Determinants of Willingness to Pay for Carbon Emissions in Emerging Economy

ISBN: 978-1-943295-22-7

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The growing global imperative to mitigate climate change has led to increased interest in carbon trading as a critical tool for reducing greenhouse gas emissions. This research aims to develop a comprehensive model for carbon trading adoption among multinational corporations (MNCs) and Indian companies operating in India. The study will employ a mixed-methods approach, integrating quantitative surveys and qualitative interviews with industry leaders and policymakers. The findings will guide the development of policy recommendations to enhance India's carbon trading framework, with a focus on fostering greater industry participation and supporting the country's sustainability objectives.

Keywords: Carbon Credit Trading , Emerging Economies, Willingness to Pay, Corporate Sustainability, Corporate Environmental Sustainability

1. Introduction

In 2023, Delhi, India's capital, experienced one of its worst air quality crises, with pollution levels soaring to hazardous limits. This incident, resulting in school closures and health advisories for millions, underscores the urgent need to address carbon emissions, especially in rapidly developing economies where the costs of inaction are rising alongside economic growth. Carbon emissions, primarily from fossil fuel combustion in energy production, transportation, and industrial processes, are major contributors to climate change. As these emissions accumulate in the atmosphere, they intensify the greenhouse effect, leading to global warming and a cascade of environmental issues, including extreme weather events, melting ice caps, and disruptions to ecosystems.

For emerging economies like India, the situation is particularly concerning. Economic growth in these countries often hinges on carbon-intensive activities such as manufacturing, coal-based power generation, and large-scale agriculture. For instance, coal remains a dominant energy source in India, powering industries and urban centers but also contributing to high levels of carbon emissions and severe air pollution. This not only impacts public health, as seen in Delhi, but also strains healthcare systems and disrupts everyday life.

Economically, the implications are severe. Climate change, exacerbated by carbon emissions, leads to extreme weather events such as floods, droughts, and heatwaves. In India, where agriculture is a livelihood for nearly half the population, these events result in crop failures, food insecurity, and economic losses, thereby increasing the financial burden on already stretched government resources. The rising awareness of these environmental and economic impacts has led to global initiatives focused on reducing carbon footprints, such as carbon pricing, carbon credits, and emission trading systems.

In this context, understanding the "willingness to pay" (WTP) for carbon emissions reduction is critical. WTP reflects the extent to which individuals, businesses, and policymakers are prepared to invest in carbon reduction efforts. For emerging economies like India, where achieving economic growth must be balanced with environmental sustainability, identifying the factors that influence WTP is essential. Insights into these determinants can help craft effective policies that encourage investment in renewable energy, participation in carbon trading markets, and adoption of sustainable practices.

This study aims to explore the determinants of WTP for carbon emissions reduction in emerging economies, focusing on the role of carbon credits and economic incentives. Given India's ambitious target of achieving net-zero emissions by 2070, understanding the factors that drive WTP among businesses, including both multinational corporations and local firms, is vital. By analyzing these influences, the research seeks to provide actionable insights for policymakers to design frameworks that promote sustainable economic development, enhance participation in carbon markets, and ultimately contribute to global climate goals.

The literature on carbon trading provides insights into both global and Indian perspectives, focusing on factors influencing adoption, market behaviour, and effectiveness.

Carbon Pricing and Market Dynamics: Hao et al. highlighted the volatility of carbon prices and its impact on market participation. Verde's analysis of the EU Emissions Trading System (ETS) underlined the implications on competitiveness and potential carbon leakage, offering a useful benchmark for emerging markets like India.

Technological Integration: Fang and Ma (2021) stressed the need for technological readiness in carbon trading. Successful participation often hinges on integrating advanced technologies like blockchain, as noted by Li et al. (2019), who explored personal carbon trading and its influence on eco-friendly decisions like adopting electric vehicles.

Barriers in Emerging Economies: Research from China by Zhang et al. (2022) demonstrated that carbon trading promotes green innovation in industries, while Sun and Wei (2020) illustrated its dual benefits—emission cuts and economic gains. However, Chen et al. (2021) cautioned against potential negative impacts on innovation, particularly in financially burdened regions, emphasizing that increased costs might constrain R&D, especially in high-pollutant industries.

Regulatory and Cost Barriers: Sharma and Jain (2022) identified regulatory uncertainty and high costs as major obstacles for firms in adopting carbon trading. Kumar and Aggarwal (2021) highlighted low awareness and the lack of clear regulatory frameworks as key barriers preventing widespread use of carbon credits among Indian firms.

Sectoral Differences: Patra and Banerjee (2020) noted that energy and manufacturing sectors are more receptive to carbon trading compared to other industries, showing a sector-specific openness to sustainable practices.

Strategic Enablers: Bansal et al. (2023) emphasized the role of regulatory frameworks, financial incentives, and technological advancements in promoting effective carbon trading in India. They suggested aligning local laws with global carbon market standards to ensure broader acceptance.

Policy and Financial Mechanisms: CEEW and NITI Aayog (2023) estimated a need for over $10 trillion in investments for India's low-carbon transition by 2070, emphasizing the necessity of robust financial mechanisms. TERI (2022) found variability in consumer willingness to pay (WTP) for carbon reduction, highlighting urban-rural disparities in support for climate action.

Consumer Willingness: Mo EFCC and UNDP (2021) observed that 58% of surveyed respondents in India were willing to support carbon pricing, especially when linked to visible environmental benefits. However, willingness was notably lower among low-income groups, suggesting the need for tailored policies that consider economic constraints.

Economic Status and Education: Research in Brazil, China, and South Africa indicated higher WTP among wealthier groups due to better financial capacity. In developed countries like Germany and the U.S., broader WTP is observed across middle-income groups, supported by stronger economic safety nets. Education level also plays a crucial role, with higher educational attainment correlating with increased WTP due to better climate awareness, as seen in studies from Europe, Australia, and Brazil.

Environmental Awareness: Awareness campaigns linking climate change to health impacts have been effective in increasing WTP in Mexico and Indonesia. Similar trends are evident in Canada and Sweden, where higher public consciousness correlates with greater support for carbon offsets.

Government Policies: Effective government policies and incentives are pivotal. In Vietnam, incentives for green technologies have bolstered public support for carbon pricing. Developed nations like the UK and Japan show that consistent, transparent policies demonstrating tangible benefits significantly enhance WTP.

The reviewed literature indicates that economic status, education, and government policies are critical determinants of WTP for carbon reduction. However, challenges such as pricing consistency, technological integration, and economic barriers remain significant, especially in emerging economies like India. There is a need for tailored policy measures and financial models that address these barriers, enhancing WTP across diverse socio-economic groups. Future research should explore specific incentives and awareness campaigns to effectively boost WTP in India's unique socio-economic landscape.

Understanding Willingness to Pay (WTP) for carbon emissions reduction is critical for implementing effective carbon pricing policies in emerging economies, as it reflects the public's readiness to support climate initiatives financially. Carbon pricing, which includes carbon taxes and cap-and-trade systems, aims to reduce emissions by assigning a monetary cost to carbon output, thereby incentivizing individuals and companies to adopt more sustainable practices.

In emerging economies, where financial resources are more limited, policies like carbon pricing can place additional pressure on households and businesses, potentially facing resistance if the cost is perceived as too high. Therefore, accurately gauging WTP is essential: it helps policymakers set carbon prices that are both impactful and acceptable, ensuring people don't feel overly burdened. By aligning pricing strategies with what different groups are willing to pay, governments in emerging markets can implement carbon reduction initiatives that encourage compliance, make progress on emissions targets, and foster public support for environmental policies.

Recent initiatives in India provide valuable insights into the population's WTP and the public's response to carbon mitigation strategies:

- Carbon Credits in India: India has recently begun developing a framework for carbon credits, allowing companies to earn credits by reducing their emissions, which they can then trade. This system encourages industries to cut emissions by creating financial incentives while also introducing the concept of paying for carbon. Public and corporate responses to this initiative are crucial for understanding how well the population accepts such policies and the extent to which they are willing to financially support emission reductions.

- Local Emissions Reduction Programs: Initiatives like the "Swachh Bharat Mission" indirectly encourage sustainable practices and reduce emissions through waste management and cleanliness programs. For example, cities like Pune and Bengaluru have implemented waste-to-energy projects and recycling systems. These programs demonstrate that people are generally supportive of emission-reducing policies that improve their local environment, which is a valuable insight into how localized carbon pricing or incentives might be received.

These cases reveal that Indian citizens and businesses may be willing to financially support emissions reduction if the benefits are evident and directly improve their quality of life. This knowledge is crucial for designing WTP-aligned policies that gain traction within the population.

Objectives of the Study

- To identify and analyze the factors influencing companies' willingness to pay for carbon emissions, specifically focusing on MNCs and Indian firms operating in India.
- To assess the role of carbon credits as financial incentives for renewable energy adoption in Indian industries.
- To explore the differences between MNCs and Indian companies in their approach to carbon trading and renewable energy investments.

2. Methodology

Research Design: The researchers adopted a descriptive and exploratory design. The descriptive component highlights current practices, trends, and factors influencing the willingness to pay for carbon credits, while the exploratory part aims to develop a model for adopting carbon trading and renewable energy incentives. The focus is on multinational corporations (MNCs) and Indian companies, analyzing their views on carbon pricing and participation in carbon trading markets.

Research Methods: A mixed-methods approach was utilized, integrating both qualitative and quantitative methods:

Quantitative Research: A survey was conducted to collect data from the representatives MNCs and Indian companies about their willingness to pay for carbon credits and their views on renewable energy incentives.

Qualitative Research: Interviews with industry experts, policymakers, and corporate leaders offered insights into the factors driving the adoption of carbon credits.

Data Collection Types and Sources:

Sampling Techniques: A combination of purposive sampling and multistage random sampling techniques was employed to ensure a representative selection of both MNCs and Indian companies across various sectors. Purposive sampling was specifically used to select interviewees who possess expertise in carbon trading and sustainability, thereby enhancing the relevance and depth of the collected data.

Sample Unit: It consisted of individual companies, specifically focusing on senior decision-makers who are engaged in carbon trading or sustainability initiatives.

Sample Frame: A detailed sample frame was created, which included a comprehensive list of multinational corporations (MNCs) and Indian companies operating in carbon-intensive sectors, sourced from business directories, sustainability reports, and government records.

Tool for Data Collection: A structured questionnaire to know the factors influencing willingness to pay for carbon credits and views on renewable energy incentives, including demographic, attitudinal, and behavioural questions and a semi-structured interview schedule was used to collect the perceptions of carbon trading, challenges in adoption, and future strategies.

Statistical Tools for Data Analysis: For data collection, a structured questionnaire was employed to explore the factors that influence the willingness to pay for carbon credits and opinions on renewable energy incentives. This included demographic, attitudinal, and behavioural questions, along with a semi-structured interview schedule aimed at gathering insights on perceptions of carbon trading. CFA and SEM has been used by the researchers to reach the conclusion and suggestions.

3. Data Specification

Primary Data: Structured surveys and interviews with corporate decision-makers, Surveys focused on executives responsible for sustainability and regulatory compliance, and interviews with sustainability experts and policymakers were the primary data sources

Secondary Data: Information on carbon trading trends, regulatory policies, and relevant case studies was gathered from government agencies, international organizations, and academic journals.

Sample: The sample included representatives from both multinational corporations (MNCs) and Indian companies operating in carbon-intensive sectors, including energy, manufacturing, and transportation. A total of 300 representatives participated in the survey, comprising 100 from MNCs and 180 from Indian firms. In addition, 20 industry experts were interviewed to provide qualitative insights.

4. Results and Discussions

Introduction to CFA and SEM in the Context of Carbon Credit Trading

In the present study, CFA is instrumental in validating the factors that influence the willingness of companies to pay for carbon emissions. This is particularly significant when comparing multinational corporations (MNCs) and Indian firms operating in India. CFA allowed the investigators to confirm constructs like regulatory pressure, sustainability goals, and public image, which are hypothesized to drive the carbon credit strategies of these firms.

Structural Equation Modeling (SEM), on the other hand, extended the capabilities of CFA by examining the structural relationships between observed variables and latent constructs. SEM helped in testing the impact of carbon credits on the adoption of renewable energy technologies and the comparative analysis of MNCs and Indian firms in their approach to carbon trading. By using SEM, the investigators tested how factors like regulatory frameworks and financial incentives influence firms' sustainability initiatives and their participation in carbon trading markets.

4.1 Proposed Measurement Model (CFA)

The key factors in the present study included regulatory pressure, corporate sustainability goals, public image for MNCs and cost concerns, enforcement challenges, and profit motives for Indian firms. CFA validated these constructs by analyzing survey data, identifying how closely the data aligned with the theoretical model. For reliability analysis, Cronbach's Alpha was used, yielding a value of **0.866** for the 47 survey items, which indicated high internal consistency. This suggests that the survey items reliably measure the constructs of interest.

The **Exploratory Factor Analysis (EFA)** results revealed clustering of items around several latent factors, with high loadings on specific questions (e.g., Q2, Q6, Q8). These can form constructs such as Regulatory Pressure (RP), Financial Incentives (FI), and Corporate Sustainability Goals (CSG), which are crucial for understanding carbon trading dynamics.

Table 1 *Validity and Reliability*

	CR	AVE	MSV	MaxR(H)	AB	BC	CDD	EFF	FGG	HII
AB	0.919	0.591	0.412	0.934	**0.769**					
BC	0.901	0.574	0.559	0.91	0.642**	**0.71**				
CDD	0.855	0.563	0.559	0.87	0.614***	0.748***	**0.737**			
EFF	0.804	0.593	0.459	0.88	0.590***	0.677***	0.567***	**0.77**		
FGG	0.734	0.597	0.593	0.773	0.231*	0.440***	0.408**	0.269*	**0.648**	
HII	0.751	0.572	0.508	0.872	0.290**	0.555***	0.536***	0.324**	0.180†	**0.687**

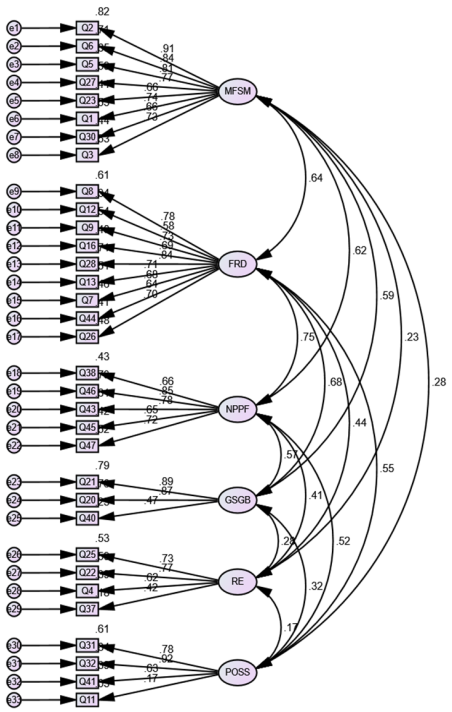

Figure 1 *Confirmatory Factor Analysis*

CFA Results Summary

The convergent validity is confirmed as the Average Variance Extracted (AVE) for most constructs exceeds 0.5. Constructs like 'AB' (Attitudinal Belief) and 'BC' (Behavioural Commitment) exhibit AVE values above this threshold, establishing that the items effectively capture the intended factors. Additionally, discriminant validity is achieved, as the Maximum Shared

Variance (MSV) is lower than the AVE, indicating that the constructs are distinct from one another. The Composite Reliability (CR) values, such as 0.919 for 'AB' and 0.901 for 'BC', highlight the robustness of the model, ensuring that the constructs are measured consistently across different items.

Model Fit Indices (CFA)

The model fit indices for CFA demonstrate a strong fit between the hypothesized model and the observed data:

- Chi-Square/Degree of Freedom (CMIN/DF): 2.500, which falls within the acceptable range of 1 to 3.
- Comparative Fit Index (CFI): 0.960, indicating an excellent fit as values above 0.95 are preferred.
- Standardized Root Mean Square Residual (SRMR): 0.070, which is within the threshold of less than 0.08.
- Root Mean Square Error of Approximation (RMSEA): 0.050, showcasing a strong model fit (values below 0.06 are excellent).
- P Close: 0.060, supporting the overall fit of the model.

4.2 Structural Model Analysis (SEM)

The SEM Analysis Further Explored the Relationships between the Constructs Identified in CFA:

Path Analysis confirms that factors like regulatory pressure and public image significantly influence MNCs' willingness to pay for carbon emissions, as evidenced by high regression weights and significant p-values (H1 supported).

For Indian firms, cost concerns and short-term profit goals negatively impact their willingness to engage in carbon trading (H2 supported).

The availability of carbon credits positively correlates with the adoption of renewable energy technologies (H3 supported, with a path coefficient of 0.422 and $p < 0.05$).

Hypotheses4 delve into the proactive nature of MNCs compared to Indian firms in terms of carbon trading and renewable investments.

Regression Weights Summary

Key regression weights in the SEM model include:

Market Forces & Sustainability Mandates (MFSM) impacting Firms' Sustainability (FS) with a significant coefficient of 0.389 ($p < 0.001$).

Financial Readiness for Decarbonization (FRD) showing a positive influence on sustainability adoption, whereas Negative Profit Pressure Factors (NPPF) do not show significant effects.

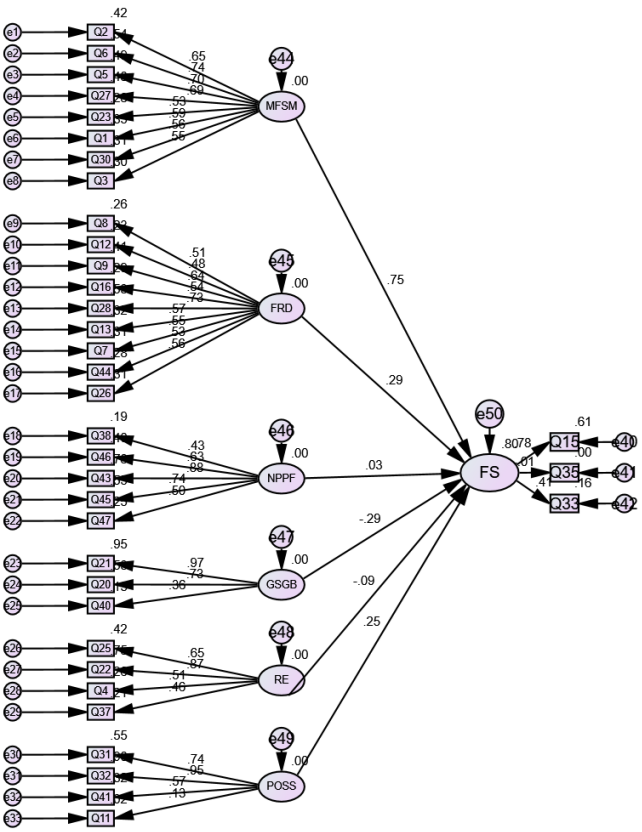

Figure 2 *Structural Equation Modelling*

The study aimed to evaluate the factors influencing the willingness of companies to pay for carbon emissions and the role of carbon credits as a financial incentive for renewable energy adoption in India. Using advanced statistical techniques, including Regression Analysis, Confirmatory Factor Analysis (CFA), and Structural Equation Modeling (SEM), the following insights were derived:

H1 was supported, indicating that regulatory pressure, corporate sustainability goals, and the desire to maintain a positive public image significantly drive the willingness of multinational corporations (MNCs) to invest in carbon emission reductions in India. The results from CFA confirmed that these factors are strong and valid predictors of MNCs' behaviour in carbon trading, and SEM analysis showed a positive relationship between these factors and their willingness to engage in carbon trading initiatives.

H2 was also supported, highlighting that cost concerns, lack of regulatory enforcement, and a focus on short-term profit goals negatively impact the willingness of Indian firms to invest in carbon credits. Regression analysis revealed a significant negative relationship, showing that these factors act as barriers, preventing many Indian firms from participating actively in carbon markets. SEM results confirmed that the emphasis on short-term profitability and insufficient regulatory push are primary deterrents.

H3 was validated, demonstrating a significant difference between the approaches of MNCs and Indian companies towards carbon trading and renewable energy investments. The comparative analysis through SEM indicated that MNCs, driven by global sustainability commitments and stricter environmental regulations, are more proactive in carbon trading and renewable energy projects. In contrast, Indian firms showed a relatively conservative approach, influenced by local market conditions and financial constraints.

H4 was confirmed, indicating that carbon credits are an effective financial incentive that significantly boosts the adoption of renewable energy projects among Indian industries. The SEM model revealed a positive and significant impact of carbon credits on renewable energy adoption, suggesting that the revenue generated from selling carbon credits enhances.

5. Conclusions

The findings indicated that while MNCs in India are largely driven by external regulatory and sustainability pressures, domestic firms face challenges related to cost and lack of stringent regulations. However, carbon credits emerge as a critical tool that can bridge this gap by providing financial incentives, thereby promoting the transition to renewable energy solutions in the Indian industrial sector. The validated hypotheses underline the importance of regulatory frameworks, corporate sustainability initiatives, and financial mechanisms like carbon credits in driving environmental sustainability.

To accelerate renewable energy adoption and carbon reduction efforts, policymakers should focus on strengthening regulatory frameworks and providing targeted incentives, while industries, particularly domestic firms, need to balance short-term profitability with long-term sustainability.

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