Journal of International Commercial Law and Technology
Print ISSN: 1901-8401

Website: https://www.jiclt.com/

Article

A Systematic Literature Review on Effect of Environmental Regulation on A Firm's Performance

Article History:

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How to cite this article:
Sharma P, *et, al,* A Systematic Literature Review on Effect of Environmental Regulation on A Firm's Performance. *J Int Commer Law Technol*. 2026;7(1):390–400.

Received: *16-12-2025*
Revised: *31-12-2025*
Accepted: *12-01-2026*
Published: *30-01-2026*

Abstract: In recent times, the effect environmental regulations have on firm performance has garnered significant attention amongst the academic literature as well as policy circles. We identified key research agendas to synthesize the studies and find a) the effect of stringent environmental interventions on firm's performance b) the influence of moderating factors of environment regulation such as industry characteristics and region on firm performance, and c) future research gaps. The essential objective is to reduce the possibility of prejudgment and to promote clarity throughout the entire review process by relying on precise evidence and to evaluate the caliber of the included studies .With the help of an exhaustive systematic literature review along with analysis of already existing literature, we have examined and cross-related 49 papers which have been published in Scopus database over the period of 2006-2024.The findings showed that a dominantly positive relationship between environment regulation and firm performance. This review contributes to a clear and novel understanding of the ways environmental regulations can shape firm behavior and its performance, offering implications for both theoretical development and managerial practice in the realm of sustainable business strategies.

Keywords: environment regulations; firm performance; Industrial Growth; emissions; firm behavior; environmental law.

INTRODUCTION

There is significant discussion and view of the most suitable and notable environmental regulatory norms to keep the industry under certain checks. Broadly, the effects of these regulations can be classified into positive and negative behaviors (Xiaoting *et al*., 2022). This can have an impact on the firms "performance" and "productivity" as well. The literature and surveys on firm performance focus on R&D intensity on the corporate profit rate (Chen *et al*., 2022), the changing behaviors of firms, the aggregated environmental and economic performance, and other parameters that are affected by environmental regulation, both industrial and regional (Li and Li, 2022). For the purpose of this paper, ER shall be used as an abbreviation to Environmental regulation.

In view of performance, Porter Hypothesis suggests ER leads to an increase not only in firms' development (R&D) investment but it's innovation level too (Xiaoting *et al*., 2022). It emphasizes that firms' productivity is improved; however, rigorous and increased ER can negatively impact FP. (Li and Li, 2022) Therefore, it becomes essential for studies to explore the effects ER have on firms' behavior and then guide the government in making suitable regulations.

ER has emerged as a significant research subject in many countries, especially where industrial growth is high. ER is an evolving field that has gained prominence and it is difficult to define its scope concretely. According to Crandall, it has become popular or "fashionable" to blame excessive environmental regulations for a wide range of societal and economic issues (Moosa, 2016). ER is defined as the imposition of certain restrictions or obligations to be fulfilled on people, businesses, and other organizations to prevent environmental harm, screen public health, and/or reinstate deteriorated ecosystems. In this article, the term is used to focus on the legislation and regulations mandated by industry sectors. (Percival *et al*., 2020) ER inherently influences outcomes by determining how regulatory costs and benefits are allocated, thereby shaping winners and losers in the process (Wang *et al*., 2024). Over the past few years, the sharp increase in emissions from industries has been positively correlated with stringent ER. (Brolund and Lundmark 2017)) For example, in China, rapid growth over the past 40 years has resulted in high environmental costs (Kong, 2024). Therefore, to offset industrial impacts, the government implements ER to benefit society as a whole. Existing literature reveals contrasting views on how environmental regulations are shaping business performance.

Firstly, rigorous regulations coerce firms to innovate and comply with sustainable practices. This impacts production processes, earmarking of resources, and compliance related costs. (Han *et al*., 2023) Secondly, Environmental Policies boost the profitability of companies in the pilot cities. These companies are better equipped to develop low-carbon and green concepts, innovate, integrate and convert innovation inputs and outputs efficiently, and raise the bar for high-tech and environmentally friendly development on a constant basis.(T Iqbal, 2022) For example, a study concluded that Organizational Environmental Management System (EMS) in textile sector in Pakistan has a positive impact on environmental performance and organizational performance (Ou and Jiang, 2023). Thirdly, Large-scale exporters are most affected by the reallocation effect of global markets after having to deal with stricter environmental laws. (Porter and Linde, 1995)

Based on the above reasons, more and more companies' invest in technological innovation, so as to benefit from green innovation compensation, thereby improving enterprises' competitiveness. (Han *et al*., 2023) However, some studies also conclude that when weighed against increasing the profitability of small businesses, these laws do not have the same proportional importance for huge corporations. (Di Zhu *et al*., 2022)

While there exists some relevant literature reviews, most of them emphasize on sustainability and environmental practices related to industries. For instance, when reviewing the existing literature on corporate sustainability (Oliveira *et al*., 2024) reviewed data from 2011 to 2020 without any special focus on firm's performance whereas Amna Farrukh (2022) considered data which included flexible packaging and Environmental Sustainability Issues. Thus, to the best of our knowledge, prior review no study has exclusively focused on effect of ER on firms performance. Therefore, it becomes pertinent to undertake a systematic literature review (SLR) which specifically focuses on ER in relation to firm's performance and behavior to gain a comprehensive and critical understanding of the advancements and identify gaps in the research.

The essential objective of the SR approach is to reduce the possibility of prejudgment and to promote clarity throughout the entire review process by relying on precise evidence and to evaluate the caliber of the included studies. (Lame, 2019) To help achieve these objectives, the current study answers three pertinent research questions:

(RQ1): What is the research profile of relevant studies that cross examined the effect of Environment regulations on a firms and industry's performance?

(RQ2) What are implications of environment regulations on firm's behavior and do they result in positive impact?

(RQ3) What divergent thematic research areas and research methodology have been used in the existing literature?

(RQ4) What are the existing gaps and future research avenues (or areas for research) for the respective topic?

The present study followed the SLR protocol and steps recommended by the prior research. (Lame, 2019) The review protocol is mentioned in Table I.

Table I: Review protocol

Unit of analysis	Open access journal articles in the English language were selected
Search limitations	The search was limited to journal articles on the effect of environment regulations on firms behaviour
Type of analysis	Qualitative
Time period of analysis	Not specified
Boolean operators used	AND and OR
Search fields	Title, abstract, keywords
Databases	Keywords were searched in different combinations from the popular database SCOPUS
Keywords used	Environmental

	Regulation, Environmental Law, Firm behaviour, , firm performance

After implementing the preceding research protocol that will be elucidated in research methodology part xx, we will give response to the Research Questions. In respect to RQ1, we employed content analysis to outline the key impact of regulations on various industries in different countries. We approached RQ2 by generating descriptive statistics of methodology deployed and outline of key themes from selected studies by outlining the research context. Finally, in the latter part, we discussed RQ3 by studying limitations and discovering avenues for further research.

The introduction focuses on objective of the research and further, it mentions the data set utilized and identified for the SLR. The Scopus database was chosen for the literature search, because it is an international database of peer-reviewed publications from all over the world nature, making research comprehensive (Schotten *et al*., 2017). Secondly, the PRISMA model was employed as a systematic review protocol to mention the studies excluded and included in the research. The application of the PRISMA protocol has supported to create a dataset of papers. Thirdly, comprehensive content oriented research was undertaken to study the composition of the papers, and to identify the methodology used, hypothesis taken, objectives, findings and gaps thereof in each paper. The paper follows a structured outline comprising several sections. Initially, in first part of the review we provide the descriptive analysis of data identified and the search process. We also add the comprehensive dissection on the basis of year, research methodology, industry and country. Subsequently, we delve into by studying the objectives and findings of articles selected. Moving ahead, we conclude by addressing the limitations encountered during the study and offering insights into potential future research directions.

IDENTIFICATION OF DATA

Firstly, 1903 empirical studies were selected from Scopus Database only. The keywords employed to find the concerned publications were Environmental Regulation, firm behavior, Environmental Law, firm performance. We used broad keywords to retrieve more exhaustive and inclusive results as this was the initial stage of research (Xiao and Watson, 2017)

Figure I: PRISMA MODEL 2020 Flow diagram

A set of keywords were identified and used to refine collection of data that was to be used in the search and subsequent. A general search string was formed using these keywords. Data was searched using the search string: "environment" AND "regulations" OR "laws". Additional search string added was: "firm" AND "behavior" OR "performance". Publications adhering to the search string were identified.

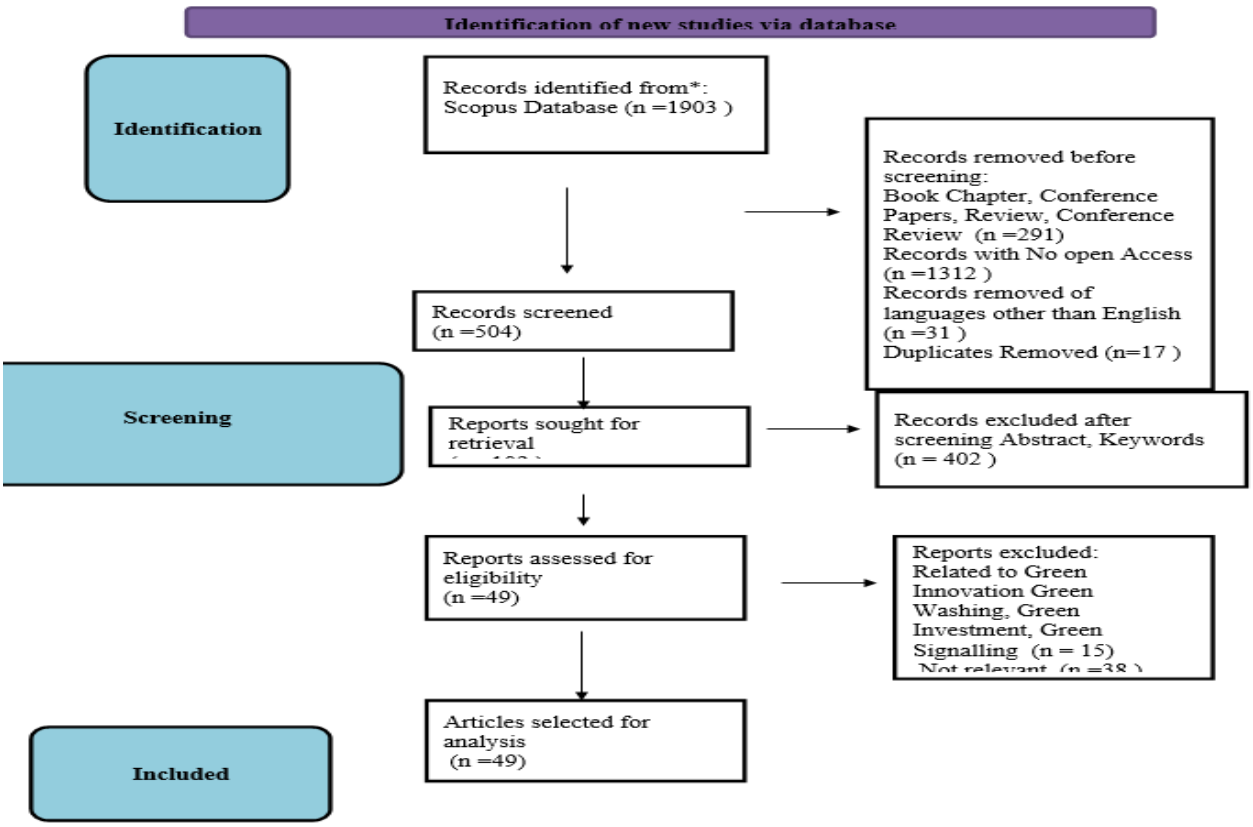
The researchers assessed each article under the inclusion and exclusion criteria given in Table II.

Table II : Inclusion exclusion criteria

Criterion	Inclusion	Exclusion
Literature Type	Article	Book Chapter, Conference Papers, Review, Conference Review
Content	Discusses about impact of ER on firms behaviour	Broader study; Green Innovation Green Washing, Green Investment, Green Signalling
Language	English	Non-English
Access	All Open Access	No open access

The following were excluded from the SLR: Book Chapter, Conference Papers, Review, Conference Review, Records with No open Access and Records of languages other than English. As a result, we received 521 articles. After analysis the Duplicate and redundant records comprising 17 articles were further extracted.

Further, after thorough analysis, we excluded themes related to green innovation green washing, green investment, and green signaling to keep the scope of the research precise and concrete. Only those articles which were focused only on the relationship between environmental regulations and industrial dynamics were selected. At the final stage, 49 articles meeting the inclusion criteria and so were being incorporated in the evaluation procedure. A detailed PRISMA 2020 statement is attached to improve the transparency and consistency of reports in Figure I below. (Sohrabi *et al*., 2021).



The following characteristics of research methodology reliability were coded: (a) research methodology (example, DID model, Interview, Case study, Regression) (b) Hypothesis formed (c) Objective of the research (d) Findings (e) Time frame in on which research was conducted (f) Industry (g) Country

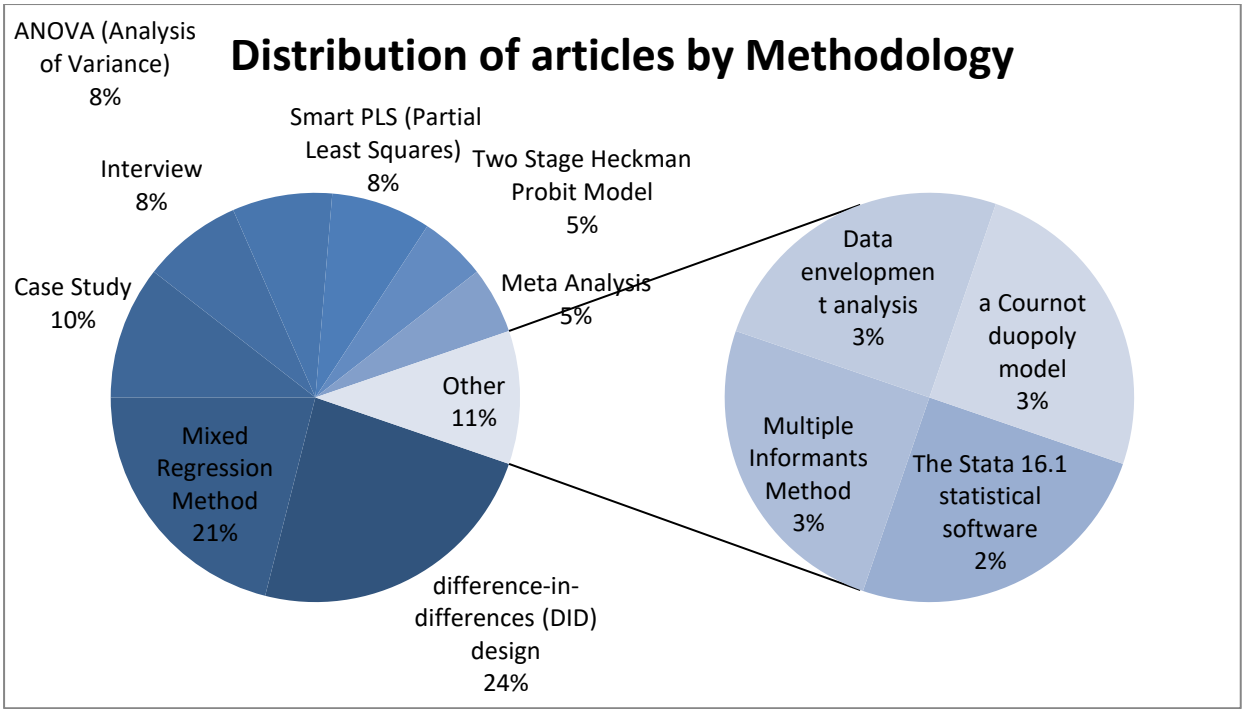
To obtain responses to the research questions, the present systematic review looked at 49 research publications about impact of ER on an industry and firms behavior published from the year 2006 to 2024. The uniqueness and importance of this study lies in its ability (1) to provide the most comprehensive and latest review of impact of ER , summarizing the current studies on industries within an integrated framework; (2) to reduce the intricacies of industrial response on environmental regulations by offering structured review and coherence; and (3) to furnish links between firm's innovation through ER , established viewpoints in the literature on management, environment, corporate governance and law. In addition, it is one of the first SLRs specifically focused on effect of ER on firm's performance, identified key emerging thematic research areas, gaps, and avenues of future research as well as developing an important research framework.

DISTRIBUTION OF STUDIES

Distribution of studies according to Methodology and Hypothesis

Our methodology analysis revealed that mostly quantitative analysis was carried out using different research models. In statistical analysis of data, difference-in-differences (DID) modeling was the most popular. Regression analysis and least square methods held equal importance while Analysis of Variance (ANOVA) test or LPM had fewer references. Questionnaires were prominently used while interviews, personal communication and company documents had also been used. Focus groups, SLR, Meta analysis, conceptual reviews, and case studies had fewer references. Keeping up with the technology, Stata 16.1 statistical software, computerized models and open coding were also used. The distribution of studies according to research methodology is illustrated in the figure II

Figure II: Distribution of articles by methodology

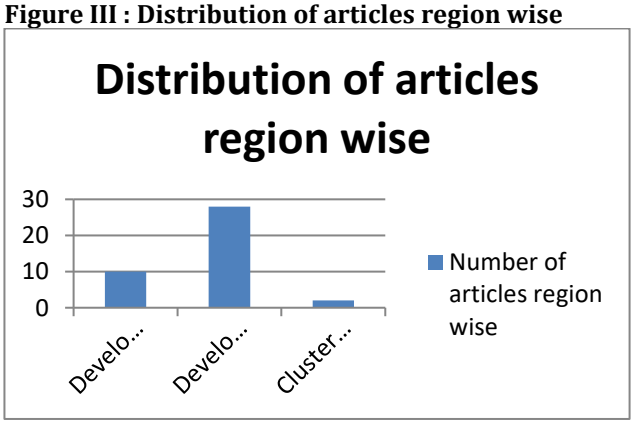


Most of the papers, 29% adopted porter hypothesis (Zhu and Zhao 2022 , Mu *et al*., 2022, Liu *et al*., 2022) while rest developed their own propositions and hypothesis (Yuan Ao *et al*., 2023, Beule *et al*., 2022). Pollution-haven hypothesis and Cost Regulation hypothesis (CRH) have also been worked upon by a few (Yi Zhou *et al*., 2017, Manderson and Kneller, 2012, Liu *et al*., 2022). Some literature shows that environmental regulation has an adverse effect on financial performance in the short term due to green innovation investment. However, in a prolonged period, it has a positive impact due to increased operational efficiency. This supports both, the Porter Hypothesis as well as the Costly Regulation Hypothesis. (Liu *et al*., 2022). It has also been observed that the Porter Hypothesis is more likely to find support at broader scales such as the state, regional, or national levels, rather than at more localized levels like individual facilities, firms, or industries. (Cohen and Tubb 2017)

Distribution of Studies region wise

In accordance of the World Economic Situation Prospects 2024, Studies were categorized into developing or developed countries (International Council on Archieves, 2024). It was identified that, of the 40 empirical papers, 2 are cluster papers, one of which examine the case of developed countries together, Canada, France, Germany, Hungary, Japan , Norway and United States (Manuel Frondel *et al*., 2018) and the other examines developed and developing country (United Kingdom and China) (Ramanathan *et al*., 2016). Further, 82 percent of the remaining publications from those 38 papers examine developing countries (e.g. China, Pakistan, Korea, Morocco) and the rest 18 percent focus on the developed countries (e.g. Poland, United Kingdom's, Europe, Australia, Germany). A significant proportion of the publications investigate China's industries, with 60 percent of the research papers. In contrast, region least represented is the Baltic Sea with only 2.5 percent of publications. The distribution of studies region wise is illustrated in the figure III.

Figure III : Distribution of articles region wise



Analysis conducted from the SLR affirms that research was carried across various diverse geographical locations, namely developed, developing countries. Nevertheless, most studies examine environmental regulation in developing country, China. The UK (with 4 studies) and Europe (with 3 studies) are the countries in majority out of the developed cluster, but only 1 study examines the effect of environment regulation on industries from the US (citation). This is not surprising in view that US has comparatively non stringent environmental policies at the scale of 3.03 on the OECD

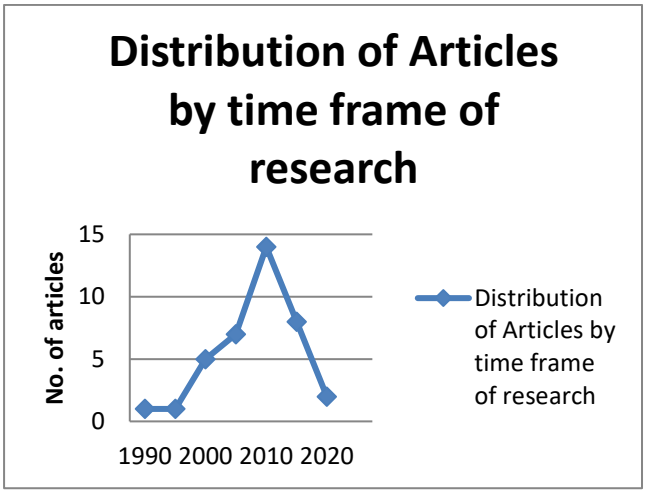
Environmental Policy Stringency Index (EPS) (OCED Stats, 2024). In addition, based on our findings, 1 study offers insights between industries in United Kingdom and China. It suggests that firms with adequate resources and capabilities tend to benefit more from sustainability by adopting innovative strategies to comply with environmental regulations effectively. Although, based on 9 case studies, this research does not truly constitute a comparative study.

Distribution of studies on the basis of time frame

The analysis of these articles reveals intriguing trends across different time frame. The findings show that maximum number of articles studied the effect of environment regulations for the year 2010-2015. Only few studies were done for the time period of 1990-1995. Research was extensively done 2000 year onwards, which indicates that environmental regulations were actively studied of these years due to alarming issues of firm's responses. A decline is seen in the study for 2020-2025 periods; however more studies can be expected on this time period in future.

The distribution of studies according to time frame of research is illustrated in the figure IV.

Figure IV: Distribution of articles by time frame of research



Distribution of studies industry wise

A noteworthy number of the research has been carried out in general, rather than emphasis on a particular industry. Large and listed companies appear lot more times and seem to be the first ones to follow environmental regulations (Yuan & Bangzheng 2024, Chen *et al*., 2022, Sun and Zhang 2023). The findings indicates that empirical studies were carried across various categories of industries, namely starting from the pulp and paper industry (4, 14), olive oil industry (Bounadi *et al*., 2022), shipping industry (Stalmokaitė and Yliskylä-Peuralahti 2019) to textile industry (T Iqbal *et al*., 2022, Gong *et al*., 2022). However, most research is found in the Chinese A-share companies listed on the Shanghai and Shenzhen stock exchanges (29%) and manufacturing sector setting (20.4%). Case companies of different industries which are under the ambit of a range of environmental regulations locally, nationally or internationally are also taken up by some papers. (Ramanathan *et al*., 2016).

In particular, almost half of the articles included target the enterprises representing highly polluting industries with manufacturing plants (Ramakrishnan *et al*., 2017, Frondel *et al*., 2018, Stoever & Weche, 2018). This can be attributed to the fact that manufacturing sector consumes significant amount of energy, which results to an increase in the carbon emissions and other pollutants.

The examination of multiple industries underscored varied effects across different industries. While some reacted positively and showed a growth across their environmental and financial performance (Wenzhe Yu *et al*., 2024), there were others which displayed negative trends like decline in profits (Wanga and Liu, 2023). This was specially ascertained in the power sector which is usually subjected to stricter environmental regulations. This sector showed a major decline across its profit and output, along with a decrease in firm's emissions and inputs, both labor and capital (H. Wang *et al*., 2024). Similarly, in the heavily polluting industries of China also, a negative relation has been observed between the environmental regulations and the industries financial performance, both short-term and long-term. Although it was also observed that the technological innovation and adaptation were able to partially offset this negative impact (Yiling and Tong, 2022).

A case study on olive oil industry concludes that environmental regulation encourages the acquisition of environmental technology by olive oil mills, but it does not have domination on their environmental performance. (Bounadi I *et al*., 2022) It linked adherence to environmental standards with external factors such as collaboration with external entities and international market focus, as well as internal factors such as environmental awareness and technical expertise of the producers.

Wenzhe Yu also points out to the interplay of various factors such as ownership type and financial constraints that can significantly affect the association between environmental restrictions and firm's response.(Wenzhe Yu *et al*., 2024) Stalmokaite, Igne focused on shipping sector and concluded that the environmental regulation cannot operate in a closed environment and therefore apart from it, there are many other factors that affect shipping sector's taking up of particular technological solutions and hence it's costs and profits. (Ignė, and Yliskylä-Peuralahti. 2019)

In the energy industry, firm size distribution and investment decisions are significantly impacted by

the choice of policy instrument. Firm's optimal scale gets affected by emission taxes and performance standards as decided by environmental regulatory bodies. Firms also get incentivized for adopting various compliance models and technologies. As a result emission reducing technologies fare better as compared to market based instruments. Overall it has been observed that small firms are favored by regulatory asymmetries regarding emission standards. Whereas large scale firms have to suffer a decline in profits as emission standards are observed to have a more regressive impact across firm size. (Coria and Kyriakopoulou, 2018)

In the polluting industry , a firm in the green sector having high carbon dioxide emissions has been found to adapt faster to the constraints imposed by stern environmental regulations and enhance job opportunities and efficiency in labor output. In comparison, a firm belonging to non-environmental sector faces increase in costs due to highly polluting nature and thus is negatively affected by the regulations. (Yoo and Heshmati, 2019)

RESULTS AND DISCUSSION

This SLR indicated a predominantly positive impact that environmental implications have on firm's effectiveness , except for some research (Wang and Liu, 2022), (Yiling and Tong, 2022) .A positive impact of environmental regulation was consistently demonstrated by empirical research.(Wenzhe Yu *et al*., 2024, T Iqbal *et al*., 2024, Di Zhu *et al*., 2022) However, there was evidence supporting both positive and negative impacts on financial performance.(Liu *et al*., 2022, Chen *et al*., 2022 , Yoo and Heshmati, 2019, Hua Tan *et al*., 2017)

Although environmental regulations seem to negatively affect firm's financial performance due to various compliance related costs, their financial performance improve with time. (Liu *et al*., 2022). M Li and Z Li observed that the relation between environmental regulation and firm performance is not linear but an inverted U-shape. That's because compliance of some degree to environmental regulation significantly increases firm performance. (Li and Li, 2022) However, adherence to same beyond a certain degree starts showing declined trends on firm performance. This is also ascertained by Wlodarczyk and Woszczyna. (Włodarczyk *et al*., 2024)

On the other hand Xing, Liu, Shen and Wang (Xing *et al*., 2020) concluded that environmental regulation and financial performance are not significantly linked. In fact Environmental regulations often influence financial performance indirectly through the development of green dynamic capabilities and innovation in sustainability exploitation.

If the environmental regulations faced by a firm are flexible and offer more freedom to firms in meeting the requirements of regulations, then the firm's financial performance is significantly improved. Whereas, inflexible regulations are not so effective in improving their financial performance with their innovation capabilities (Ramakrishnan *et al*., 2017).Nevertheless stricter regulations forcing firms into environmental compliance and protection reaped benefits for them in terms of reduced costs, incentives and increased profit rate (Chen *et al*., 2022).

Similarly, firms are deterred from investing in potential host countries if they operate stringent environmental regulations as their cost of compliance is significantly increased. This will significantly affect location decisions of multinational enterprises (Manderson and Kneller, 2012).

In fact, regulatory bodies such as government should introduce new environmental policies tailor made according to different firm characteristics like size.(Bertarelli and Lodi 2019) It's because adapting and responding to environmental regulation depends upon firm resources and capabilities. Those who are proactive in their compliance to such regulations are able to reap better and private benefits of sustainability. (Ramanathan *et al*., 2016) For instance, a paper observed that when a firm is small, its growth could be suppressed under emissions tax, especially during the initial phases and therefore environmental regulation does not affect it strongly. (Hartl and Kort, 1996)

FUTURE RESEARCH RECOMMENDATIONS

The systematic literature review offers valuable insights into potential avenues for future research, focusing on two primary areas of investigation:

i) Topics concerning environmental regulation and avenues for future research in this field ;

ii) Various levels of analysis in future research work.

Most of the research papers reviewed focus on the effects of a particular environment regulation (Geng *et al*., 2012 , Bertarelli and Lodi 2019). There is a need for consideration of other types of environmental regulations also as these could affect the organizations in a completely different way. Studies could also be undertaken to understand an integrated effect of overall pollution regulations on firm behavior. Many of the results and observations made are general in character. The probability of industry or organizations readjusting accordingly has not been considered. The analysis of many does not consider the interplay various factors such as prices, customers, costs, output and quality show in the process of an organization's adherence to environmental regulations. In fact it has been assumed that these factors are not affected and do not affect the organization's enforcement of the environmental regulations. (Downing *et al*., 1975)

These factors which have been left unobserved still account for unreported bias that influences the

relationship between environmental laws and business performance. In addition to this, there might be organization specific selection mechanisms to prefer certain environmental regulations which in itself could contribute to better performance of the respective organization. (Frondel *et al*., 2018)

Although the literature used focuses on the role of environmental regulations on firm behavior, the fact that the regulatory control is not the only factor contributing to firm performance can't be ignored. There is a need to look into the interplay between various other factors (e.g., cost of compliance, scale of firm, industry, customer group) in firm performance. Also, environmental regulations of different categories such as mandatory Vs voluntary regulations can influence firm behavior in different ways. It is desirable that some research should be conducted regarding this too. (Xing *et al*., 2020). More longitudinal and in depth case studies could help to understand the long term effects environmental regulations have on firm performance. It is also essential to understand whether these effects persist over time or tend to perish in long term. (Frondel *et al*., 2018)

Studies should also be conducted to bring to the forefront the effects environment regulations have on environmental Vs non-environmental sectors respectively.(Yoo and Heshmati, 2019)

Similarly more studies could be carried out on state-owned Vs non-state-owned firm's reactions to environment regulations. (Tang and Demeritt, 2017). It should also be noticed that business organizations tend to collaborate and adapt while facing environmental adversities. Therefore these collaborations and adaptations as a result of environmental regulations also warrant further research and attention. (Yuan Ao *et al*., 2023)

Most of the research papers reviewed in this SLR use CO2 emissions as a parameter to define polluting industries. Using other pollutants such as SO2 to expand this definition can be more informative. (Yoo and Heshmati,2019). The existing literature has overlooked the diverse impacts of industrial and regional environmental regulations on the performance of both state-owned and non-state-owned firms. (Li and Li, 2022). Exploring regional heterogeneity, analyzing various types of environmental regulations, and examining spatial spillover effects is yet to be considered.(Chen *et al*., 2022)

CONCLUDING REMARKS

The concept of environment regulations and its impact has been studied in divergent fields. Our study contributes to get understand in-depth scope of firms response to these implications. This research contributes for the growth of firms to achieve sustainable growth while regulating emissions. This SLR offers deep insights to academia, policy makers and practitioners about the relation that exists between environment regulations and firm performance. The SLR helps regulatory authorities to reflect on the effectiveness of the regulatory laws and also offers an insight into interplay of various factors leading to compliance of these laws. These insights are helpful not only while designing of regulations but also oversees their effective implementation. It points out how compliance and effectiveness of different laws can vary from industry to industry, region to region and so on. It supports the idea of heterogeneity across organizations and industries. Thus this research has practical implications for policy makers and regulatory authorities. The SLR could therefore be of help to them in developing better strategies and policies for effective environment regulation of firms. They can also understand lack of research in certain critical areas and thus can help in fostering further research on recent trends like green washing, green innovations etc.

However, there are few limitations to this review. Firstly, few publications, which might be related to the wider issue of environmental regulations might have been excluded due to the choice of the search keywords. A follow up research which could analyze and provide insight on these specific topics is advantageous to contribute to the literature further.

Secondly, papers only from Scopus database were selected. This led to the exclusion of not only papers in books, book chapters and those presented at the conferences but also those indexed in journals of other databases. Thirdly, only English language articles were reviewed though we can't be oblivion of the fact that indexed articles written in other languages such as French, Spanish etc., contribute equally to the literature. The literature published in languages other than English could be reviewed in future. Our research identifies opportunities for further research. This can help scholars identify areas which need further attention and thus could be researched upon. In fact Universities also can actively contribute by promoting research on these gaps in the literature.

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