

Evaluating Research & Science Based Programs

The Small Business Innovation Research Program



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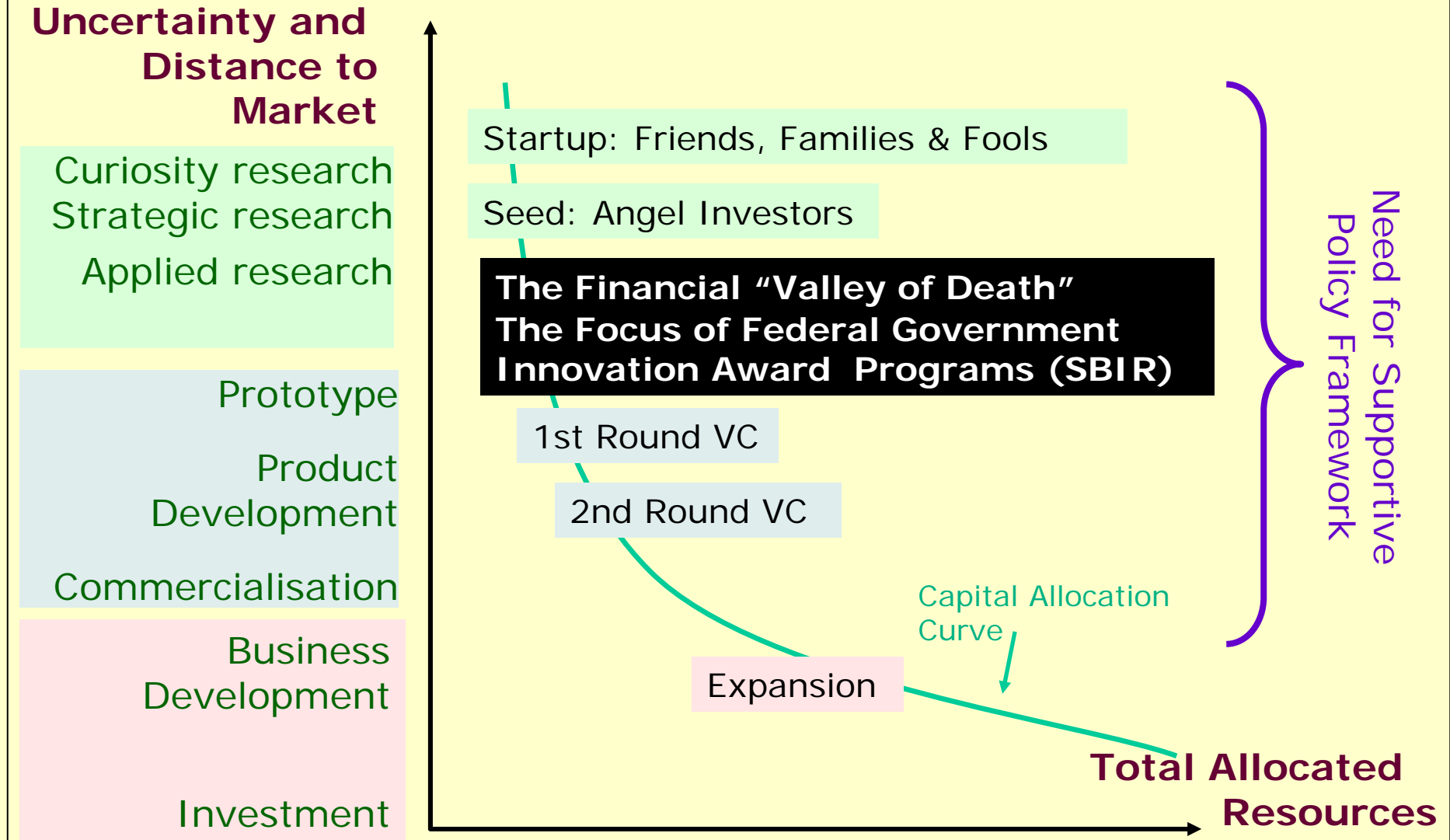
Presentation Topics

- The SBIR Concept
 - Role & History
 - Program Structure
- Key Strengths
 - User Friendly
 - Enhances Market Efficiency
 - Flexible & Adaptable Administration
- The University Connection
- The NRC Assessment
 - History of the Assessment
 - Evaluation Tools

The SBIR Concept

Addresses Gaps in
Very-Early-Stage Financing

Bridging the Valley of Death



Role of U.S. Government in Early-Stage Technology Development

- Markets for Allocating Risk Capital to Early-Stage Technology Ventures are not Efficient
- Most Early-Stage Funding comes not from Venture Capitalists but from
 - Individual “Angel” investors,
 - Corporations, and
 - The Federal Government
- Federal Technology Development funds Complement Private Funds
 - More important than we thought

Recent Research: U.S. Funding Sources for Early-Stage Technology Development

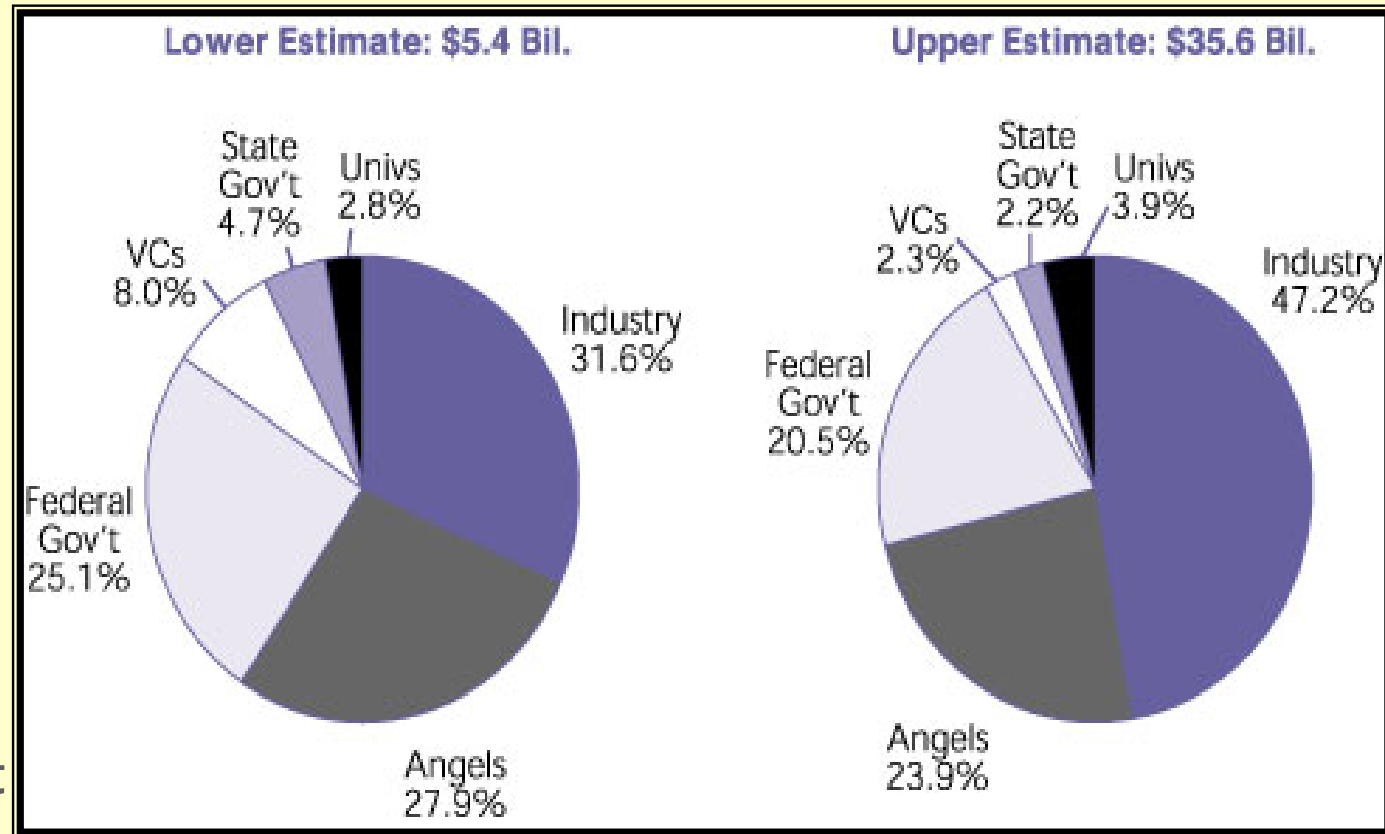
Multiple Actors

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Multiple Sources of Finance Focused on Different Stages

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Government Role is Significant



Branscomb & Auerswald, *Between Invention and Innovation An Analysis of Funding for Early-Stage Technology Development*, NIST, 2002

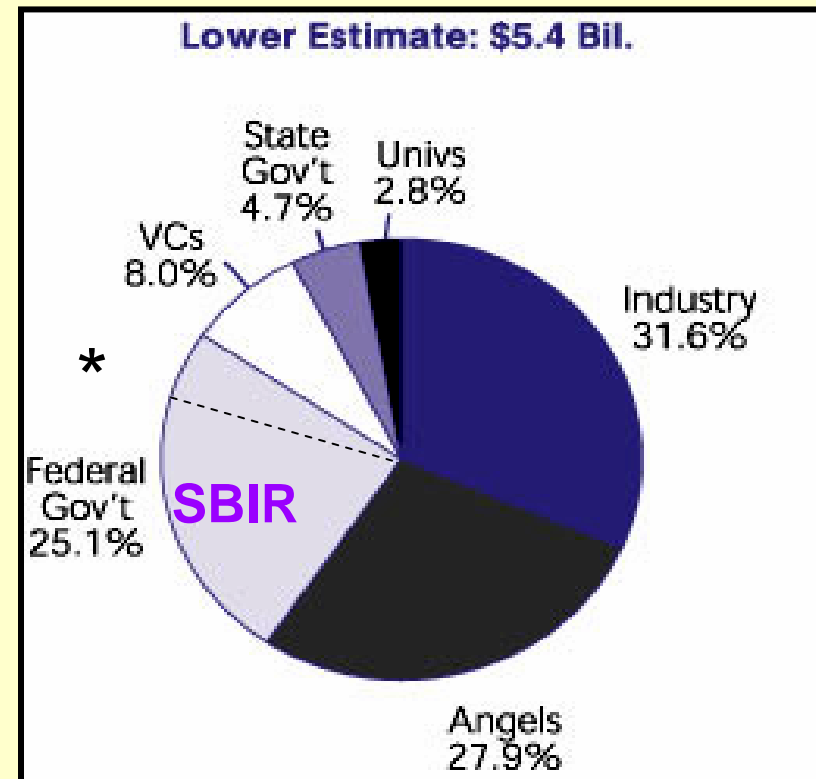
Figures based on 1998 data

The Small Business Innovation Research (SBIR) Program

- Created in 1982, Renewed in 1992 & 2001
- Participation by all federal agencies with an annual extramural R&D budget of greater than \$100 million is mandatory
 - Agencies must set aside 2.5% of their R&D budgets for small business awards
- To be a \$2 billion per year program in 2004
 - Largest U.S. Partnership Program

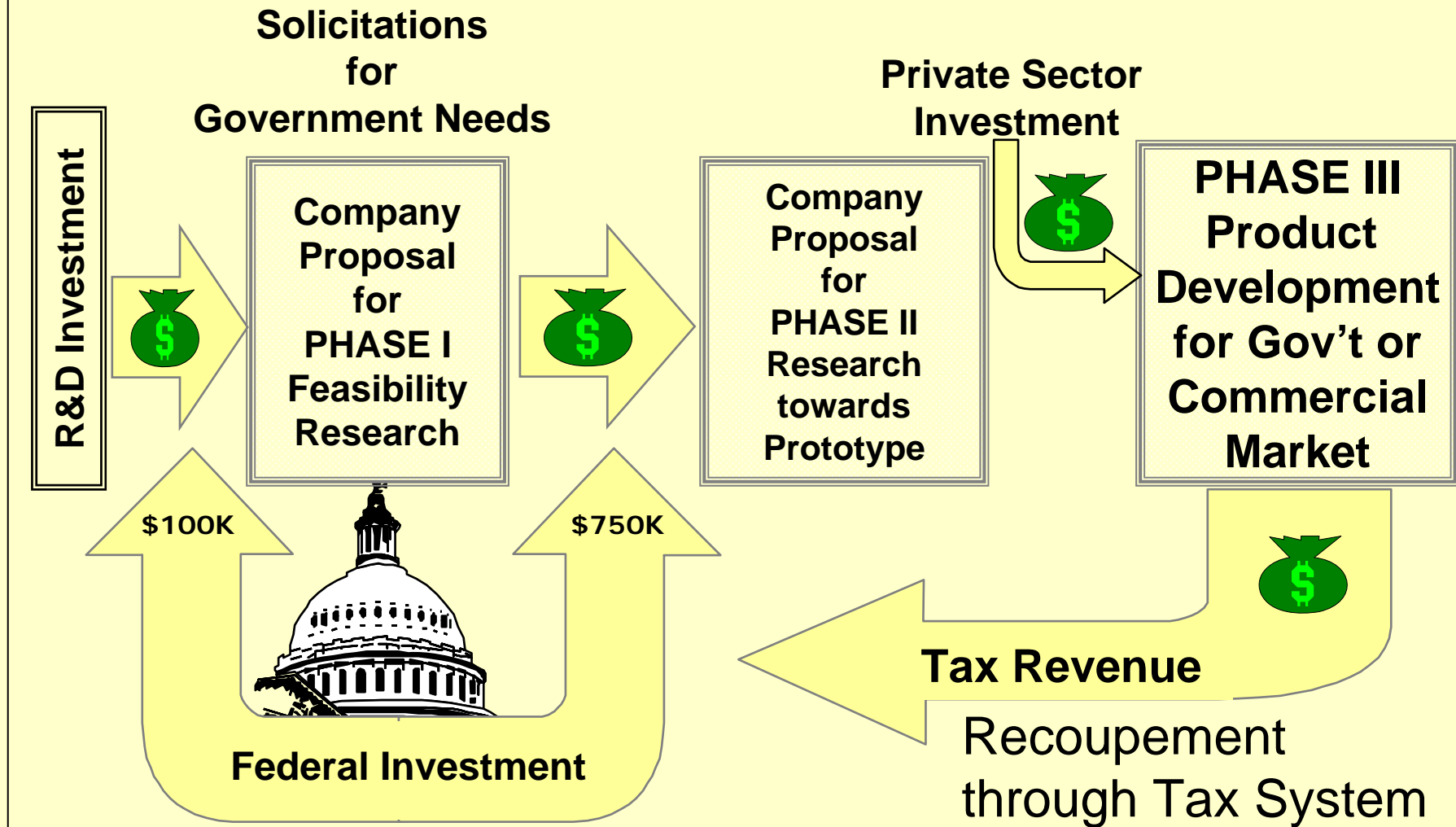
SBIR: Critical Source of Predictable Funding for Early-Stage Finance

- SBIR—Main Source of Federal Funding for Early-Stage Technology Development
 - SBIR over **85%** of Federal Financial Support for Early-Stage Development
 - SBIR over **20%** of Funding for Early-Stage Development from *all sources*



*Estimate of Federal Government Funding Flows to Early-Stage Technology Development—Based on total funding for ATP, SBIR & STTR programs by Branscomb and Auerswald 2002

SBIR Model



Key Strengths of SBIR

SBIR is User-Friendly

- A **Stable** Program
 - Funding set at 2.5% of Agency Extramural R&D Budget
 - Predictability enhances program's value to small companies and researchers
- An **Adaptive** Program
 - Adapts Rapidly to new and varied Agency Missions and Technology Needs
 - Flexible: Exemptions permitted if justified
 - SBA does not use a "one-size-fits-all" approach
- A **Substantial** Program
 - Now \$2 billion a year program (but in a \$10 trillion economy)—Still impacts cutting-edge technology

SBIR's Attraction to New Entrepreneurs

- Having a company not required to apply for a grant
- Companies and Researchers can apply to different agencies at the same time
- Agency outreach programs provide guidance and encouragement
- Entrepreneur can explore technical and commercial feasibility under Phase I before taking the full plunge

SBIR is Entrepreneur Friendly

- Why do Entrepreneurs like it?
 - No dilution of ownership
 - No repayment required
 - Grant recipients retain rights to IP developed using SBIR funds
 - No royalties owed to government
 - Awards attract private capital
 - Certification Effect

SBIR is Industry-Driven & Government Validated

- SBIR is a Self-Select Mechanism
 - Agencies post broad Solicitations;
Companies define terms of Proposals
 - Most Agencies have “Open Windows,”
permitting Unsolicited Proposals from
Companies
 - Paperwork Burden is high but manageable;
Possibly serves as a necessary Filter
- SBIR Examines for both Technical **and**
Commercial viability

SBIR Improves Market Efficiency

- The Program's 2-stage grant structure acts as a valuable sorting mechanism
 - Encourages innovative proposals
 - Then Provides funds to develop
- **Information Generated by SBIR Examinations Attracts Private Investment**
 - Crowds-in rather than Crowds-out Private Investment—Awards Certify Quality
 - Evidence for Crowding Out is problematic
 - See David, Hall and Toole (2000)
- Program focus in on poorly understood, weakly documented area of Early-Stage Finance

SBIR is a Bridge in the Innovation System

- Provides a Bridge between Small Companies and the Agencies, especially for Procurement
- Contributes New Methods and New Technologies to Government Missions
- Provides a Bridge between Universities and the Marketplace
- Encourages Local and Regional Growth, increasingly through the University connection
 - Creates jobs and justifies R&D investments to the general public

Addressing Multiple & Different Agency Goals

- NIH
 - Research Tools, Medical Devices, Drug Development, and Audio-Visual Health Materials
- DOD
 - Vaccines
 - Neural Network Processors for remotely piloted jets
 - Wireless Communications for Divers
 - Low-cost, High-performance Drones
- NASA
 - Aeronautics and Aircraft Systems
 - Robots to assist in surgery
 - Air cleaners for space capsules
- **Commendable Flexibility & Diversity**

SBIR is Flexibly Administered

- Department of Agriculture
 - Smaller Program, Smaller Awards
 - Phase I: \$30,000 to \$60,000
 - Focus on Regional Development
- National Institutes of Health
 - Larger Programs, Larger Awards
 - Large Programs (e.g. Drug Development) can receive funding up to \$3 million over 3 years
- National Science Foundation
 - Phase I = \$100,000
 - Phase II = \$500,000
 - Phase II-b = \$250,000 plus

The University Connection

SBIR Plays a Key Role

University-Industry Cooperation is Key

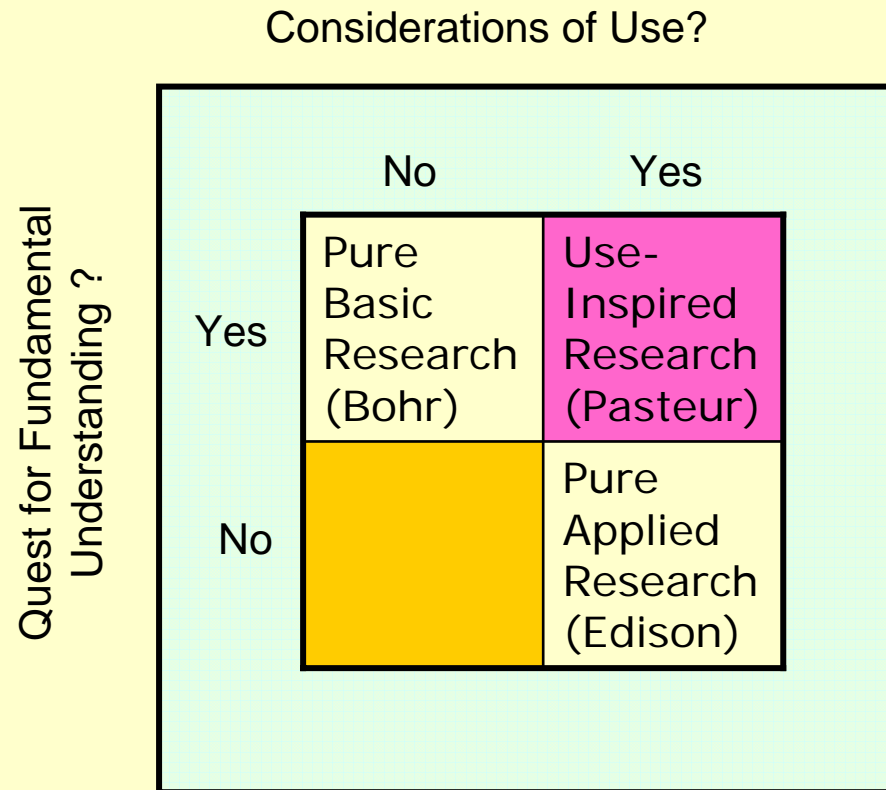
- Cooperative Research
 - University research draws ideas from commercial trends more than ever before
 - Feedback loops from industry to universities are important
 - Major contribution to training for real jobs
- Regional Growth
 - Regional economies need their research universities more than ever before
- Firm Formation
 - University innovation + early government funding have been key to the growth of many successful technology companies
- Supportive University Culture & Incentives are crucial

Pasteur's Quadrant: Research can be Applied, Practical, and Basic at the Same Time

- Use-inspired research
 - increases existing understanding *and* creates improved technology.
 - can take existing technology to new levels but it
- can also improve understanding of fundamental principles

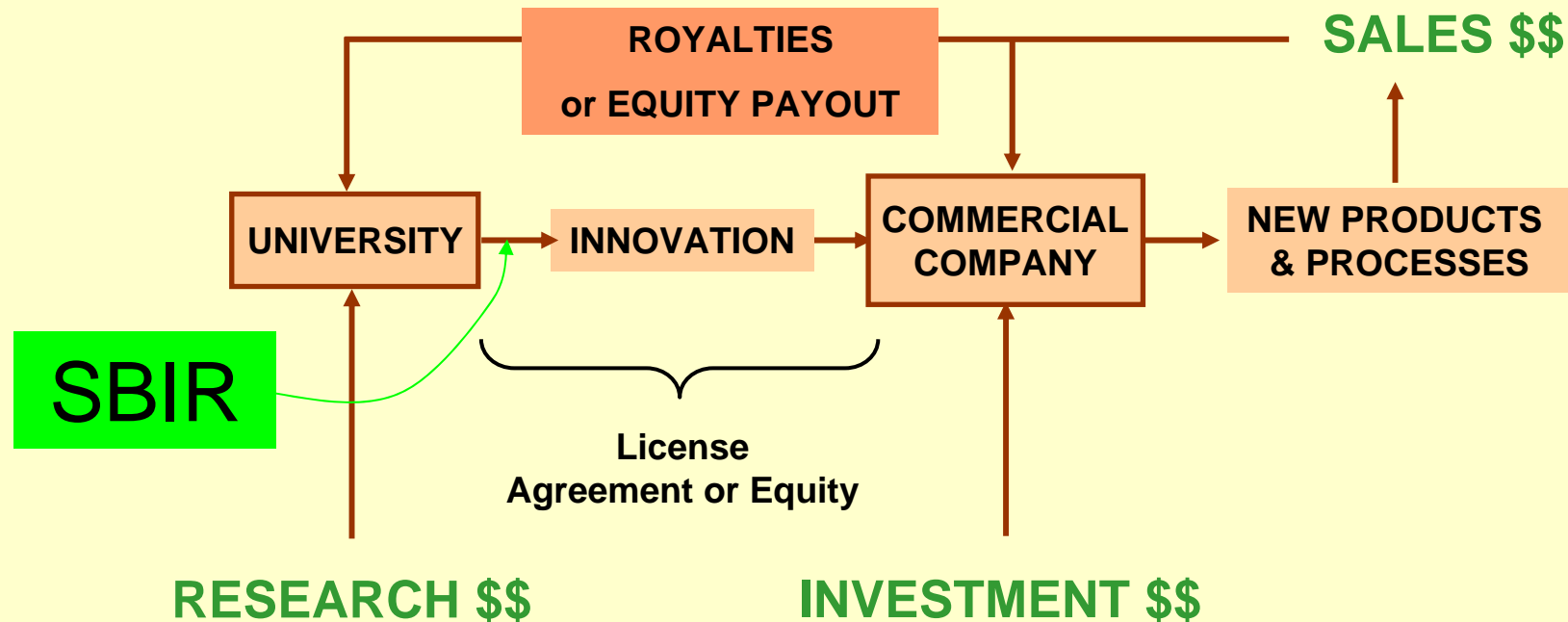
**From Donald Stokes,
Pasteur's Quadrant, 1997**

Quadrant Model of Scientific Research



How Ideas are Commercialized

Transferring University Technology to Firms



- Licensing to existing companies – brings royalty \$
- New company formation – brings royalties and/or equity
- Other, less direct, contributions to regional economic activity – **Est. 5,000 Good New Jobs in Pittsburgh Area**

Drawn from C. Gabriel, Carnegie Mellon University

The Benefits of University-Industry Cooperation

- SBIR Innovation Awards Directly Cause Researchers to create New Firms
 - Firms contribute Jobs and Regional Growth
 - Cooperation creates High-Tech Jobs
- Universities help diversify and grow the job base
 - Increasingly universities are the largest regional employer for all types of employment
- Cooperation validates Research Funding
 - Returns to Society in Health, Wealth, & Taxes
 - SBIR is a proven mechanism in an uncertain game

In Concept, SBIR is

Good for Small Firms

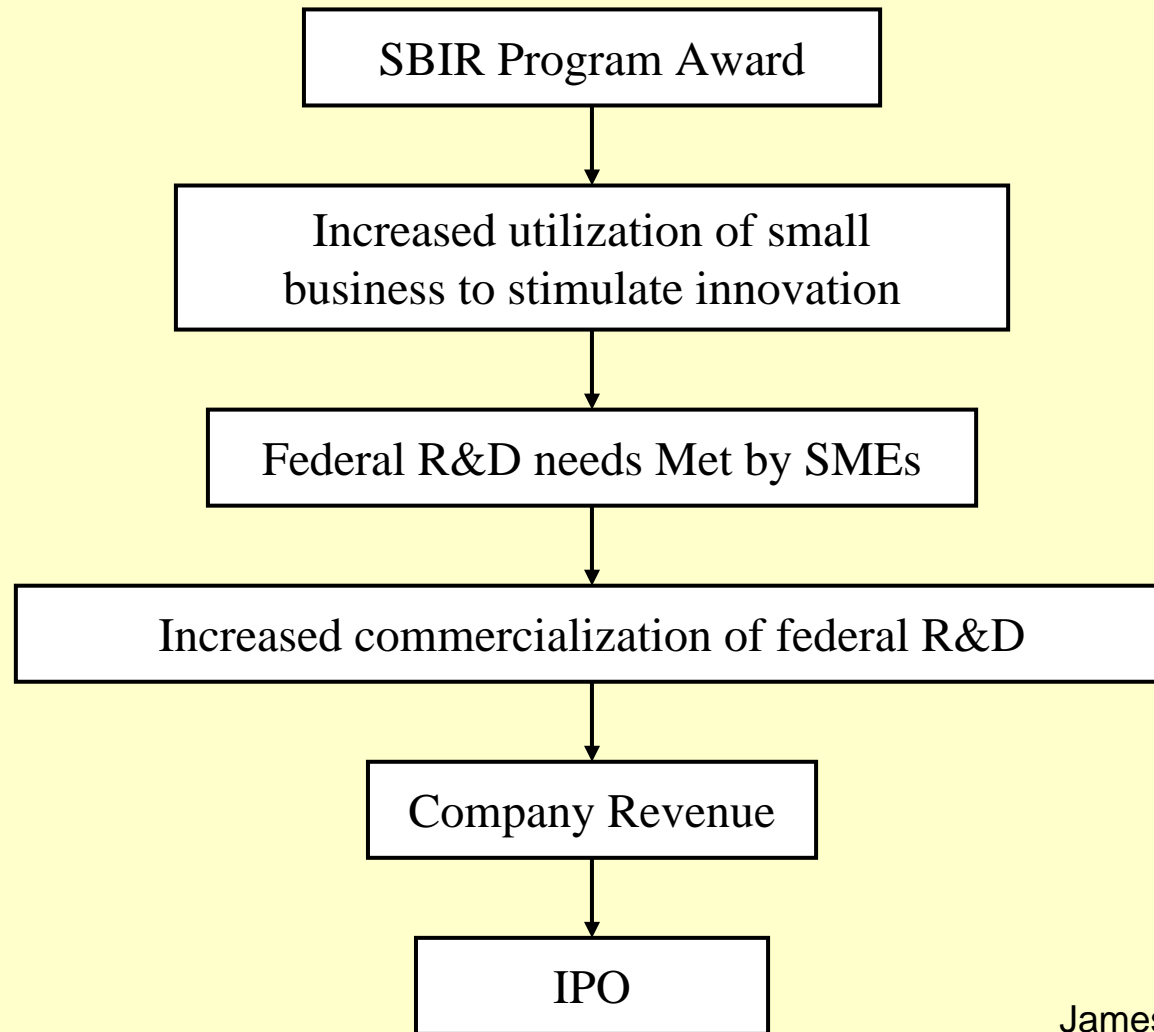
Good for Universities

Good for Regional Growth

Is it Working in Practice?

The Challenge is in Assessment

Common perception of the SBIR program



James Woo, InterScience

Evaluating SBIR

The NRC Assessment

The Role of Analysis

- Program and Project Analysis are Essential to:
 - Clarify program goals and objectives early on
 - Develop meaningful metrics
 - Generate measurable definitions of success
 - Contribute to a better appreciation of the role of partnerships among government, university, and industry
 - Help inform public and policy makers of the opportunities, benefits, and risks involved in public-private cooperation
- Common Criticisms of SBIR—next...
 - Do they have basis in fact?

Common Criticisms of the SBIR Program

- **Set Aside**— A “tax” on R&D budgets
 - The program interferes in the effective management of agency R&D by favoring a sub-set of companies
- **Program Capture**
 - Presence of multiple award winners with many awards but little commercialization
 - Targeted awards for pet projects
- **High Paperwork : Funding Ratio**
 - Involves too much paperwork for relatively little funding—6 reports in 6 months for \$100K

Common Criticisms of the SBIR Program

- **Crowding Out of Private Capital**
 - The program encourages the funding of marginal firms and replaces private capital
- **Selection Bias**
 - Selected firms would have done as well without SBIR award
- **Low Commercial Rates of Return**
 - Results are highly skewed; Few firms succeed

Required: A More Analytical Perspective

- Few firms succeed—but with high pay-backs
 - Few? Compared to What?
- Crowding out of private capital seems doubtful
 - Empirical evidence of systematic crowding out is absent (David, Hall, and Toole 2000)
 - “Crowding in” does occur—awards attract private investors (Feldman & Kelly 2000)
 - Venture Capitalists tend not to invest upstream (David Morgenthaler, Morgenthaler Venture Capital)
- SBIR is not a “public venture capital program”
 - Lerner 1999
 - Why not?
 - No equity ownership
 - No loss of control
 - No management input
 - No exit strategy

An Analytical Perspective

- Claims that “firms would have succeeded in any event” overlooks two important functions of SBIR.
 - SBIR develops and signals information about firm potential, improving the information available to private investors.
 - Second, SBIR awards can motivate a researcher’s decision to start a firm. (Audretsch et al, 2002)
- No empirical evidence of Selection Bias as a problem in SBIR awards
 - (Jaffe, 2003)

SBIR is Under-Evaluated

- Limited Academic Analysis
 - Program too big, topic too important
- Limited Government Analysis
 - Reviews are anecdotal
 - Most internal reviews are never released
- Most Agencies Have Limited or No External Assessment
- First NRC Analysis of SBIR at DOD Recommended More, and More Regular, Assessment

New Multi-Year, Multi-Agency NRC Study of SBIR

Congress Agreed and requested the NRC review the 5 largest agencies that account for 97% of the program's funding in 2003

- Department of Defense
- National Institutes of Health
- Department of Energy
- National Aeronautics and Space Administration
- National Science Foundation
- \$5 million, 3- 6 year study

Evaluation Challenges

- Counterfactual
 - Was the commercialization or its timing *caused* by the SBIR award?
 - It is not sufficient to observe that an SBIR award was made and later that the awardee commercialized a new product.
 - What impact do we expect the awards to have?
- Selection Bias
 - Are the firms that apply special in some way?
- Firm-Based Surveys or Project-Based Surveys?
 - What data is available? How is it organized?

Some Metrics of Success

- Publications
 - Citations
- Patents
 - Citations
 - Licensing (or Theft and Litigation)
- Firm Survival/Growth
 - Additional Funding: Angels, VC, Corporate Partners
- Support for Agency Mission
- Product Commercialization
 - Procurement or Commercial Market
- **Myth: One Award, One Invention, One Product**

Proposed Evaluation Techniques

- Surveys
 - Phase I Recipient Survey
 - Phase II Recipient Survey
 - Program Manager Survey
 - Technical Manager Survey
- Case Studies
 - Directed to company officers and individual research scientists as well as to research managers within the funding agency.
 - Purpose:
 - To generate detailed data not accessible through surveys
 - To pursue lines of inquiry suggested by surveys
 - To identify anecdotes that illuminate findings

Evaluating SBIR

- “Compared to What?”
 - Competitive Awards: Not Subsidy
 - Early-Stage Finance: Higher Risk
 - High Skew is Normal
 - Greatest Returns from Few Investments
- Compared to VC Portfolios?
- Compared to R&D Tax Credits?

Innovation Awards vs. Tax Credits

- R&D Tax Credits are often too Broad in Application
 - Cost is too High Compared to Innovation Awards
- Incentive Effect of Tax Credits Depends on Revenue
 - Small Innovation Firms often Have no Revenue—thus Tax Credits provide Little Incentive
 - Tax Credits can Help Established Businesses
- Additional Impact of Tax Credit Hard to Calculate
 - Encourages Creative Accounting
- Effectiveness of Tax Credits in U.S. compromised by “history of repeated, limited extensions”
 - National Association of Manufacturers

Innovation Awards vs. Tax Credits

- Innovation Awards are
 - Targeted on Specific Outcomes
 - Higher Impact at Lower Cost
 - Targeted at Critical Juncture in the Innovation System
 - Valley of Death
 - Effective and Flexible
 - Powerful—Leverages Resources
 - Conditional—work can be stopped
 - Industry-driven
 - Less bureaucratic
 - Closer to market
 - More “take up” of technologies

Conclusions

SBIR: Broader Policy Implications

- Small Business is Instrumental in Bringing the Benefits of University Research to the Marketplace
 - Small firms employ the Majority of the Workforce while contributing to Economic Growth
 - The SBIR addresses Key Elements of the National Innovation System and is therefore of Central Policy Interest

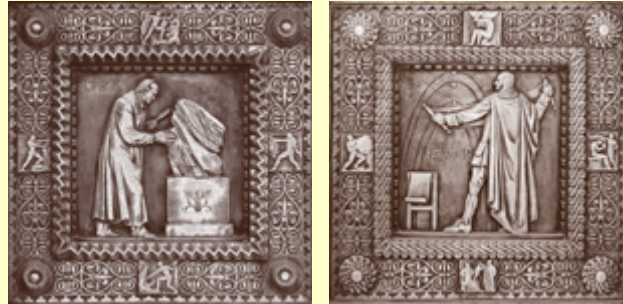
The Nature of Evaluations

- Evaluations need to be
 - Transparent
 - Institutionalized, i.e, regular internal and external assessments
 - Based on objective criteria
- Project failure does not necessarily imply program failure
 - Political leadership seeks high-risk, high-payoff investments
 - Political leadership also prefers assured success
- Failure to Evaluate is a Program Failure

Assessment and Benchmarking are Key

- Need to Better Understand Early-stage Finance and SBIR's Role in Firm Creation and Growth
- Need to Better Understand how to realize the promise of SBIR
 - What can be done better?
- Learning from Each Other and Adopting Best Practice is the Way Forward

THANK YOU



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