FROM REGULATION TO RENEWABLE: THE MEDIATING IMPACT OF PROACTIVE ENVIRONMENTAL MANAGEMENT ON ENERGY CHOICES IN MENA FIRMS

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ABSTRACT

This paper investigates the impact of environmental regulations, specifically energy taxes (TAX) and energy performance standards (EPS), on the adoption of in-house renewable energy (REN) by firms in the Middle East and North Africa (MENA) region. Utilizing data from the World Bank Enterprise Survey (2019-2020) covering 5,001 firms across six MENA countries, the study employs logistic regression and generalized structural equation modeling (GSEM) to analyze both direct and indirect effects. The results reveal that while EPS significantly promote the adoption of REN, TAX has a negative impact, hindering renewable energy investments due to increased operational costs. The mediating role of proactive environmental management (PEM) is also examined, confirming that EPS enhance, while TAX diminishes, the effectiveness of PEM in fostering in-house renewable energy adoption. These findings underscore the need for balanced regulatory frameworks that combine clear performance standards with supportive measures to mitigate the financial burdens of energy taxes, thereby promoting the achievement of Sustainable Development Goals (SDGs) in the MENA region.

1 INTRODUCTION

The intersection of environmental sustainability and corporate responsibility is garnering increasing attention globally, particularly in the context of renewable energy utilization (REN) in the Middle East and North Africa (MENA) region. This region, known for its abundant energy reserves and dynamic regulatory environment, presents a unique setting for integrating sustainable energy alternatives with traditional energy sources. Academic discourse on environmental regulations at the macro level is extensive and varied. Studies like those by Tang et al. (2017) and Shi et al. (2019) support environmental regulations, such as taxation, for reducing emissions and stimulating green industry growth. However, Yi and Li (2018) and Xie Dai et al. (2018) offer a more cautious perspective, emphasizing the complexities and potential economic impacts of such policies.

Despite extensive macro-level research, there is a notable gap in understanding how individual firms, especially those in the MENA region, respond to environmental regulations and adopt in-house renewable energy. This paper aims to fill this gap by analyzing the effects of energy taxes/levies and energy performance standards on in-house renewable energy adoption in MENA firms.

The study introduces Proactive Environmental Management (PEM) as a mediator in the relationship between these regulations and REN adoption, aiming to reveal how proactive strategies can enhance or hinder the impact of regulations on REN adoption. This approach underscores the importance of corporate environmental responsibility in achieving environmental objectives and sustainable development goals (SDGs). The specific research problem we address is threefold:

- To determine the direct influence of energy taxes/levies on REN utilization in MENA firms,
- To assess the direct influence of energy performance standards on REN utilization in MENA firms,

https://doi.org/10.52202/077185-0139

- To explore how PEM mediates the relationship between these regulatory measures and REN adoption.

The paper is structured as follows: the literature review and hypothesis are in Section 2, the methodology in Section 3, the results are discussed in Section 4, and Section 5 concludes by summarizing key findings and their implications for sustainable development in the MENA region.

2 LITERATURE REVIEW AND HYPOTHESIS

2.1 Environmental Regulations and Renewable Energy Utilization

The literature on environmental regulations (ER) and their impact on renewable energy and emissions is extensive and varied. Studies by Tang et al. (2017) and Weng et al. (2018) suggest that ER can reduce pollution and emissions while boosting green industry growth, with Shi et al. (2019) highlighting improvements in energy efficiency. Villoria-Saez et al. (2016) provide empirical support for the effectiveness of emission trading schemes and environmental taxes. High taxation is argued by Bi et al. (2019) and Mardones and Baeza (2018) as necessary to significantly reduce CO2 emissions, supported by Román et al. (2017). Positive effects of ER in China are shown by Zhang et al. (2019) and Zhao et al. (2020), indicating improvements in environmental quality and energy consumption reductions. Murshed et al. (2021) and Zhou et al. (2018) highlight ER's role in reducing emissions across sectors, including transportation. Research by Shuai et al. (2018) and Pei et al. (2019) indicates that ER benefits include reducing emissions and improving technological efficiency, with Murshed (2020) and Akalin and Erdogan (2020) noting positive impacts of environmental innovations fostered by governance.

Conversely, some scholars express concerns about the long-term effectiveness and economic impacts of ER. Yi and Li (2018) highlight potential shortcomings of environmental taxes, suggesting they may not be effective long-term, while Xie Dai et al. (2018) emphasize possible economic drawbacks of CO2 taxes. Tian et al. (2017) offer a cautious view on CO2 taxes, suggesting limited impact on emissions and potential short-term economic challenges. Omojolaibi and Nathaniel (2022) indicate that ER's impact is not uniformly positive and can sometimes foster renewable energy sector growth, supporting the Environmental Kuznets Curve (EKC)[1] concept. Based on this literature, we propose the following hypotheses:

H1a: Energy taxes/levies have a negative effect on firms' utilization of in-house renewable energy.
H1b: Energy performance standards have a positive effect on firms' utilization of in-house renewable energy.

2.2 The Mediating Role of Proactive Environmental Management

Proactive Environmental Management (PEM) is essential for shaping sustainable business strategies. Aragon-Correa and Rubio-Lopez (2007) view PEM as a voluntary and holistic approach, extending beyond compliance with environmental regulations. This approach includes strategies such as eco-friendly product development and green marketing (Peng and Lin, 2008). Klassen and Whybark (1999) and Gilley et al. (2000) categorize PEM practices into pollution prevention, management activities, and pollution control, distinguishing between process-driven and product-driven initiatives. Potrich et al. (2019) note that firms engaged in PEM often surpass regulatory requirements, using these regulations as a foundation for innovation and integrating renewable energy into their strategies. PEM involves a continuous improvement cycle for refining environmental practices in line with evolving regulations. Buysse and Verbeke (2003) indicate that resource-based capabilities and stakeholder integration enhance the adoption of proactive environmental strategies and renewable energy sources. Darnall and Kim (2012) highlight environmental and operational improvements resulting from environmental management systems.

PEM encourages structural and organizational changes, fostering leadership and employee motivation towards sustainable practices, leading to efficient resource management and productivity improvements (Pereira-Moliner et al., 2015). Ozusaglam et al. (2018) emphasize the synergy at different organizational levels, augmenting green technology implementation and waste reduction. Menguc et al.

[1] Hypothesizes that as an economy develops, environmental degradation initially increases, then reaches a peak, and subsequently declines, forming an inverted U-shape relationship between environmental impact and economic growth.

https://doi.org/10.52202/077185-0139

(2005) demonstrate the benefits of prioritizing environmental goals, supported by voluntary certifications that attest to a firm's environmental commitment (Chan et al., 2018). Therefore, the proposed hypotheses are:

H2a: Proactive environmental management mediates the relationship between energy taxes/levies and firms' adoption of in-house renewable energy.

H2b: Proactive environmental management mediates the relationship between energy performance standards and firms' adoption of in-house renewable energy.

2.3 Research Gap

Most research on the relationship between environmental regulations and renewable energy adoption has focused on macro-level trends and policy impacts on corporate practices. However, there is a notable lack of detailed analysis at the micro or firm level, particularly in the MENA region. This gap is significant considering the region's unique environmental challenges and its crucial role in global sustainability and renewable energy development. Additionally, current discussions often overlook the mediating effect of firm behavior on regulatory pressures and environmental outcomes. Our study addresses this gap by analyzing how proactive environmental management (PEM) influences firms' responses to environmental regulations and their shift to in-house renewable energy within the MENA context. Specifically, we explore the impact of energy taxes/levies and energy performance standards on firms' ability to adopt renewable energy and examine the role of corporate environmental responsibility in achieving sustainable development goals.

Our research framework, illustrated in Figure 1, begins with testing two hypotheses: *H1a* examines the negative effect of energy taxes/levies on firms' adoption of in-house renewable energy, while *H1b* examines the positive effect of energy performance standards on firms' adoption of in-house renewable energy. We then progress to hypotheses *H2a* and *H2b*, exploring the role of PEM as a mediator in these relationships. This comprehensive framework provides a nuanced understanding of how environmental regulations and proactive management practices drive the shift towards renewable energy in the MENA region, offering valuable insights for policymakers and business leaders.

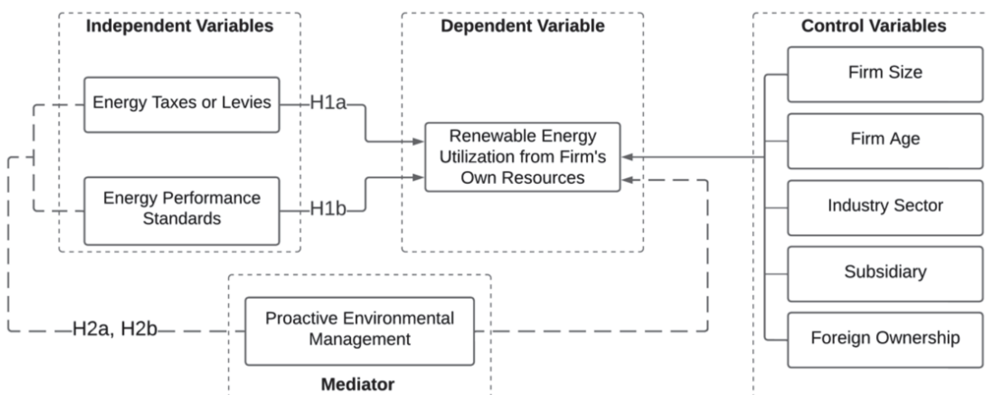

Figure 1: Research Framework and Hypothesis

3 EMPIRICAL METHODOLOGY

3.1 Data and Sample

For our empirical analysis, we used data from the World Bank Enterprise Survey (WBES)[2] covering 6284 firms from various MENA countries, refined to 5001 firms after data cleaning. This survey provides extensive data on business environments and is designed for cross-country comparability, focusing on private sector growth and economic evolution. The dataset includes recent information (2019-2020) from six MENA countries[3], selected for their availability of microdata from the WBES,

[2] This data, consistently computed across all surveys, is openly accessible and does not require special authorization for use, catering primarily to academic researchers, policy makers, and international institutions. The details of the sampling methodology and other information related to the survey can be found on the website www.enterprisesurveys.org.

[3] Egypt, Jordan, Lebanon, Morocco, Tunisia and West Bank and Gaza.

https://doi.org/10.52202/077185-0139

and offers a homogenous pool for accurate cross-country analysis. The World Bank's stratified random sampling method, categorizing firms by size, sector, and location, ensures data representativeness and robustness, enhancing the validity of our results.

3.2 Description of Variables

- Dependent variable

Renewable Energy Utilization from Firm's Own Resources (*REN*): is crafted to assess whether establishments utilize energy from their own renewable sources, such as power plants using solar, wind, hydro, biomass, or geothermal energy. This variable is operationalized as a binary metric.

- Independent variables

- Energy Tax/Levy (*TAX*): Represents the financial charges imposed on firms for energy consumption, capturing whether a firm is subject to an energy tax or levy, allowing evaluation of financial regulatory measures' impact on renewable energy adoption.

- Energy Performance Standard (*EPS*): Represents regulatory requirements for energy efficiency and performance, illustrating whether a firm complies with energy performance standards, enabling assessment of regulatory performance requirements' impact on renewable energy adoption.

- Mediating variable

Proactive Environmental Management (*PEM*): is measured using two discernible indicators:

- The inclusion of environmental concerns within strategic objectives;

- The appointment of a designated manager responsible for environmental issues;

Each indicator is coded as 1 for presence and 0 for absence. These are then aggregated into a composite variable, functioning as an ordinal metric to represent the degree of proactive environmental management in establishments.

- Control variables

- Firm Size (*SIZE*): Logarithm of the number of full-time permanent employees, larger firms are more likely to adopt environmentally friendly practices (Delmas & Toffel, 2004; Horbach, 2008).
- Firm Age (*AGE*): Logarithm of the difference between the survey year and the firm's establishment year, indicating accumulated experience and adaptability in adopting green initiatives (Wang, Y., 2015).
- Industry Type (*INDUSTRY*): Binary variable, 1 represents manufacturing and 0 signifies services, highlighting differences in environmental impact and regulatory compliance (Shen et al., 2019).
- Subsidiary Status (*SUBSIDIARY*): Binary variable indicating if a firm is part of a larger company, reflecting corporate governance structures influencing environmental strategies.
- Foreign Ownership Status (*FOREIGN*): Binary variable capturing potential cross-border transfer of environmental practices and regulatory compliance behaviors.

Having delineated the variables under consideration and specifying that the unit of analysis for this study is firms in the MENA region, we now present the descriptive statistics in Table 1 to offer a preliminary overview of the data's distribution and central tendencies.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
REN	5001	.029	.168	0	1
TAX	5001	.267	.443	0	1
EPS	5001	.067	.25	0	1
PEM	5001	.17	.477	0	2
AGE	5001	3.134	1.321	0	8.786
SIZE	5001	2.865	.74	0	5.094
INDUSTRY	5001	.582	.493	0	1
SUBSIDIARY	5001	.095	.293	0	1
FOREIGN	5001	.04	.195	0	1

Source: Author's own calculations using World Bank Enterprise Survey 2019/2020 (WBES), analyzed in Stata.

https://doi.org/10.52202/077185-0139

The average adoption of in-house renewable energy (REN) among firms is low, with a mean of 0.029 and a standard deviation of 0.168. Energy tax/levy (TAX) is imposed on approximately 27% of firms, while 6.7% comply with energy performance standards (EPS). Proactive Environmental Management (PEM) has a mean of 0.17 with more variability (standard deviation of 0.477). Firm age (AGE) has a mean value of 3.134 years, reflecting significant variation in firm ages (standard deviation of 1.321). The distribution of industry types shows that 58.2% of firms are in the manufacturing sector. Subsidiary status (SUBSIDIARY) and foreign ownership (FOREIGN) are less common, indicating that a small proportion of firms are subsidiaries or have foreign ownership. These statistics provide a snapshot of the data's distribution, highlighting the low prevalence of renewable energy adoption and the varying degrees of regulatory and management practices among firms in the MENA region.

3.3 Econometric Model

In our study, we utilize logistic regression to analyze our binary dependent variable, which is the firm's use of energy from its own renewable sources. This method is well-suited for binary outcomes, efficiently modeling the probability of an event occurring in categorical data and identifying non-linear relationships, as highlighted by Hosmer & Lemeshow (2000).

We also explore the mechanisms potentially influencing the impact of environmental regulations on renewable energy adoption in firms, hypothesizing that proactive environmental management (PEM) serves as a mediating factor. To investigate this, we employ mediation analysis, aligning with the theoretical framework of Baron & Kenny (1986).

However, due to the ordinal nature of our mediator (PEM), we opt for generalized structural equation modeling (GSEM)[4]. Our proposed model can be encapsulated by the following set of equations:

$$REN_{ijt} = \beta_0 + \beta_1 TAX_{ijt} + \beta_2 EPS_{ijt} + \lambda X_{ijt} + \eta_j + \delta_t + \varepsilon_{ijt} \quad (1)$$

$$log\left(\frac{P(PEM \leq j|covariates)}{1 - P(PEM \leq j|covariates)}\right) = \alpha_0 + \alpha_1 TAX_{ijt} + \alpha_2 EPS_{ijt} + \gamma X_{ijt} + \eta_j + \delta_t + \varepsilon_{ijt} \quad (2)$$

$$REN_{ijt} = \phi_0 + \phi_1 TAX_{ijt} + \phi_2 EPS_{ijt} + \phi_3 PEM_{ijt} + \phi_4 X_{ijt} + \eta_j + \delta_t + \varepsilon_{ijt} \quad (3)$$

The first equation (1) models the probability, using a logit model, of a firm utilizing renewable energy (REN_{ijt}) as a function of energy taxes/levies (TAX_{ijt}) and energy performance standards (EPS_{ijt}), influenced by a set of control variables (λX_{ijt}), fixed effects for countries (η_j), time (δ_t), and an error term (ε_{ijt}). The second equation (2) is a logistic regression model, using an ordered logit model, that delineates the log odds of the proactive environmental management level (PEM_{ijt}) being at or below a certain threshold (j), given energy taxes/levies, energy performance standards, and other covariates. The final equation (3) integrates both energy taxes/levies and energy performance standards with proactive environmental management to assess their combined effect on renewable energy utilization.

Our model's equations are crafted to examine the distinct yet interrelated ways in which energy taxes/levies, energy performance standards, and proactive environmental management practices impact firms' use of renewable energy. This will enable us to thoroughly explore the complex dynamics driving firms in the MENA region to use renewable energy sources, contributing to the achievement of sustainable development goals (SDGs).

4 RESULTS AND DISCUSSION

We begin our analysis by examining the primary relationship central to our research. Table 2, presenting outcomes from the GSEM, provides a detailed quantification of the interrelationships among key variables, forming the basis for our in-depth analysis and offering vital insights into the core dynamics of our study.

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[4] GSEM is more capable of addressing the complexities of our data and the hypothesized relationships, enabling a comprehensive analysis of the interconnected variables in our study.

https://doi.org/10.52202/077185-0139

Table 2: Generalized Structural Equation Model

	Coef.	Std.Err.	z	P>z	[95%Conf.	Interval]
REN (DV)						
TAX	-0.714	0.249	-2.870	0.004	-1.203	-0.226
EPS	1.150	0.286	4.020	0.000	0.590	1.710
PEM	0.908	0.120	7.580	0.000	0.673	1.142
SIZE	0.173	0.067	2.590	0.010	0.042	0.303
AGE	0.244	0.127	1.930	0.054	-0.004	0.493
INDUSTRY	-0.637	0.186	-3.420	0.001	-1.002	-0.271
SUBSIDIARY	0.804	0.217	3.710	0.000	0.379	1.229
FOREIGN	0.356	0.338	1.050	0.292	-0.306	1.019
_cons	-4.911	0.404	-12.160	0.000	-5.702	-4.119
PEM (DV)						
TAX	-0.227	0.112	-2.020	0.043	-0.447	-0.007
EPS	1.962	0.143	13.690	0.000	1.681	2.242
SIZE	0.464	0.033	14.050	0.000	0.399	0.529
AGE	0.121	0.064	1.880	0.060	-0.005	0.246
INDUSTRY	0.075	0.097	0.770	0.439	-0.115	0.265
SUBSIDIARY	-0.260	0.208	-1.250	0.211	-0.669	0.148
FOREIGN	0.105	0.136	0.770	0.441	-0.162	0.372
PEM						
/cut1	4.065	0.213	19.110	0.000	3.648	4.482
/cut2	5.333	0.224	23.840	0.000	4.895	5.772

Source: Author's own calculations using World Bank Enterprise Survey 2019/2020 (WBES), analyzed in Stata.

4.1 Direct Impact of Energy Taxes and Energy Performance Standards on In-House Renewable Energy Adoption

The results from the generalized structural equation model indicate that the imposition of an energy tax or levy (*TAX*) has a significant negative effect on the adoption of in-house renewable energy (*REN*) by firms. The negative coefficient of -0.714 suggests that firms subject to energy taxes or levies are less likely to adopt in-house renewable energy sources. The imposition of energy taxes increases the operational costs for firms, which can deter investments in renewable energy infrastructure. Firms may find it financially challenging to allocate resources for renewable energy projects when they are already burdened with additional taxes. While energy taxes are designed to penalize excessive energy consumption and encourage efficiency, they may not provide the immediate financial relief necessary for firms to transition to renewable energy. This highlights the need for complementary policies, such as subsidies or tax credits for renewable energy investments, to balance the financial burden imposed by energy taxes. The negative impact of energy taxes on renewable energy adoption underscores the importance of understanding firm behavior. Firms might opt for less capital-intensive solutions to reduce energy costs, such as improving energy efficiency, rather than investing in renewable energy sources that require substantial upfront investment. The direct negative impact of energy taxes on renewable energy adoption, confirms the first hypothesis (H1a), suggesting that while such taxes are effective in promoting energy efficiency, they may not be sufficient to drive the transition to renewable energy on their own. Policymakers should consider implementing complementary measures, such as subsidies for renewable energy projects and tax credits, to offset the financial burden of energy taxes and encourage firms to invest in renewable energy.

However, the model shows that compliance with energy performance standards (EPS) has a significant positive effect on the adoption of in-house renewable energy (REN) by firms, with a strong coefficient of 1.150 (standard error = 0.286, p-value = 0.000). This positive coefficient suggests that firms adhering to EPS are more likely to adopt renewable energy sources. The positive impact of EPS on renewable energy adoption can be understood through several key mechanisms. First, energy performance standards set specific efficiency benchmarks that firms must meet, often necessitating the adoption of advanced technologies and processes, including renewable energy sources. This regulatory push ensures that firms integrate sustainable practices into their operations to meet the mandated criteria. Second, adherence to EPS signals a firm's commitment to sustainability and energy efficiency, enhancing its reputation and making it more attractive to environmentally conscious consumers and

https://doi.org/10.52202/077185-0139

investors. This incentivizes firms to adopt renewable energy solutions that align with EPS requirements. Third, meeting EPS often results in long-term cost savings through improved energy efficiency and reduced operational costs. While renewable energy sources require initial investment, they can lower energy expenses over time, encouraging firms to make these investments. Fourth, energy performance standards can stimulate technological innovation as firms seek cost-effective ways to comply, promoting the development and adoption of in-house renewable energy and fostering a culture of continuous improvement and innovation within firms. Our second hypothesis (H1b) is confirmed, highlighting the effectiveness of regulatory measures in promoting sustainable energy practices. By setting clear efficiency benchmarks, EPS not only compels firms to integrate renewable energy into their operations but also drives technological innovation, cost savings, and competitive advantage. This underscores the importance of well-designed regulatory frameworks in facilitating the transition to renewable energy and achieving broader environmental and economic goals.

4.2 Comparative Impact of Energy Tax and Energy Performance Standards on In-House Renewable Energy Adoption

Energy taxes and energy performance standards have markedly different impacts on the adoption of in-house renewable energy by firms, as demonstrated by our GSEM. These divergent impacts can be attributed to the distinct mechanisms through which each regulatory aspect influences firm behavior. Energy taxes increase the immediate financial burden on firms, leading them to prioritize cost-cutting measures over long-term investments in renewable energy. The need to maintain financial viability in the face of higher operating costs discourages firms from undertaking the capital-intensive shift to renewable energy. This is further illustrated in table 3, where 57.44% of firms reported that measures in favor of renewable energy investments are not a priority relative to other investments, 15.81% cited a lack of financial resources as a barrier, and 6.74% mentioned that it is not profitable.

Table 3: Main Reasons for Not Adopting Measures in Favor of In-House Renewable Energy Utilization

What is the main reason measures in favor of in-house renewable energy utilization were not adopted?	Freq.	Percent	Cum.
Don't know	400	10.18	10.18
Not a priority relative to other investments	2257	57.44	67.63
Not profitable	265	6.74	74.37
Lack of financial resources	621	15.81	90.18
Uncertainty about regulation	94	2.39	92.57
Uncertainty about future prices	194	4.94	97.51
Operational and/or technical risk	61	1.55	99.06
Other	37	0.94	100.00
Total	3929	100.00	

Source: Author's own calculations using World Bank Enterprise Survey 2019/2020 (WBES), analyzed in Stata.

Conversely, EPS set specific performance benchmarks that firms must meet, thereby directly incentivizing the adoption of energy-efficient technologies and practices, including renewable energy. By providing a clear regulatory framework, EPS reduce uncertainty and foster a more predictable environment for investment in sustainable technologies. This regulatory clarity and the associated long-term cost savings from enhanced energy efficiency make the transition to renewable energy more appealing and feasible. Table 3 supports this view, as uncertainty about regulation (2.39%) and future prices (4.94%) were minor barriers compared to financial constraints and investment priorities.

The different impacts of these regulatory measures also highlight how similar companies operating under the same regulatory framework might adopt different approaches to renewable energy. For example, a firm with sufficient financial resources might view compliance with EPS as an opportunity to gain a competitive advantage through sustainability initiatives, while another firm struggling with financial constraints may focus on immediate cost savings to remain operational under the burden of energy taxes.

Thus, while energy taxes aim to curb excessive energy consumption by penalizing high usage, they may inadvertently stifle renewable energy investments due to increased costs. In contrast, EPS encourage

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proactive investments in energy efficiency and renewable technologies by setting clear standards and creating a favorable environment for sustainable innovation. This nuanced understanding of how different regulatory mechanisms influence firm behavior underscores the importance of designing balanced policies that both discourage unsustainable practices and actively promote the adoption of renewable energy.

Our results align with and expand upon existing literature on environmental regulations (ER) and their impact on renewable energy and emissions. Similar to findings by Tang et al. (2017) and Weng et al. (2018), our study confirms that ER can influence corporate behavior, though our results show divergent impacts of different types of regulations. While Shi et al. (2019) highlighted improvements in energy efficiency due to ER, our findings specifically indicate that energy performance standards (EPS) positively affect the adoption of in-house renewable energy. Villoria-Saez et al. (2016) support the effectiveness of environmental taxes, but our study shows that such taxes can have a negative impact on renewable energy adoption due to increased operational costs, echoing concerns by Yi and Li (2018) and Xie Dai et al. (2018) about the economic drawbacks of CO2 taxes. Conversely, the positive impact of EPS on renewable energy adoption aligns with the findings of Zhang et al. (2019) and Zhao et al. (2020), who demonstrated that ER can lead to improvements in environmental quality and energy consumption reductions.

4.3 Indirect Effects of Energy Tax and Energy Performance Standards on In-House Renewable Energy Adoption through Proactive Environmental Management

The generalized structural equation model also explores the indirect effects of energy taxes (TAX) and energy performance standards (EPS) on the adoption of in-house renewable energy (REN) through the mediator, proactive environmental management (PEM). The indirect effect of each regulatory measure is calculated by multiplying the coefficient of PEM on REN by the coefficients of TAX and EPS on PEM[5].

$$Indirect\ Effect\ of\ TAX = \alpha_1 \times \phi_3 = -0.227 \times 0.908 = -0.206 \quad (4)$$

$$Indirect\ Effect\ of\ EPS = \alpha_2 \times \phi_3 = 1.962 \times 0.908 = 1.781 \quad (5)$$

The analysis reveals that while both TAX and EPS have significant direct effects on renewable energy adoption, their indirect effects through PEM differ substantially. The negative indirect effect of TAX on REN through PEM suggests that energy taxes might hinder the proactive environmental strategies that could otherwise facilitate renewable energy adoption. This finding aligns with the notion that financial burdens imposed by taxes can limit the resources available for firms to engage in proactive environmental management, thereby reducing the overall effectiveness of PEM. In contrast, the positive indirect effect of EPS on REN through PEM underscores the role of clear and enforceable performance standards in fostering a corporate culture that values sustainability and proactive environmental management. By setting specific benchmarks, EPS encourage firms to adopt comprehensive environmental strategies, including renewable energy initiatives, thus amplifying the positive impact of PEM on renewable energy adoption.

These findings highlight the nuanced ways in which different types of environmental regulations can shape corporate behavior and environmental outcomes. While energy taxes aim to curb excessive consumption, they may inadvertently stifle proactive environmental initiatives. Conversely, EPS not only directly promote renewable energy adoption but also enhance the effectiveness of PEM, leading to more robust and sustainable corporate practices.

These results confirm both our hypotheses (H2a & H2b). EPS supports PEM, enhancing the adoption of renewable energy, aligning with Aragon-Correa and Rubio-Lopez (2007), who highlight the role of PEM in fostering eco-friendly product development and green marketing. This aligns with Potrich et al. (2019), who note that firms engaged in PEM surpass regulatory requirements, using them as a foundation for innovation. Buysse and Verbeke (2003) and Darnall and Kim (2012) emphasize resource-based capabilities and stakeholder integration in enhancing proactive strategies, supported by

[5] To accurately reference the coefficients within equation 4 & 5, please refer to equation 2 & 3 in the econometric model.

https://doi.org/10.52202/077185-0139

our findings on EPS. Contrary to the literature, we also found that energy taxes hinder PEM, suggesting they impose financial burdens that limit the scope for proactive environmental management.

In addition to examining the direct and indirect effects of energy taxes and energy performance standards on renewable energy adoption, our study also considers several control variables to ensure a comprehensive analysis. Larger firms are significantly more likely to adopt renewable energy solutions due to greater resources, aligning with Delmas & Toffel (2004) and Horbach (2008). Older firms show a marginally significant positive effect on renewable energy adoption, likely due to accumulated experience and established practices, as noted by Wang (2015). Manufacturing firms are significantly less likely to adopt renewable energy compared to service-oriented firms, reflecting higher environmental footprints and regulatory challenges, consistent with Shen et al. (2019). Subsidiaries of larger companies are significantly more likely to adopt renewable energy, benefiting from corporate governance structures and resources. Foreign ownership shows a positive but not statistically significant effect on renewable energy adoption, indicating potential cross-border transfer of environmental practices, though further research is needed.

4.4 Implications and Recommendations

- **Policy Implications**

- Balanced Regulatory Frameworks: Policymakers should implement regulatory frameworks that combine clear performance standards with subsidies or tax incentives for renewable energy investments, mitigating financial burdens from energy taxes and enhancing proactive environmental management (PEM).

- Support for Large and Established Firms: Providing tailored support and incentives, such as grants for technological upgrades and rewards for exceeding regulatory requirements, can encourage large and established firms to lead the transition to renewable energy.

- Targeted Assistance for Manufacturing Sector: Developing specific policies and support mechanisms, including technical assistance, reducing initial capital costs, and facilitating access to clean technology, can address the challenges faced by the manufacturing sector in adopting renewable energy.

- **Business Recommendations**

- Proactive Environmental Strategies: Firms should adopt proactive environmental management strategies, including eco-friendly product development, green marketing, and continuous improvement of environmental practices, to drive innovation, cost savings, and competitive advantages.

- Leveraging Corporate Structures: Firms should leverage their corporate networks to access resources, share best practices, and integrate sustainable practices, benefiting from the supportive governance structures of larger companies.

- Focus on Long-term Benefits: Firms should focus on the long-term benefits of renewable energy adoption, such as cost savings from improved energy efficiency and enhanced corporate reputation, despite the immediate financial burdens posed by energy taxes. Future regulatory changes may further support sustainable practices.

- **Achieving Sustainable Development Goals (SDGs)**

The study's findings have significant implications for achieving several SDGs in the MENA region:

- SDG 7 (Affordable and Clean Energy): By promoting balanced regulatory frameworks and providing incentives for renewable energy investments, policymakers can make clean energy more affordable and accessible to firms.

- SDG 9 (Industry, Innovation, and Infrastructure): Support for large, established firms and the manufacturing sector can drive innovation and infrastructure development in renewable energy, fostering sustainable industrial growth.

- SDG 13 (Climate Action): Encouraging the adoption of renewable energy through proactive environmental management and supportive policies directly helps decrease greenhouse gas emissions and fight climate change.

https://doi.org/10.52202/077185-0139

5 CONCLUSION

This study explores the impact of energy taxes (TAX) and energy performance standards (EPS) on the adoption of in-house renewable energy by firms in the MENA region, with a focus on the mediating role of proactive environmental management (PEM). Utilizing data from the World Bank Enterprise Survey (2019-2020) and applying logistic regression and generalized structural equation modeling (GSEM), the findings reveal significant differences in the impacts of TAX and EPS.

Energy taxes have a negative impact on renewable energy adoption, both directly and indirectly. The direct effect indicates that the financial burden imposed by energy taxes discourages firms from investing in renewable energy. This is further compounded by the indirect effect through PEM, where energy taxes reduce the effectiveness of proactive environmental strategies. This suggests that while energy taxes are intended to curb excessive energy consumption, they may inadvertently hinder firms' ability to implement sustainable practices due to increased operational costs.

In contrast, energy performance standards (EPS) have a positive impact on renewable energy adoption. The direct effect shows that clear and enforceable standards drive firms to integrate renewable energy solutions into their operations. The indirect effect through PEM further enhances this impact, as EPS encourage firms to adopt comprehensive environmental strategies that go beyond compliance. This highlights the role of EPS in fostering a corporate culture that values sustainability and innovation, leading to long-term benefits such as cost savings and competitive advantages.

These findings confirm that PEM mediates the relationship between both TAX and EPS and firms' adoption of in-house renewable energy. However, the contrasting effects of TAX and EPS underscore the need for balanced regulatory frameworks. Policymakers should consider combining performance standards with supportive measures such as subsidies or tax incentives to offset the financial burdens of energy taxes. This approach can enhance the effectiveness of PEM and promote the adoption of renewable energy.

However, the study is not without limitations. The reliance on self-reported data from the World Bank Enterprise Survey and the focus on specific countries within the MENA region may limit the generalizability of the findings. Future research should aim to address these limitations by incorporating longitudinal data, expanding the geographical scope, and exploring the role of additional factors such as technological innovation and market dynamics. Furthermore, studies need to examine more closely how foreign ownership might influence renewable energy adoption. This would enhance our understanding of the multifaceted interactions between environmental policies, corporate behavior, and sustainable development, contributing further to the pursuit of a greener and more sustainable future in the MENA region and beyond.

In conclusion, achieving Sustainable Development Goals (SDGs) in the MENA region requires a strategic approach that leverages the positive impacts of EPS while mitigating the negative effects of energy taxes. By fostering a regulatory environment that supports proactive environmental management, policymakers can drive the transition to renewable energy and contribute to the region's environmental and economic sustainability.

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