

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

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## 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).<sup>1-3</sup>
- 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.<sup>4-7</sup>
- A transparent and replicable approach for capturing all innovative private-sector pharmaceutical R&D investment is crucial for researchers and policymakers.

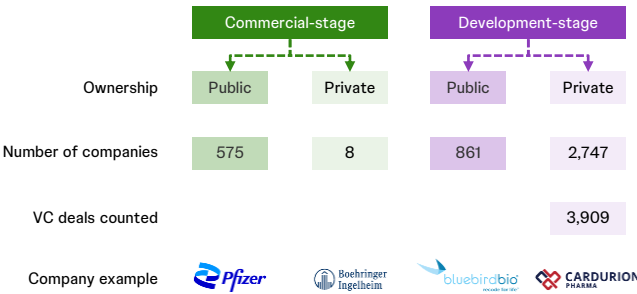
## Research objectives

- 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

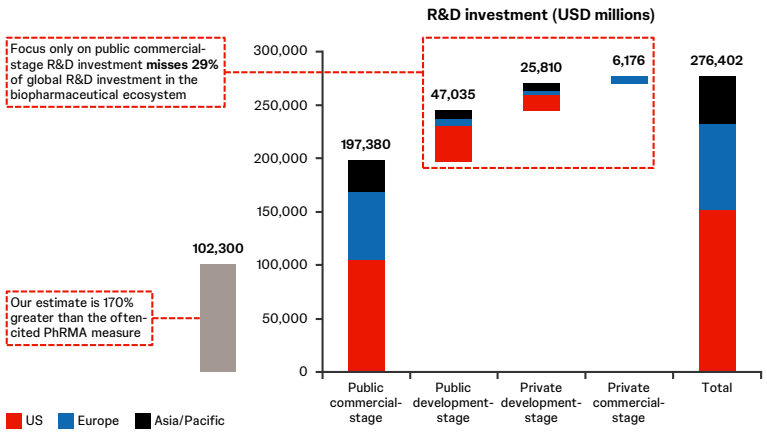


## Results

### 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 |               |         |              |                    |
| R&D investment                | United States | Europe  | Asia/Pacific | Total <sup>a</sup> |
| 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%                |

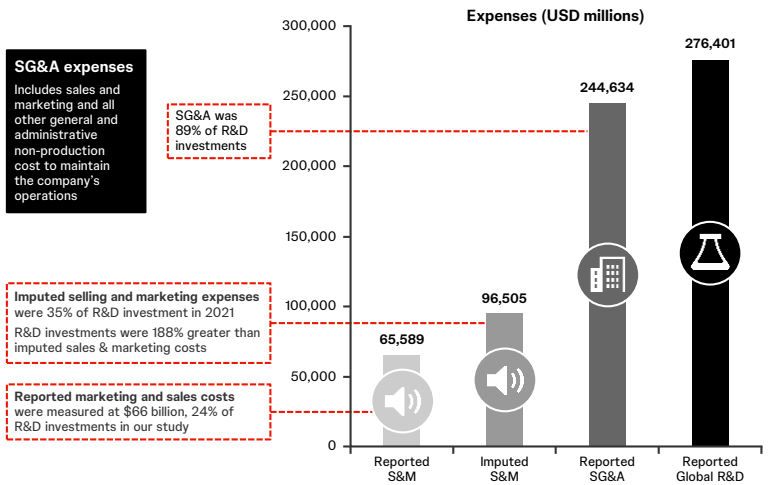
<sup>a</sup> Total includes other: Canada, Africa, the Middle East, Latin America, and the Caribbean.

### 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%.<sup>3</sup> 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.<sup>8,9</sup>
- 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 2021').

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/amitabh-chandra>.

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