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R&D

Research and Development: U.S. Trends and International Comparisons

Technical Appendix

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This publication is part of the *Science and Engineering Indicators* suite of reports. *Indicators* is a congressionally mandated report on the state of the U.S. science and engineering enterprise. It is policy relevant and policy neutral. *Indicators* is prepared under the guidance of the National Science Board by the National Center for Science and Engineering Statistics, a federal statistical agency within the National Science Foundation. With the 2020 edition, *Indicators* is changing from a single report to a set of disaggregated and streamlined reports published on a rolling basis. Detailed data tables will continue to be available online.

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Measuring U.S. R&D

The statistics on U.S. research and experimental development (R&D) discussed in this section reflect the current edition of the *National Patterns of R&D Resources* reports from the National Science Foundation's National Center for Science and Engineering Statistics (NCSES) (<https://www.nsf.gov/statistics/natlpatterns/>). The *National Patterns* statistics provide current data on the levels and key trends of the performance and funding of R&D in the United States.

The *National Patterns* report series draws primarily from NCSES's regular national surveys of the R&D expenditures and funding of the organizations that perform the bulk of U.S. R&D—including businesses, federal and nonfederal government, higher education, and nonprofit organizations. Additional details on levels and trends are provided by type of R&D performed (i.e., basic research, applied research, and experimental development). The *National Patterns* data are reported in both current and inflation-adjusted dollars, with comparisons to the historical record for U.S. R&D (back to 1953) and to the corresponding pace of overall U.S. economic growth.

NCSES's R&D surveys have long been consistent with international definitions and standards, as reflected in the Organisation for Economic Co-operation and Development (OECD) *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development* (OECD 2015).

Details on the particular R&D expenditure surveys involved and the essentials on how their data are integrated into U.S. national totals are covered in "Technical Notes" included with new editions of *National Patterns* reports and data releases (<https://nces.nsf.gov/pubs/nsf21325#technical-notes>).

Comparing International R&D Expenditures

Comparisons of international R&D statistics are hampered by the lack of R&D-specific exchange rates. Two approaches are commonly used: (1) express national R&D expenditures as a percentage of gross domestic product (GDP), or (2) convert all expenditures to a single currency. The first method is straightforward but permits only gross comparisons of R&D intensity. The second method permits absolute level-of-effort comparisons and finer-grain analyses but entails selecting an appropriate method of currency conversion. For all practical purposes, the choice is between market exchange rates (MERs) and purchasing power parities (PPPs), both of which are available for many countries over an extended period.

MERs represent the relative value of currencies for cross-border trade of goods and services but may not accurately reflect the cost of nontraded goods and services. They are also subject to currency speculation, political events, wars or boycotts, and official currency intervention. PPPs were developed to overcome these shortcomings (Ward 1985); they take into account the cost differences of buying a similar market basket of goods and services covering tradables and nontradables. The PPP basket is assumed to be representative of total GDP across countries.

PPPs are the preferred international standard for calculating cross-country R&D comparisons and are used in all official R&D tabulations of the OECD. The PPP indices are prepared and maintained by the International Comparison Program, a worldwide statistical initiative, which is managed by the World Bank under the auspices of the United Nations Statistical Commission (<https://www.worldbank.org/en/programs/icp>). The most recent set of PPP indices was released in May 2020, covering 176 of the world's economies.

Because MERs tend to understate the domestic purchasing power of developing countries' currencies, PPPs can produce substantially larger R&D estimates than MERs for these countries. For example, China's R&D expenditures in 2017 (as reported to OECD) were \$496 billion in PPP terms but only \$260 billion using MERs. However, PPPs for large developing countries, such as China and India, are often rough approximations and have shortcomings. For example, structural differences and income disparities between developing and developed countries may result in PPPs based on markedly different sets of goods and services. In addition, the resulting PPPs may have very different relationships to the cost of R&D in different countries.

R&D performance in developing countries is often concentrated geographically in the most advanced cities and regions in terms of infrastructure and level of educated workforce. The costs of goods and services in these areas can be substantially greater than for the country as a whole.

Nonetheless, there are some unresolved questions about the use of GDP PPPs for deflating R&D expenditures. One such issue is the differences in dollar comparisons resulting from PPPs specific for R&D expenditures versus those from the standard GDP-based PPPs. In analyzing the manufacturing R&D inputs and outputs of six industrialized OECD countries, Dougherty and colleagues concluded that "the use of an R&D PPP will yield comparative costs and R&D intensities that vary substantially from the current practice of using GDP PPPs, likely increasing the real R&D performance of the comparison countries relative to the United States" (Dougherty et al. 2007:312).

References

- Dougherty SM, Inklarr R, McGuckin RH, Van Ark B. 2007. *International Comparisons of R&D Expenditures: Does an R&D PPP Make a Difference?* NBER Working Paper 12829. Cambridge, MA: National Bureau of Economic Research.
- Ward M. 1985. *Purchasing Power Parities and Real Expenditures in the OECD*. Paris: OECD Publishing.