

Research and development (R&D) investment by the biopharmaceutical industry: A global ecosystem update

Neumann U¹, Martin S¹, Chandra A²

¹Johnson & Johnson, Titusville, NJ, USA; ²Harvard University, Cambridge, MA, USA

Background

- Cost estimates of pharmaceutical R&D vary across media, academic research, and policy discourse.
- Conventional insights into the magnitude, intensity, and productivity of private R&D investment primarily stem from industry association surveys, proprietary data analyses, or non-representative company subsets (mostly large public firms).¹⁻³
- Confusion also persists as to how R&D spending compares to sales and marketing expenses and other operational costs, fueling additional debate in policy discussions.⁴⁻⁷
- A transparent and replicable approach for capturing all innovative private-sector pharmaceutical R&D investment is crucial for researchers and policymakers.

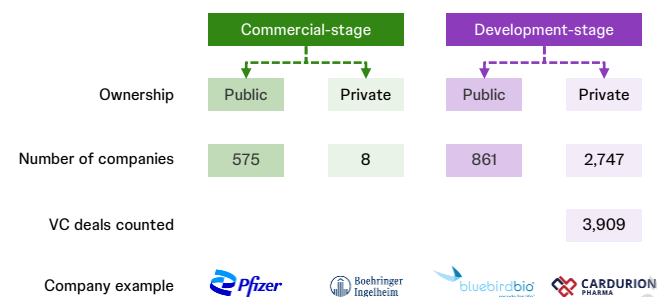
Research objectives

- Develop a methodologically transparent new measure of R&D investment that reflects the entire private-funding ecosystem of innovative pharmaceutical development.

Data and methods

- The private-sector ecosystem was categorized into publicly listed and privately owned companies, each classified as either in the commercial or development stage, yielding four distinct populations (Figure 1).
- A company was designated as commercial-stage if it had annual revenues exceeding \$1 billion, any product approval over the past 10 years, or specific keywords suggestive of commercial operations.
- Detailed adjustments were applied to prevent overcounting within and between populations.
- For public commercial-stage companies, reported 2021 data were sourced from S&P Capital IQ and adjusted via sub-industry codes and detailed keyword algorithms to exclude firms not involved in innovative R&D (e.g., generics, contract manufacturing, medical devices).
- Payments for mergers and acquisitions not linked to in-process R&D expenses (acquired but incomplete R&D) were excluded from R&D investment calculations.
- For public development-stage companies, we used reported 2021 net loss (income) assuming their entire cost structure supported R&D activities in the absence of launched products (potential revenue from research agreements was already captured in commercial-stage partners' R&D accounting).
- Private commercial-stage company data were gathered using S&P Capital IQ and manual searches for financial disclosures where publicly available.
- Private development-stage company data were derived from Pitchbook, using a 3-year average of total capital raised (via venture funds, private equity, and debt) to adjust for timing disparities between capital acquisition and deployment.

FIGURE 1: Mutually exclusive sets of companies constituting the full private biopharmaceutical R&D ecosystem

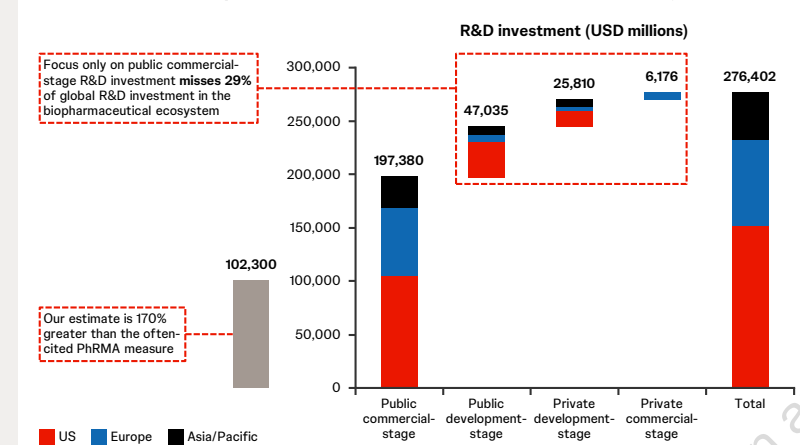


Results

Global R&D volume

- 2021 global R&D investment (Figure 2) was \$276 billion across 4191 global companies, with total net revenues of \$1022 billion across 583 companies.
- Of total R&D investment, 583 commercial-stage and 3608 development-stage companies represented \$204 billion (74%) and \$73 billion (26%), respectively; 2755 private firms contributed \$32 billion (12%).
- The top 20 companies (representing 71% of total revenue) contributed 49.5% of all global R&D investment.

FIGURE 2: Global biopharmaceutical R&D investment across the ecosystem



Company R&D by region

- Based on company headquarters shown in Table 1, 55% of all R&D investment was from the US, 29% from Europe, and 15% from Asia/Pacific.
- Global average R&D intensity stood at 27%, with the US leading (34%), followed by Europe (22%) and Asia/Pacific (20%).

TABLE 1: R&D investments by headquarters location

| USD millions | Headquarter geographic region | | | Total ^a |
|---------------------------|-------------------------------|----------------|----------------|--------------------|
| | United States | Europe | Asia/Pacific | |
| R&D investment | | | | |
| Public commercial-stage | 105,077 | 64,048 | 27,505 | 197,380 |
| Public development-stage | 32,647 | 6,159 | 6,795 | 47,035 |
| Private development-stage | 14,827 | 3,815 | 6,592 | 25,810 |
| Private commercial-stage | 131 | 5,890 | 155 | 6,176 |
| Total | 152,683 | 79,912 | 41,048 | 276,402 |
| % of total | 55% | 29% | 15% | |
| Revenue | | | | |
| Public commercial-stage | 455,480 | 323,490 | 183,648 | 968,444 |
| Private commercial-stage | 230 | 34,150 | 19,375 | 53,755 |
| Total | 455,710 | 357,640 | 203,023 | 1,022,199 |
| % of total | 45% | 35% | 20% | |
| R&D intensity | 34% | 22% | 20% | 27% |

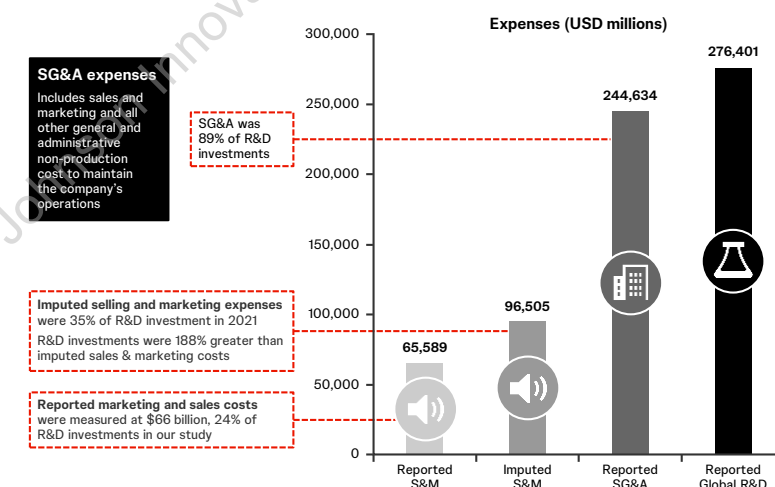
^aTotal includes other: Canada, Africa, the Middle East, Latin America, and the Caribbean.

R&D investment relative to other expenditures

- As shown in Figure 3, industry R&D investments were 13% greater than all other expenses to maintain companies' regular operations as recorded in SG&A (\$244.6 billion).
- Relative to their revenues, US companies spent the least on SG&A (20%) compared with companies headquartered in Europe (25%) or Asia/Pacific (30%).

- R&D expenditure across the global ecosystem exceeded reported sales and marketing (S&M) costs by 321%, per data from audited financial accounts sourced for this study. If firms without commercial operations were excluded, R&D exceeded S&M by 210%.
- Addressing concerns of potentially underreported S&M data, an exploratory analysis imputing costs for firms with no recorded S&M spending in 2021 (based on ratios from those who did) showed R&D exceeded S&M by 186% across all companies and by 111% for commercial-stage companies.
- Adjusted for difference in net revenues, the disparity between R&D and imputed S&M was disproportionately higher for US companies, which invested 8.3 times more in R&D than they spent on marketing, compared with 1.9 times for companies headquartered in Europe.
- Observed regional differences are partly attributable to variations in reporting standards and the classification of reported S&M items in the S&P Capital IQ dataset. Compared to U.S.-based companies operating under Generally Accepted Accounting Principles (GAAP), data for companies following International Financial Reporting Standards (IFRS) typically contained a broader range of non-advertising items within reported S&M (e.g., including expenses such as commissions to distributors or trade bad debt).

FIGURE 3: Industry R&D investment relative to other operational expenditures



Discussion

- Our comprehensive measure of global R&D investment is substantially larger than widely cited estimates that only capture R&D from among the largest public companies.
- Our results confirm prior research designating the US as the global hub for biopharmaceutical R&D: Approximately 48% of global companies engaged in biopharma R&D were headquartered in the US, accounting for 55% of worldwide R&D investments and 65% of all development-stage funding.
- The Congressional Budget Office (CBO) calculated that publicly traded US firms reinvested a growing share of revenues into R&D from 2000 to 2019, with R&D intensity averaging 19% up to a peak of 25%.³ Our findings of 30% R&D intensity for public US companies in 2021 suggest a continued upward trend of this relationship; adding private companies provides an even higher estimate for the entire US R&D ecosystem (34%).
- Contrary to reports in the media and some advocacy groups, industry sales and marketing costs are vastly smaller than R&D investment:
 - In an exploratory analysis restricted to US companies with commercialized products in 2021, we find that for every dollar spent on S&M, they invested \$5.7 in R&D (assuming a scenario that imputed S&M cost for companies not reporting any that year).
 - It's important to note that our measure of S&M includes various commercialization costs, e.g. for sales force and training, market research, disease awareness, professional conferences, and physician education. While only a fraction of imputed S&M is directly attributable to consumer advertising, the aggregate S&M measure does not capture all non-advertising items companies may report within S&M, and definitions of S&M expenses can vary across accounting standards and practices.^{8,9}
- As with previous studies in this area, several limitations for measuring R&D costs apply (e.g., our cross-sectional study may be impacted by potentially divergent R&D/financing patterns in 2021, accounting standards, incomplete or inaccurate financial disclosures, imperfect availability of private commercial-stage company financials, and understated private development-stage R&D costs due to potential limitations on available data for venture deal volume).

Conclusions

Studies risk undervaluing industry R&D investments if they fail to systematically encompass all contributions made within the complex and interconnected funding ecosystem.

Based on a comprehensive measure, industry R&D funding appears to be substantially larger than conventionally reported: Every year, the private sector commits upwards of a quarter trillion dollars to research to develop innovative medicines.

While the top 20 companies ranked by revenue fund 49.5% of global R&D investment, it's important for policymakers to understand that taking their contributions to represent the entire industry would fail to capture the other half of all R&D funding. Similarly, depending exclusively on survey data from industry organizations as a gauge for the entire ecosystem would overlook 63% of all biopharmaceutical R&D investment (e.g., PhRMA reported \$102.3 billion in 2021¹).

Although the US accounts for a majority of pharmaceutical sales revenue, on average US firms reinvest a disproportionately larger revenue share back into R&D and allocate a relatively smaller portion to operational expenses and marketing compared with those headquartered in markets with lower sales.

To the extent that greater R&D intensity indicates increased risks and thus costlier drug development, academic research should discern policy levers to support R&D productivity.

Our methodology offers a foundational model for future studies examining longitudinal trends in R&D investment, activity in various submarkets, and the consequences of policy decisions for the entire funding ecosystem.

Disclosures

Ulrich Neumann and Silas Martin are employees of Johnson & Johnson and hold shares in the company. Amitabh Chandra serves on the Congressional Budget Office's Panel of Health Advisors and is paid as an Academic Affiliate of Analysis Group, Inc., a consulting company that received research support from Janssen Scientific Affairs, a subsidiary of Johnson & Johnson, for this study. He is also an advisor to, and holds stock in, SmithRx, Health Engine, and Kyruus. A full list of disclosures is available at <https://www.hks.harvard.edu/faculty/amatabh-chandra>.

Acknowledgments

We would like to thank John Drum, Michael Daly, Henry Mirsberger, Samuel Spare and Noam Kirson at Analysis Group, Inc., who have all been involved in the conceptualization, design, data collection, and interpretation of the research.



Presented at ISPOR
May 5-8, 2024
Atlanta, Georgia, USA

POSTER CODE HPR63

REFERENCES

- PhRMA annual membership survey; 2022.
- Evaluate Pharma. World Preview 2021: Outlook to 2026... (14th ed); Jul 2021.
- Congressional Budget Office. Research and development in the pharmaceutical industry; Apr 2021.
- Colombo C, Banzl R. High drug prices are not justified by industry's spending on research and development. *BMJ*. 2023;380:e071710.
- Ezell S, Zhao K. How skeptics misconstrue the link between drug prices and innovation. *ILF.org*; Sep 2023.
- Brennan Z. Do biopharma companies really spend more on marketing than R&D? *RAPS.org*; Jul 2019.
- Socolar D, Sager A. Pharmaceutical marketing and research spending: the evidence does not support PhRMA's claims. Presented at APHA annual meeting, Atlanta, GA; Oct 2001.
- Jiang J, Kong J, Grogan J. How did the public US drugmakers' sales, expenses and profits change over time? *USC Schaeffer Evidence Base*; Nov 2021.
- Schwartz LM, Woloshin S. Medical marketing in the United States, 1997-2016. *JAMA*. 2019;321:80-96.