.g,. bringing products to market
  - Support by multiple private firms is a key condition for government financial participation
- Shared costs provide a constant, active, and powerful “reality check”—50/50 works well.
  - Losing only half the cost of research projects is not career enhancing for private managers
  - Private actors abandon poor investments quickly – more quickly than government actors

Concluding Remarks

Concluding Points and Broader Policy Implications

- **Advances in Technology drive economic growth, and thus generate jobs, enhance welfare, and assure national security**

- **Government can stimulate scientific research which will <u>not</u> be performed by industry alone via programs such as SBIR and ATP**

- **Government funding for science activities serves as a catalyst among and within companies to develop new ideas**

- **Current NRC assessment efforts seek to provide a comprehensive analysis of ongoing contributions, accomplishments, and challenges of public-private partnerships.**

Concluding Points and Broader Policy Implications

- **Generating science-based growth is a major policy interest around the world.**

- **The role of small business and university-based growth is seen as increasingly instrumental to bringing the benefits of research to the marketplace.**

- **Public-Private Partnerships address key elements of the innovation system and is therefore of central policy interest**

- **OECD should be commended for its research and analysis of best-practice in public-private partnerships**