

How is basic discovery/technology transferred to the commercial sector, where jobs and economic benefits are created? How efficient are these processes?

The essential interactions between the academic and commercial sectors involve a range of 'channels', including¹:

- Academic Publications
- Academic-sector Patents
- Formal 'technology transfer' interactions
- Direct Consulting Interactions
- Hiring of Students, Interns, etc.

The weight of evidence², perhaps surprisingly, suggests that publications and academic sector patents are minor contributors to the flow of technologies into the commercial sector. Instead, the primary route is through consulting and other direct interactions, such as joint research and movement of students into the commercial sector. This requirement for personal interactions is probably the primary force behind observed correlations between commercial sector activity and the proximity of research universities and institutes. There are reciprocal local effects which derive from the location of major research-based commercial sector entities; sometimes called the 'anchor tenant effect.'³ The commercial sector must itself be research-competent if technology transfer from the academic sector is to succeed.

Fund awards are intended to facilitate the creation of such 'face-to-face' interactions between the State's academic and commercial sectors, as well as between the State's academic institutions. The Fund's interest in SBIR/STTR projects grows from their typical involvement of early stage technology-based companies. Generally, in such projects the discovery process effectively overlaps commercialization—an ideal situation for technology transfer, but a situation replete with company management challenges.⁴

From the point of view of the impacts of TBED investments, a comparison between Indiana and Georgia may be instructive. In the early 90's Georgia began investing in TBED initiatives, while Indiana began such investments in early 2000. Georgia (8,684,715) is somewhat more populous than Indiana (6,195,643) (2003 figures). In 2003 Georgia was home to 684,700 small businesses, while the corresponding number for Indiana was 445,200. Many other measures show the same differences, which may well be simply due to differences in population. However, two critical numbers point to potential effects of Georgia's early TBED investments: First, in 2001 Georgia ranked 7th in federal extramural R&D funding per capita, while Indiana ranked 42nd; and second, the first quarter 2000 venture capital survey showed Georgia with 50 (\$717 million) and

¹ The Impact of Academic Research on Industrial Performance, National Academy of Engineering, The National Academies Press, 2003, p.215.

² A. Agrawal and R. Henderson (2002) Putting Patents in Context: Exploring Knowledge Transfer from MIT; *Management Science* **48** 44-60.

³ A. Agrawal and I. Cockburn (2003) The Anchor Tenant Hypothesis: Exploring the Role of Large, Local, R&D-Intensive Firms in Regional Innovation Systems; *International Journal of Industrial Organization* **21** 1227-1253.

⁴ L.M. Branscomb, F. Kodana, and R. Florida (eds.) *Industrializing Knowledge: University-Industry Linkages in Japan and the United States*; MIT Press, 1999, p. 15.

Indiana with 8 (\$41.5 million) deals. Such critical measures of the health of a state's innovation system, and its efficiency, are telling. In 2002 Georgia received 49 SBIR phase I awards vs. Indiana's 29. The federal SBIR process is seen by many as supporting the critical bridge between discovery and innovation.⁵

Another comparison is interesting. Country-scale investments in R&D are generally in the 2-3% range. Indiana's approximately \$190 billion SDP contributes about 2% to the USA \$10 trillion GDP. At these levels Indiana should be investing about \$2.8 billion for R&D related activities. Indiana investment is slightly above this level, based on the recent Tech Summit report, but has unfortunately leveled off. The challenge for Indiana may be less the total amount invested and more its effective use.

“Long-term cooperation among R&D and innovation actors, between public and private actors but also among private actors, appears increasingly fundamental for raising R&D investment and improving its effectiveness. Therefore, measures promoting networking need to be explicitly looked for and enforced.”⁶ In addition, there are important threshold effects and external economies intrinsic to R&D investments. Furthermore, local critical mass is an important consideration—possibly limiting the return on investment in lagging geographical areas.⁷

⁵ L.M. Branscomb and P.E. Auerswald (2002) *Between Invention and Innovation: An Analysis of Funding for Early-Stage Technology Development*; NIST GCR 02-841.

⁶ *Benchmarking of National Policies. Public Private Investments in R&D*

⁷ D. Audrestch and M. Feldman (1996) *R&D Spillovers and the Geography of Innovation and Production. American Economic Review* **86** 630-640.