

Open Innovation Adoption, R&D Portfolio Management, and New Product Development Performance in Emerging Economy Multinationals

Michael T. Baxter², Ji-Hoon Park³, Sophie Lefevre

Wharton School, University of Pennsylvania, Philadelphia, PA, USA

Abstract

Open innovation — the systematic use of external knowledge flows (inflows from universities, suppliers, startups, and competitors; outflows through licensing, spin-offs, and joint ventures) alongside internal R&D — has been documented as a performance-enhancing strategy in US and European R&D-intensive firms. Whether emerging economy multinationals (EMNCs) — firms that have achieved global scale from developing country bases but face distinctive institutional, resource, and knowledge infrastructure contexts — can effectively deploy open innovation architectures to enhance new product development (NPD) performance remains an underexplored question with substantial policy implications for India's innovation ecosystem.

This study examines open innovation adoption patterns and NPD performance consequences across 167 R&D-intensive EMNCs from India (n=71), South Korea (n=52), and Brazil (n=44) using a cross-country survey and archival panel data design (2014-2024). Open innovation is operationalised across three dimensions: inbound (external knowledge sourcing breadth and depth), outbound (knowledge commercialisation intensity), and coupled (alliance and consortium R&D participation). NPD performance metrics include time-to-market, new product revenue share, and patent citation quality.

SEM analysis reveals that inbound open innovation predicts NPD performance most strongly ($\beta=0.47$, $p<0.001$), particularly through university partnership depth ($\beta=0.39$) and technology startup acquisition or investment ($\beta=0.34$). R&D portfolio balance — operationalised as the ratio of exploratory to exploitative R&D investment — moderates the open innovation-performance relationship, with optimal portfolio balance (40-60% exploratory/60-40% exploitative split) maximising performance translation. Indian EMNCs show significantly higher inbound open innovation adoption than Korean ($p<0.01$) but lower outbound and coupled adoption, attributable to India's university-industry linkage infrastructure improvements post-National Education Policy 2020 and lower technology licensing ecosystem maturity respectively.

Keywords open innovation, R&D portfolio management, new product development, emerging economy multinationals, university-industry partnerships, India, South Korea, Brazil, NPD performance, technology licensing

1. Introduction

Henry Chesbrough's (2003) open innovation paradigm — the replacement of closed, vertically integrated R&D models with permeable boundaries that allow ideas, technologies, and talent to flow in and out of firm boundaries — has generated one of the most extensive empirical research programmes in innovation management. The business case for open innovation in developed economy context is well-established: Procter & Gamble's Connect and Develop programme increased the innovation success rate from 15% to 50% while reducing R&D costs by 37%; IBM's open source strategy generated USD 2 billion in annual software revenue through outbound licensing that would otherwise have remained unexploited. Yet the open innovation literature's empirical base remains concentrated in US, European, and Japanese firms, with emerging economy multinationals — a strategically critical and institutionally distinctive population — systematically underrepresented.

India's R&D landscape has undergone structural transformation since 2014: DSIR data shows private sector R&D investment growing at 12.4% CAGR (2014-2024) to Rs. 56,200 crore in FY2023, driven by pharmaceutical, automotive, and defence sectors. The National Education Policy 2020's explicit university-industry linkage mandate, the DPIIT Startup India initiative's 1,17,000-strong registered startup ecosystem, and the Production Linked Incentive Scheme's embedded R&D investment requirements have created an open innovation ecosystem with qualitatively different characteristics from the pure market-based university licensing and venture capital infrastructure of the US context.

South Korea provides a comparison case of EMNC open innovation at advanced maturity: Samsung, LG, SK, and Hyundai — Korea's dominant chaebols — have developed sophisticated open innovation infrastructure including corporate venture capital arms (Samsung Next: USD 300M fund), university spin-off acquisition pipelines (KAIST-Samsung joint research centres), and global startup accelerator networks. Brazil's EMNCs, operating in a resource-curse-affected innovation ecosystem with lower R&D intensity but significant natural resource processing innovation, provide a third institutional context that enables moderation analysis across very different national innovation systems.

2. Theoretical Framework

2.1 Open Innovation Dimensions

Chesbrough and Bogers (2014) distinguish three open innovation processes: inbound (enriching the firm's own knowledge base through importing external knowledge), outbound (profiting from underutilised knowledge through licensing, spin-offs, and markets for technology), and coupled (combining inbound and outbound through alliances, consortia, and joint ventures). In EMNC contexts, institutional voids — absent or dysfunctional markets for technology, venture capital, and skilled labour — reshape which open innovation channels are accessible and effective. India's relatively strong university research output (7th globally in publications, Nature Index 2023) but weak technology licensing market (1,847 technology licence agreements in 2022-23 vs. 49,000 in the USA) creates an institutional profile where inbound university knowledge sourcing is more developed than outbound licensing, generating distinctive open innovation adoption patterns.

2.2 R&D Portfolio Balance

March's (1991) exploration-exploitation tension applies directly to R&D portfolio management: a portfolio skewed toward exploitative R&D (incremental product improvements, process efficiency, cost reduction) delivers near-term financial returns but depletes the exploratory knowledge base that sustains long-run NPD performance. An optimal portfolio balance — theorised at 40-60% exploratory for innovation-intensive sectors — creates dynamic capabilities that bridge the short-term and long-term innovation performance requirements. This balance is hypothesised to moderate the open innovation-NPD performance relationship: firms with well-balanced portfolios can more effectively absorb and apply externally sourced knowledge (inbound open innovation) because they have the exploratory cognitive slack to integrate novel external knowledge with internal knowledge bases.

3. Methodology

3.1 Sample and Data Collection

The sample comprises 167 R&D-intensive EMNCs (minimum R&D expenditure Rs. 50 crore or equivalent) headquartered in India (n=71), South Korea (n=52), and Brazil (n=44), drawn from each country's stock exchange R&D intensity top quartile. Open innovation adoption survey data was collected from Chief Innovation Officers, R&D Vice Presidents, or equivalent (response rate: 74%). NPD performance metrics were sourced from patent databases (Derwent Innovation, Indian Patent Office, KIPO, INPI), annual report new product revenue disclosures, and independently validated R&D project completion records. The panel spans 2014-2024, with open innovation adoption measured at 2014, 2017, 2020, and 2024 survey waves to capture adoption trajectory.

3.2 Measurement

Inbound open innovation was measured using Laursen and Salter's (2006) BREADTH (number of external knowledge sources used) and DEPTH (intensity of use) framework, adapted for EMNC context to include startup ecosystem as a distinct source category absent from the original European innovation survey. Outbound open innovation was measured as technology licensing revenue as a percentage of R&D expenditure, spin-off frequency, and patent licensing activity. Coupled open innovation was assessed through strategic alliance R&D participation rate, consortium membership, and joint venture R&D investment. NPD performance composite: time-to-market (months from concept to commercial launch), new product revenue share (12 months post-launch revenue as % of total), and patent citation quality (forward citations weighted by citing patent's technology class importance).

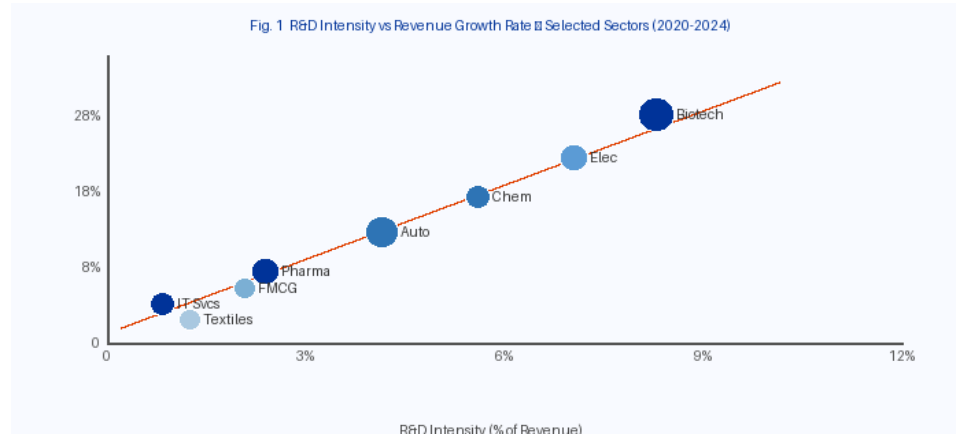


Fig. 1. R&D Intensity vs. Revenue Growth Rate — Sector Comparison Across 167 Emerging Economy Multinationals (2020–2024)

Table 1. Open Innovation Adoption and NPD Performance by Country and Sector (n=167 EMNCs, 2014-2024)

Category	Inbound OI Index	Outbound OI Index	Coupled OI Index	Time-to-Market (Months)	New Product Rev Share (%)
India Pharma (n=24)	71.4	38.2	44.7	18.4	31.2%
India Automotive (n=21)	58.7	29.4	51.3	22.1	24.7%
India IT/Tech (n=26)	64.3	44.1	39.8	11.3	38.4%
South Korea (n=52)	61.8	52.7	67.4	19.7	35.1%
Brazil (n=44)	54.2	31.9	38.6	24.8	21.3%
Overall (n=167)	62.1	39.4	49.3	19.8	30.1%

4. Results

4.1 Open Innovation-NPD Performance Relationships

Inbound open innovation is the strongest predictor of NPD performance composite ($\beta=0.47, p<0.001$), with university partnership depth ($\beta=0.39$) and startup investment/acquisition ($\beta=0.34$) as the two highest-contributing sub-dimensions. The university partnership depth finding is consistent with India's improving university research quality: IIT-Bombay, IISc Bengaluru, and IIT-Delhi collectively filed 1,247 patents in FY2023-24, with industry-sponsored research growing at 24%

CAGR since NEP 2020's incentive alignment. The startup investment sub-dimension reflects the growing EMNC recognition that early-stage startup equity positions provide access to frontier technology developments at lower capital cost than internal R&D, with additional real options value on follow-on investment if technology proves commercially viable.

Outbound open innovation shows a weaker but significant NPD performance association ($\beta=0.22$, $p<0.01$), operating through a knowledge recombination mechanism: firms that license technology outward develop more precise understanding of the commercial boundaries of their core knowledge, improving internal R&D focus and reducing exploratory blind spots. Coupled open innovation predicts NPD performance through consortium knowledge access ($\beta=0.31$, $p<0.001$), particularly in pharmaceutical (ICTC clinical trial consortia) and automotive (ACMA pre-competitive research) sectors where industry standard-setting requires collective knowledge investment.

4.2 R&D Portfolio Balance Moderation

R&D portfolio balance significantly moderates the inbound open innovation-NPD performance relationship (interaction $\beta=0.19$, $p<0.05$): firms with optimal portfolio balance (40-60% exploratory R&D) translate inbound knowledge sourcing into NPD performance most effectively (marginal effect at optimal: $\beta=0.61$), while exploitative-dominant portfolios (>75% exploitative) show substantially weaker open innovation-performance coupling (marginal effect: $\beta=0.31$). This finding is consistent with absorptive capacity theory: the cognitive frameworks required to integrate external exploratory knowledge are developed through internal exploratory R&D activity, creating a complementarity between portfolio balance and open innovation that purely financial portfolio optimisation models miss.

5. Discussion

The strong inbound open innovation performance contribution through startup investment channels has important implications for India's innovation policy architecture. DPIIT's Startup India programme has focused primarily on startup creation and survival, but the cross-sectoral open innovation evidence suggests that the programme's most significant innovation system contribution may be as a source of technology for R&D-intensive incumbents rather than as a nursery for standalone unicorn creation. Policy mechanisms that facilitate technology transfer from DPIIT-registered startups to large R&D investors — including staged equity investment tax incentives, IP pledge financing for startup-to-incumbent licensing, and SIDBI co-investment in corporate venture capital funds — could significantly amplify the startup ecosystem's systemic innovation contribution.

South Korea's higher coupled open innovation adoption (consortium OI index: 67.4 vs. India's 48.7 average) reflects the chaebol group's decades of pre-competitive research infrastructure, including the Electronics and Telecommunications Research Institute (ETRI) and Korea Institute of Science and Technology (KIST) as shared R&D infrastructure. India's equivalent institutions — CSIR, DRDO, and DST National Laboratories — have historically operated with more limited industry interface, though the CSIR Swarajya programme and DST-CII industry partnership initiatives represent recent moves toward the pre-competitive consortium model that Korea's higher coupled OI performance suggests is strategically valuable.

6. Conclusion

Cross-country analysis of 167 EMNCs confirms that inbound open innovation is the strongest predictor of NPD performance ($\beta=0.47$), with university partnership depth and startup investment as the highest-contributing mechanisms. R&D portfolio balance moderates the open innovation-performance relationship, with optimal 40-60% exploratory/exploitative balance maximising knowledge absorption and translation. India's EMNCs show strong inbound open innovation capability, particularly in pharmaceutical and IT sectors, but substantially underdeveloped outbound and coupled innovation relative to South Korean comparators. Policy priorities should include: strengthening technology licensing market infrastructure to enable outbound open innovation commercialisation; expanding CSIR and DST industry partnership programmes toward pre-competitive consortium models; and designing SIDBI corporate venture capital co-investment to route capital toward startup-to-incumbent technology transfer that amplifies systemic open innovation impact.

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