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Assessing the Impact of CBAM on EITE Industries in India

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Designed by Mukesh Rawat

Assessing the Impact of CBAM on EITE Industries in India

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List of abbreviations

2SLS	Two Stage Least Squares
BCA	Border Carbon Adjustments
CBAM	Carbon Border Adjustment Mechanism
CGE	Computable General Equilibrium
CMIE	Centre for Monitoring Indian Economy
EC	European Commission
EITE	Energy-Intensive and Trade-Exposed
ETS	Emissions Trading System
EU	European Union
GTAP	Global Trade Analysis Project
UNCTAD	United Nations Conference on Trade and Development
PAT	Profit After Tax
RoA	Return on Assets
TFP	Total Factor Productivity
WPI	Wholesale Price Index

Abstract

The implementation of the Carbon Border Adjustment Mechanism (CBAM) in 2026 is expected to pose considerable challenges for nations heavily dependent on exporting energy-intensive goods and materials to the European Union (EU). This research specifically focuses on the uncertainties surrounding the potential impact of CBAM on trade-exposed sectors with high energy intensity, particularly in developing countries like India. The primary aim of this study is to assess the effects of fluctuations in energy prices and carbon taxes on the economic performance of companies operating within these trade-exposed sectors. To achieve this objective, the study analyses data from Indian manufacturing firms belonging to five key trade-exposed industries with high energy intensity within the timeframe from 2012 to 2021.The research's key findings indicate that a 10% increase in fuel costs corresponds to a 2.41% decrease in earnings from exports, a 0.23% reduction in Return on Assets (RoA), and a 1.34% decline in post-tax profits. Additionally, our study underscores the significance of a firm's size and age. For a 10% rise in fuel costs, medium-sized enterprises demonstrate a statistically significant 2.9% profit decrease, while large firms experience a 3.5% decline, although this latter finding is not statistically significant. In contrast, smaller firms exhibit a statistically significant profit decrease of approximately 0.75%, and newer firms witness a 2.1% profit drop along with a 0.26% RoA reduction. This suggests that larger and newer companies are more vulnerable to fuel cost fluctuations. Furthermore, when examining sector-specific impacts, the cement industry faces a substantial 6.7% decrease in post-tax profits. In contrast, the coal, fertiliser, and steel and iron industries experience RoA declines of around 0.22%, 0.24%, and 0.21%, respectively. Moreover, the steel and iron industry also suffers a statistically significant 2.9% reduction in export earnings. In summary, the implementation of CBAM is poised to have an adverse effect on the economic performance of enterprises operating within India's Energy-Intensive and Trade-Exposed (EITE) industries.

1. Introduction

The increasing recognition of the necessity to address climate change has led to a global consensus on the urgency of curbing greenhouse gas emissions. In recent years, many countries have made commitments to reduce their net carbon emissions to zero by 2060 or 2070. In this context, carbon taxation and trading are recognised as some of the key climate change mitigation options. Carbon taxes, on one hand, are a pricing mechanism aimed at correcting market failures by internalising the negative externalities associated with production. On the other hand, cap and trade seeks to achieve the same objective by allocating emission quotas and allowing the trading of surplus allowances at a market-determined price. Despite the perception of simplicity associated with such market-based instruments, decarbonisation policies encounter numerous practical challenges due to uncertainties surrounding projected emissions, abatement costs, and international politics.

Additionally, successful decarbonisation requires the implementation of supplementary policies and measures. For instance, according to Rosenbloom et al. (2019), relying solely on carbon pricing is unlikely to be adequate for meeting the goals of the Paris Agreement and effectively mitigating climate change. Therefore, a comprehensive and multifaceted approach is necessary to address the complexities of decarbonisation and ensure meaningful progress towards climate goals. By integrating carbon pricing with other policy instruments such as regulations, subsidies, and public investments, sustainability transition could be achieved much more effectively (Rosenbloom et al., 2019). A comprehensive and integrated policy framework is required, which addresses multiple sources of emissions and overcomes systemic barriers to low-carbon innovation and diffusion (Rosenbloom et al., 2019).

Multiple studies evaluating the impact of carbon pricing show adverse consequences on the competitiveness of firms, loss in employment, income, and output, particularly for those with higher carbon emissions and higher exposure to international competition, mainly due to the increase in energy costs (Anger and Oberndorfer, 2008; Abrell et.al., 2011; Chan et al. 2013, Rivers and Brandon Schaufelee, 2014).

Although a positive effect on TFP (Total Factor Productivity) growth and return to capital for the participating countries has been reported (Commins et.al., 2009, Metcalf, 2019), the existence of policy variation among countries strongly suggests that the impact on competitiveness and carbon leakage, where emissions shift to countries with less stringent environmental regulations, can differ significantly (Fischer, 2015).

In a bid to combat the effects of climate change, the European Union has strengthened its climate goals with the introduction of the “Fit for 55” initiative. This package seeks to achieve a reduction of at least 55% in net greenhouse gas emissions by 2030, ultimately leading to carbon neutrality by 2050. On July 14, 2021, the European Commission (EC) put forth a formal proposal for one key policy within this framework, the Carbon Border Adjustment Mechanism (CBAM), which is set to begin its initial phase in 2023. CBAM is designed to establish fair competition by addressing the carbon-related costs faced by both EU establishments adhering to the EU Emissions Trading System (ETS) and imported commodities. The core mechanism involves imposing a fee on the carbon emissions (direct and indirect) linked to specific imports, parallel to the charges levied on domestic products under the ETS. This approach serves as a protective measure against carbon leakage, a phenomenon where companies relocate their production operations outside the EU to circumvent the financial implications of conforming to environmental regulations (European Commission).

In its initial phase, CBAM will be applicable to specific items within industries characterised by high carbon intensity. These industries encompass sectors like iron and steel, cement, fertilisers, aluminium, electricity, and hydrogen. Furthermore, the coverage will extend to include certain precursor materials and a restricted range of downstream products. Nevertheless, the CBAM regulation mandates the European Commission to formulate a timeline that progressively includes all commodities falling under the scope of the EU ETS. This expansion will encompass both indirect emissions and emissions stemming from international transportation, with the target date for complete inclusion set at 2030. The CBAM implementation is planned to unfold in four sequential phases. Starting October 2023, there will be an initial transition period during which exporters must report the carbon content for the included sectors without incurring taxes. As of January 2026, exporters will begin tax payments. Additionally, it is expected that new sectors will be included under the CBAM framework by 2034. Finally, after 2034, all imported goods and materials entering the EU will fall under the scope of CBAM and will be subject to taxation.

In an extensive literature review conducted by Newman (2020), the Carbon Border Adjustment Mechanism (CBAM) is frequently advocated as an "effective, WTO compliant, non-discriminatory tariff, and a precautionary measure." While the review acknowledges the favourable aspects of CBAM as a policy initiative, it also emphasises the importance of taking certain essential steps for its successful implementation. These include establishing a transition period to mitigate costs and supply shocks, implementing standardised emissions calculations to reduce administrative burdens, garnering sufficient international support, and addressing and mitigating the disproportionate impact on developing countries.

The CBAM concept, as put forth by the EU, aims to mitigate the risk of carbon leakage resulting from reduced competitiveness due to the implementation of carbon taxation within the home country. A recent study by UNCTAD (2021) shows that, through CBAM, a 44 USD per tonne carbon tax would cut leakage by more than half, from 13.3% to 5.2%. While CBAM has several benefits, its adverse consequences could also be significant. Imposing an additional price on items at the border will likely increase domestic demand compared to costlier foreign items (imports), which, in turn, could prompt exporting countries to impose retaliatory taxation (Notani, 2022). Additionally, developing economies would be disproportionately affected due to a lack of access to clean technology, particularly in energy intensive industries and trade exposed (EITE) sectors such as cement, steel, aluminium, and fertilisers, which are to be included in this mechanism (Lin and Wesseh, 2020; Thivierge, 2020). For instance, studies on India estimate that Indian exporters of steel and aluminium could lose between one to two billion USD due to border taxation in European countries, bearing in mind that, India was the eighth-largest exporter of iron and steel to the EU in 2019 (Notani, 2022). Moreover, smaller developing countries could face relatively higher risks, while larger countries may be less exposed due to their stronger internal markets that decrease the importance of EU trade relative to GDP (Eicke et al, 2021). As a result, it would primarily lead to a shift in the burden away from the developed countries.

The EC (2021) estimates that EU imports of CBAM products would decrease by 14% by 2030. Considering the 2019 share of 3% of CBAM products in the total goods imports of the EU, this indicates a decline in total goods imports of approximately 0.4%. This decline attributes to a reduction in total exports of 0.9% for Russia, 0.3% for India, and 0.04% for China in 2030 compared to the current regimen (Simola, 2021). With a significant portion of CBAM-exposed exports having high carbon intensity and low levels of technological innovation, CBAM is anticipated to become a critical issue for these countries (Overland and Sabyrbekov, 2022; Magacho, 2022; Zhong and Pei, 2022).

Overall, the literature dealing with the impact of climate regulations is still emerging. To counteract the losses in competitiveness and carbon leakages, initiating a new policy will require cautious considerations of price pressures. However, given the lack of widespread implementation of carbon taxation at a global level, there exists a divergence between ex-ante predictions of the impacts of carbon taxes on various facets of the economy and ex-post outcomes based on experiences of a few developed economies that have implemented such taxes. Furthermore, there is a lack of understanding in terms of the same in the developing country economies as they are yet to implement carbon pricing or taxation in any systematic way. Additionally, the issue of the implication of leakage-preventing measures such as CBAMs on such economies is far from settled. In this sense, CBAM is best regarded as a temporary policy or a threat to promote the participation of non-climate coalition countries in global climate cooperation, while in the long run, the development of green technologies is the key to solve competitiveness and consequent problems (Zhong and Pei, 2022).

The objective of this study is to provide insights into the uncertainties surrounding the effects of the Carbon Border Adjustment Mechanism (CBAM), specifically its implications for Indian industries that are both energy-intensive and trade-exposed (EITE). This research question is particularly relevant considering the context of developing countries. While Indian firms may have potential long-term adaptation options to the CBAM policy, the short-term impacts remain uncertain. The study aims to examine the potential consequences of increased taxes at the border resulting from CBAM in the short-run. It seeks to determine which aspects of the Indian

EITE industries will be most affected, such as profitability, exports, or competitiveness. To address these questions, we utilise a comprehensive 10-year panel dataset of Indian manufacturing firms collected from CMIE Prowess. By analysing the data and employing relevant econometric modelling techniques, this study attempts to provide valuable insights into the potential impacts of increased border taxes on Indian EITE industries. The research will shed light on whether profitability, exports, or competitiveness will experience the most significant effects from CBAM.

The remainder of the paper is organised as follows. Section two provides a brief literature review examining the potential effects of CBAM, with a focus on developing countries. Section three presents the hypothesis that increased carbon taxes will adversely impact Indian firms' economic performance. Section four describes the dataset and outlines the econometric methodology. Section five presents the empirical results, analysing the effects of fuel costs on profitability, exports, and competitiveness indicators. The results are also examined across firm size and age categories and for specific industries. Section six concludes with a summary of the key findings and implications for Indian EITE sectors. The appendix provides supplementary results and robustness checks.

2. Potential effects of CBAM: Literature review

In Section 2.1, we provide a brief review of the literature exploring the impact of carbon taxes on carbon leakage, competitiveness, potential losses and gains, and the flow of trade across borders. Section 2.2 exclusively focuses on the impact of CBAM on developing countries. Lastly, Section 2.3 discusses how changes in energy prices due to carbon taxes may affect trade competitiveness.

2.1 Carbon leakage, competitiveness, welfare, and international trade

Branger and Quirion (2014) conducted a meta-analysis of 25 studies carried out between 2004 and 2012 to investigate the impact of border carbon adjustments (BCA) on carbon leakage and competitiveness. Their findings indicated that in the absence of BCAs, the leakage ratio varied from 5% to 25%, with a mean of 14%. However, with the implementation of BCAs, the leakage ratio ranged from -5% to 15%, with a mean of 6%. This study also examined the output loss for EITE industries and found that the loss ranged from 0% to 4%, with a mean of 2% without BCAs. The use of BCA mitigated the output loss in computable general equilibrium (CGE) models, although its effectiveness was somewhat reduced in sectoral models. The econometric model used in Branger and Quirion (2014) is presented in table 1.1.

In a more recent study conducted by UNCTAD (2021), which utilised a general equilibrium model, a comprehensive analysis was carried out to examine the effects of CBAM on three crucial aspects—reduction in CO_2 emissions, carbon leakage beyond Europe, and its impact on production within and outside the EU. The study revealed that implementing a carbon tax of 44 USD per tonne could lead to a reduction in carbon leakage by more than half, from 13.3% to 5.2%. This suggests that both carbon emissions and leakage would decrease within the EU, resulting in a shift in trade patterns towards more carbon-efficient production from both EU and non-EU sources. Naturally, many countries may have concerns about limitations or constraints on their exports to the EU. However, the study argues against this notion, indicating that the reduction in exports from developing countries would only be 1.4% and 2.4% under the respective tax brackets of 44 USD per tonne and 88 USD per tonne. The study also sheds light on the welfare losses and gains experienced by developed and developing countries. It highlights that developed countries' incomes would increase by 2.5 USD billion with a 44 USD per tonne CO_2 tax, while developing countries would face a loss of 5.9 USD billion. Despite the effectiveness of CBAM in reducing emissions and carbon leakage, the study acknowledges that it does not provide a clear roadmap for achieving these objectives. However, the study emphasises that the optimal approach lies in utilising the revenue generated by CBAM to develop advanced and greener technologies.

In a policy note by Simola (2021), the potential economic impacts of CBAM on major import sources of the European Union (EU) for CBAM-related products, namely China, Turkey, India, Ukraine, and Russia are discussed. The study estimates the annual costs of CBAM for exporting countries and calculates that the CBAM costs for India would amount to approximately EUR 220 million, equivalent to 9% of the total value of EU CBAM imports from India.

2.2 CBAM and developing countries

CBAM is associated with several benefits and limited drawbacks, as highlighted in existing literature. However, there are potentially significant adverse consequences. This section reviews the evidence on its impact on developing countries, covering aspects such as retaliatory taxes, high risks, potential welfare losses, or even technological innovation.

Introducing an additional price on items at the border logically ensures higher domestic demand relative to expensive foreign items (imports). This, in turn, could lead to retaliatory taxation by exporting countries. Notani (2022) presents scenarios for India's export market, which will be significantly affected by becoming less competitive in the EU market due to the financial and administrative burden imposed by CBAM. The study highlights stress in areas of aluminium, iron and steel for Indian firms, given that total exports to the EU from India in these sectors accounted for almost 10.4% in 2020. Consequently, this means that India could lose USD 1-1.7 billion in exports of energy-intensive goods if CBAM is implemented which explains India's opposition to the new policy.

Developing economies, especially those in energy-intensive industries, are expected to be disproportionately impacted by CBAM. Lin and Wesseh (2020) found that carbon pricing in China stimulated research and development (R&D) intensity but did not significantly boost sales and profits for energy-intensive industries, such as steel and iron.

Smaller developing countries are at a higher relative risk compared to larger countries due to their limited access to clean technology and the importance of EU trade in their economies. Eicke et al (2021) constructed a relative risk index and found that smaller developing countries faced higher risks, while larger countries with stronger internal markets were less exposed.

Various studies have also examined the potential impacts of CBAM on global trade and carbon emissions. Zhong and Pei (2022) estimated the competitiveness and welfare impacts of EU CBAM and found that while EU output would increase, the output in the rest of the world would decrease. Xiaobei et al. (2022) used a computable general equilibrium model to analyse the impact of CBAM and found that it would reduce global emissions but also lead to a decline in global trade, with China and developing economies being the most affected.

Additionally, the literature suggests that carbon pricing can have both positive and negative effects on firms and economies. It can stimulate green technology innovation, improve firm profitability, and increase productivity. However, asymmetric environmental regulations and the expectation of long-term regulations may result in higher compliance costs, potential relocation of firms to countries with less stringent regulations and impacts on employment. Overall, the literature highlights the complexity and trade-offs associated with the implementation of carbon pricing mechanisms like CBAM. The impacts on different sectors, countries, and regions vary; there is still much to learn, especially regarding the potential impact on developing economies.

2.3 Impact of carbon taxes on trade competitiveness through energy prices

While our primary focus remains the analysis of the effects of CBAM on firm productivity, output, and competitiveness, it is equally insightful to delve into studies examining the impact of energy prices on the various aspects of firms' performance. Given CBAM's proposal to encompass indirect emissions, such as those stemming from electricity use in manufacturing products, the direct impact of carbon taxes under CBAM is anticipated to influence energy prices. This section aims to review such studies.

A study conducted by Abeberese (2013) delves into the influence of electricity costs on firm performance in India. Using data sourced from the Annual Survey of Industries spanning the period 2001-2008 and involving 22,227 firms, the study sheds light on several key observations. It finds a noteworthy correlation between higher electricity costs and diminished firm performance, particularly among small and medium-sized firms. The study also reveals that firms respond to higher electricity costs by reducing consumption and adopting energy-saving technologies, but these choices are insufficient to fully offset the negative impact on firm performance. These findings suggest that policies aimed at reducing electricity costs or promoting energy efficiency could significantly benefit firm performance and contribute to economic growth.

Another study by Marin and Vona (2019) investigates the impact of energy prices on the socioeconomic and environmental performance of French manufacturing establishments from 1997 to 2015. The research reveals that elevated energy prices have a negative short-term effect on employment and wages; nevertheless, these effects are counterbalanced by long-term productivity gains. The study emphasises the significance of energy policies that promote energy efficiency, decrease carbon emissions, and minimise negative socioeconomic impacts.

Hannes et al. (2021) examine the impact of energy prices and generator usage on the environmental performance of manufacturing firms in Indonesia. The study employs data from 6,055 manufacturing firms obtained from the Indonesian Manufacturing Census in 2001 and 2006. The results indicate that increased energy prices correlate with reduced carbon emissions and enhanced environmental performance. Nevertheless, the utilisation of generators has a negative effect on environmental performance, particularly in terms of carbon emissions.

Furthermore, Cevik and Ninomiya (2022) explore the relationship between renewable energy sources, energy transition, and electricity prices in Europe. Employing panel data analysis, the study examines the impact of renewable energy consumption, energy efficiency, and additional factors on electricity prices. The study reveals that renewable energy consumption, particularly from wind sources, has a considerable downward effect on electricity prices in Europe. Nonetheless, this relationship between renewable energy consumption and electricity prices is complex, influenced by various factors such as governmental support for renewables, the availability of storage technology, and market distortions. This study provides valuable insights into the potential effects of renewable energy sources on electricity prices, underscoring the necessity for further research and policy initiatives to bolster the transition to a low-carbon economy.

Table 1.1: Overview of Papers, Methods, and Results

Authors	Industry/Sector, Period, Country	Methodology	CBAM Measure	Model Specification	Key Findings
Branger and Quirion (2014)	Chemical products, non-metallic minerals, iron and steel industry, non-ferrous metals 2004-2012 Various countries	Meta-analysis on 25 studies and meta-regression analysis	Border carbon adjustment	$\text{Leakage}_{ij} = \text{Const} + \beta_1.\text{GE}_{ij} + \beta_2.\text{Coa-size}_{ij} + \beta_3.\text{Abatement}_{ij} + \beta_4.\text{Link}_{ij} + \beta_5.\text{GHG}_{ij} + \beta_6.\text{Armington}_{ij} + \beta_7.\text{BCAs}_{ij} + u_{ij}$	Carbon leakage estimates vary from 5% to 25% (mean 14%) without policy and from -5% to 15% (mean 6%) with BCAs. Output loss from 0% to 4% (mean 2%) without BCAs.
UNCTAD (2021)	CBA sectors: cement, glass, aluminium, paper, petroleum, coal products, chemicals and fertilisers 51 economies, 20 sectors	Energy-oriented GTAP model	Carbon Taxes	Scenarios: Domestic carbon price (base 44 and base 88) CBAM 44 CBAM 88	EU producers' CO_2 emissions decrease, CBAM curbs carbon leakage, and trade shifts toward nations with superior carbon efficiency. Employment and wage alterations stay below 0.1%.
Simola (2021)	Cement, electricity, fertilisers, steel and aluminium China, India, Russia, Turkey and Ukraine	Estimating Annual cost estimates of CBAM	Carbon Taxes		Projected additional costs range from EUR 200 million in India to EUR 2.1 billion in Russia, with a carbon price of 60 euros per ton. In relative terms, these extra costs span from 0.1% of Chinese imports' value to 4% of Ukrainian imports' value to the EU.

Authors	Industry/Sector, Period, Country	Methodology	CBAM Measure	Model Specification	Key Findings
Beaufils et al. (2022)	26 sectors and 189 regions 2016 Various countries	Throughflow-based accounting method	Carbon taxes	Different CBAM implementation options, and revenue recycling schemes	The extent to which countries can adjust depends inter alia on their export portfolio, their technological capabilities, and their potential to produce renewable energy
Notani (2022)	Aluminium, Iron and steel, cement, fertiliser and electricity	Review/Opinion Piece	CBA	-	Specifically, it highlights strain on sectors like aluminium, and iron and steel, as these accounted for nearly 10.4% of India's total exports to the EU in 2020. Consequently, the implementation of CBAM could lead to a loss of USD 1-1.7 billion in energy-intensive goods exports from India.
Lin and Wesseh (2020)	31 industries 2013-2017 China	Panel regression	Carbon prices, from Chinese Emission Trading Scheme	$Iit = \alpha i + \mu_t + \beta_1.I_{it-1} + \beta_2.CP_{it} + \beta_3.E_{it} + \beta_n.X_{itn} + \epsilon_{it}$	Key results indicate that a carbon price spurs R&D intensity (innovation input), but this increase doesn't necessarily translate into higher sales and profits for industries (innovation output). Industries with greater energy consumption display greater innovation tendencies.
Eicke et al. (2021)	EITE sectors Various countries having trade relations with EU	Relative Risk Index	CBAM price	Scenarios: CBAM addressing only emissions-intensive sectors, and CBAM targeting the whole economy.	Relative risks from an EU CBAM are distributed unevenly across the globe. The design of the CBAM matters, as the countries at relatively high risk vary between the two scenarios. We find that most countries with relatively high risks across both scenarios are located in Africa. Given their high trade dependence on the EU, South-Eastern European countries also face relatively high risks.
Zhong and Pei (2022)	EITE sectors such as electricity, gas, non-metallic mineral products, mining, transport and warehousing EU trading partners	Multi-regional IO approach	CBAM price	Multiple scenarios on CBAM price	CBAM causes notable shifts in market shares within emission-intensive and trade-intensive sectors. Countries most impacted by CBAM are those with substantial exports from such sectors and high EU export exposure.

Authors	Industry/Sector, Period, Country	Methodology	CBAM Measure	Model Specification	Key Findings
Xiaobei et al. (2022)	CBAM goods 24 non-EU countries	Dynamic CGE model	CBAM price	Scenarios: Direct Emissions from production of imported goods CBAM extends to all imported goods and services All indirect emissions from upstream value chains calculated using carbon content	CBAM would reduce global emissions but also lead to a decline in global trade, with China and developing economies being the most affected.
Abeberese (2013)	Electricity sector 2001-2008 India	Econometric analysis	Electricity prices	$y_{isrt} = \beta_0 + \beta_1.\log(\text{electricity price})_{isrt} + \beta_2 X_{isrt} + \beta_3 S_{st} + \lambda_i + \eta_{rt} + \delta_{st} + e_{isrt}$ $\log(\text{electricity price})_{isrt} = \alpha_0 + \alpha_1 \text{thermal shares} * \log(\text{coal price}_t) + \alpha_2 X_{isrt} + \alpha_3 S_{st} + \lambda_i + \eta_{rt} + \delta_{st} + \mu_{isrt}$	Higher electricity costs are associated with lower firm performance, particularly for small and medium-sized firms. Firms respond to this reducing consumption and adopting energy-saving technologies, but these choices are insufficient to fully offset the negative impact on firm performance.
Marin and Vona (2019)	15 industrial sectors 1995-2011 14 European Countries	Econometric Analysis	Energy prices	$DY_{ijt} = b_1 p^E{}_{ij,t-1} + b_2 Dp^E{}_{ij,t} + g.\log(GHG/VA)_{ij,1995} + j^c{}_{ij,1995} + m_{i,t} + q_{j,t} + e_{ij,t}$	The study reveals that higher energy prices have a negative short-term effect on employment and wages, but these effects are offset by long-term productivity gains. The study emphasises the importance of energy policies that encourage energy efficiency, reduce carbon emissions, and minimise negative socioeconomic impacts
Hannes et al. (2021)	Manufacturing sector 2001-2006 Indonesia	Econometric Analysis	Energy prices	$y_{isdt} = \beta_0 + \beta_1 G_{isd[t-1,t-5]} + \beta_2 G_{isd[t-1,t-5]} \times D_t + \beta_3 G_{isd[t-1,t-5]} \times E_t + \beta_4 L_{isdt-2} + \beta_5 K_{isdt-2} + \beta_6 M_{isdt-2} + \lambda_i + \kappa_{dt} + \gamma_{st} + e_{isdt}$	The findings suggest that higher energy prices are associated with lower carbon emissions and improved environmental performance. However, the use of generators has a negative effect on environmental performance, particularly in terms of carbon emissions.

Authors	Industry/Sector, Period, Country	Methodology	CBAM Measure	Model Specification	Key Findings
Cevik and Ninomiya (2022)	Power Sector 2014-2021 24 European Countries	Econometric Analysis	Electricity prices	$ep_{i,t} = \alpha.RE_{i,t} + \beta.X_{i,t} + \eta_i + \mu_t + \epsilon_{i,t}$	Renewable energy, especially wind power, notably lowers electricity prices in Europe. However, the connection between renewable energy use and electricity prices is intricate, influenced by factors like government support, storage tech, and market conditions.
Commins et al. (2009)	Manufacturing sector 1996-2007 Europe	Econometric regression	Energy Taxes	$Y_{jst} = b^k{}_s.k_{jst} + b^l{}_s.l_{jst} + a_i + h_s + m_t + e_{jst}$	A marginal tax shift slightly boosts TFP growth, reduces employment, moderately raises profitability, and maintains investment. Industry impacts vary significantly.
Abrell et al. (2011)	Non-metallic mineral products, electricity & heat, paper & paper products, basic metals, coke & refined petroleum products 2005-2008 Europe	Propensity score matching and difference-in-difference	EU ETS	$y_{it} = \alpha_0 + \alpha_1.d_{it} + \alpha_2.cv_{it1} + \alpha_3.c_{vit2} + \epsilon_{it}$	EU ETS is found not to have an impact on firm added value, profit margin or employment, and led to emission reductions in second phase.
Chan et al. (2013)	Power, cement, iron and steel 2001-2009 10 European Countries	Matching and difference-in-difference	EU ETS	$y_{it} = ad_{it} + x_{it}.\beta + f_i + d_{ct} + u_{it}$	No discernible impacts observed in cement, and iron and steel sectors. The EU ETS doesn't influence power plant employment but does elevate unit material costs. Participation in Phase II of the EU ETS correlates positively with power plant turnover.
Rivers and Schaufele (2014)	Manufacturing, Gasoline Market 1990-2011 British Columbia	Econometric analysis	Carbon tax	$X_{ijt} = a.\tau_{jt} + b_{ij} + d_{it} + f(t_{jt}, p_{jt}) + \epsilon_{ijt}$	No robust negative or positive competitiveness effect of the electricity tax reduction on manufacturing firms could be identified.

Source: Authors' Analysis.

3. Hypothesis

Given the limited evidence available regarding the potential response of Indian manufacturing firms to carbon taxes implemented under the Carbon Border Adjustment Mechanism (CBAM) policy, this study aims bridge this research gap. This analysis focuses on data from five energy-intensive industries in India. The primary objective is to investigate the potential impact of carbon taxes on firms' economic performance. Based on an extensive literature review and careful reasoning, we propose the hypothesis that increased carbon taxes will positively affect firms' fuel costs.

In the absence of both carbon markets and carbon taxes in India, this study employs companies' fuel expenses as a proxy for carbon price-related policies. Consequently, it is anticipated that firms' fuel expenditure will adversely affect profits, and export earnings. In essence, a significant negative relationship is expected to be observed between fuel costs and key indicators of firms' competitiveness: profits[1], RoA[2], and export earnings.[3]

4. Data and Econometric Model

In this section, we present the data sources and variables utilised in our study, focusing on a sample of 336 Indian manufacturing firms across five industry groups. Additionally, we outline the econometric methodology employed to examine the impact of power and fuel costs on various performance indicators of these firms.

4.1 Data

CBAM is initially targeted at imports from sectors known for their significant carbon intensity and the potential for carbon leakage. These sectors include cement, iron and steel, aluminium, fertilisers, electricity, and hydrogen, as previously mentioned. During the 2022-23 period, the EU, which stands as India's second-largest trading partner after the United States and the second-largest destination for Indian exports, received $74 billion in exports. This accounted for 15.39% of India's total exports, as reported by the Department of Commerce and Industry (Ministry of Commerce & Industry, 2022). Over the past decade, trade in goods between the EU and India has increased by approximately 30%, and trade in services between the two reached €30.4 billion in 2020 (European Commission).

The implementation of the EU's CBAM is expected to impact India's exports of steel, aluminium, cement, and fertilisers. Indian companies selling these products to the EU are likely to face higher prices, potentially reducing their competitiveness and decreasing demand in the EU market. As per a recent report from the Global Trade Research Initiative (GTRI, 2023), the introduction of CBAM is expected to pose a significant challenge to India's metal sector. In 2022, India exported iron, steel, and aluminium products valued at $8.2 billion to the European Union (EU), constituting 27% of its total exports in these categories (Table 1.2). In contrast, exports of cement, fertiliser, electricity, and hydrogen are minimal, and therefore, these sectors will be less affected.

The steel industry is not only a major contributor to exports but also a significant domestic carbon emitter. Primary steel producers have an average emission intensity of approximately 2.6 metric tons (MT) of CO_2 per MT of crude steel, which is 12% higher than the global average of about 2.32 MT of CO_2 per MT of crude steel from the blast furnace route (ICRA, 2023). According to the International Energy Agency (IEA), carbon emissions from iron and steel production have been increasing over the past decade due to rising steel demand and the energy-intensive nature of production. Consequently, the steel and iron industry are expected to bear the brunt of such a carbon policy due to their higher export volumes and carbon content. This imposition of higher fees could potentially diminish their competitiveness and profit margins in the EU markets. Similarly, the aluminium sector demonstrates an exceptionally high carbon intensity, estimated to range from 17 to 20 tonnes of CO_2 per tonne of aluminium (ICRA, 2023).

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[1] In all the regression equations, log of profits after tax is utilized. That is, dependent variable in all the results displayed in the paper are expressed in terms of log(Profit After Tax).

[2] In all the regression equations, RoA has been utilized in its absolute term.

[3] In all the regression equations, log of export earnings is utilized. That is, dependent variable in all the results displayed in the paper are expressed in terms of log(Export Earnings).

Table 1.2: India's 2022 Exports to the World and the EU

Sectors covered under CBAM	India's Exports (US $ Million)		EU's share	Impact on India's exports
	To World	To EU		
Iron ore, concentrates	1619.6	322.9	19.9	High
Steel Products	7316.9	1460.7	20	
Iron and Steel	11770.3	3696.4	31.4	
Aluminium, Products	9866.4	2734.2	27.7	
Cement	93	5.7	6.1	Low
Fertiliser	92	0.6	0.7	
Hydrogen	0	0	0	
Electrical Energy	647.9	0	0	
Total of above	**31406.1**	**8220.4**	**26.2**	
India's Total Goods Exports	453325.7	73670.2	16.3	
Share of CBAM products (%)	6.9	11.2		

Source: Retrieved from GTRI Report (March 2023).

Our research focuses on examining the impact of fuel costs on firms' performance. Thus, we conducted a comprehensive study involving 336 companies from four major EITE (Energy Intensive and Trade Exposed) industries in India. These include aluminium and aluminium products, fertilisers, cement, and steel and iron, which are regulated under CBAM. They are anticipated to be significantly affected due to their export intensity and carbon intensity, as summarised in Table 1.2.

Additionally, we included the coal industry due to its significant role in electricity production through thermal power plants using coal, which account for approximately 75% of the total power generation in India. This substantial reliance on coal contributes to the indirect emissions covered under CBAM. Furthermore, industries such as steel and iron utilise coal as an input, contributing to direct emissions, once again falling under CBAM.

Therefore, to provide a holistic view of the impact of CBAM in India, we included four EITE industries (aluminium and aluminium products, fertilisers, cement, steel and iron), along with coal. Table 2.1 demonstrates the distribution of firms from the five industries in our dataset. The steel and iron industry represents the highest number of firms (data for 10 years for 130 firms), followed by firms in the fertiliser industry (104 firms) and coal industries (61 firms). For this data set, we have fewer firms in the aluminium and cement industries. Our dataset for the 336 firms is balanced for the list of variables analysed in this study.

To gather the necessary data, we utilised a panel dataset spanning a period of ten years, from 2012 to 2021, sourced from CMIE's ProwessIQ database. ProwessIQ is an interactive interface that provides information on over 56,000 Indian firms listed on the Bombay Stock Exchange and National Stock Exchange. From the Annual Financial Statements available in Prowess, we extracted financial performance variables, including profit after tax, return on capital, firm age, size, total assets, total expenses, number of employees, and others. All the financial data was recorded in Crore of Indian Rupees.

Table 2.1: Industry Category[4]

Industry Category	Freq.	Per cent	Cum.
Aluminium	100	2.98	2.98
Cement	310	9.23	12.20
Coal	610	18.15	30.36
Fertiliser	1,040	30.95	61.31
Steel and Iron	1,300	38.69	100.00
Total	3,360	100.00	

Source: Authors' Analysis.

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[4] Dataset is unbalanced to start with. Our next analysis is to explore other datasets and expand the sample size.

4.1.1. Variable Definition

Dependent Variables: To evaluate the impact of fuel costs on firms' performance, we have selected profit after tax (PAT), RoA, and export earnings as our primary dependent variables.

Independent Variable: Our primary independent variable is fuel cost per unit sales, serving as a proxy for carbon taxes in India. The Power and Fuel charges of firms are extracted from CMIE Prowess under the total expenses category. Consequently, Fuel Cost per unit Sales = Power and Fuel Charges/Sales.

Control Variables: It is evident that the influence of fuel costs on economic performance can vary among firms and industries. To address firm-specific attributes, we incorporated control variables, including firm age, size, and others as outlined below:

a) **Firm Age:** We hypothesise that a firm's age could impact its performance. Some research indicates a positive association between age and profitability, implying that older firms typically achieve greater profitability. Conversely, other studies propose a negative correlation between a firm's age and its performance. Multiple investigations suggest a nonlinear relationship between age and profitability, indicating that younger firms may experience higher profits until they reach a certain age threshold. Beyond this point, older firms are inclined to surpass their younger counterparts (SELCUK (2016); Haykir, O & Celik, M (2018)).

b) **Raw Material Costs:** Furthermore, we consider the influence of raw material expenses or production costs on a firm's annual performance, recognising the potential significance of this factor. Several studies have indicated that efficient inventory management can positively impact profitability (Prempeh, Kwadwo Boateng (2015)). On the other hand, some research posits that production costs may not directly impact profits. Instead, an increase in operational costs could potentially lead to lower profits, while a reduction in operational costs might result in higher profits (Muhammad Istan et al (2021)). Additionally, fluctuations in input prices have been observed to affect both profits and export earnings (Jurnal Ilmu Ekonomi (2016)).

c) **Capital Intensity:** Capital-intensive sectors are distinguished by a notably larger allocation of capital in production processes relative to labour. Enterprises operating within capital-intensive industries must commit substantial resources to acquire fixed assets, essential for both initiating and sustaining their operations. This frequently entails the deployment of state-of-the-art machinery and equipment. Such investments can contribute to enhanced productivity (Grazzi, Jacoby, & Treibich (2016)), amplified production, and ultimately improved performance and competitiveness.

d) **Firm Size:** In accordance with classical neoclassical theory, it is anticipated that the size of a firm will positively influence its financial performance. The magnitude of operations can be contingent upon factors such as the nature of the business, the level of capital investment, the workforce size, or the overall assets held by the enterprise. Larger firms are commonly thought to leverage economies of scale; thereby, augmenting their competitive prowess. Moreover, engaging in export activities is anticipated to have a positive impact on financial performance, as previous research has demonstrated that companies engaged in exportation tend to exhibit higher productivity levels compared to those primarily focused on domestic markets (J. Wagner (2007)).

e) **Economic Growth:** Economic growth serves as a reflection of the broader macroeconomic landscape and operates as an indicator of shifts in economic activities within a nation. It is presumed that fluctuations in economic activities can influence a company's performance. Therefore, incorporating this variable into the profitability model allows us to account for the business cycle, encompassing periods of economic upturns and downturns. During phases of economic growth, there is an upswing in the demand for a firm's products and services, resulting in heightened sales and enhanced profitability. However, adverse economic conditions, such as those experienced during economic contractions, including recent recessions, can have an adverse impact on a firm's performance (Pattitoni, Petracci, and Spisni (2014); Khatib et al. (2023)).

Table 2.3 and Table 2.4 represent the descriptive statistics and correlation matrix respectively for the overall data. Some variables have been transformed to log to fit the normal distribution.

Table 2.2: Explanatory Variables List/Controls

Variable	Constructed using:
Fuel Cost per rupee sales	Power and Fuel Expenses/Sales
Raw material expenses per rupee sales	Raw material expenses/Sales
Firm's age	Continuous variable
Capital Intensity	Total Capital Investment/Total salaries and wages
Labour Cost	Total Salaries and Wages/Sales
Small, Medium, and Large Dummy Variables	Classification: Small: Total capital investment < 10 crores Medium: 10 crores < Total capital investment < 50 crores Large: Total capital investment > 50 crores
Old and New Dummy Variables	Classification: New: Year of Incorporation reported is after 1990 Old: Year of Incorporation reported is before 1990

Source: Authors' Analysis.

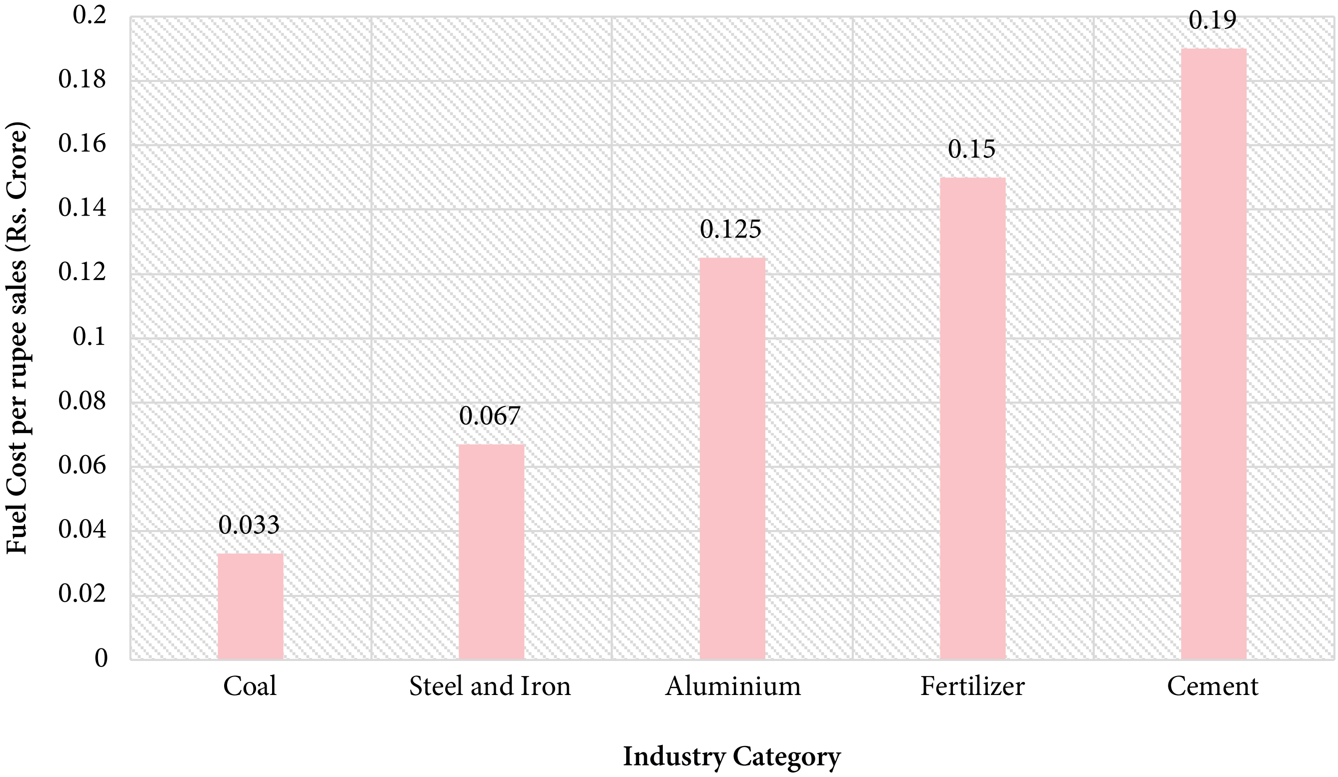
Table 2.3: Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Profit After Tax	2,960	141.3134	1075.142	-5890.72	33011.2
RoA	2,920	-6.168229	78.02397	-1980.65	96.08
Export Earnings	659	518.3712	2201.467	0	23238
Fuel Cost	2,392	0.117227	1.218248	0	59.1
Labour Cost	2,409	0.173978	3.200106	.0001892	156.4
Capital Intensity	2,593	46.24537	429.1484	.0062267	17936
Total Assets	3,050	3349.129	14457.58	0.01	230368
Raw Material Expenses/Sales	2,303	0.5639573	0.7921934	-.0660793	35.625
Age	3,360	29.73512	16.984	-9	114
Annual growth rate of GDP	3,360	5.61	4.053861	-5.8	9.1

Source: Authors' Calculation

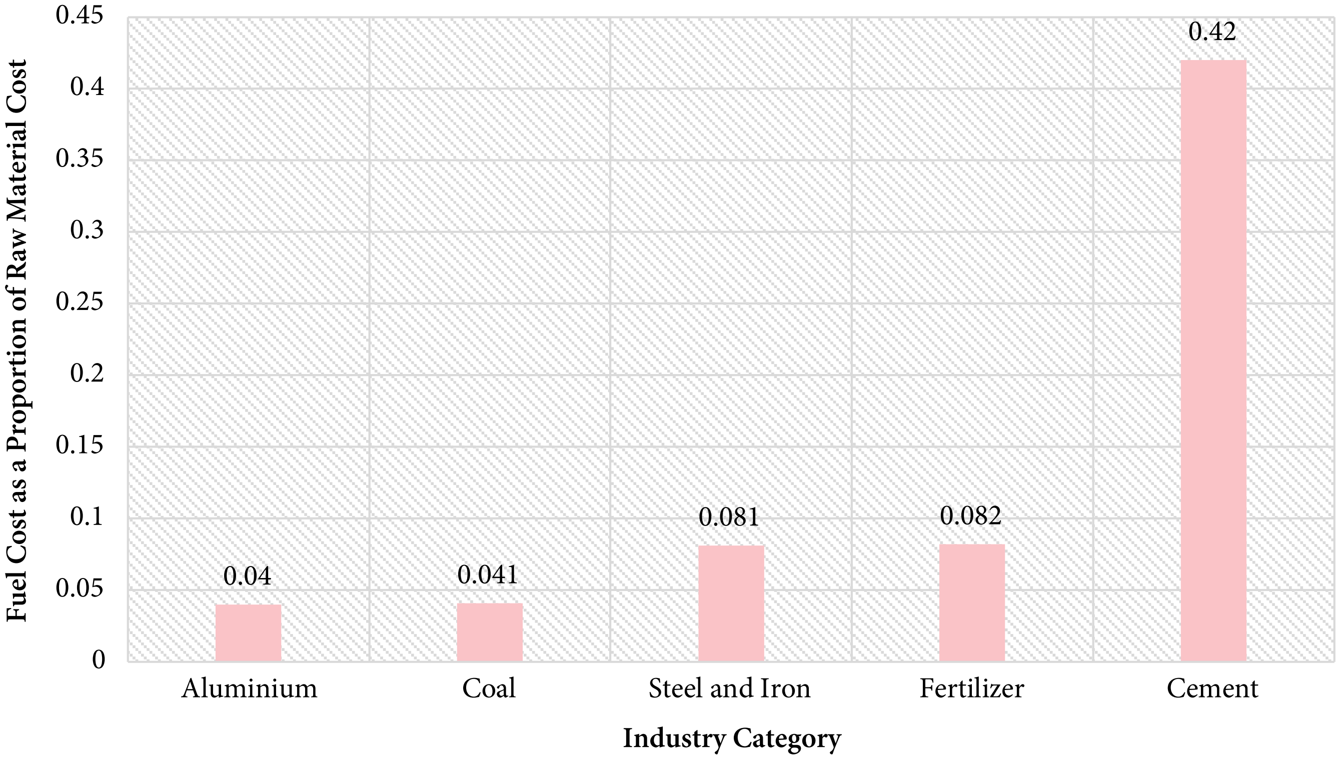
Additionally, we provide the average fuel cost per rupee sales across various industries throughout the entire time period, as illustrated in Figure 1. On the other hand, Figure 2 showcases the average fuel costs relative to the total raw material cost within each of the five industries. Similarly, Figures 3, 4, and 5 display the averaged profits after tax, sales figures, and export earnings for these same industries over the entire time span.

Figure 1: Average Fuel Costs of Firms across Five Categories: 2012-2021



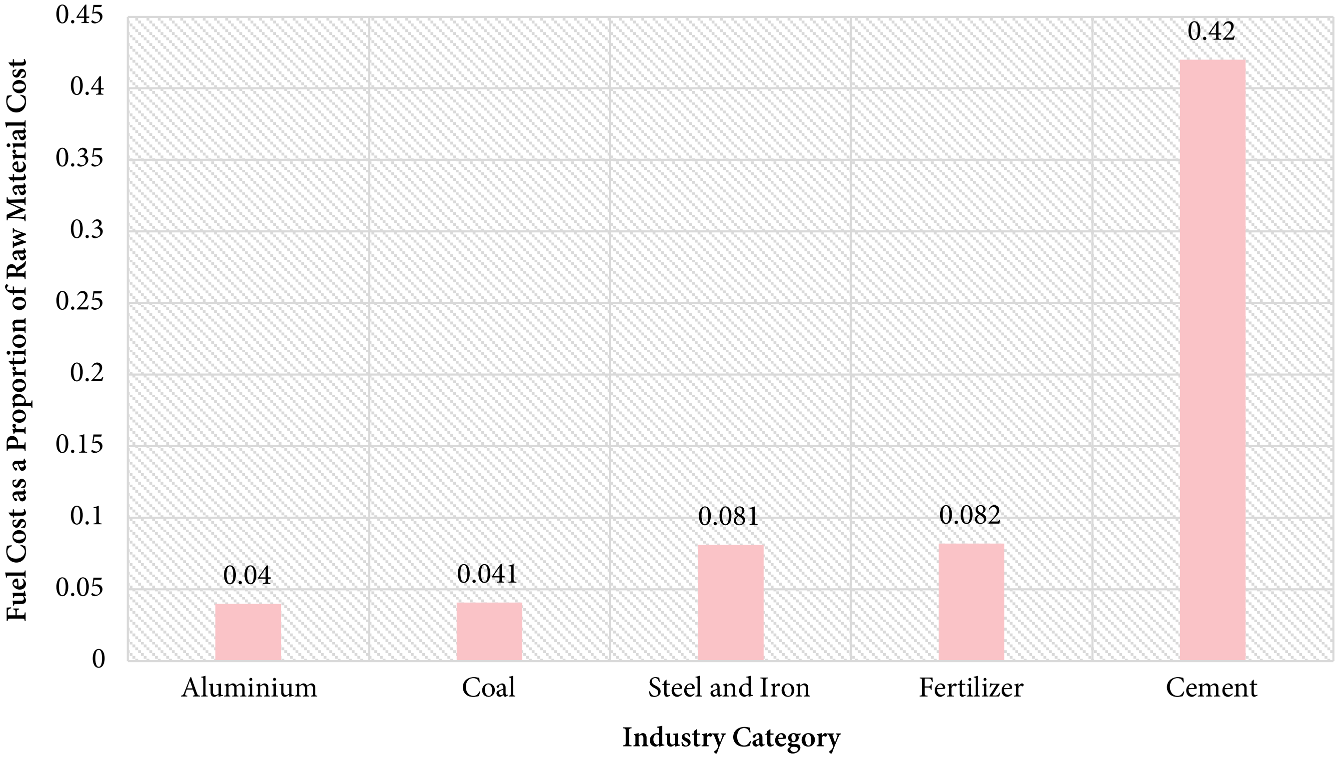
Source: Authors' Calculation.

Figure 2: Fuel Cost as a Proportion of Total Raw Material Expenses: Average across Five Firm Categories, 2012-2021



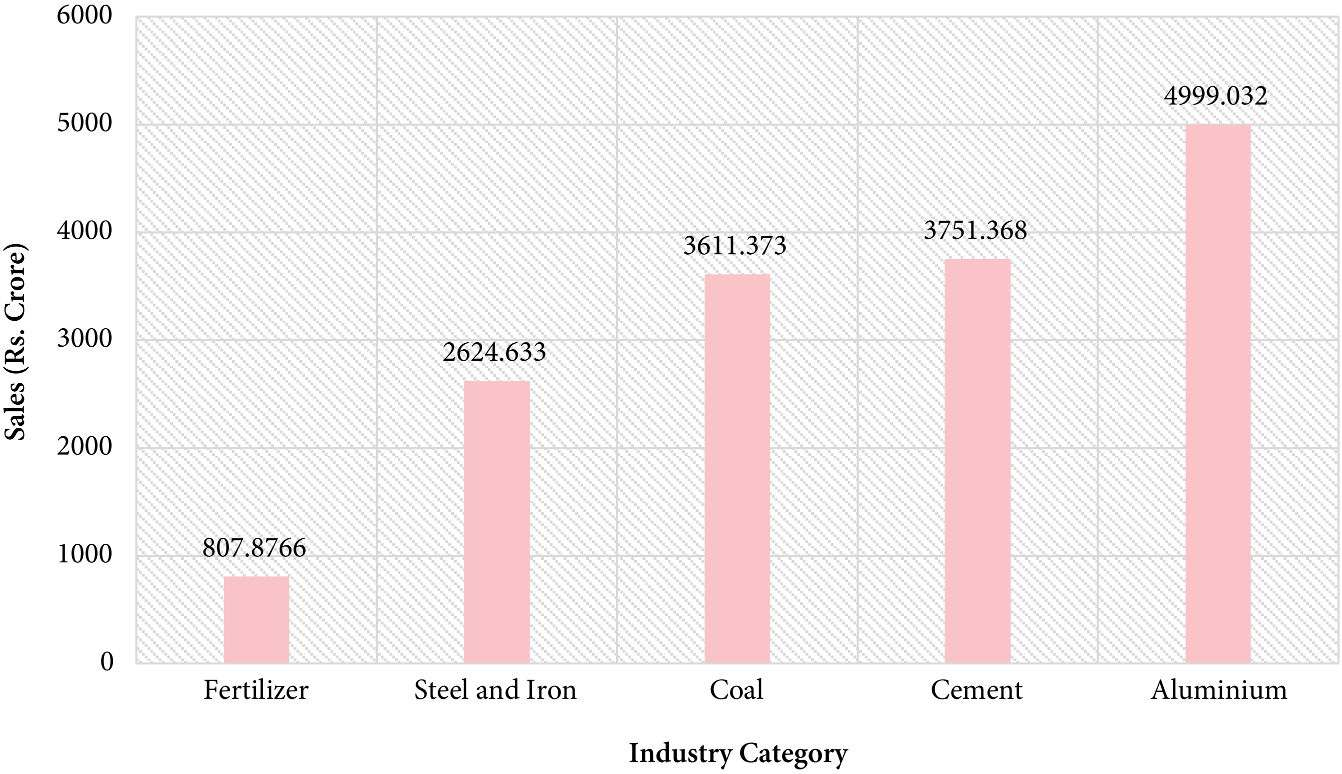
Source: Authors' Calculation.

Figure 3: Represents Post-Tax Profits of the Firms Operating in the Five Categories, Averaged over the time period 2012 - 2021



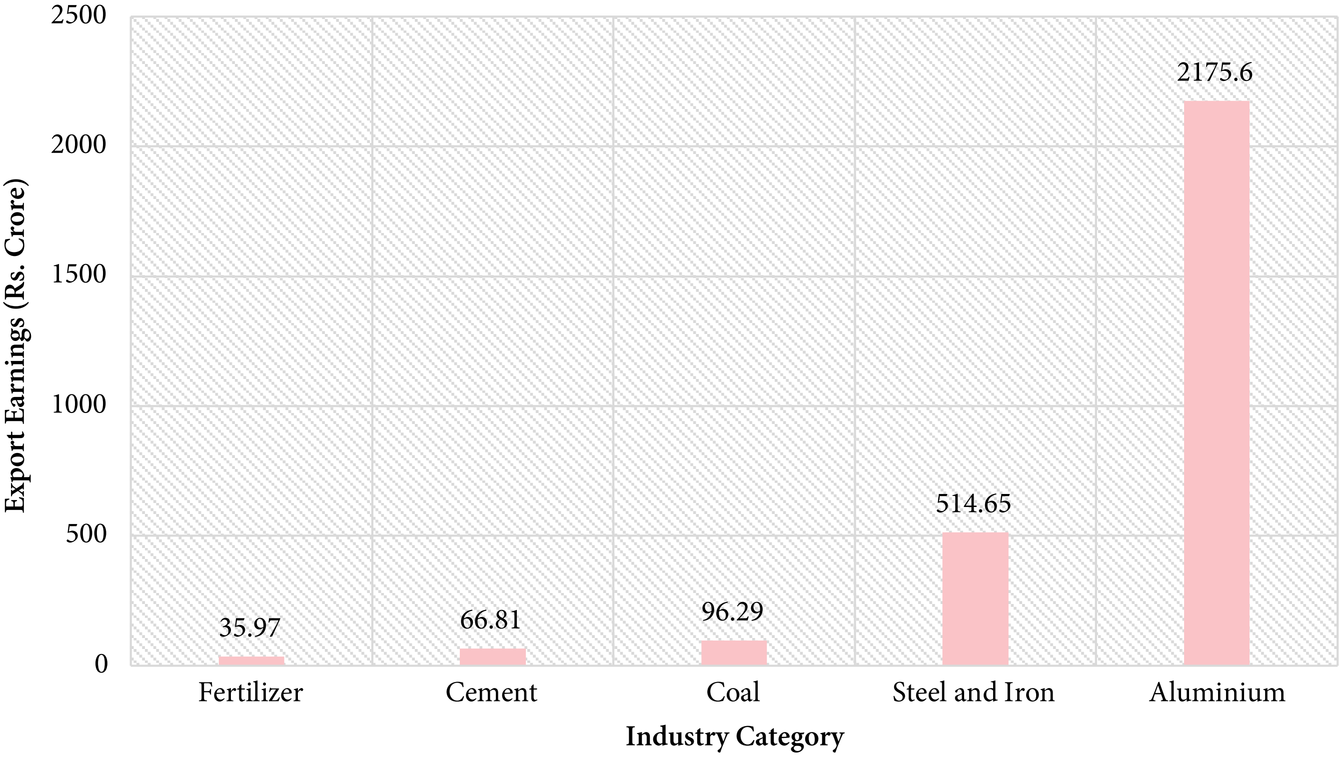
Source: Authors' Calculation.

Figure 4: Average Sales of Firms across Five Categories: 2012-2021



Source: Authors' Calculation.

Figure 5: Average Export Earnings of Firms across Five Categories: 2012-2021



Source: Authors' Calculation.

Table 2.4: Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Profit after tax	1									
ROA	0.2612	1								
Export Earnings	0.6234	0.1008	1							
Fuel Cost	-0.0064	-0.0204	0.0138	1						
Labour Cost	-0.0501	-0.1761	-0.0815	0.0951	1					
Capital Intensity	-0.1056	-0.1938	-0.0657	-0.0694	-0.0721	1				
Total Assets	0.6429	0.1006	0.7417	0.0017	0.0497	-0.0880	1			
Raw Material Expenses/Sales	-0.0894	-0.2321	0.0405	-0.5258	-0.3128	0.1304	-0.0663	1		
Age	0.1277	0.1355	0.0901	0.1164	0.1438	-0.1625	0.1916	-0.3294	1	
Annual growth rate of GDP	-0.0551	-0.0259	-0.0359	-0.0019	-0.1207	-0.0224	-0.0309	-0.0288	-0.0399	1

Source: Authors' Calculation.

4.2 Econometric Model

We test the following model specification (borrowed from Dussaux D. (2020)), using the statistical software STATA, to investigate the short-term impact of fuel cost (carbon taxes) on firms' performance:

$$Y_{it} = \alpha_i + \beta_0 .\ FuelCost_{it} + \beta_1 . X_{it} + \delta_t + \mu_{i.} + \epsilon_{it} \quad (1)$$

Here, Y denotes our choice of dependent variables (log of PAT, RoA, and log of Export Earnings) for firm i in year t. Fuel cost per rupee sales for firm i in year t is constructed using power and fuel expenses and their sales. X_{it} refers to the firm-level controls such as age etc. δ_t refers to time fixed effects or year dummies. μ_i refers to firm fixed effects, and ϵ_{it} refers to the stochastic error term. The fixed effects for time capture the same essence as including a dummy variable for each specific time period. This includes any and all variables, measurable or conceivable or not, that are *present for all firms* during the period 2012-2021 and that may influence the outcome variable, Y. Firm fixed effects are included to capture unique, firm specific variables that vary across firms but remain constant over time, such as geographic location, etc., which may influence our outcome variable, Y. While several model specifications have been tested and are displayed in appendix, we report the summary of the regression in the next section. Though the original model in Dussaux D. (2020) utilises lagged regressors, we have opted not to incorporate a one-period lag on fuel costs. This decision is based on the understanding that the current fuel cost is more likely to have an immediate impact on present profits, RoA, and export income. Notably, the correlation between fuel costs in the current year (t) and the preceding year (t-1) within our dataset stands at 0.85.

In Table 2.4, we generate a correlation matrix to examine the relationship between the variables of interest, particularly fuel cost and the three dependent variables. A correlation coefficient of 1 indicates a perfect positive correlation, while a correlation above 0.7 suggests the presence of multi-collinearity. In our analysis, fuel cost displayed negative correlations with RoA (-0.0204), profit after tax (-0.0064), while a positive correlation with export earnings (0.0138). While there was no evidence of multi-collinearity, we exercised caution when including controls or other explanatory variables.

Furthermore, we conducted a Hausman test to compare the advantages of the fixed effects model against the random effects model. We also performed tests for heteroscedasticity and time effects. Our test confirmed the presence of a heteroscedastic error term. It was determined that a fixed effects panel data regression model was appropriate for our analysis. Consequently, we utilised a panel data regression model with fixed effects, which serves as our final regression model.

5. Results

5.1 First-order effects

We evaluated our hypothesis by analysing various regression model specifications, and the results are presented in Tables 3.1 and 3.2. These tables showcase the impact of fuel costs per unit of sales on our selected dependent variables, which serve as indicators of either competitiveness or firm performance, specifically post-tax profits, Return on Assets (RoA), and export earnings, referred to as first-order effects.

In appendix Table 8.B.1, you can find insights into the association between fuel costs and post-tax profits using a log-log regression model, where the coefficients represent elasticities. Our findings support our hypothesis, as indicated by consistently negative and statistically significant coefficients (β_0) across various specifications, including those with individual control variables. Similarly, Table 8.B.2 illustrates the influence of fuel costs on firms' RoA using a linear-log regression specification spanning a decade. Irrespective of the model specifications used, the results consistently reveal significant negative coefficients (β_0).

Table 8.B.3 presents the effect of fuel costs per rupee of sales on firms' export earnings, employing a log-log model across different specifications. To consolidate our findings from the previous models, we refer to Tables 3.1 and 3.2, which employ fixed effects panel regression. These tables underscore that export earnings are more sensitive to fluctuations in fuel costs, subsequently impacting profits and RoA. Specifically, when considering only the age as a control variable (Table 3.1), a 10% increase in fuel costs leads to a 2.41% reduction in earnings from exports, a 0.23% decrease in RoA, and a 1.34% decline in post-tax profits. More importantly, these coefficients are statistically significant. However, when we introduce additional control variables that influence firm performance besides from fuel costs (Table 3.2), we observe that a 10% increase in fuel costs results in a 1.94% profit decrease, a 0.21% RoA reduction, and a statistically insignificant 0.7% drop in export earnings.

Although raw material expenses per rupee of sales (raw material intensity) exhibit expected negative impacts, the coefficients do not achieve statistical significance. Contrary to existing literature, the influence of capital intensity is negative and statistically insignificant. Additionally, the impact of the annual growth rate of GDP, reflecting India's macroeconomic performance over the decade, is positive and significant on firm profits and RoA. However, labour costs (defined as total salaries and wages per unit of sales) negatively affect firm performance, representing an expenditure incurred in production and thus a cost to the firm.

It is worth noting that β_0 values vary as we transition from Table 3.1 to Table 3.2 due to correlations, whether negative or positive, between control variables and fuel costs themselves. Consequently, we conclude that an increase in fuel costs resulting from higher carbon taxes will have detrimental effects on firms' economic performance, particularly in the Energy-Intensive and Trade-Exposed (EITE) industries. Therefore, enterprises operating in the aluminium, steel and iron, cement, coal, and fertiliser sectors will be especially vulnerable to increased carbon taxes under CBAM policy.

Table 3.1: The Impact of Fuel Costs on Post-Tax Profits, RoA, and Export Earnings for All Firms

	Profit-After Tax	**RoA**	**Export Earnings**
Log of Fuel Cost (per unit sales)	-0.134* (0.0645)	-2.361*** (0.456)	-0.241* (0.118)
Firm's Age	0.123*** (0.0178)	0.0643 (0.127)	0.0754* (0.0317)
Constant	-2.214*** (0.629)	-8.417 (4.294)	-0.531 (1.170)
Fixed Effects	Yes	Yes	Yes
No. of observations	1677	2306	633
R-squared	0.126	0.040	0.044
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001			

Source: Authors' Calculation.

Note: Regression results are displayed in the standard table format such that dependent variables: profit after tax, RoA, and export earnings are presented in columns highlighting each specification, and independent variables: Fuel cost, age etc. are presented in rows.

Table 3.2: Impact of Fuel Costs on Post-Tax Profits, RoA, and Export Earnings Across All Firms

	Profit-After Tax	RoA	Export Earnings
Log of Fuel Cost (per unit sales)	-0.194* (0.0767)	-2.117*** (0.501)	-0.0791 (0.141)
Firm's Age	0.142*** (0.0190)	0.184 (0.126)	0.0953** (0.0311)
Raw Material Expenses per unit Sales	-0.210 (0.246)	0.115 (0.270)	-1.782** (0.609)
Capital Intensity	-0.0105 (0.00983)	0.00649 (0.0167)	-0.00670 (0.0107)
Annual Growth rate of GDP	0.0151* (0.00629)	0.202** (0.0662)	0.0355 (0.0194)
Labour Cost	-1.278* (0.558)	-3.703 (2.361)	-7.784** (2.513)
Constant	2.985*** (0.694)	-12.58** (4.583)	0.687 (1.181)
Fixed Effects	Yes	Yes	Yes
No. of observations	1433	1979	565
R-squared	0.175	0.047	0.107
Standard errors in parentheses * $p<0.05$, ** $p<0.01$, *** $p<0.001$			

Source: Authors' Calculation.

5.2 Impact of fuel costs on small, medium, and large firms

It is plausible that firms respond differently based on their size. Some studies suggest that small enterprises may face challenges in adjusting to shifts in their input mix and could be more vulnerable to fluctuations in fuel costs. Conversely, larger and medium-sized enterprises possess greater resources and capabilities to adapt (Caves and Barton (1990); Sadorsky (2008)). On the contrary, other research suggests that smaller businesses might not bear as much of the burden of rising fuel prices. This is due to their tendency to be more efficient and encounter fewer organisational issues compared to their larger counterparts (Dussax (2020)).

To examine the diverse impacts of fuel costs on firm performance, we introduce two interaction terms: "Fuel Cost * Small," where "small" is a dummy variable taking the value 1 if the total capital investment in the firm is less than 10 crores, and 0 otherwise, and "Fuel Cost * Large," where "large" is a dummy variable taking the value 1 if the total capital investment in the firm is more than 50 crores and 0 otherwise. In all the results presented in the paper, the interaction terms explicitly denote log (Fuel Cost per rupee sales)*Dummy variable. Consequently, the impact on medium-sized firms is represented by those with total capital investments ranging from 10 to 50 crores. The regression model can be formulated as follows:

$$Y_{it} = \alpha_i + \beta_0 .\ FuelCost_{it} + \beta_1 .FuelCost_{it} {}^*Small \\ + \beta_2 .\ FuelCost_{it} {}^*Large + \beta_3 .X_{it} + \delta_t + \mu_{i.} + \epsilon_{it} \qquad (2)$$

Table 4 provides the findings regarding the impact of fuel costs (per rupee of sales) on post-tax profits, RoA, and export earnings across all firms categorised as small, medium, and large. The table reveals that in response to a 10% increase in fuel costs, medium-sized firms experience a statistically significant 2.9% decline in profits, while large firms encounter a 3.5%[5] decrease, although it is not statistically significant. In

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[5] The partial coefficient for the effect of fuel cost on large firms will be calculated as: $\beta_0 + \beta_2$ *(since Large = 1)*

contrast, smaller firms undergo a statistically significant 0.75%[6] reduction in profits. RoA also shows a decrease, with medium-sized firms experiencing a 0.23% decline, smaller firms observing a 0.22% drop, and larger firms recording a 0.15% decrease.

Consequently, based on these findings, one could infer that in the short-term, medium and larger firms tend to experience more pronounced declines in profitability compared to their smaller counterparts. However, the results regarding RoA and export earnings do not exhibit a clear distinction among the firm sizes.

Table 4: Impact of Fuel Costs on Post-Tax Profits, RoA, and Export Earnings Across Small, Medium, and Large Firms

	Profit After Tax	RoA	Export Earnings
Log of Fuel Cost (per unit sales)	-0.296*** (0.0841)	-2.385*** (0.533)	-0.0626 (0.158)
Fuel Cost*Small	0.221*** (0.0561)	0.0972 (0.509)	0.241** (0.0877)
Fuel Cost*Large	-0.0576 (0.0669)	0.810 (0.530)	-0.0957 (0.106)
Firm's age	0.134*** (0.0185)	0.193 (0.126)	0.0792* (0.0317)
Raw Material Expenses per unit Sales	-0.203 (0.258)	0.123 (0.282)	-1.926** (0.607)
Capital Intensity	-0.0145 (0.00817)	0.00667 (0.0163)	-0.00681 (0.0121)
Annual Growth rate of GDP	0.0156* (0.00620)	0.202** (0.0667)	0.0364 (0.0192)
Labour Cost	-1.472* (0.569)	-3.667 (2.408)	-8.057** (2.499)
Constant	-2.694*** (0.684)	-12.96** (4.637)	1.465 (1.271)
Fixed Effects	Yes	Yes	Yes
No. of observations	1433	1979	565
R-squared	0.195	0.05	0.143
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001			

Source: Authors' Calculation.

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[6] The partial coefficient for the effect of fuel cost on small firms will be calculated as: $\beta_0 + \beta_1$ *(since Small = 1)*

5.3 Impact of fuel costs on old vs new firms

It is worth considering that newer firms might respond differently compared to well-established ones. Despite the absence of literature supporting the performance of newer or older firms in response to changes in fuel costs, we aim to conduct an econometric analysis to assess this impact and contribute to the existing body of knowledge. As previously discussed, existing literature suggests that older firms generally perform better, while newer firms may exhibit higher performance only up to a certain point, beyond which older firms tend to outperform them.

To investigate whether alterations in fuel costs have any effect on the performance of older versus newer firms, we introduce the following model. The regression equation now includes an interaction term: "Fuel Cost * Old," where "Old" is a dummy variable taking the value 1 if the firm's year of incorporation predates 1990, and 0 otherwise.

$$\begin{gathered} Y_{it} = \alpha_i + \beta_0.\ FuelCost_{it} + \beta_1.FuelCost_{it} \\ {*}Old + \beta_2.X_{it} + \delta_t + \mu_{i.} + \epsilon_{it} \end{gathered} \tag{3}$$

Table 5 presents the outcomes of fuel cost on firm performance, categorised into two groups: "old" firms, which were established before 1990, and "new" firms, established after 1990. The data clearly shows that changes in fuel costs have a more substantial and statistically significant impact on the performance of newer firms. Specifically, a 10% increase in fuel costs results in a 2.1% decrease in profits and a 0.26% decline in RoA for newer firms. In contrast, the results indicate that the effects of fuel cost changes are statistically insignificant for older firms, suggesting a comparatively less pronounced impact on this group.

Table 5: Impact of Fuel Costs on Post-Tax Profits, RoA, and Export Earnings for Old and New Firms

	Profit After Tax	RoA	Export Earnings
Log of Fuel Cost (per unit sales)	-0.211* (0.0980)	-2.604*** (0.721)	-0.130 (0.220)
Fuel Cost*Old	0.0476 (0.157)	1.242 (0.969)	0.0969 (0.254)
Raw Material Expenses per unit Sales	-0.222 (0.247)	0.167 (0.280)	-1.801** (0.595)
Capital Intensity	-0.0106 (0.00985)	0.00534 (0.0162)	-0.00724 (0.0106)
Annual Growth rate of GDP	0.371*** (0.0489)	0.646 (0.336)	0.274** (0.0824)
Labour Cost	-1.324* (0.565)	-3.826 (2.385)	-7.694** (2.578)
Constant	-1.002* (0.506)	-9.455** (3.128)	2.467*** (0.657)
Fixed Effects	Yes	Yes	Yes
No. of observations	1433	1979	565
R-squared	0.175	0.049	0.108
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001			

Source: Authors' Calculation.

5.4 Sector-specific impacts and vulnerability ranking

To ensure the reliability of our findings, we conducted a specialised analysis that specifically examined the impact of fuel costs on the dependent variables within each industry sector. Tables 6.1 and 6.2 present the results of this analysis for companies operating in the Steel and Iron sector. These results corroborate our earlier findings and underscore the adverse effects of fluctuations in fuel costs on profits, sales, and export earnings. While the effect on profits is not statistically significant in both tables (with and without control variables), the negative coefficient suggests a potential adverse effect.

To be precise, a 10% increase in fuel costs leads to a statistically significant 2.9% reduction in export earnings and a 0.21% decrease in RoA when age is the only control variable considered. Additionally, when multiple controls are introduced, a 10% rise in fuel costs results in a statistically significant 0.14% decline in RoA. These findings provide further confirmation of the detrimental impact of fuel cost fluctuations on profits, RoA, and export income within the Steel and Iron industry sector.

Table 6.1: Impact of Fuel Costs on Post-Tax Profits, RoA, and Export Earnings in the Steel and Iron Industry

	Profit After Tax	RoA	Export Earnings
Log of Fuel Cost (per rupee sales)	-0.125 (0.109)	-2.192** (0.666)	-0.298* (0.132)
Firm's age	0.161*** (0.0309)	0.200 (0.217)	0.0457 (0.0357)
Constant	-3.704*** (1.031)	-12.79 (6.798)	1.120 (1.191)
Fixed Effects	Yes	Yes	Yes
No. of observations	619	967	387
R-squared	0.182	0.049	0.053
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001			

Source: Authors' Calculation.

Table 6.2: Impact of Fuel Costs on Post-Tax Profits, RoA, and Export Earnings in the Steel and Iron Industry

	Profit After Tax	RoA	Export Earnings
Log of Fuel Cost (per unit sales)	-0.127 (0.120)	-1.451* (0.591)	-0.150 (0.139)
Firm's Age	0.182*** (0.0299)	0.280 (0.204)	0.0911** (0.0342)
Raw Material Expenses per unit Sales	-1.258** (0.440)	-6.094* (3.069)	-2.819** (0.973)
Capital Intensity	-0.0216 (0.0196)	0.0294 (0.0207)	0.0141* (0.00559)
Annual Growth rate of GDP	0.0138 (0.00989)	0.469*** (0.126)	0.0227 (0.0217)
Labour Cost	-3.140 (2.754)	-5.831 (3.735)	-10.16*** (2.676)
Constant	-3.290** (1.111)	-12.25 (6.447)	2.376* (1.145)
Fixed Effects	Yes	Yes	Yes
No. of observations	554	878	344
R-squared	0.218	0.071	0.165
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001			

Source: Authors' Calculation.

To assess the impact of fuel costs on the economic performance metrics of companies across various industries, we re-implemented the fixed effects model. Figure 6 displays the individual elasticities (β_0) obtained for each industry category from the fixed effects panel regression. This analysis specifically examines the impact of fuel costs on profits, RoA, and export earnings, considering solely the control variable of age. The regression equation employed is as follows:

$$Y_{it} = \alpha_i + \beta_0 . \, FuelCost_{it} + \beta_{1.} Age_{it} + \delta_t + \mu_i + \epsilon_{it} \qquad (4)$$

Most coefficients support our hypothesis and echo the previously mentioned findings by displaying negative values. However, the statistical significance of these coefficients varies, with the significant ones highlighted in red. Within the cement industry, firms experience a notable 6.7% reduction in post-tax profits when facing a 10% increase in fuel costs. As for RoA, companies in the coal, fertiliser, and steel and iron sectors experience significant declines of 0.22%, 0.24%, and 0.21%, respectively, in response to a 10% surge in fuel costs. Additionally, the steel and iron industry witness a significant three per cent decline in export earnings.

Therefore, we can infer that the cement industry is highly susceptible to changes in post-tax profits due to fluctuations in fuel costs, ranking highest in terms of vulnerability to fuel cost changes. The fertiliser industry follows, with coal and steel and iron subsequently demonstrating greater vulnerability to fuel cost fluctuations.

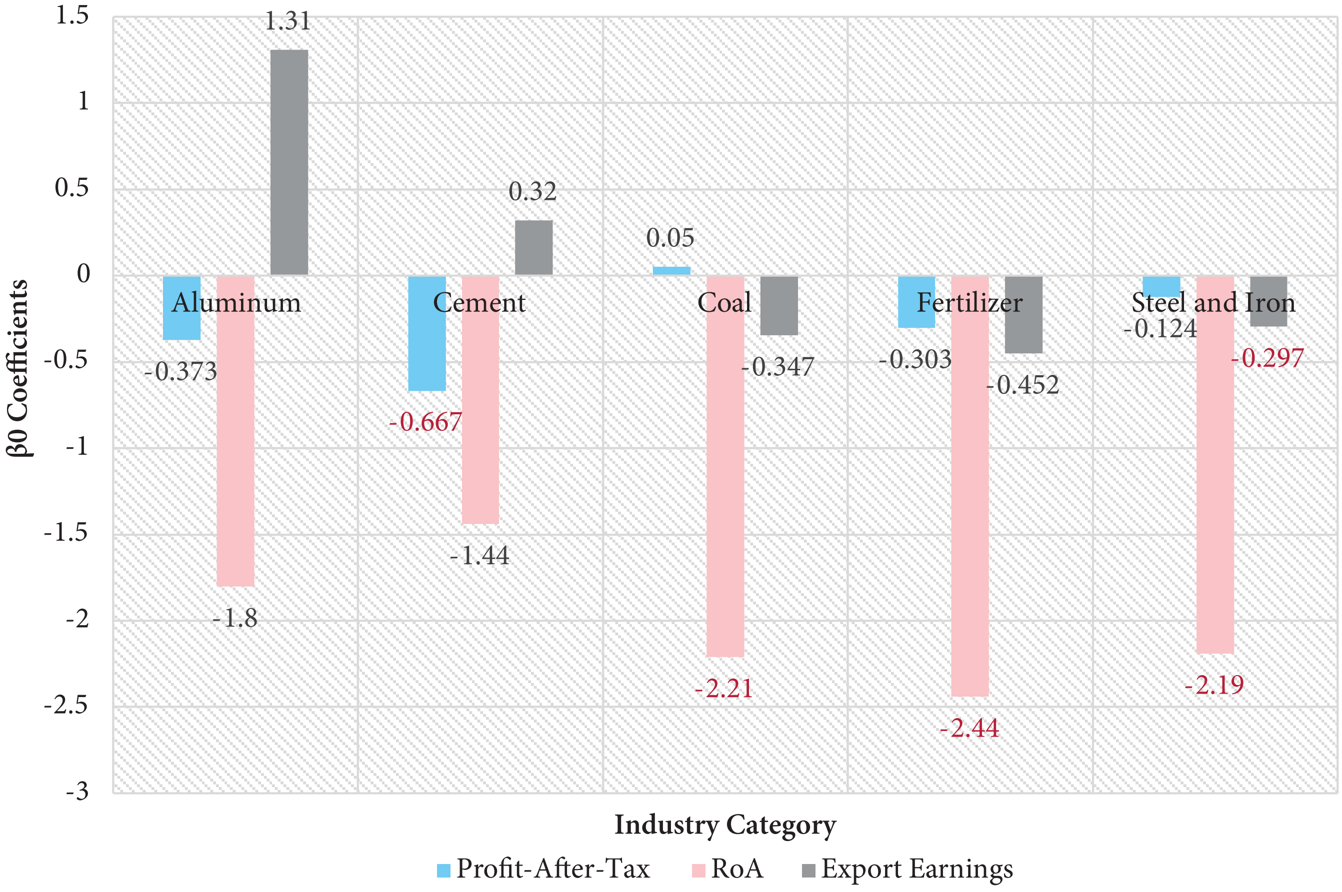
5.5 2SLS regression model

In addition to the fixed effects model, we conducted additional robustness checks to ensure the reliability of our findings. The results of these checks are presented in Tables 8.E in the appendix displays, where we employed the Two Stage Least Squares (2SLS). The 2SLS model is favoured over fixed effects panel regression as it addresses potential endogeneity issues by using an instrument variable. In our case, the instrument variable is an exogenous fuel and power wholesale price index extracted from RBI Bulletin, specifically the Price and Production Data on Wholesale Price Index for the period 2013-2021. If the goal is to capture shifts in carbon taxes solely through changes in prices, then we use the substitution of the firms' encountered price index to assess the impact. This instrument variable is considered exogenous for all firms and industries, reflecting changes in fuel costs based solely on variations in fuel and power prices.

Upon examining these results, we observe negative and adverse effects on sales and export earnings due to fuel cost changes, although the coefficients are not significantly different from zero. It is worth noting that the reliability of this information may be questionable as the WPI is based on domestic prices rather than internationally standardised prices. While there may be variations in the statistical significance of coefficients across the different models considered, it is important to highlight that the core results remained consistent. The negative direction of the coefficients still indicates a detrimental impact of fuel cost shocks on the dependent variables. The variations in statistical significance can be attributed to the different assumptions and specifications of the models.

Overall, these robustness checks provide further support to our findings, as the fundamental results regarding the adverse effects of fuel cost changes on the dependent variables remained consistent across different model specifications, including the fixed effects panel regression, and the two-stage least squares.

Figure 6: Impact of Fuel Costs on Post-Tax Profits, RoA, and Export Earnings Across Sectors: Industry-wise β0 Coefficients



Source: Authors' Calculation.

6. Conclusion

This study presents new empirical evidence on the influence of fuel cost shocks on firm-level economic performance indicators, utilising a unique dataset that encompasses micro-level information from Indian manufacturing firms in five EITE industry categories: aluminium, cement, coal, fertilisers, and steel and iron. The analysis employs a panel data technique with fixed effects regression to evaluate the impact of fuel costs.

The findings reveal that a 10% escalation in fuel costs corresponds to a 2.41% reduction in export earnings, a 0.23% decrease in RoA, and a significant 1.34% decline in post-tax profits when considering only the age of firms as the control variable. These coefficients exhibit statistical significance. Similarly, upon introducing various control variables influencing firm performance beyond fuel costs, we observe that a 10% increase in fuel costs leads to a 1.94% profit decrease, a 0.21% RoA reduction, and a statistically insignificant 0.7% decrease in export earnings.

Investigating whether a firm's size influences its susceptibility to fuel cost fluctuations, the study finds that medium and large enterprises experience more substantial performance declines compared to their smaller counterparts. For instance, in the face of a 10% increase in fuel costs, medium-sized firms encounter a statistically significant 2.9% profit decrease, while large firms experience a 3.5% decline, though the latter figure is not statistically significant. In contrast, smaller firms only experience a statistically significant 0.75% profit reduction.

Analysing the impact of fuel costs on older versus newer firms, it was discovered that newer firms undergo a 2.1% profit decrease and a 0.26% RoA decline in response to a 10% fuel cost hike. Although the results are statistically insignificant for older firms, they suggest that the effect of fuel cost changes is less pronounced in this group.

When focusing on the steel and iron industry alone, the findings confirm the overall results, highlighting a negative impact of higher fuel costs on the profitability, RoA, and export earnings. Particularly, RoA sees a significant decline of 0.21%, and export earnings decrease by 2.9% when only firm's age is controlled for. Although post-tax profits are adversely affected, the effect is not statistically significant.

Furthermore, sector-specific impacts are explored, revealing the consequences of a 10% increase in fuel costs. The cement industry experiences a significant drop in post-tax profits of approximately 6.7%, while the coal, fertiliser and steel and iron industries witness significant declines in RoA of around 0.22%, 0.24%, and 0.21%, respectively. Additionally, there is a statistically significant reduction in export earnings, amounting to 2.9% in the steel and iron industry as discussed earlier. Sector-specific heterogeneity concludes that cement is the most vulnerable industry to changes in fuel costs, followed by fertiliser, coal, and steel and iron.

In conclusion, these results suggest that climate policies, particularly the implementation of CBAM, leading to increased fuel costs for firms, will have adverse effects on Indian manufacturing firms operating in the EITE industries. Profits, return on assets, and export income will suffer detrimental consequences, at least in the short-term, until firms explore alternative options such as cleaner and greener fuels. While this study provides valuable insights into the impact of CBAM on the Indian EITE sector, further research is necessary to draw more comprehensive policy implications. Specifically, the analysis would benefit from the availability of output data for firms in the EITE sector to assess the potential effects on production and production reallocation. Additionally, plant-level data on carbon emissions would be essential to understand the relationship between carbon taxation, pollution levels, and firms' economic performance. Finally, to comprehend the long-term implications of CBAM, it would be necessary to model higher-order effects, such as the firms' ability to adopt new technologies.

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8. Appendix

8.A Description of the variables used in the study.

Table 8.A: Description of Study Variables

Variable	Unit	Source
Sales	Rs. Crore	CMIE Prowess
Post-tax Profits	Rs. Crore	CMIE Prowess
Fuel Costs per rupee sales	Rs. Crore	CMIE Prowess
Net Worth	Rs. Crore	CMIE Prowess
Raw material expenses	Rs. Crore	CMIE Prowess
Salaries and Wages	Rs. Crore	CMIE Prowess
Total Assets	Rs. Crore	CMIE Prowess
Number of Employees	Number	CMIE Prowess
Export Earnings	Rs. Crore	CMIE Prowess
Age	Years	CMIE Prowess
Total Capital	Rs. Crore	CMIE Prowess
Long-term Investments	Rs. Crore	CMIE Prowess
Return on Assets (roa)	%	CMIE Prowess
Annual Growth rate of GDP	%	World Bank Open Data
Fuel and Power WPI	-	Production and Price, RBI Bulletin

Source: Authors' Analysis.

8.B Results assessing the impact of fuel cost (per rupee sales) on firms' economic performance.

Table 8.B.1: Regression Analysis of Post-Tax Profits on Fuel Costs per Rupee Sales

	Profit After Tax	Profit After Tax	Profit After Tax	Profit After Tax	Profit After Tax	Profit After Tax
Log of Fuel Cost (per rupee sales)	-0.134* (0.0645)	-0.134* (0.0645)	-0.240** (0.0737)	-0.230** (0.0739)	-0.230** (0.0739)	-0.194* (0.0767)
Firm's Age		0.123*** (0.0178)	0.137*** (0.0190)	0.146*** (0.0195)	0.140*** (0.0189)	0.142*** (0.0190)
Raw Material Expenses per unit Sales			-0.188 (0.233)	-0.250 (0.246)	-0.250 (0.246)	-0.210 (0.246)
Capital Intensity				-0.00949 (0.00974)	-0.00949 (0.00974)	-0.0105 (0.00983)
Annual Growth rate of GDP					0.0158* (0.00635)	0.0151* (0.00629)
Labour Cost						-1.278* (0.558)
Constant	1.217*** (0.253)	-2.214*** (0.629)	-3.102*** (0.660)	-3.178*** (0.693)	-3.092*** (0.688)	-2.985*** (0.694)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1677	1677	1523	1433	1433	1433
R-squared	0.126	0.126	0.153	0.169	0.169	0.175
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001						

Source: Author's Calculation.

Table 8.B.2: Regression Analysis of RoA on Fuel Costs per Rupee Sales

	RoA	RoA	RoA	RoA	RoA	RoA
Log of Fuel Cost (per rupee sales)	-2.361*** (0.456)	-2.361*** (0.456)	-2.587*** (0.535)	-2.391*** (0.488)	-2.391*** (0.488)	-2.117*** (0.501)
Firm's Age		0.0643 (0.127)	0.130 (0.135)	0.248 (0.137)	0.168 (0.129)	0.184 (0.126)
Raw Material Expenses per unit Sales			0.0401 (0.198)	-0.0690 (0.239)	-0.0690 (0.239)	0.115 (0.270)
Capital Intensity				0.00884 (0.0171)	0.00884 (0.0171)	0.00649 (0.0167)
Annual Growth rate of GDP					0.200** (0.0663)	0.202** (0.0662)
Labour Cost						-3.703 (2.361)
Constant	-6.649*** (1.690)	-8.417 (4.294)	-11.36* (4.669)	-14.18** (4.628)	-13.12** (4.553)	-12.58** (4.583)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	2306	2306	2118	1979	1979	1979
R-squared	0.040	0.040	0.042	0.043	0.043	0.047
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001						

Source: Author's Calculation.

Table 8.B.3: Regression Analysis of Export Earnings on Fuel Costs per Rupee Sales

	Export Earnings	Export Earnings	Export Earnings	Export Earnings	Export Earnings	Export Earnings
Log of Fuel Cost (per rupee sales)	-0.241* (0.118)	-0.241* (0.118)	-0.163 (0.119)	-0.179 (0.127)	-0.179 (0.127)	-0.0791 (0.141)
Firm's Age		0.0754* (0.0317)	0.0886** (0.0317)	0.0950** (0.0349)	0.0793* (0.0325)	0.0953** (0.0311)
Raw Material Expenses per unit Sales			-1.277 (0.659)	-1.694** (0.643)	-1.694** (0.643)	-1.782** (0.609)
Capital Intensity				-0.00501 (0.0116)	-0.00501 (0.0116)	-0.00670 (0.0107)
Annual Growth rate of GDP					0.0390 (0.0199)	0.0355 (0.0194)
Labour Cost						-7.784** (2.513)
Constant	1.863*** (0.391)	-0.531 (1.170)	-0.0484 (1.145)	0.179 (1.224)	0.464 (1.197)	0.687 (1.181)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	633	633	622	565	565	565
R-squared	0.044	0.044	0.060	0.079	0.079	0.107
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001						

Source: Author's Calculation.

8.C Results assessing the impact of fuel cost (per rupee sales) on firms' economic performance classifying firms into small, medium, and large based on their total capital investment

Table 8.C.1: Regression Analysis of Post-Tax Profits on Fuel Costs per Rupee Sales by Firm Size

	Profit After Tax	**Profit After Tax**	**Profit After Tax**	**Profit After Tax**	**Profit After Tax**	**Profit After Tax**
Log of Fuel Cost (per unit sales)	-0.226** (0.0718)	-0.226** (0.0718)	-0.338*** (0.0821)	-0.331*** (0.0832)	-0.331*** (0.0832)	-0.296*** (0.0841)
Fuel Cost*Small	0.164*** (0.0482)	0.164*** (0.0482)	0.192*** (0.0496)	0.209*** (0.0548)	0.209*** (0.0548)	0.221*** (0.0561)
Fuel Cost*Large	-0.0224 (0.0619)	-0.0224 (0.0619)	-0.0473 (0.0687)	-0.0556 (0.0680)	-0.0556 (0.0680)	-0.0576 (0.0669)
Firm's Age		0.117*** (0.0177)	0.129*** (0.0188)	0.138*** (0.0191)	0.132*** (0.0185)	0.134*** (0.0185)
Raw Material Expenses per unit Sales			-0.198 (0.244)	-0.250 (0.257)	-0.250 (0.257)	-0.203 (0.258)
Capital Intensity				-0.0132 (0.00814)	-0.0132 (0.00814)	-0.0145 (0.00817)
Annual Growth rate of GDP					0.0164** (0.00626)	0.0156* (0.00620)
Labour Cost						-1.472* (0.569)
Constant	1.187*** (0.257)	-2.068** (0.624)	-2.863*** (0.651)	-2.920*** (0.680)	-2.831*** (0.675)	-2.694*** (0.684)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1677	1677	1523	1433	1433	1433
R-squared	0.138	0.138	0.169	0.187	0.187	0.195
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001						

Source: Author's Calculation.

Table 8.C.2: Regression Analysis of RoA on Fuel Costs per Rupee Sales by Firm Size

	ROA	ROA	ROA	ROA	ROA	ROA
Log of Fuel Cost (per unit sales)	-2.415*** (0.495)	-2.415*** (0.495)	-2.668*** (0.560)	-2.655*** (0.528)	-2.655*** (0.528)	-2.385*** (0.533)
Fuel Cost*Small	-0.222 (0.460)	-0.222 (0.460)	-0.215 (0.509)	0.0871 (0.512)	0.0871 (0.512)	0.0972 (0.509)
Fuel Cost*Large	0.732 (0.534)	0.732 (0.534)	0.762 (0.528)	0.822 (0.534)	0.822 (0.534)	0.810 (0.530)
Firm's Age		0.0842 (0.126)	0.146 (0.135)	0.257 (0.137)	0.177 (0.129)	0.193 (0.126)
Raw Material Expenses per unit Sales			0.0645 (0.211)	-0.0585 (0.252)	-0.0585 (0.252)	0.123 (0.282)
Capital Intensity				0.00901 (0.0166)	0.00901 (0.0166)	0.00667 (0.0163)
Annual Growth rate of GDP					0.201** (0.0667)	0.202** (0.0667)
Labour Cost						-3.667 (2.408)
Constant	-6.655*** (1.713)	-8.970* (4.349)	-11.95* (4.778)	-14.56** (4.684)	-13.50** (4.615)	-12.96** (4.637)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	2306	2306	2118	1979	1979	1979
R-squared	0.043	0.043	0.044	0.045	0.045	0.05
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001						

Source: Author's Calculation.

Table 8.C.3: Regression Analysis of Export Earnings on Fuel Costs per Rupee Sales by Firm Size

	Export Earnings	Export Earnings	Export Earnings	Export Earnings	Export Earnings	Export Earnings
Log of Fuel Cost (per unit sales)	-0.249* (0.123)	-0.249* (0.123)	-0.164 (0.126)	-0.173 (0.136)	-0.173 (0.136)	-0.0626 (0.158)
Fuel Cost*Small	0.184 (0.101)	0.184 (0.101)	0.217* (0.0973)	0.240** (0.0890)	0.240** (0.0890)	0.241** (0.0877)
Fuel Cost*Large	-0.103 (0.116)	-0.103 (0.116)	-0.0849 (0.110)	-0.0765 (0.110)	-0.0765 (0.110)	-0.0957 (0.106)
Firm's Age		0.0613 (0.0321)	0.0741* (0.0324)	0.0795* (0.0359)	0.0636 (0.0332)	0.0792* (0.0317)
Raw Material Expenses per unit Sales			-1.373 (0.708)	-1.845** (0.659)	-1.845** (0.659)	-1.926** (0.607)
Capital Intensity				-0.00489 (0.0130)	0.00489 (0.0130)	-0.00681 (0.0121)
Annual Growth rate of GDP					0.0399* (0.0196)	0.0364 (0.0192)
Labour Cost						-8.057** (2.499)

	Export Earnings	Export Earnings	Export Earnings	Export Earnings	Export Earnings	Export Earnings
Constant	1.971*** (0.430)	0.0247 (1.203)	0.622 (1.204)	0.915 (1.307)	1.205 (1.276)	1.465 (1.271)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	633	633	622	565	565	565
R-squared	0.067	0.067	0.088	0.113	0.113	0.143
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001						

Source: Author's Calculation.

8.D Results assessing the impact of fuel cost (per rupee sales) on firms' economic performance classifying firms into old and new firms based on their year of incorporation

Table 8.D.1: Regression Analysis of Post-Tax Profits on Fuel Costs per Rupee Sales for Old vs New Firms

	Profit After Tax	Profit After Tax	Profit After Tax	Profit After Tax	Profit After Tax
Log of Fuel Cost (per unit sales)	-0.119 (0.0967)	-0.215* (0.0991)	-0.220* (0.0980)	-0.220* (0.0980)	-0.211* (0.0980)
Fuel Cost*Old	-0.0343 (0.129)	-0.0610 (0.154)	-0.0251 (0.152)	-0.0251 (0.152)	0.0476 (0.157)
Raw Material Expenses per unit Sales		-0.170 (0.231)	-0.243 (0.245)	-0.243 (0.245)	-0.222 (0.247)
Capital Intensity			-0.00946 (0.00974)	-0.00946 (0.00974)	-0.0106 (0.00985)
Annual Growth rate of GDP				0.366*** (0.0491)	0.371*** (0.0489)
Labour Cost					-1.324* (0.565)
Constant	1.203*** (0.252)	0.623 (0.338)	0.823* (0.344)	- 1.192* (0.496)	-1.002* (0.506)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
No. of observations	1677	1523	1433	1433	1433
R-squared	0.127	0.154	0.169	0.169	0.175
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001					

Source: Author's Calculation.

Table 8.D.2: Regression Analysis of RoA on Fuel Costs per Rupee Sales for Old vs New Firms

	RoA	RoA	RoA	RoA	RoA
Log of Fuel Cost (per unit sales)	-2.305*** (0.655)	-2.562*** (0.742)	-2.845*** (0.738)	-2.845*** (0.738)	-2.604*** (0.721)
Fuel Cost*Old	-0.122 (0.909)	-0.0589 (1.047)	1.137 (0.970)	1.137 (0.970)	1.242 (0.969)
Raw Material Expenses per unit Sales		0.0379 (0.205)	-0.0265 (0.249)	-0.0265 (0.249)	0.167 (0.280)
Capital Intensity			0.00785 (0.0166)	0.00785 (0.0166)	0.00534 (0.0162)
Annual Growth rate of GDP				0.603 (0.341)	0.646 (0.336)
Labour Cost					-3.826 (2.385)
Constant	-6.698*** (1.691)	-7.876*** (2.000)	-6.972*** (1.887)	-10.29*** (3.035)	-9.455** (3.128)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
No. of observations	2306	2118	1979	1979	1979
R-squared	0.040	0.042	0.044	0.044	0.049
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001					

Source: Author's Calculation.

Table 8.D.3: Regression Analysis of Export Earnings on Fuel Costs per Rupee Sales for Old vs New Firms

	Export Earnings	Export Earnings	Export Earnings	Export Earnings	Export Earnings
Log of Fuel Cost (per unit sales)	-0.264 (0.145)	-0.278 (0.147)	-0.263 (0.163)	-0.263 (0.163)	-0.130 (0.220)
Fuel Cost*Old	0.0404 (0.224)	0.216 (0.194)	0.163 (0.220)	0.163 (0.220)	0.0969 (0.254)
Raw Material Expenses per unit Sales		-1.317* (0.643)	-1.728** (0.630)	-1.728** (0.630)	-1.801** (0.595)
Capital Intensity			-0.00596 (0.0115)	-0.00596 (0.0115)	-0.00724 (0.0106)
Annual Growth rate of GDP				0.239** (0.0872)	0.274** (0.0824)
Labour Cost					-7.694** (2.578)
Constant	1.878*** (0.421)	2.869*** (0.447)	3.307*** (0.470)	1.992** (0.645)	2.467*** (0.657)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
No. of observations	633	622	565	565	565
R-squared	0.044	0.062	0.081	0.081	0.108
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001					

Source: Author's Calculation.

8.E Results assessing the impact of fuel cost (per rupee sales) on firms' economic performance using 2SLS regression. Instrument used: Fuel and Power WPI

Table 8.E: Regression Analysis of Profit After Tax, RoA, and Export Earnings on Fuel Costs per Rupee Sales using 2SLS Method

	Profit-After Tax	RoA	Export Earnings
Log of Fuel Cost (per unit sales)	-5.245 (7.197)	-38.41 (77.18)	-2.479 (5.694)
Firm's Age	-0.0428 (0.107)	-0.332 (0.833)	-0.00951 (0.0537)
Raw Material Expenses per unit Sales	-8.634 (7.415)	-18.95 (33.87)	-6.265 (8.036)
Capital Intensity	-0.138 (0.117)	-0.00418 (0.0532)	-0.00418 (0.0360)
Annual Growth rate of GDP	-0.0297 (0.0729)	0.294 (0.387)	0.0178 (0.0729)
Labour Cost	-7.427 (6.431)	27.77 (73.98)	4.031 (17.01)
Constant	-7.521 (15.70)	-102.1 (197.9)	-0.162 (11.84)
Robust standard errors	Yes	Yes	Yes
No. of observations	486	787	298
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001			

Source: Author's Calculation.

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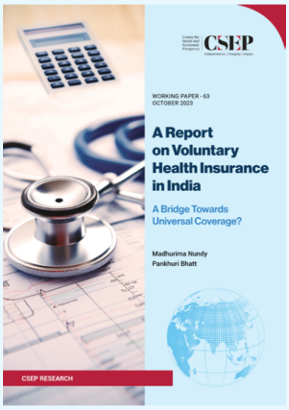
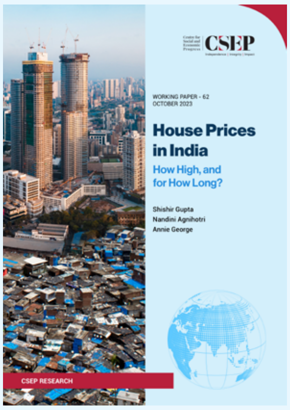
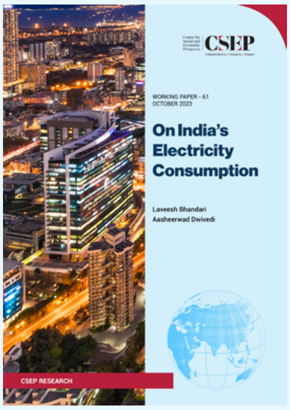
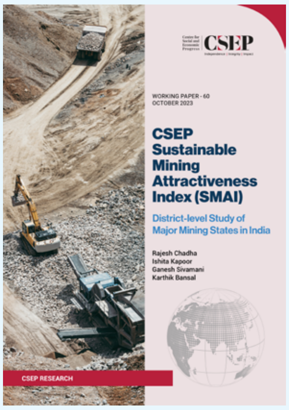
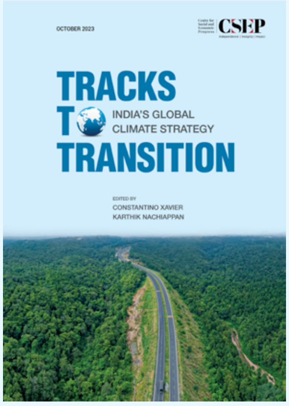
Other publications

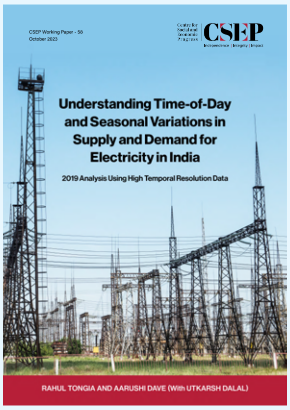


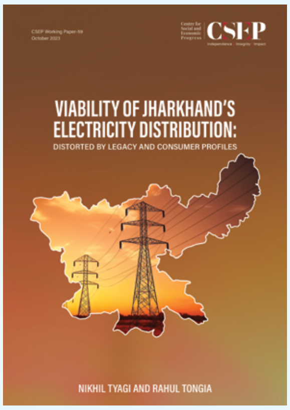


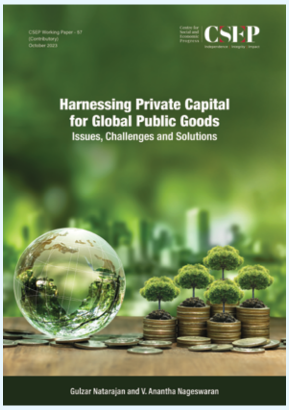


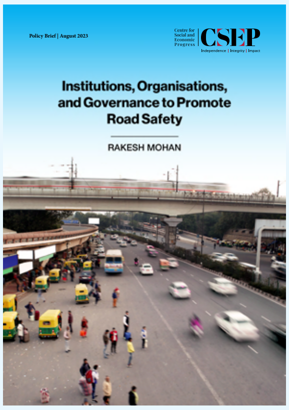


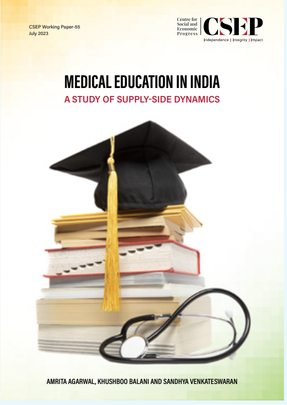


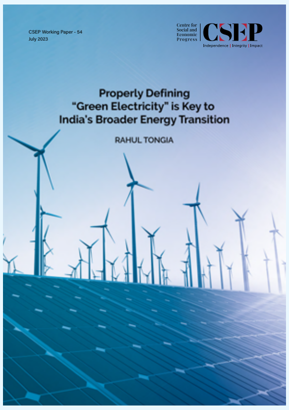










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Policy Brief | July 2023

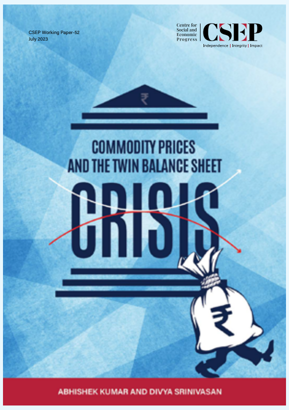
Health System Reforms for Universal Health Coverage: Insights from Select Emerging Market Countries

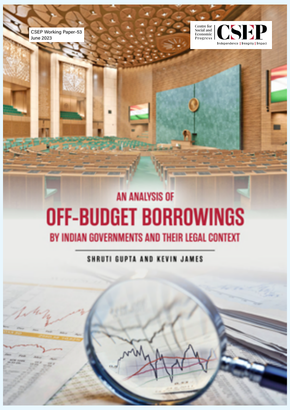
Sandhya Venkateswaran, Madhurima Nundy, Alok Kumar Singh and Pankhuri Bhatt

1. Introduction

The Alma-Ata Declaration on Primary Health Care in 1978, endorsed by countries across the world, failed to reach the desired goal of 'Health for All by 2000'. In the early 2000s, varied political, economic, and social contexts led to the initiation of health-sector reforms aimed at consolidating fragmented health systems towards universal and equitable coverage. The year 2010 saw the global endorsement of the idea of universal health coverage (UHC) that had its roots in the Alma-Ata declaration.

Universal health coverage is now included in the global development agenda under the Sustainable Development Goals (SDGs) of 2015. The idea of UHC, as envisaged globally, is that all individuals should receive comprehensive health services—preventive, promotive, curative, palliative, and rehabilitative—when they need them and where they need them, without suffering financial hardship. It embodies within it, the ideas of equitable, quality, and responsive health services. Though UHC goals are common to all, they are interpreted and adapted in different ways due to the diversity in the socio-economic, political, epidemiological, and demographic contexts and the varied opportunities and challenges faced by health systems across countries. The pathways and trajectories that countries follow are informed by these contexts, hence there is no standard solution





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