ASSESSING THE IMPACT OF ISO 14001 ADOPTION ON CORPORATE ENERGY PERFORMANCE

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Overview

ISO 14001 is a global certifiable standard aimed at improving the environmental performance of firms by promoting systematic environmental management, continuous improvement, legal compliance, risk management, stakeholder engagement, and resource efficiency. Despite its widespread adoption worldwide, the impact of ISO 14001 remains a subject of debate among both managers and scholars. Previous research at the firm level has predominantly focused on its effectiveness in reducing CO2 emissions, enhancing profitability, and fostering environmental innovation. The empirical evidence has yielded mixed results. A meta-analysis of scholarly literature conducted by Erauskin-Tolosa *et al*. (2020) suggests the prevalence of positive effects from adopting environmental management system certifications such as ISO 14001 and EMAS.

However, although one of the expected benefits of ISO 14001 is the reduction of energy consumption, there is a notable lack of research addressing this aspect. This study aims to fill this gap by examining whether the adoption of ISO 14001 by companies leads to a decrease in their energy intensity and an increased utilization of cleaner and less polluting energy sources. Specifically, we assess the impact of increased adoption of ISO 14001 on four key dimensions of corporate environmental performance: (i) energy intensity, defined by total direct energy consumption divided by output; (ii) carbon intensity, measured as firm total greenhouse gases emissions per unit of energy used; (iii) electrification ratio, defined as the ratio of firm electricity used to total energy used by the firm, and (iv) utilization of renewable energy sources, measured as the proportion of renewable energy used relative to total energy consumption.

Moreover, most previous empirical research on ISO 14001 consists of studies typically focused on a single country, using cross-sectional data generally gathered through questionnaires to company managers (Boiral *et al*., 2018). Studies based on longitudinal and broader international samples grounded on secondary data are very scarce (Arocena *et al*. 2021, 2023). In this paper, we use dynamic panel data methods to test our hypotheses on a panel of 1,484 multinational enterprises (MNEs) from 2008 to 2021.

Methods

Numerous economic relationships exhibit dynamic characteristics, and panel data offer a valuable advantage by enabling researchers to gain deeper insights into the dynamics of adjustment processes (Baltagi, 2021). In these dynamic relationships, one notable feature is the inclusion of a lagged dependent variable among the regressors, as a potential solution to tackle the endogeneity issue that arises from reverse causality. However, the inclusion of a lagged dependent variable introduces some problems. By construction the lag of the dependent variable is correlated with the fixed effect. This makes OLS and FE estimators biased and/or inconsistent. Thus, we adopt the two-step system GMM proposed by Blundell and Bond (1998) to estimate the following equations

$$Y_{\mathrm{i,t}} = \alpha + \delta\, Y_{\mathrm{i,t-1}} + \beta\, ISO14001_{\mathrm{i,t}} + \gamma\, X_{\mathrm{i,t}} + u_{i,t} \quad \text{for i} = 1,\ldots,\mathrm{N} \text{ and t} = 1,\ldots,\mathrm{T} \tag{1}$$

In equation (1), the dependent variable $Y_{\mathrm{i,t}}$ represents either energy intensity, carbon intensity, renewable energy intensity or electrification ratio of firm *i* at time *t*, while $Y_{\mathrm{i,t-1}}$ refers to the lag of the dependent variable. The main explanatory variable is *ISO*14001, which denotes the percentage of facilities of a firm that have ISO 14001 certification. Finally, $X_{\mathrm{i,t}}$ denotes the set of control variables. Several control variables capture firm-specific factors: capital intensity (*K/L*), calculated as the ratio of fixed assets to the total number of full-time employees; firm size (*SIZE*), measured by the number of full-time employees, the implementation of certified quality management standards (*ISO*9000). Two control variables account for country-specific factors: Gross Domestic Product per capita (*GDPpc*), used to control for the country's level of economic development, and the diffusion of ISO 14001 in the MNE's home country (*ISODIFF*), measured as the number of ISO 14001 certifications awarded divided by GDP in PPP international dollars at constant 2017 prices.

Results

Table 1 presents the estimates of equation (1) for each dependent variable. The first column shows a positive, though not statistically significant, coefficient for ISO14001, suggesting an insignificant effect of ISO14001 adoption on energy intensity. In contrast, the negative and statistically significant coefficient of ISO14001 in column (2) indicates that ISO14001 adoption is negatively associated with carbon intensity. Furthermore, the positive and statistically coefficients for ISO14001 in columns (3) and (4) indicate that the adoption of the environmental standard contributes to an increase in the use of electricity and renewable energies.

Table 1. Impact of ISO 14001 on energy performance

VARIABLES	(1) Energy Intensity	(2) CO_2 Intensity	(3) Renewable Energy	(4) Electricity Ratio
Y_{t-1}	0.867*** (0.0356)	0.561*** (0.0713)	0.920*** (0.0338)	0.753*** (0.0492)
ISO14001	0.0006 (0.1390)	-0.162** (0.0805)	0.691** (0.280)	0.0630** (0.0310)
K/L	-0.105*** (0.0286)	0.0142 (0.0144)	-0.0405 (0.0503)	-0.0057* (0.003)
SIZE	-0.0258 (0.0420)	-0.0227 (0.0401)	-0.0721 (0.0756)	-0.0077 (0.0081)
ISO9000	0.290* (0.168)	-0.0143 (0.0356)	-0.285 (0.299)	-0.0176 (0.0154)
ISODIFF	-1.81e-05 (1.23e-05)	1.14e-05** (5.02e-06)	1.79e-05 (2.05e-05)	4.86e-06** (2.03e-06)
GDPpc	0.0913 (0.106)	0.0280 (0.0313)	0.0533 (0.0877)	0.0158 (0.0102)
Observations	4,564	3,830	1,462	3,439
Firms	734	529	352	589
Instruments	209	290	117	171
AR (1)	0.000	0.000	0.001	0.000
AR (2)	0.703	0.459	0.591	0.805
Hansen Test	0.386	0.614	0.992	0.680
Exogeneity Test	0.153	0.762	0.978	0.359

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusions

Our research findings indicate that the adoption of ISO14001 does indeed contribute to reducing negative environmental effects, such as carbon intensity. To achieve this goal, certified firms appear to prioritize actions aimed at altering their energy mix, favoring the use of electricity and renewables over fossil fuels, without affecting their energy intensity. In other words, if a company increases production, energy consumption increases in the same proportion. However, it is worth noting that such production increases may result in higher total fossil fuel consumption, albeit to a lesser extent than renewable energies. In summary, our findings suggest that ISO14001 is not an effective tool for promoting energy savings. Therefore, its joint implementation with specific energy management standards, such as the new ISO 50001, could reinforce the company's environmental strategy.

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