The United States Research and Development Satellite Account: Estimates and Challenges

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Measuring the Nation's Economy.

BEA
BUREAU OF ECONOMIC ANALYSIS
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Overview

- Motivation
- Conceptual challenges for measuring R&D investment
- Overview of the estimation process
- Results from September 2007 release
- Next steps: Toward an innovation account

Why measure expenditures on intangibles as capital formation?

- Economic theory:
  - Expenditures on tangible and intangible assets that reduce current consumption and increase future output should be treated as capital formation.
- National accounting consistency
  - Many intangible expenditures have the qualities of produced assets
- Improved measurement of intangibles important for:
  - Improving accuracy of GDP estimates
  - Developing quantitative measures of innovation
  - Identifying sources of economic growth

Conceptual Challenges

- Definition of the unit of R&D output
- R&D output price index
- Depreciation and obsolescence
- Public goods qualities of R&D

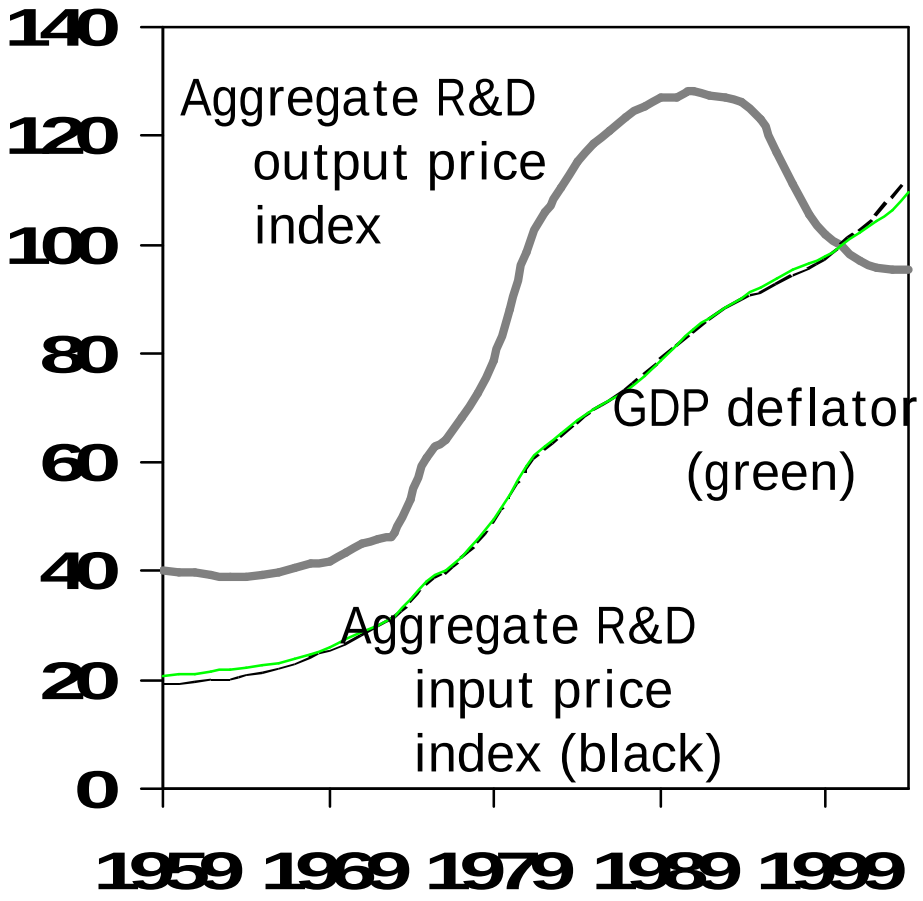
NSF Time Series of R&D Expenditure Data

- National Science Foundation Survey of Industrial R&D
  - Over 50 years of industry-level R&D expenditure data
  - Data on costs for employees, materials, and depreciation
  - Focus on R&D in physical and life sciences and engineering

- BEA-NSF collaboration on R&D satellite Account

Challenge: R&D Price Index

- Purchase price of the original
  - Limited transactions data, and no unit of output
- Comparable Market Approach
  - Purchase price of substitutes or similar products are also hard to identify
- Income or Net Present Value
  - Difficult to estimate future income generated by the R&D and income generated by other factors
- Aggregate R&D input price index
  - Weighted combination of input prices
  - Tracks with GDP deflator (green line)
- Aggregate R&D output price index
  - Uses BEA industry output prices, (based on producer price indexes)
  - Weighted by R&D investment by R&D intensive industries



Challenge: Depreciation estimates for R&D assets

- Consumption of fixed capital (economic depreciation) measures the value of the capital used up in production
  - Wear and tear for tangibles
  - Obsolescence and "leaking out" for intangibles

- R&D assets: Currently using averages from academic literature:
  - Chemical manufacturing, including pharmaceutical and medicine manufacturing: 11% per year
  - Transportation equipment manufacturing: 18% per year
  - Computer equipment manufacturing: 16.5% per year
  - All other industries, government, and non-profit R&D investment, including colleges and universities: 15% per year

Non-rivalry affects R&D within multi-unit firms

- How to value R&D shared between:
  - Units in different business segments
  - Units in different states
  - Units in different countries
- Preliminary discussions:
  - "The Treatment of International Research and Development as Investment," Daniel Yorgason
  - http://www.bea.gov/papers/pdf/yorgason_rd_paper.pdf
  - "Issues Related to treating R&D as investment in BEA's regional accounts," G. Andrew Bernat
    - http://www.bea.gov/papers/pdf/RegionalIssues.pdf

Construction of R&D Satellite Account

- Estimates of R&D capital stock and investment flows based on funder:
  - Private
    - Business
    - Universities and colleges
    - Other Non-profits
  - Government
    - Federal Government extramural
    - Federal Government intramural
    - State and Local governments, excluding universities and colleges
    - Universities and colleges

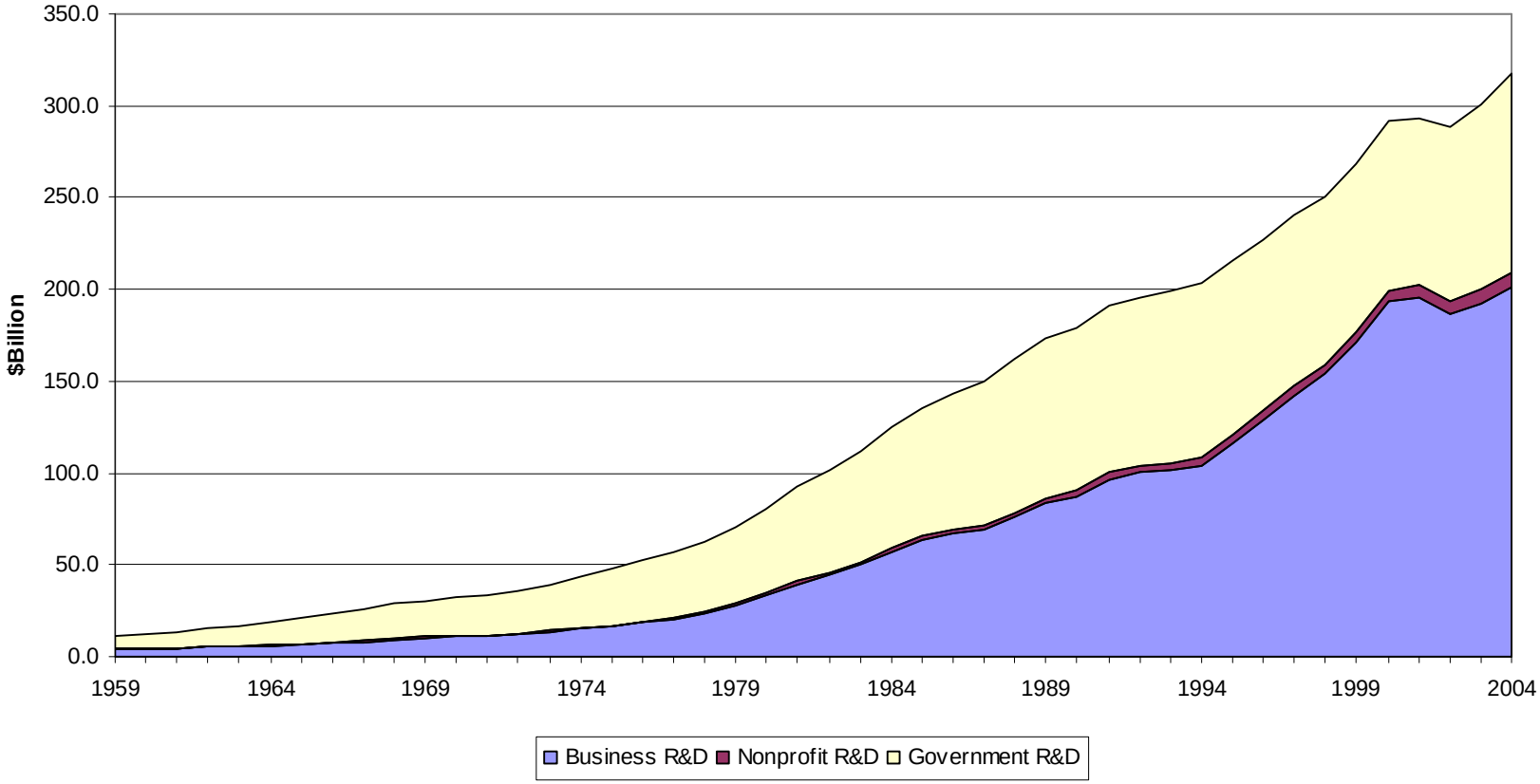
Overview of Estimate Construction

- Current dollar investment: sum input costs from NSF survey data
- Deflate current dollar investment
- Create capital stocks with perpetual inventory method: cumulative R&D investment less R&D depreciation
- For government and non-profit institutions: include a return to R&D
- Recalculate GDP and other macroeconomic variables

Results from BEA's 2007 R&D Satellite Account:

- Between 1959-2004, R&D accounted for 5 percent of growth in real GDP
- Between 1995-2004, R&D's contribution rose to 7 percent
  - In comparison, business gross fixed capital formation in commercial and all other types of buildings accounted for just over 2 percent of real GDP growth.
  - R&D's stepped-up contribution is almost as large as the contribution of computers in the existing GDP measure.

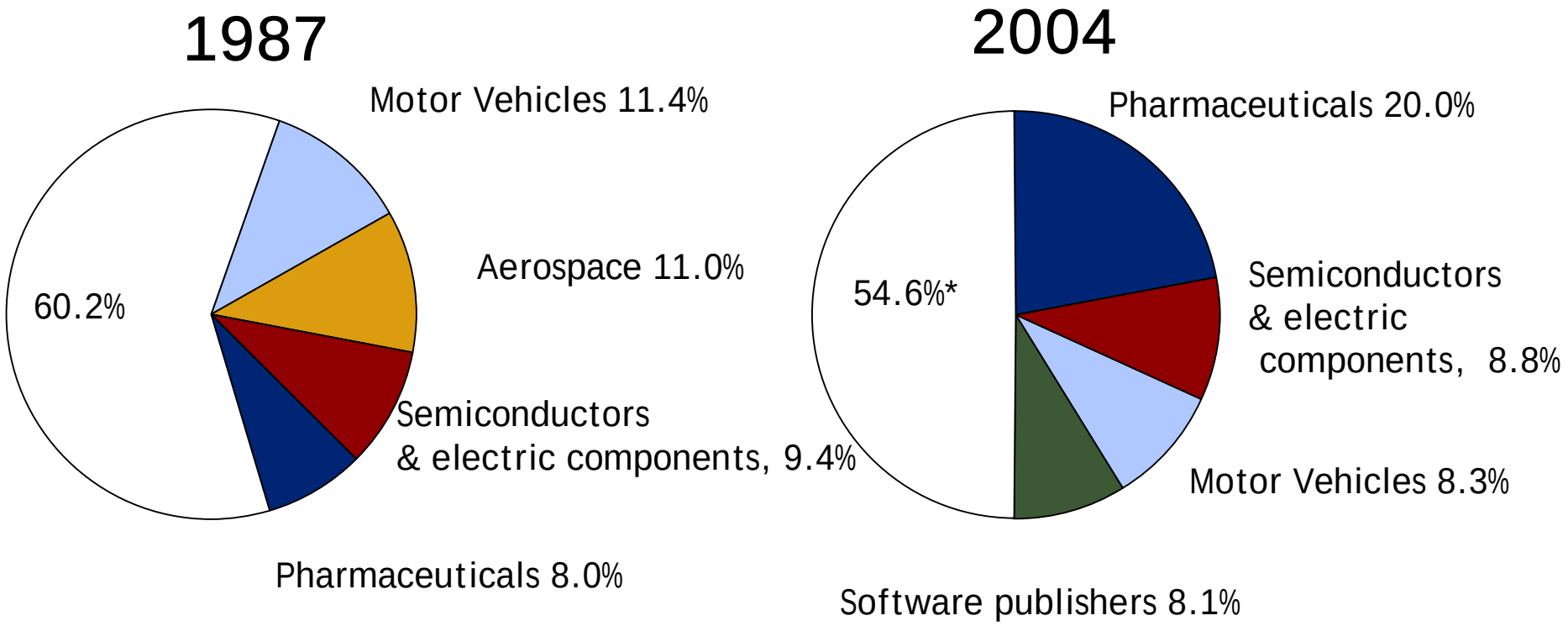
Addition to GDP from R&D Investment



current dollar

Top Four Private Business R&D-investing Industries

[% of Private Business Investment in R&D]



*Does not sum to 100% due to rounding errors

Industry Impacts: Average Percent Change in the Level of Value Added, 1987-2004

Pharmaceutical and medicine mfg	38.4
Chemicals minus pharmaceutical and medicine mfg	7.9
Computer and peripheral equipment mfg	29.8
Communications equipment mfg	22.1
Semiconductor and other electronic component mfg	25.7
Navigational, measuring, electro-medical, and control instruments mfg	12.2
Other computer and electronic products mfg	9.1

Motor vehicles, bodies and trailers, and parts mfg	14.5
Aerospace product and parts mfg	14.3
Other transportation equipment mfg	4.1
Software publishers	14.2
Computer systems design and related services	2.4
Scientific R&D services	12.7
All other industries	0.7

current dollar

Conclusion: What's Next?

- R&D in an Input-Output framework
- Regional and international aspects of R&D as investment
- Developing more timely indicators of R&D investment
- Prototype Innovation Account

Expanded measurement of intangibles – Candidates for innovation satellite account

- Research and Development (R&D): Spending on scientific and engineering R&D
  - Product and process innovation
  - More timely data and more frequent indicators
  - Receipts (royalties and license fees) as well as expenditures
  - Associated capital investment expenditures
  - Someday: Valuation of Intellectual Property
- Expenditures on Design and Development (D&D): Spending on social science design and development of new products and processes.
  - Expanded sample frame
  - Explicit subcategories for:
    - Industrial product and process design and development
    - Artistic and entertainment product and process design and development
- Human Capital: Employer spending on employee training and development

For more information

- Detailed information on the R&D satellite account is available at:

http://www.bea.gov/national/index.htm#researchanddevelopment