

Environmental Regulation and Corporate Performance in Emerging Markets

¹Dr. Ayaz Ahmad, ²Dr. Rakesh Kumar, ³Dr. Km. Savita, ⁴Ashutosh Priya

¹Assistant professor Faculty of commerce and management United University, Prayagraj

²Assistant Professor Faculty of commerce and management Savitribai Phule Pune, University

³Postdoctoral fellow, ICSSR Jamia Millia Islamia, New Delhi

⁴Professor, Department of Regional Economics, MJP Rohilkhand University, Bareilly

Abstract:

In today's technical and global era, pollution is a major issue that is affecting the lives of living beings on Earth. Environmental regulation creates a continuing tension between the social objective of pollution control and the private objective of firm performance. This systematic literature review synthesises theoretical and empirical research on the relationship between environmental regulation and corporate performance in emerging markets, with attention to India. The review integrates the neoclassical cost perspective, Porter's hypothesis, the natural-resource-based view, market valuation mechanisms, and institutional theories of enforcement. The evidence indicates that environmental regulation stimulates innovation and efficiency in some settings, but general competitiveness or profitability gains are not assumed. Indian evidence is heterogeneous. Murty and Kumar (2003) report higher technical efficiency among more compliant sugar firms, while Oak (2017) finds no significant average effect of the Perform, Achieve and Trade (PAT) scheme on energy intensity in the examined cement and pulp-and-paper firms. Pal, Mukhopadhyay and Bhagawan (2024), using matching-based difference-in-differences, find no statistically important PAT effect on energy efficiency but report a negative effect on firm value. Duflo et al. (2013) provide experimental evidence that changing third-party auditor incentives improved environmental reporting and reduced pollution in Gujarat. Gupta and Goldar (2005) show that environmental-performance information affect Indian stock prices. These evidences suggest that instrument design, enforcement credibility, firm capabilities, industry characteristics, adjustment costs, and the selected performance indicator are central to understanding regulatory effects. The review identifies important gaps in causal identification, measurement of realised regulatory stringency, coverage of small and unlisted firms, and analysis of mechanisms linking regulation to innovation, investment, productivity and valuation.

Keywords: environmental regulation; corporate performance; Porter hypothesis; environmental innovation; Perform, Achieve and Trade; India; emerging markets; systematic literature review etc.

1. Introduction

Environmental regulation has become a strategic issue for firms as governments seek to reduce pollution, improve resource efficiency and respond to climate-related risks. For firms, regulation generates direct compliance expenditure, requires capital investment and constrains production choices. It also creates incentives for cleaner technologies, process innovation, energy efficiency and improved environmental management. The empirical problem is not whether environmental regulation is inherently beneficial or harmful, but under which institutional and organisational conditions regulatory instruments affect dimensions of firm performance.

The traditional economic view treats environmental regulation as a constraint that raise production costs. Evidence from regulated US industries has documented effects on industrial activity, plant location and productivity (Greenstone, 2002; Becker and Henderson, 2000; Gray and Shadbegian, 2003). Porter and van der Linde (1995), however, proposed that appropriately designed regulation expose inefficiencies and stimulate innovation. Later work distinguishes weak, narrow and strong forms of the Porter hypothesis. Lanoie et al. (2011) find strong support for the innovation-oriented weak form, qualified support for the narrow form, and no

support for the strong form in their multi-country facility-level analysis. Ambec et al. (2013) similarly conclude that evidence for a universal competitiveness gain remains conditional.

India provides an important setting because its environmental governance combines statutory pollution-control requirements with monitoring, auditing, disclosure and market-oriented energy-efficiency instruments. The Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, and the Environment (Protection) Act, 1986 form major components of the regulatory framework. The Central Pollution Control Board and State Pollution Control Boards implement important aspects of pollution control. The PAT mechanism adds a market-based approach to energy efficiency for designated energy-intensive industries.

2. Theoretical Framework:

2.1 Neoclassical cost perspective

The conventional perspective predicts that environmental requirements impose costs because firms must devote labour, capital and managerial resources to pollution control rather than alternative productive uses. The magnitude of the effect depends on regulatory stringency, technology, capital vintage, input substitution and the time allowed for adjustment. This perspective is important because environmental regulation produces real social benefits even when private financial returns are negative.

2.2 Porter hypothesis

The Porter hypothesis proposes that well-designed environmental regulation stimulates innovation that reduces waste and improves resource productivity. The weak form predicts environmental innovation; the narrow form predicts that flexible instruments stimulate more innovation than prescriptive rules; and the strong form predicts that innovation more than offset compliance costs. The strongest version requires considerably more evidence than the observation of innovation alone (Lanoie et al., 2011).

2.3 Natural-resource-based view

Hart's (1995) natural-resource-based view suggests that pollution prevention, product stewardship and sustainable capabilities become strategic resources. The implication for environmental regulation is that firms with stronger technological and organizational capabilities are able to transform regulatory pressure into productive innovation.

2.4 Market and information mechanisms

Environmental performance affects firm value through information, reputation and investor expectations. Konar and Cohen (2001) report an association between poor environmental performance and lower intangible asset value in large US firms. Gupta and Goldar (2005) report that environmental-performance information affected stock-market responses in India. Regulation operates through financial-market information even when the direct production-cost effect is ambiguous.

2.5 Institutional enforcement

In emerging economies, written rules and realised regulatory pressure may differ. Inspection capacity, auditor incentives, monitoring technology and enforcement credibility influence whether formal standards alter firm behaviour. Duflo et al. (2013) provide strong Indian evidence: a randomised reform of third-party environmental auditing improved reporting accuracy and reduced pollution. This supports treating enforcement as part of the regulatory treatment rather than as a background variable.

3. Indian Regulatory Context

India's environmental framework rests on major central statutes governing water pollution, air pollution and environmental protection. India Code identifies the Water Act 1974 as providing for prevention and control of water pollution and for pollution-control boards; the Air Act 1981 provides for prevention, control and abatement of air pollution. CPCB materials identify 17 categories of highly polluting industries, including

cement, fertilizer, integrated iron and steel, oil refining, pulp and paper, sugar, thermal power and other sectors. Such sectoral variation matters because firms face different technologies, compliance costs and opportunities for environmental innovation.

The Bureau of Energy Efficiency describes PAT as a regulatory instrument intended to reduce specific energy consumption in energy-intensive industries, with Energy Savings Certificates providing a market mechanism for trading excess savings. Designated consumers have specified energy-performance obligations and reporting and audit requirements. PAT provides a useful setting for examining whether a flexible instrument improves energy efficiency and how its costs and benefits appear in firm valuation.

The current BEE material confirms that PAT remains an active regulatory mechanism and that later PAT cycles and verification arrangements continue to evolve. Studies of older PAT cycles are interpreted as evidence about specific policy periods rather than as complete evidence about the current scheme.

4. Methodology

4.1 Review design

The review follows the reporting principles of PRISMA 2020 and the systematic-review logic proposed by Tranfield et al. (2003), Snyder (2019) and Paul and Criado (2020). PRISMA 2020 requires transparent reporting of identification, selection, appraisal and synthesis. Because the literature uses heterogeneous regulatory exposures and outcome measures, thematic narrative synthesis is more defensible than a pooled meta-analysis unless a sufficiently homogeneous evidence set is established.

4.2 Search strategy

The intended primary database is Scopus, with optional validation through Web of Science and backwards and forward citation searching. The proposed coverage is 1995–2026. The core search expression is:

TITLE-ABS-KEY (("environmental regulation*" OR "environmental polic*" OR "pollution control" OR "environmental standard*" OR "emission* trading" OR "cap-and-trade") AND ("firm performance" OR "financial performance" OR "corporate performance" OR productivity OR profitab* OR "firm value" OR competitiveness) AND (India OR "emerging market*" OR "emerging econom*" OR "developing countr*")).

For the final journal submission, the authors must insert the actual Scopus search date, export counts, duplicate-removal procedure, screening decisions and final included-study count. The supplied manuscript contained placeholder PRISMA numbers; this revised version deliberately does not invent them.

4.3 Eligibility Criteria:

Criterion	Include	Exclude
Population	Firms/plants and firm- or industry-level observations	Households or studies without relevant performance outcomes
Exposure	Environmental regulation, enforcement, standards, audits, disclosure, trading or energy-efficiency policy	Purely voluntary initiatives without a regulatory link
Outcome	Financial performance, productivity, efficiency, value, innovation, energy intensity or competitiveness	Environmental outcomes with no firm-performance link
Setting	India and emerging/developing economies; advanced-economy benchmarks	Outside the conceptual scope
Evidence	Empirical studies plus influential theory/review articles	Editorials and unsupported opinion

4.4 Screening and quality appraisal

The recommended final protocol uses two independent reviewers for title/abstract and full-text screening, with disagreements resolved through discussion or a third reviewer. Cohen's kappa reported when independent coding is performed. Each included study coded for country, sector, period, sample, instrument, regulation measure, outcome, moderator, identification strategy and principal finding. Quality appraisal assess measurement validity, selection into treatment, data quality, identification, robustness and transparency of causal interpretation.

5. Evidence Synthesis:

5.1 Verified evidence core

Study	Design / setting	Instrument	Key result
Murty & Kumar (2003)	92 Indian sugar firms; panel 1996–1999	Water-pollution regulation/compliance	Technical efficiency increased with compliance and water-conservation effort.
Duflo et al. (2013)	Randomised field experiment; Gujarat	Third-party audit reform	More accurate reporting and reduced pollution.
Gupta & Goldar (2005)	Indian listed firms; event study	Environmental ratings	Poor environmental-performance announcements were associated with negative abnormal returns.
Oak (2017)	Indian cement and pulp/paper; DiD	PAT	No significant average PAT effect on energy intensity.
Pal et al. (2024)	Indian firms, 2006–2015; matching DiD	PAT	No significant average energy-efficiency effect; negative firm-value effect; several adjustment channels identified.
Bagchi & Sahu (2024)	Indian manufacturing; firm-level data	Environmental stringency, pollution and ownership interactions	Evidence links regulation with heterogeneous productivity, FDI and pollution-haven/halo mechanisms.

The Indian evidence does not support a single-direction conclusion. Murty and Kumar (2003) report an efficiency gain associated with environmental compliance in the sugar industry. Oak (2017), studying cement and pulp-and-paper firms, finds no significant average PAT effect on energy intensity. Pal, Mukhopadhyay and Bhagawan (2024) use matching-based difference-in-differences and similarly find no statistically significant PAT effect on energy efficiency, while reporting a negative effect on firm value and identifying repair and maintenance expenditure, R&D, machinery purchases and productivity as potential channels. These results demonstrate why environmental regulation should be analysed jointly with outcome definition and adjustment horizon.

Duflo et al. (2013) provide a different but complementary result. Their randomised field experiment shows that changing the incentives of third-party auditors affected both reporting and pollution. The study demonstrates that enforcement architecture are causally important even when the statutory standard itself is unchanged.

Gupta and Goldar (2005) provide evidence for an information channel. Their event study of Indian firms reports negative stock-market reactions to announcements of weak environmental performance.

5.2 International evidence and the Porter hypothesis

The broader literature indicates that the innovation response is more consistently supported than the strong claim of a net competitiveness gain. Lanoie et al. (2011) find strong support for the weak Porter hypothesis and no support for the strong form in a multi-country facility-level study. Ambec et al. (2013) likewise emphasise that design and context matter. Dechezleprêtre and Sato (2017) conclude that competitiveness effects are generally small and often temporary, while stressing heterogeneity across industries and regulatory contexts.

5.3 Outcome heterogeneity

The term corporate performance covers conceptually different outcomes. Technical efficiency concerns the transformation of inputs into outputs; energy intensity captures energy use relative to activity; productivity captures output relative to inputs; accounting performance reflects realised financial outcomes; and market value incorporates investors' expectations and risk assessments. A regulation improve efficiency while reducing short-run market value if investors anticipate adjustment expenditure. Aggregating these outcomes into a single positive or negative effect is misleading.

5.4 Moderators

The evidence suggests several moderators: R&D capability, financial resources, technology, capital vintage, industry pollution intensity, ownership, access to external finance, and enforcement credibility. These factors determine whether regulation is absorbed as a cost or converted into process and product innovation. The institutional setting is especially important in emerging markets because formal regulatory stringency is not correspond to actual monitoring intensity.

6. Discussion and Propositions

The central synthesis is that environmental regulation is conceptualised as a conditional treatment rather than a homogeneous shock. Four mechanisms recur: compliance costs, innovation, resource efficiency and information/valuation. Their relative importance varies by instrument and context.

P1. Instrument design: Flexible or performance-based instruments produce stronger innovation responses where targets are credible, and measurement is reliable.

P2. Time horizon: Short-run financial costs and longer-run efficiency or innovation effects may differ in magnitude and direction.

P3. Capability: Firms with greater R&D, financial and technological capacity is better able to convert regulatory pressure into productive innovation.

P4. Enforcement: Credible monitoring and reliable verification strengthen the behavioural effect of regulation.

P5. Outcome heterogeneity: Efficiency, productivity, accounting performance and market valuation respond differently to the same intervention.

P6. Ownership and technology: Ownership structure and access to external technology and finance moderate regulatory responses.

7. Research Agenda

Priority	Research gap	Recommended approach
Causal effects	Regulatory exposure is often endogenous	Staggered DiD, event studies, RD or synthetic control with pre-trend and heterogeneity tests
Stringency	Statutory rules do not equal realised enforcement	State $\times$ industry $\times$ year measures using inspections, notices, closures and compliance records
Mechanisms	Limited mediation evidence	Green capex, R&D, energy productivity, maintenance and financing-cost channels
Firm coverage	Listed firms dominate	ASI and other appropriate plant/firm datasets to study small and unlisted firms
Disclosure	Limited evidence on newer reporting regimes	Event studies and panel designs around mandatory disclosure changes
Comparative institutions	Policy and institutional effects are difficult to separate	Comparable designs across emerging economies
Distributional effects	Firm outcomes mask labour and regional adjustment	Employment, wages and regional outcomes alongside profitability

The next generation of research should also make systematic-review materials reproducible. Search strings, screening logs, coding decisions and analytical files should be archived where licensing and confidentiality permit. Such transparency is important for reviews claiming systematic database coverage.

8. Policy and Managerial Implications

For policymakers, the evidence supports careful attention to monitoring credibility, measurement quality, adjustment periods and firm capability. Market-based mechanisms require reliable baselines and verification. Smaller firms may need finance and technical assistance to adopt cleaner technology. Evaluation should consider environmental effectiveness together with productivity, investment and distributional effects rather than relying on a single corporate-performance measure. For managers, compliance should be integrated with energy management, process innovation, technology upgrading and disclosure strategy. The literature does not justify assuming that every environmental investment will raise profitability. It does, however, indicate that regulatory pressure can create opportunities for efficiency and innovation in firms possessing the necessary capabilities.

9. Conclusion:

The reviewed literature shows that environmental regulation and corporate performance are linked through multiple mechanisms and that the direction and magnitude of effects depend on regulatory design, enforcement, firm capabilities, industry conditions and outcome definition. Evidence for innovation responses is stronger than evidence for a universal competitiveness gain. Indian studies reinforce this conditional interpretation: compliance has been associated with efficiency gains in some industries, while PAT evidence is mixed across energy efficiency and firm value, and experimental evidence demonstrates the importance of audit incentives.

The major opportunity for future research is to move beyond broad correlations toward credible causal identification and mechanism-based explanation. Better measures of realised enforcement, longer post-policy periods, broader coverage of unlisted firms, and explicit analysis of innovation, investment, productivity, financing and valuation channels would substantially strengthen the evidence base.

10. Limitations

This revised manuscript is based on the supplied paper plus independently verified scholarly and official sources. It should not be presented as a completed Scopus census until the authors have executed the stated Scopus search and completed the screening process. The original draft contained placeholder PRISMA counts and an incomplete corpus; those values have intentionally not been fabricated here. The final manuscript should report the actual search date, number of records, duplicate removal, screening exclusions, final corpus, inter-rater agreement and supplementary coding file. Heterogeneity in study designs and outcome measures also limits statistical aggregation.

References:

- [1] Ambec, S., Cohen, M. A., Elgie, S., & Lanoie, P. (2013). The Porter hypothesis at 20: Can environmental regulation enhance innovation and competitiveness? *Review of Environmental Economics and Policy*, 7(1), 2–22. <https://doi.org/10.1093/reep/res016>
- [2] Bagchi, P., & Sahu, S. K. (2024). The conundrum of Porter hypothesis, pollution haven hypothesis, and pollution halo hypothesis: Evidence from the Indian manufacturing sector. *Clean Technologies and Environmental Policy*, 27(1), 205–217. <https://doi.org/10.1007/s10098-024-02886-z>
- [3] Callaway, B., & Sant'Anna, P. H. C. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225(2), 200–230.
- [4] Cohen, M. A., & Tubb, A. (2018). The impact of environmental regulation on firm and country competitiveness: A meta-analysis of the Porter hypothesis. *Journal of the Association of Environmental and Resource Economists*, 5(2), 371–399.
- [5] Dechezleprêtre, A., & Sato, M. (2017). The impacts of environmental regulations on competitiveness. *Review of Environmental Economics and Policy*, 11(2), 183–206. <https://doi.org/10.1093/reep/rex013>
- [6] Duflo, E., Greenstone, M., Pande, R., & Ryan, N. (2013). Truth-telling by third-party auditors and the response of polluting firms: Experimental evidence from India. *Quarterly Journal of Economics*, 128(4), 1499–1545.
- [7] Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, 225(2), 254–277.
- [8] Gray, W. B., & Shadbegian, R. J. (2003). Plant vintage, technology, and environmental regulation. *Journal of Environmental Economics and Management*, 46(3), 384–402.
- [9] Greenstone, M. (2002). The impacts of environmental regulations on industrial activity. *Journal of Political Economy*, 110(6), 1175–1219.
- [10] Greenstone, M., & Hanna, R. (2014). Environmental regulations, air and water pollution, and infant mortality in India. *American Economic Review*, 104(10), 3038–3072.
- [11] Gupta, S., & Goldar, B. (2005). Do stock markets penalize environment-unfriendly behaviour? Evidence from India. *Ecological Economics*, 52(1), 81–95. <https://doi.org/10.1016/j.ecolecon.2004.06.011>
- [12] Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, 20(4), 986–1014.
- [13] Jaffe, A. B., Peterson, S. R., Portney, P. R., & Stavins, R. N. (1995). Environmental regulation and the competitiveness of U.S. manufacturing. *Journal of Economic Literature*, 33(1), 132–163.
- [14] Konar, S., & Cohen, M. A. (2001). Does the market value environmental performance? *Review of Economics and Statistics*, 83(2), 281–289. <https://doi.org/10.1162/00346530151143815>
- [15] Lanoie, P., Laurent-Lucchetti, J., Johnstone, N., & Ambec, S. (2011). Environmental policy, innovation and performance: New insights on the Porter hypothesis. *Journal of Economics & Management Strategy*, 20(3), 803–842. <https://doi.org/10.1111/j.1530-9134.2011.00301.x>

- [16] Mandal, S. K., & Bhandari, A. K. (2020). Does win-win opportunity always result in pollution abatement? An application of directional distance function to Indian cement industry. *Journal of Developing Areas*, 54(4), 161–174.
- [17] Murty, M. N., & Kumar, S. (2003). Win-win opportunities and environmental regulation: Testing of Porter hypothesis for Indian manufacturing industries. *Journal of Environmental Management*, 67(2), 139–144. [https://doi.org/10.1016/S0301-4797\(02\)00203-7](https://doi.org/10.1016/S0301-4797(02)00203-7)
- [18] Oak, H. (2017). Measuring Perform-Achieve-Trade: Analysis of Indian cement and pulp & paper industries. *International Journal of Environmental Science and Development*, 8(12), 809–814. <https://doi.org/10.18178/ijesd.2017.8.12.1062>
- [19] Page, M. J., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>
- [20] Pal, K., Mukhopadhyay, J. P., & Bhagawan, P. (2024). Does cap-and-trade scheme impact energy efficiency and firm value? Empirical evidence from India. *Energy Economics*, 134, 107581. <https://doi.org/10.1016/j.eneco.2024.107581>
- [21] Palmer, K., Oates, W. E., & Portney, P. R. (1995). Tightening environmental standards: The benefit-cost or the no-cost paradigm? *Journal of Economic Perspectives*, 9(4), 119–132.
- [22] Paul, J., & Criado, A. R. (2020). The art of writing literature review: What do we know and what do we need to know? *International Business Review*, 29(4), 101717.
- [23] Porter, M. E., & van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, 9(4), 97–118.
- [24] Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333–339.
- [25] Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 14(3), 207–222.