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Strengthening Indonesia's Research and Innovation Ecosystem: Why Rising Rankings Mask Fragile Foundations

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ABSTRACT

Indonesia's improved Global Innovation Index (GII) position does not by itself demonstrate an equivalent improvement in research capacity. This article evaluates Indonesia's 2020–2025 innovation indicators through an integrated national innovation system, triple-helix and system-failure diagnostic. It compares WIPO profiles, successive BRIN statistical editions, policy instruments and evidence available through the November 2026 manuscript revision. The 2025 profile combines relatively strong market and institutional positions with weaker research-related indicators, although changing coverage and data vintage prevent causal attribution. BRIN reports 2024 research expenditure of 0.23% of GDP, including business-performed research of 0.034%; the revision of the same 2023 expenditure year by approximately Rp13.1 trillion reflects higher-education accounting changes, not established new activity. Public 2025 figures record 30 tax-incentive applicants and realized benefits for 19 of 224 submitted proposals, but not fiscal cost or additional research induced. University–industry surveys, co-publications, contracts and commercialization measure different relationships and should not be directly equated. The analysis therefore distinguishes observed patterns, competing explanations and untested mechanisms. It proposes a staged policy agenda covering data reconciliation, evaluation of fiscal-incentive implementation, targeted risk-sharing finance, differentiated collaboration metrics and talent mobility, with responsibilities assigned to relevant institutions. The results are descriptive and do not claim causal confirmation of the proposed mechanisms. These proposals remain contingent on reliable administrative records, transparent fiscal-cost measurement, disaggregated firm evidence, explicit implementation responsibilities, and independent credible evaluation before any nationwide scaling is justified.

Keyword: Strengthening, Innovation, Ecosystem, Policy

INTRODUCTION

Indonesia's position in the Global Innovation Index (GII) improved from 85th in 2020 to 54th in 2024, before ranking 55th among 139 economies in 2025. Although this development has attracted considerable policy attention, an

innovation ranking represents a relative and composite assessment rather than a direct measurement of national research capabilities. Differences in the number of participating economies, reference years of underlying data, normalized indicator values, and aggregation methodologies may affect comparability across editions. Indonesia's reported confidence interval for 2025 ranges from 54th to 60th, indicating that the one-position decline between 2024 and 2025 cannot be interpreted as evidence of substantive deterioration in national innovation performance. Consequently, this study positions changes in innovation rankings as an initial analytical reference rather than evidence of causal relationships concerning institutional performance (WIPO, 2025).

Indonesia's innovation profile in 2025 reveals considerable disparities across individual dimensions. The country ranked 39th in institutions and 50th in market sophistication, compared with 92nd in human capital and research and 83rd in business sophistication. More favorable positions were recorded in market scale, entrepreneurship policies and culture, and intangible asset intensity, which ranked 8th, 10th, and 11th, respectively. Conversely, educational expenditure relative to gross domestic product (GDP) and scientific articles relative to GDP both occupied the 133rd position. These indicators incorporate different denominators, reference periods, and conceptual foundations. Although their collective interpretation indicates an uneven national innovation profile, the observed disparities do not establish that market size directly contributed to improvements in the aggregate ranking or that every unfavorable research indicator represents a policy failure. The central analytical concern is whether independent indicators of research financing, technological capabilities, and institutional relationships reveal structural vulnerabilities that remain obscured within composite innovation rankings (WIPO, 2025).

Three considerations reinforce the importance of maintaining this analytical distinction. First, innovation systems scholarship emphasizes the significance of cumulative technological learning and complementary capabilities in supporting long-term economic development. Second, Indonesia's research administration experienced substantial institutional consolidation following the enactment of Presidential Regulation No. 78 of 2021, while Presidential Regulation No. 12 of 2025 established the National Medium-Term Development Plan for 2025–2029. Nevertheless, institutional restructuring cannot independently demonstrate improvements in national innovation outcomes. Third, national research and development (R&D) expenditure estimates exhibit differences across successive publications issued by the National Research and Innovation Agency (BRIN), while several GII research-input indicators continue to rely on data from earlier observation periods. These circumstances necessitate a clear analytical separation between substantive developments within the national innovation system and methodological changes affecting its measurement (BRIN, 2024, 2025; Fagerberg & Srholec, 2008; Lall, 1992; WIPO, 2025).

Existing scholarship provides complementary theoretical perspectives for examining national innovation performance, although each framework offers distinct explanatory contributions. The national innovation systems approach emphasizes interactive learning, institutional arrangements, and the cumulative development of technological capabilities. Within this perspective, innovation emerges through relationships among organizations and institutional environments rather than through isolated research activities. Meanwhile, the triple-helix framework examines the overlapping roles and interactions among universities, industry, and government. Although this framework facilitates an

understanding of institutional relationships, it cannot independently establish the effectiveness of particular policy interventions (Etzkowitz & Leydesdorff, 2000; Freeman, 1987; Lundvall, 1992; Nelson, 1993).

The system-failure perspective provides an alternative diagnostic framework by distinguishing infrastructural, institutional, interaction-related, and capability-based constraints within innovation systems. Research concerning the innovation paradox in developing countries further suggests that increased innovation expenditure may produce limited outcomes when complementary organizational and technological capabilities remain insufficient. Similarly, studies examining university engagement and R&D tax incentives demonstrate the importance of distinguishing different intervention mechanisms and their associated outcomes. These theoretical perspectives provide complementary analytical instruments for investigating innovation constraints without presuming that all institutional weaknesses originate from identical mechanisms (Cirera & Maloney, 2017; Dechezleprêtre et al., 2023; Klein Woolthuis et al., 2005; Perkmann et al., 2013).

Within the Indonesian context, previous research has examined the implementation of R&D tax facilities and explored opportunities for institutional collaboration within the pharmaceutical sector. These investigations provide relevant insights into policy incentives and collaborative innovation arrangements. Nevertheless, an integrated diagnosis of national innovation performance requires explicit identification of the mechanisms explained by each theoretical framework rather than the simultaneous application of multiple perspectives without clear analytical differentiation (Bhuana & Ardiansyah, 2025; Pratistha et al., 2026).

The theoretical integration developed in this study establishes a distinct division of analytical functions. The national innovation systems perspective defines the relevant units of analysis, including institutional actors, organizational capabilities, and institutional arrangements influencing technological learning, without prescribing a single empirical measure of innovation performance. The triple-helix framework directs analytical attention toward relationships among public research institutions, private enterprises, and government organizations. Such relationships may generate valuable outcomes through professional training, consulting activities, and contract-based research without necessarily producing patents or commercially available products. The system-failure perspective subsequently provides a classification of potential constraints that may explain why particular institutional relationships do not generate anticipated innovation outcomes (Etzkowitz & Leydesdorff, 2000; Klein Woolthuis et al., 2005; Perkmann et al., 2013).

Market-failure perspectives provide an additional theoretical justification for public intervention by emphasizing knowledge spillovers, uncertainty surrounding research financing, and barriers associated with the transition from research development to commercialization, commonly described as the *valley of death*. Nevertheless, these theoretical perspectives do not permit the identification of specific innovation failures solely through differences in national rankings. Their combined analytical contribution lies in establishing a conditional diagnostic sequence that begins with observing innovation outcomes and evaluating data quality, proceeds to identifying relevant institutional relationships and comparing plausible explanatory mechanisms, and concludes by examining policy instruments capable of addressing the identified constraints (Arrow, 1962; Auerswald & Branscomb, 2003; Hall & Lerner, 2010). For analytical operationalization, this study distinguishes three interconnected layers. The

financing layer examines research expenditure according to performing institutions, expenditure categories, and funding sources. The capability and behavior layer addresses firm-level R&D activities, research personnel, technological learning, and institutional incentives. Meanwhile, the linkage and governance layer examines different forms of institutional collaboration, policy mandates, and innovation measurement practices. Observed patterns within these analytical layers are subsequently classified as documented indicators, interpretations supported by available evidence, or propositions requiring further empirical investigation. This classification establishes explicit boundaries between observable institutional conditions and theoretically informed explanations.

Three propositions guide the analytical process heuristically rather than functioning as hypotheses subjected to statistical testing. The first proposition (P1) anticipates that uneven innovation indicators may coexist with relatively weak research inputs. The second proposition (P2) suggests that mechanisms connecting different analytical layers become more plausible when supported by converging evidence from several independent indicators. The third proposition (P3) anticipates that the relevance and potential effectiveness of policy instruments depend on their suitability for addressing the particular constraints experienced by targeted institutional actors. Accordingly, the theoretical contribution of this study resides in developing an explicit diagnostic framework that integrates complementary theoretical perspectives while maintaining appropriate evidentiary boundaries, rather than proposing a new causal theory of innovation.

The national innovation systems perspective cannot independently determine the effects of individual regulations, while successful triple-helix relationships may generate benefits through training, consulting, or contractual research without necessarily producing patents. Similarly, system-failure classifications constitute interpretative categories rather than independently observed empirical variables. The novelty of this study therefore lies in developing a falsifiable diagnostic framework that generates conditional implications for subsequent empirical examination. Where apparent weaknesses primarily originate from outdated observations, measurement improvement becomes the initial priority. Where limited market demand and insufficient firm-level capabilities constitute the principal constraints, broadly implemented tax deductions are unlikely to provide adequate solutions. Where institutional interfaces remain underdeveloped, empirical assessments should concentrate on actual transactions and jointly implemented research projects (Klein Woolthuis et al., 2005; Perkmann et al., 2013).

By addressing these questions, this study contributes to the reconciliation of different BRIN data vintages, the development of a differentiated understanding of university–industry relationships, and the formulation of institution-specific policy priorities. The analytical findings are deliberately restricted to descriptive patterns, documented administrative conditions, and theoretically informed propositions. This evidentiary approach provides a foundation for interpreting Indonesia's innovation performance without attributing causal significance to aggregate ranking changes or institutional arrangements that have not undergone systematic empirical testing.

RESEARCH METHOD

This article employs document-based qualitative policy analysis with transparent descriptive comparisons; it does not undertake interviews, firm-level

econometrics, counterfactual evaluation or causal identification. The primary statistical observation window is 2020–2025, using the latest data points available in the cited 2023–2025 BRIN publications and 2024–2025 WIPO country profiles. The manuscript was substantively revised in November 2026, permitting discussion of scholarly work published in 2026 and previously reported 2025 administrative uptake figures. Observational year, source publication year and manuscript revision year are distinguished throughout. The 2024 issue metadata inherited from a template is not treated as a valid publication date for this 2026 revision; journal volume, issue, pages and article DOI require editorial verification.

Table 1 identifies the source families and their functions. WIPO (2024, 2025) provides internationally standardized but partly dated and perception-based indicators; BRIN (2023, 2024, 2025) supplies domestic expenditure and personnel estimates by source vintage; OECD (2015) supplies the definitions for expenditure interpretation. The institutional and fiscal setting is read against Government Regulation 45/2019, Minister of Finance Regulation 153/PMK.010/2020, Presidential Regulations 78/2021 and 12/2025, and publicly reported information on utilization of the R&D deduction. Peer-reviewed comparative studies support possible mechanisms but cannot substitute for a domestic counterfactual. The 2025 uptake statement is treated as a contemporaneously reported administrative figure, not an audited tax-expenditure series.

Table 1. Data Sources and Their Role in the Analysis

Source	Content used	Role in the analysis
WIPO Global Innovation Index 2024 and 2025 (country profiles)	Overall, input and output ranks; pillar, sub-pillar and indicator ranks; data-availability tables	Comparable ranks and component context; flag age, coverage, and survey uncertainty
BRIN Indicators of Science, Technology, Research and Innovation 2023, 2024, 2025	Research budgets and spending by sector; research personnel; publications, patents; intellectual property payments; trade by technology intensity	Sector totals and composition; distinguish vintage revisions and provisional data
OECD Frascati Manual (2015)	Definitions of R&D, sectors and cost categories	Measurement standard for comparing spending series
Peer-reviewed literature and books	Innovation systems, triple helix, market and system failure, absorptive capacity, fiscal incentives, intermediaries	Theoretical frame and comparative evidence
Legal instruments	Structure of the R&D super deduction; institutional basis of BRIN and the 2025–2029 plan	Mandate and incentive-design context; not evidence of realized program impacts

Source: Compiled by the authors, 2026

The analysis followed six replicable decision rules. First, each number was recorded with its reference year, source vintage, unit, denominator and whether

it measured perception, administrative activity or an output. Second, changes in GII ranks were interpreted alongside component patterns, country coverage, statistical uncertainty and available indicator-age information; rank movements were not treated as changes in absolute capability. Third, alternative estimates of the same R&D year were reconciled sector by sector, and a changed accounting estimate was not counted as additional economic activity. Fourth, an institutional weakness was considered documented only when a formal mandate or administrative fact established it; otherwise it was stated as an inference requiring further validation. Fifth, alternative explanations including industry mix, firm size, corporate location of R&D and measurement error were examined before applying a system-failure label. Sixth, policy instruments were screened for matching mechanism, responsible authority, budget exposure, delivery capacity, measurable outcomes and risk of subsidizing activity that would occur anyway. A proposition is judged consistent with evidence only; the analysis does not report statistically 'confirmed' hypotheses.

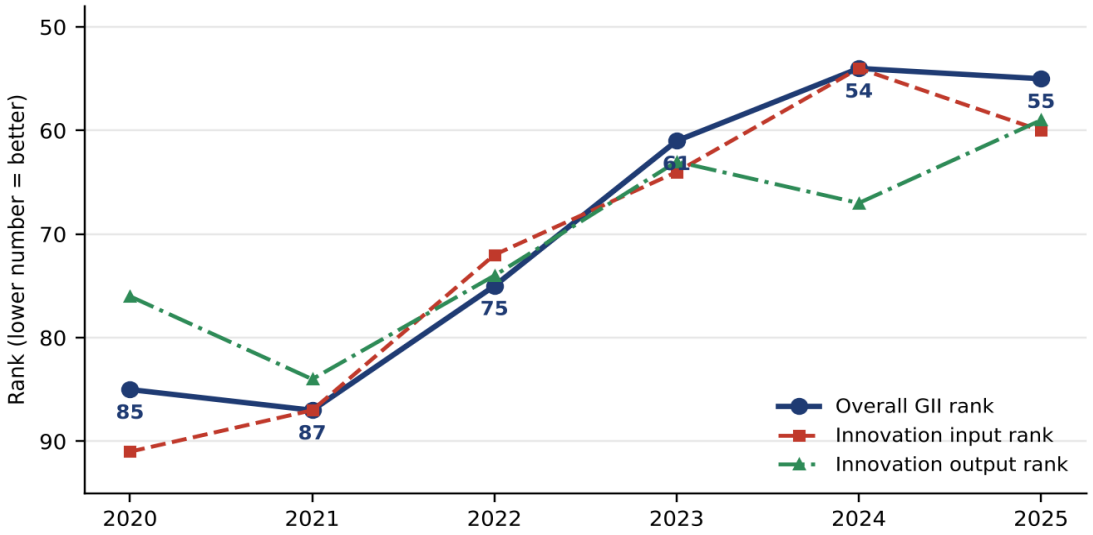
Analytical validity rests on source triangulation and on a conservative evidence hierarchy: official data or regulation for descriptive claims, studies and administrative reporting for associations, and explicitly labelled theoretical inference for mechanisms. GII editions vary in economy coverage, aggregation and indicator data vintage; the 2025 profile identifies 13 outdated indicators, and perception measures cannot be equated with observed collaboration transactions (WIPO, 2025). BRIN estimates incorporate preliminary and revised components, while headcounts and full-time equivalents are not interchangeable (BRIN, 2025; OECD, 2015). For fiscal incentives, public application and realization counts do not identify rejected applications, foregone tax revenue, claimant size distribution or the counterfactual change in R&D expenditure. The paper reports none of these unknown quantities as measured facts. Aspirational GII and expenditure targets mentioned in official communications are illustrative benchmarks only and are not represented as binding approved targets without verifying the relevant formal planning documents.

To avoid circularity, classification of an 'institutional failure' requires a specific legal or administrative discrepancy, whereas classification of an 'interaction failure' requires records of a missing or obstructed transaction in addition to weak aggregate indicators. Where these records are absent, the text uses 'possible constraint', 'risk' or 'hypothesis'. No statement that P1–P3 is statistically supported is made. These procedures reduce, but do not eliminate, interpretive bias in a secondary-data study.

RESULTS AND DISCUSSION

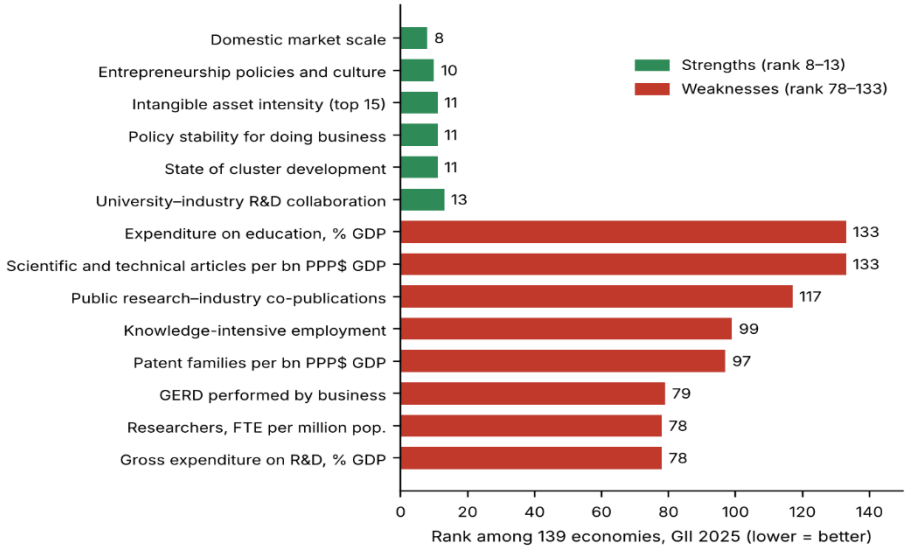
1. The Rank Trajectory and the Foundations Behind It

Graph 1 displays Indonesia's reported rank trajectory: the overall rank was 85th in 2020, 54th in 2024 and 55th in 2025; the innovation-input rank moved from 91st to 54th and then to 60th, while the output rank was 76th in 2020, 67th in 2024 and 59th in 2025 (WIPO, 2025). These are ordinal positions within each edition's comparison set. Neither a 31-place rank gain nor the 2025 input–output divergence measures the absolute size of an improvement, because competing economies, indicator coverage and scoring distributions may have changed. WIPO's 2025 confidence interval of 54–60 also makes the difference between 54th and 55th statistically uninformative. Graph 1 is thus a descriptive visualization rather than an estimated policy effect.



Graph 1. Indonesia's GII Rank, Input Rank and Output Rank, 2020–2025
Source: WIPO (2025), country profile, plotted by the authors.

Graph 2 presents the 2025 contrast between relatively strong market-scale and institutional indicators and weaker measures of formal R&D and scientific output. Although the institution pillar ranks 39th and the human-capital-and-research pillar 92nd, the indicators are heterogeneous and should not be interpreted as independent comparable quantities of institutional quality or research productivity (WIPO, 2025).



Graph 2. Selected GII 2025 Indicators: Strengths and Weaknesses of Indonesia
Source: Author, 2026

The 2024 profile shows a similar disparity, with human capital and research at 90th and business sophistication at 78th (WIPO, 2024). Such recurrence is consistent with P1's expectation of an uneven profile, especially when combined with domestic financing figures; it cannot establish that structural market factors caused the overall rise. Differences in economy coverage, variable availability, survey composition, PPP denominators and data age offer alternative measurement explanations for part of the observed contrasts (WIPO, 2024, 2025).

Comparative research supports the importance of long-term capabilities but does not establish Indonesia-specific causality here (Fagerberg & Srholec, 2008; Cirera & Maloney, 2017).

The university–industry collaboration measure moved from 6th in 2024 to 13th in 2025 and is based on executive opinion, rather than a census of contracts or licences (WIPO, 2024, 2025). Similarly, the profile draws on research-input observations from several years before 2025, including R&D expenditure and researcher indicators. Differences between these measures and publications or patent indicators can arise both from genuinely different dimensions of activity and from inconsistent years, populations and denominators. Without a consistent score series or matched firm/university data, the analysis cannot attribute changes to reorganization or policy design.

Robustness cannot be claimed from rankings alone. A stricter test would reconstruct normalized GII scores for indicators common to the 2020 and 2025 vintages, hold a common economy set where the data permit, disclose imputed and survey-derived observations, and repeat comparisons on measures available in both years. Such harmonized micro-indicator and uncertainty calculations are not supplied by the sources assembled here. Consequently, Graphs 1 and 2 document patterns only; the study avoids quantitative decomposition or attribution claims it has not performed.

2. The Financing Layer

a. How Much is Spent and How Reliably is it Measured

BRIN's estimates follow the Frascati conceptual approach to R&D expenditure, but the published series are not necessarily measurement-invariant across editions (OECD, 2015; BRIN, 2023, 2024, 2025). Table 2 juxtaposes different reference years and publication vintages rather than treating them as a continuous growth series. In the 2024 publication, 2023 expenditure was Rp20.39 trillion, approximately 0.10% of GDP; the 2025 publication restated the same year as Rp33.49 trillion, or 0.16% of GDP, and reported Rp50.28 trillion, or 0.23%, for 2024 (BRIN, 2024, 2025). WIPO's GII profile reports 0.28% of GDP for the different reference year 2020, with a business R&D figure from 2018 (WIPO, 2025). The figures do not support a simple year-on-year inference without a harmonized time series.

The 2023 revision can be localized in the published sector decomposition. Government spending (approximately Rp6.61 trillion) and business spending (Rp4.40 trillion) are almost unchanged across the two editions, but the higher-education estimate increases from Rp9.39 trillion to Rp22.49 trillion. Hence, the approximately Rp13.1 trillion difference between 2023 estimates is attributable to the higher-education accounting revision, not to documented new research conducted in 2023 (authors' comparison of BRIN, 2024, 2025). BRIN (2025) describes a salary-based operational-burden estimation using sampled faculty remuneration and reports provisional values for some categories.

Table 2. Four Readings of National Research Intensity

Source	Data year	Spending (IDR trillion)	Share of GDP	Composition noted
BRIN (2023), IIRI 2023	2022	—	about 0.1%	Not decomposed here

Source	Data year	Spending (IDR trillion)	Share of GDP	Composition noted
BRIN (2024), IIRI 2024	2023	20.39	about 0.10%[a]	Higher education 46.02%; business 21.56%
BRIN (2025), IIRI 2025 (restated)	2023	33.49	0.16%	Higher education 67.13%; business 13.13%
BRIN (2025), IIRI 2025	2024	50.28	0.23%	Higher education 71.02%; business 14.96%
WIPO (2025), GII 2025 (UIS data)	2020 (GERD); 2018 (business-performed)	—	0.28%; business 0.02%	Rank 78th; business-performed rank 79th

Source: Process by Author, 2026

Under the Frascati Manual, salaries attributable to time actually spent on R&D are legitimate intramural research costs and need not be mutually exclusive with separate project budgets in an accounting presentation (OECD, 2015). However, the published aggregate does not reveal the overlap between research projects and allocated staff time, the precision of the allocation factor or whether project funding increased in real terms. Therefore, neither the revised total nor the staff-cost component alone proves excessive administrative spending, double counting, or inadequate institutional research productivity. Valid assessment requires a documented cost bridge, equivalent historical restatements and parallel outcome measures.

b. Who spends, and on What

Table 3 presents BRIN's provisional 2024 sector composition: higher education 71.02%, business 14.96%, government 13.64% and private non-profit organizations 0.39% of reported R&D performance. Within the estimated Rp35.70 trillion for higher education, BRIN identifies approximately Rp26.29 trillion in an operational-burden component associated with research-related staff time and Rp9.41 trillion in itemized spending categories (authors' calculation from BRIN, 2025). The former is about 73.6% of this sector's estimated total, but is not inherently non-research or proof that only the latter financed 'real' projects. The categories can differ in how they capture research labour embedded in sponsored projects. A finance-performance analysis would need institution-level project grants, staff-time allocation, equipment cost, direct research outputs and their overlap, ideally on a consistent Frascati basis. Business-performed expenditure is Rp7.52 trillion or 0.034% of GDP in the 2024 estimate, but comparisons with the Rp4.40 trillion in 2023 are sensitive to survey coverage and reporting changes (BRIN, 2025).

Table 3. National Research Spending by Sector, 2023–2024

Sector	2023 (IDR)	2024 (IDR)	2023 (%)	2024 (%)	Share of GDP 2024 (%)
Government	6,611.82	6,858.10	19.74	13.64	0.031
Higher education	22,485.81	35,704.05	67.13	71.02	0.161

Sector	2023 (IDR)	2024 (IDR)	2023 (%)	2024 (%)	Share of GDP 2024 (%)
Business and industry	4,397.22	7,518.93	13.13	14.96	0.034
Private non-profit	—	194.78	—	0.39	0.001
Total	33,494.85	50,275.86	100.00	100.00	0.23

Source: Author, 2026

The reported BRIN central research allocation changed from Rp6.36 trillion in 2023 to Rp5.91 trillion in 2024, while LPDP reported a research budget of approximately Rp0.56 trillion in 2024 (BRIN, 2025). These budget figures describe particular institutions, and they must not be directly subtracted from national expenditure by performing sector; the two classifications answer different questions and may overlap. Public funding can support salaries, projects, facilities and joint research, each with different time horizons and beneficiaries. Since public research is often complementary to private investment rather than a simple substitute, any recommendation to expand competitively allocated project funding should be evaluated against baseline institutional functions and the possible crowding-out of basic science (David et al., 2000; Arrow, 1962). The relevant question is not whether researchers' salaries count as R&D, but whether the financing mix enables additional, verifiable research effort and learning outcomes.

c. The Distance To An Aspirational Target

An aspiration of raising national research expenditure to 1% of GDP by 2029 has appeared in public leadership communications, but the calculation in this study is explicitly illustrative, not a forecast or evidence that a statutory budget allocation has been approved. At 2024 current-price GDP of Rp22,138,964 billion, 1% would equal about Rp221.4 trillion, or roughly 4.4 times the published 2024 total of Rp50.28 trillion (BRIN, 2025; authors' calculation). A hypothetical private component of 0.8% of the same GDP would be Rp177.1 trillion, compared with Rp7.52 trillion reported as business-performed expenditure; however, 'business-performed' and 'non-government-funded' are different classifications and should not be conflated. These static comparisons assume an unchanged GDP denominator and a consistent accounting definition, neither of which holds automatically through 2029. The scale of the difference indicates the relevance of private R&D incentives and capability, but not which instrument would produce the required increase (Hall & Lerner, 2010; Bloom et al., 2019).

3. The Capability and Behaviour Layer

a. Research workforce: concentrated in universities, thin in firms

BRIN (2025) reports 388,946 researchers by headcount in 2024 against 439,349 in 2023, with much of the difference occurring in lecturer and doctoral-student series. Higher education accounts for roughly 95% of this reported headcount, while business accounts for about 9,012 people (provisional); the number of doctorate-qualified S&T personnel recorded in business is 102 (provisional). These observations suggest a concentrated national research workforce, but the decline could reflect registry, student status or other coverage changes rather than a reduction of actual research time. In particular, BRIN headcount estimates cannot be compared one-to-one with WIPO's full-time-equivalent researchers per million population, based on earlier observations

(BRIN, 2025; WIPO, 2025). Interpretation requires both harmonized full-time equivalents and consistent sector classification.

One possible explanation is limited firm absorptive capacity: organizations need prior knowledge and internal effort to identify, assimilate and exploit external research (Cohen & Levinthal, 1990). Yet aggregate staff numbers cannot identify the causes of low firm R&D. Industry composition may favor assembling, processing and services where innovation is embedded in machinery or work routines; micro and small firms may innovate without separately reporting formal R&D; subsidiaries may conduct their principal research abroad; import licensing can substitute for in-house invention; and weak competition, uncertain demand or constrained finance can change the private return to research (Hall & Lerner, 2010; Cirera & Maloney, 2017; Lall, 1992). These mechanisms are plausible alternatives, not results demonstrated for Indonesian firms in this dataset. Firm-size, ownership, industry and product-market matched information is necessary to determine which dominates and to avoid treating formal R&D expenditure as a complete measure of innovation behaviour.

The competing explanations imply different policy tests. If low formal R&D is concentrated in smaller firms, support for experimentation and technical extension may be more relevant than patent-conditioned relief. If multinational companies conduct research at headquarters outside Indonesia, domestic subsidiary R&D figures may understate access to technology but correctly reveal limited local learning. If imports embody productive know-how, the pertinent outcome is adaptation and workforce skill rather than local invention alone. If weak rivalry or poor procurement demand suppresses expected returns, lower research taxes may have little effect without demand-side reform. None of these mechanisms can be ranked by importance without linked industrial, ownership, expenditure and innovation-survey data.

b. Output Quality and Technological Dependence

Indonesia recorded 63,737 internationally indexed documents in 2024, about 2.6% more than in 2023 according to BRIN (2025). Citation averages reported for 2020–2024 differ from several regional comparators, but such cross-country averages are influenced by field mix, co-authorship, coverage and citation windows. Similarly, the GII ratio of scientific and technical articles to GDP (133rd) depends on its selected denominator and should not be interpreted as a direct quality ranking (WIPO, 2025). Patent applications and grants describe different populations and lagged stages, so the 2023–2024 change in annual domestic grants cannot be attributed to declining research performance without cohort information. These indicators raise questions about research translation and scale while leaving institutional effectiveness unmeasured.

Licensing payments and trade data offer further context rather than a stand-alone dependency test. BRIN (2025) reports intellectual-property use payments of about US$2.65 billion and receipts of US$0.19 billion in 2024, and a high-technology export–import ratio below 40%. Acquiring foreign knowledge can support domestic productivity when local firms have learning capacity; it can also reduce incentives to develop duplicative technologies. The balance therefore cannot determine whether reliance on imports has weakened innovative behaviour without firm-level evidence about learning, competition, technology contracts and domestic value added (Lall, 1992). Together with the comparatively small business-performed R&D estimate, these patterns justify sector-specific inquiry rather than an undifferentiated diagnosis of firm failure.

4. Fiscal Incentives: Pricing Risk Without Sharing It

Indonesia's R&D super-deduction was established through Government Regulation 45/2019 and elaborated in Minister of Finance Regulation 153/PMK.010/2020. The ordinary deduction of eligible costs may be supplemented by additional relief up to a specified ceiling, contingent on defined activities and milestones. Design questions concern eligible research fields, taxable-profit requirements, the timing and condition of enhanced deductions and incentives for incremental R&D. Administrative questions instead concern the OSS filing pathway, documentation, certification, monitoring and coordination among competent agencies. Firm-level barriers concern whether an applicant has taxable income, staff to satisfy documentation requirements, a qualifying project and sufficient expected benefit relative to compliance costs. These categories must be separated rather than collectively attributed to a 'back-loaded' regulation.

Table 4. Structure of the R&D Super Deduction and Its Analytical Implications

Feature	Provision	Analytical implication
Base deduction	100% of eligible R&D costs	Works like ordinary expensing; valuable only to firms with taxable profit
Additional deduction	Capped at 200% of accumulated costs, tied to milestones	Largest rewards arrive after the riskiest stage
Milestones	Patent or plant variety protection (50%), foreign IP registration (25%), commercialization (100%), among others	Rewards success rather than risk-taking; exposed to volatility in patent grants
Scope	Priority fields and themes in the annex	Defines eligibility incentives; project timing and taxable-profit dependence require firm-level tests
Procedure	Proposal and fiscal certificate through the online licensing system; reporting	Potential compliance and interagency frictions; no administrative time-cost data assessed
Recorded uptake (reported in 2025)	30 taxpayers / 224 proposals submitted; 9 taxpayers / 19 proposals realized	8.48% of proposals realized; fiscal costs, claimant mix and additional induced R&D not observed

Source: Minister of Finance Regulation 153/PMK.010/2020; Bhuana and Ardiansyah (2025); authors' analysis.

Publicly reported implementation evidence allows a more discriminating assessment than regulatory design alone. At the 7 August 2025 science, technology and industry convention, the Finance Minister reported 30 taxpayers submitting 224 proposals, with an estimated proposed R&D cost of Rp1.46 trillion and US$15.36 million; 9 taxpayers had realized benefits for 19 proposals (Febriyanti et al., 2026). At proposal level, 19/224 is an 8.48% realization-to-submission ratio; it is not a rejection rate, a probability of approval for unique firms, or the value of actual tax expenditure. The dataset provides no firm-size distribution, tax revenue foregone, projects completed or counterfactual R&D

spending, and hence cannot demonstrate additional research induced by the incentive.

Bhuana and Ardiansyah (2025) identify limited implementation relevance through policy-actor interviews; this qualitative finding is compatible with, but not causally validated by, the uptake ratio. Comparative econometric evaluations suggest that well-designed R&D tax incentives can stimulate expenditure for financially constrained firms (Dechezleprêtre et al., 2023; Hall & Van Reenen, 2000), but their effect sizes must not be directly transferred to Indonesia. Priority should be given to publishing anonymized uptake and tax-expenditure statistics, mapping administrative drop-off points, and evaluating outcomes for comparable users and non-users before redesigning the rate or eligibility rules. P3 remains a policy proposition, not an empirically confirmed effect.

Policy uptake must be separated from policy additionality. Submissions measure interest; administrative realization measures access; recorded gross deductions and tax revenue foregone measure fiscal use; and incremental R&D requires estimating the difference between observed firm investment and what the same firms would have spent absent the incentive. Public figures cited here cover the first two dimensions only. A feasible evaluation protocol would classify applicants by sector, size, profitability and R&D history, compare eligible non-users and users over multiple years, and predefine responses for publication, patenting, contracts and jobs without assuming all are contemporaneous. Confidential tax-return analysis would require lawful access and disclosure controls (Dechezleprêtre et al., 2023; Bhuana & Ardiansyah, 2025).

5. The Linkage and Governance Layer

a. Perceived Collaboration Versus Observed Collaboration

The GII university–industry collaboration rank (6th in 2024 and 13th in 2025) is a perception indicator, whereas public research–industry co-publications (117th), patent families (97th) and knowledge diffusion measure distinct activities with different populations and denominators (WIPO, 2024, 2025). Consequently, these measures cannot be combined as a direct conversion rate from 'collaboration' to 'innovation'. Collaborative research produces shared research questions, personnel or publications; contract research is a paid service undertaken against a client's requirements; consulting may transfer tacit expertise without an academic publication; licensing is a legal transfer of specified intellectual-property rights; knowledge exchange includes informal training and mobility; and commercialization involves adoption, sales, scale-up or new ventures. Each channel requires its own denominator, time lag and outcome measure (Perkmann et al., 2013; Bozeman, 2000). Low co-publication rates cannot establish that consulting, contract services or informal knowledge exchange are weak, and a high survey ranking cannot establish that licensing or product adoption are strong.

A defensible collaboration assessment would separately measure the number and value of active contract-research agreements, duration and sector of joint projects, firm–researcher mobility, jointly authored research, patents with business co-owners, executed licences, royalty income and products adopted by firms. Contract and consulting measures should be disaggregated by firm size and sector; licensing requires distinguishing agreements signed from income actually generated; and commercialization should be tracked over a longer period than conference or project outputs. Intermediaries may assist partner search, standard agreements, knowledge transfer and pilot testing (Howells, 2006), but their

contribution cannot be asserted without program-level baselines and outcomes. Mission-oriented collaboration has been proposed for Indonesian pharmaceuticals (Pratistha et al., 2026); this is a relevant design analogy, not proof that similar arrangements already improve national performance.

One possible performance dashboard would report: collaborative research projects with formal joint budgets; consulting contracts completed and knowledge transferred; contract-research income and client adoption; active licences and royalty receipts; shared patent ownership; and commercialized products with documented sales or uptake. These categories should not be summed as a single homogeneous collaboration score. Surveys can assess perceived value, but administrative contract and adoption records are required for outcomes; neither type alone supplies attribution to a specific national reform.

b. Data Governance And Coordination

Research governance comprises different formal mandates, not simply a single coordination gap. BRIN has a national research and innovation role under Presidential Regulation 78/2021; Bappenas is responsible for national development planning and alignment of policy priorities under its governing framework and the 2025–2029 RPJMN; the Ministry of Finance and tax administration govern fiscal design, administration and tax-expenditure monitoring; the ministry responsible for higher education oversees relevant university policy; universities and firms retain operational decisions about research projects, intellectual property and investment. BPS and other statistical producers contribute definitions and national data infrastructure.

This distribution creates possible interfaces priority setting, proposal eligibility, research funding, implementation reporting and outcome evaluation at which responsibilities must be mapped, but the present document analysis contains no interviews or interagency workflow audit proving an actual mandate conflict. Overlap should therefore be treated as an accountability risk, not a documented failure. A practical governance response is a published responsibility matrix specifying the decision owner, consultation duty, data custodian, dispute-resolution pathway and evaluation timetable for each program, with Bappenas convening cross-portfolio alignment and each legally competent institution retaining its authority. This complements, rather than replaces, a consistently defined national R&D series with documented revisions and back-casts (OECD, 2015; BRIN, 2025).

The governance chain can be operationalized as follows: Bappenas aligns national priorities and cross-ministerial review; BRIN translates research priorities into scientific programs and reports relevant research performance; the Ministry of Finance and its tax bodies manage tax instruments and reporting within their statutory remit; the higher-education ministry and universities govern university programs, researcher training and IP arrangements; firms determine adoption, investment and co-funding; and BPS coordinates statistical consistency within the national statistical system. This is a proposed responsibility map based on institutional functions, not proof that the named institutions have already accepted particular program tasks.

6. Reinforcing Constraints: Why Partial Reform Disappoints

The findings indicate several coexisting constraints but do not establish a self-reinforcing causal cycle. Aggregate financing data reveal limited reported business-performed R&D; workforce data show a small recorded research staff in

firms; public incentive figures show limited realized uptake; and collaboration indicators distinguish perceived ties from selective observable outputs (BRIN, 2025; WIPO, 2025; Febriyanti et al., 2026). A plausible mechanism is that low firm absorptive capacity, uncertainty and thin incentives for joint projects may interact. Competing mechanisms include industrial specialization, offshored research, differences in survey coverage, administrative classification and the timing of outcomes. Table 5 is therefore a diagnostic hypothesis matrix and not a list of empirically adjudicated causal 'failures'.

Table 5. Interlocking Constraints in the Research and Innovation Ecosystem

Constraint	Key evidence	Mechanism	Policy implication
Composition of financing	Higher-education staff-time estimate 73.6% of its reported total; business R&D 0.034% of GDP	Project-funding effects untested; salaries may be legitimate research costs	Risk-sharing finance
Thin business research capacity	Provisional business doctoral staff count; low recorded business research expenditure	Industrial mix, firm size, offshored R&D and absorptive capacity are alternatives	Talent mobility; industrial doctorates
Back-loaded incentives	19 realized proposals from 224 submitted; design includes conditional enhancements	Administrative, design and firm barriers cannot be separated with these counts	Accessible, earlier-stage incentives
Perception–behaviour gap in linkages	Perception rank, co-publication rank and licensing are non-equivalent measures	Distinct collaboration types require their own output denominators	Problem-driven consortia; result indicators
Measurement instability	Rp20.39 vs Rp33.49 trillion for 2023; 13 outdated GII indicators	Vintage differences impair straightforward trend interpretation	Single measurement standard

Source: Authors' synthesis based on BRIN (2024, 2025), WIPO (2025), and Klein Woolthuis et al. (2005).

In the system-failure terminology of Klein Woolthuis et al. (2005), capability, interaction and institutional mechanisms could jointly explain the patterns, subject to confirmation with firm-level and interagency data. P1 is consistent with the descriptive contrast between composite rank and research-related indicators. P2 and P3 identify plausible relationships and policy-matching questions; neither has been causally tested. This restricted interpretation is stronger than claiming that correlations prove fragmentation or that the observed policy mix caused the country's GII position.

7. Policy Directions

Table 6 translates the diagnostic questions into five conditional policy directions. They are recommendations for pilot design and evaluation not

interventions of established domestic effectiveness. Priority is determined by (a) whether a measure addresses an observable information or implementation gap, (b) whether the statutory owner and minimum delivery capacity can be identified, (c) whether a bounded budget and evaluation baseline are feasible, and (d) the severity of fiscal, distributional and research-quality trade-offs. Measures that improve administrative evidence and policy learning should precede large untargeted subsidies; financing and intermediary reforms should first be piloted in sectors with identifiable demand and credible partners (Bloom et al., 2019; Edler & Fagerberg, 2017).

Table 6. Policy Directions, Instruments, Actors, Indicators and Risks

Direction	Instruments	Indicators	Main risk
Risk-sharing finance	Sector-specific, capped matching-grant pilots; stage-gated research-to-pilot support; retain protected basic research	Incremental private R&D vs baseline; cost per additional pilot; private co-funding	Budget crowd-out; low additionality; uneven access for SMEs
Accessible fiscal incentives	Release anonymized uptake/cost statistics; audit application drop-offs; pilot simplified claims before any major rate change	Applications, realizations, eligible costs, tax revenue foregone, induced R&D	Confidentiality, revenue foregone and unverified causality
Problem-driven linkage mechanisms	Mission-specific pilot consortia; standard IP agreements; separate contract, consulting, licence and adoption registers	Contract-research value; active licences; adoption; firm co-funding; mobility	Administrative events used as outcomes; concentration in large firms
Talent and mobility	Industrial doctorates, dual appointments and researcher mobility pilots	Business R&D FTE; placements; qualifications; subsequent collaborative projects	Slow payoff invites neglect
Single measurement standard and coordination	Published back-cast expenditure series and revision log; responsibility matrix; interagency data agreement	Comparable GERD series; revised-data log; current-year indicator coverage	Coordination without authority to resolve conflicts

Source: Authors' Analysis, 2026

A staged approach addresses feasibility. In the initial 0–12 months, BRIN, BPS and Bappenas can reconcile published research series, record revisions, and

specify agency-level responsibility for data releases; the Ministry of Finance and relevant administrators can publish anonymized counts of applications, approvals, realized deductions and tax expenditure by firm-size and sector group, subject to confidentiality. University and BRIN programs can inventory existing contracts, licences and collaborative research separately rather than treating event counts as outcomes. In months 12–36, competitive matching funds and problem-driven consortia should be piloted in narrowly defined sectors, with explicit ceilings, cost sharing and evaluation plans. Industrial doctorates, placements and research mobility require longer commitments and workforce measurement through full-time equivalents. This sequence prioritizes measurability, lawful administrative access and demonstrable readiness over assumed national-scale impact.

Table 7. Phased Feasibility, Institutional Responsibility and Evaluation

Stage / priority	Preconditions and delivery owner	Funding and measurable additionality
0–12 months / 1	BRIN, BPS and Bappenas agree definitions, vintage log and public baseline; finance/tax bodies supply lawful aggregate uptake series	Existing data-governance budgets first; measure missingness, revisions and published cohort counts
0–12 months / 2	Ministry of Finance/tax administration and BRIN map filing, realization and eligibility bottlenecks	Small evaluation allocation; estimate realized tax cost and comparable pre-incentive R&D
12–36 months / 3	BRIN, sector ministries, universities and firms identify sectors with specific demand, capabilities and IP arrangements	Capped matching grants; additional firm co-investment, new prototypes and adoption vs counterfactual
12–60 months / 4	Higher-education authorities, BRIN, firms and funders administer placements and industrial doctoral projects	Multi-year training commitments; incremental R&D FTE and industrial retention

Source: Authors' feasibility assessment based on the reviewed policies and comparative literature, 2026

Implementation choices create trade-offs. Public support of near-market research may divert funds from basic science, so a protected basic-research allocation and transparent peer review are essential (Arrow, 1962). Tax relief and matching grants may subsidize research firms would conduct anyway; monitoring should therefore seek additional R&D, not only the total value of awards, using staged comparisons, pre-treatment expenditure and ideally appropriate quasi-experimental designs (Bloom et al., 2019; Dechezleprêtre et al., 2023). University–industry programs may favor large incumbent firms; eligibility, small-firm participation, open competition and regional coverage require disclosure. Data consolidation may reduce conflicting reporting but creates privacy, access and decision-rights risks. Finally, doctoral training yields benefits after the

standard annual budget cycle, so milestones should include skills and placements before commercialization. These considerations support a balanced policy portfolio rather than a uniform 'best' instrument.

CONCLUSION

This document-based analysis distinguishes Indonesia's relative GII performance from its underlying research and innovation indicators. The reported overall rank reached 54th in 2024 and 55th in 2025, but component indicators, country coverage, data vintage and statistical uncertainty limit interpretation of a rank movement as institutional change (WIPO, 2024, 2025). BRIN's 2025 volume reports national R&D expenditure of 0.23% of GDP in 2024 and business-performed R&D of 0.034% of GDP. The same 2023 expenditure year was revised upward by approximately Rp13.1 trillion between published editions because of the higher-education component, illustrating a measurement break rather than verified real growth (BRIN, 2024, 2025). Research-related staff costs are legitimate expenditure under the Frascati definition and should not be equated with waste or excluded from research activity. Public reports of 30 tax-incentive applicants and 19 realized proposals out of 224 indicate limited recorded uptake, while providing no direct estimate of tax expenditure or induced R&D (Febriyanti et al., 2026).

The article's contribution is a three-layer, cross-framework diagnostic that distinguishes evidence from inference and connects finance, absorptive capacity, institutional interfaces and heterogeneous types of university–industry collaboration. Its practical implications are sequenced: establish comparable statistics and implementation reporting first; test tax-incentive administration and carefully targeted risk-sharing pilots next; and develop collaboration and research talent instruments over longer horizons. BRIN, Bappenas, the Ministry of Finance, higher-education institutions and firms have complementary but noninterchangeable responsibilities. Policy effectiveness should ultimately be judged by additional research, capability and adoption outcomes under a credible comparison strategy, not by announcements, rank changes or expenditure totals alone.

These findings remain descriptive. The analysis does not identify a causal effect of the 2021 reorganization, the super deduction, university–industry networks or any proposed reform. Some BRIN estimates are provisional; GII measures involve older data and perceptual indicators; firm-sector and research-contract microdata are unavailable; and neither the fiscal cost of deductions nor a matched counterfactual has been established. The 2026 manuscript revision incorporates sources published after 2024, so the 2024 template issue and DOI must not be treated as confirmed bibliographic metadata.

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