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Carbon Taxation and Firm Value of Listed Manufacturing Firms in BRICS Countries

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ABSTRACT

Firm value is critical to long-term profitability and the enduring sustainability of an entity as it encapsulates the wealth of the firm and its shareholders. Maintaining firm value by manufacturing concerns is subject to regulations such as carbon taxation policy due to its impact on operational costs and long-term sustainable business practice. This study examines the impact of carbon taxation on firm values of listed manufacturing firms in BRICS countries. Specifically, the study evaluates the effect of carbon tax pricing rate, revenue recycling mechanism and share of emission price on firm value proxied by Tobin's Q. The study employs quantitative methods, ex-post facto design and longitudinal panel data. The study population consists of 1390 listed manufacturing firms in BRICS with a sample size of 310. Data obtained for the period of 2016 to 2024. The study employed pooled ordinary least squares, fixed-effects and random-effects regression techniques for data analysis. Findings reveal that carbon tax pricing rate recorded a positive but insignificant effect on firm value, revenue recycling mechanism recorded a positive statistically significant effect on the firm value while share of emissions price recorded a positive but insignificant effect on the firm value of listed manufacturing companies in BRICS countries. The study concludes that the effects of carbon taxation on firm value depend on the component of the carbon tax framework being considered. Carbon tax pricing rate and share of emissions price recorded positive effects, their influences on firm value were not statistically significant while revenue recycling mechanism has significant positive effect during the study period.

Keywords: Carbon taxation, carbon tax pricing rate, revenue recycling mechanism, and share of emission price.

INTRODUCTION

Generally, corporate value is critical to long-term profitability and the enduring sustainability of an entity as it encapsulates the wealth of the firm and its shareholders (Ali & Shabn, 2024). Firm value manifests in market price and earnings which shape stakeholder perceptions regarding profitability, investment strategies, and expected returns (Njoku & Lee, 2025). Robust stock prices elevate earnings and draw investor interest by signaling the potential for premium financial gains (Iqbal, 2024). Consequently, high valuation projects, efficient operation and sound financial health generate positive market momentum (Zahra, 2025). These premium return expectations are reflected in share prices which fluctuate based on market demand and supply dynamics (Njoku & Lee, 2025). Because a strong market price directly governs asset management, financing choices, and investment decisions, it remains a central priority for corporate managers and external investors alike (Njoku & Lee, 2025). To build industry competitiveness and secure continuous capital injection, executives must aggressively pursue strategies that enhance shareholder prosperity through sustained stock performance (Iqbal, 2024). However, consistently maximising this metric presents severe operational challenges (Chireka & Moloi, 2024). Managers must balance delicate strategic trade-offs, such as internal resource allocation, liquidity preservation, and regulatory compliance where crossing efficiency thresholds can easily damage public perception and erode total firm value (Chireka & Moloi, 2024).

In pursuit of profitability and enhanced value, companies, particularly manufacturing firms engage in activities that generate carbon footprint such as greenhouse gas emission and climate change. This challenge

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has led to global pressure and advocacy for implementation of legislation and policy framework to attenuate carbon emission and achieve carbon neutrality. Carbon taxation has therefore emerged a market-based decarbonisation policy for reducing greenhouse gas emissions, promote eco-innovative technology and sustainable business practice particularly in energy-intensive sector such as manufacturing (Nong et al., 2021; Senna & Moxoto, 2024). The implications of carbon taxation for firms are attributable to its impact on cost structure, competitiveness, profitability, environmental technology, corporate reputation, and stock price. Carbon taxes have been adopted in many jurisdictions, countries and regions of the world including BRICS countries with attendant impacts on financial performance and corporate value.

BRICS nations consisting of Brazil, Russia, India, China and South Africa have strategic importance in global economy as it accounts for 42% of global population and contribute 23% of global GPD (Sadiq et al., 2023). The BRICS bloc possesses common characteristics in terms of level of development, industrialisation and manufacturing coupled with heavy reliance on fossil fuel (Khezri et al., 2022a). Together, the BRICS accounts for significant proportion of global environmental degradation due to heavy consumption of fossil energy (Balsalobre-Lorente et al., 2023; Chen et al., 2022a; Cheng et al., 2022). Considered as one of the top 10 energy users in the world, BRICS is responsible for 40% of global energy use and 43% global carbon emissions (Udeagha and Ngepah, 2022; Shen et al., 2023). China accounts for 30% while Russia, India, Brazil and South Africa contribute 6%, 4.71%, 1.29%, and 1.09% respectively to global emissions as of 2020 (World Bank, 2021; Sadiq et al., 2023). This underscores the imperative of investigating how carbon regulations impact corporate value in the bloc.

Studies have been conducted to interrogate the nexus between environmental accounting disclosure and firm value. Rinsman and Prasetyo (2020) analysed the effects of financial performance and environmental performance on firm value with environmental disclosure as an intervening variable. Asyifa and Barhany (2022) evaluated that interaction between carbon emission disclosure, environmental performance and firm value while Li, Luo and Tang (2023) explored the nexus between climate risk, opportunity exposure and firm value from international perspective. Li, Liu and Li (2024) explored the intricate relationship between renewable energy, green taxes, and trade openness on carbon neutrality in BRICS countries while Parsya, Nurazizah and Zulkarnain (2024) examined the influence of carbon tax legislation on stock price and submitted that the implementation of carbon tax law has influence on stock price. Senna and Moxoto (2025) explored the connection between carbon emission and financial performance in Brazilian stock market and concluded that carbon emission has a significant positive influence on financial performance. Carrisa and Mutasowifin (2025) evaluated the influence of financial and environmental performance on firm value. Xia et al., (2025) examined the connection between environmental management accounting, carbon emission management and, environmental social and governance. Ridwan (2025) analysed the intersection between carbon taxes and industrial competitiveness, and carbon taxes.

Carbon taxation operates as an environmental fiscal instrument designed to internalize the negative externalities of greenhouse gas emissions by disaggregating its policy architecture into distinct operational measures. The framework is multi-dimensional, comprising the carbon tax pricing level (CTP), the revenue recycling mechanism (RRM), and the share of emissions price (SEP) (Ridwan, 2026). Specifically, CTP functions as a fixed regulatory charge levied per metric ton of carbon dioxide equivalent, serving as a primary financial shock that alters operational liabilities and input costs (Muhammad, 2022; Adedeji & Olayinka, 2025). The RRM operates as an institutional cushioning variable that dictates whether collected tax revenues are permanently drained or returned to the private sector via green subsidies and corporate tax reliefs (Zhou & Mwangi, 2024; Xu, 2025). Finally, the SEP measures the explicit proportion of carbon liabilities that an enterprise internalizes, capturing its structural market power and capability to pass environmental compliance costs along the supply chain to final consumers (Wang, 2026).

The empirical literature exhibits a complex, non-linear nexus between carbon taxation measures and firm value, with several frameworks establishing a positive relationship driven by ecological modernisation and market-based incentives. While aggressive carbon pricing introduces immediate operational liabilities, structured and predictable environmental taxes act as powerful market signals that reward long-term

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regulatory compliance and sustainability (Chao, 2026). When carbon policies are paired with transparent, highly liquid revenue recycling mechanisms, capital markets systematically assign a valuation premium to unobservable intangible assets, such as proprietary green technologies and enhanced environmental credibility (Ishaq et al., 2026). Access to recycled fiscal channels, such as clean technology matching funds or targeted green subsidies, effectively minimises the contractionary impacts of environmental regulation on industrial productivity (Xu, 2025). Consequently, forward-looking investors actively reallocate capital toward these eco-innovative entities, driving their market value and Tobin's Q above inefficient, carbon-intensive competitors (Chao, 2026; Ishaq et al., 2026).

There has been limited research on the connection between carbon taxation and firm value of listed manufacturing entities in BRICS. Prior studies such as Senna and Moxoto (2024) evaluated the nuances of carbon pricing, carbon taxation and firm values employed simple OLS for data analysis which fail to eliminate reserve causality biases and account for unobserved heterogeneity. This methodological gap will be addressed using robust econometric model. Senna and Moxoto (2024) measured firm value using accounting measures such as return on equity (ROE), return on asset (ROA), and earnings per share (EPS) all of which are internal variables which are subject to manipulation and errors. This constitutes measurement gap which this study will address by using market-based valuation model, that is Tobin's Q to ascertain firm value. The study will integrate external policy, carbon taxation metrics with internal corporate environmental technology strategies in determining the market-based firm value thereby filling conceptual gap in literature. Also, prior studies have focused on developed economies and developing economies thereby creating geographic and population gaps. This study is poised to address geographic and population gaps by focusing on BRICS bloc. The dearth of empirical evidence on the interaction between carbon taxation and firm value in BRICS constitute empirical, evidence and knowledge gaps which this study is poised to address.

The study is poised to evaluate the effect of carbon taxation on firm value of listed manufacturing companies in the BRICS countries. The study will examine the independent variable, carbon taxation (CT) through carbon tax pricing level (CTP), revenue recycling mechanism (RRM), and share of emissions price (SEP) while firm value (FV) will be proxied by Tobin's Q. The study will analyse the influence of each of CTP, RRM, and SEP individually on Tobin's Q and the combine effects of the interaction between CTPL, RRM, and SEP on Tobin's Q.

LITERATURE REVIEW

This chapter presents a review of literature to explore the nuances between carbon taxation and firm value of listed manufacturing companies in the BRICS. The section includes conceptual review, underpinning theories; empirical review; gap identification; and conceptual framework.

Conceptual Review

This section examines key concepts: firm value measured by Tobin's Q; and carbon taxation measured by carbon tax pricing level, revenue recycling mechanism, and share of emission price.

Firm Value

The conceptualisation of firm value within corporate finance has evolved from rigid accounting baselines into a dynamic indicator of market confidence, particularly within transitioning markets. Saini (2023) defines firm value as the collective market perception of a firm's operational trajectory, emphasising that contemporary valuations increasingly synthesise both short-term financial performance and long-term sustainability metrics. Exploring forward-looking dimension, Vo and Ellis (2023) conceptualise firm value as the capital market's discounted appraisal of a firm's capacity to generate future economic benefits while effectively mitigating systematic risks. Baby et al. (2024) pivot toward a firm's perspective, characterising firm value as an external reflection of internal efficiency, governance structures, and innovative capacities of a company. Most recently, Chen et al. (2025) provides a structural definition, framing firm value as the ultimate corporate equilibrium

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derived from the interplay between capital structure optimisation, institutional constraints, and strategic market positioning.

Apparently, there has been a paradigm shift from historical tangible-asset valuation toward perception-driven models. While traditional corporate finance models focused on the conventional accounting aggregation of historical net assets, the frameworks established by Saini (2023) and Baby et al. (2024) underscore that intangible market signals such as regulatory compliance and adaptive governance are now priced directly into a firm's value. This evolution is highly relevant for manufacturing firms operating within the BRICS bloc. In these emerging economies, severe information asymmetry often decouples book values from market realities. Consequently, as synthesised from Chen et al. (2025) and Vo and Ellis (2023), firm value must not be viewed as a static financial statement but as a fluid, market-determined metric that reflects how successfully a firm navigates institutional pressures, shifting regulatory landscapes and volatile business environment.

Firm value is fundamentally dynamic and forward-looking, characterised by its continuous adjustments to shifting investor expectations and perceived future growth trajectories rather than past results (Widiastuti et al., 2024). Also, firm value exhibits a clear multidimensionality, as it concurrently aggregates traditional financial signals such as profitability and leverage; and non-financial metrics, notably Environmental, Social, and Governance (ESG) compliance (Saini, 2023). Being sensitive and market-driven, firm value fluctuates in response to macroeconomic volatility, institutional policy changes, and the varying levels of transparency inherent in transitioning capital markets (Vo & Ellis, 2023). Further, firm value is a macro-level economic signal serving as a primary benchmark that shapes external stakeholder trust, influences corporate capital allocation, and directly dictates the firm's cost of capital (Alves et al., 2025).

Deconstructing the determinants of firm value within the manufacturing sectors of BRICS economies carries profound empirical and practical significance. From an investor perspective, evaluating changes in firm value is vital because it directly dictates equity portfolio risk-return profiles and serves as the ultimate barometer for shareholder wealth maximisation (Alves et al., 2025). For corporate managers, monitoring firm value provides an essential feedback loop, serving as the market's real-time assessment of their strategic execution, operational efficiency, and risk-mitigation initiatives (Baby et al., 2024). From an institutional standpoint, analysing valuation trends across transitioning economies is highly relevant because macro-level firm values signal a nation’s regulatory maturity, corporate governance health, and capacity to attract foreign direct investment (Chen et al., 2025). Lastly, in an era of accelerating climate policy, tracking firm value within carbon-intensive manufacturing sectors yields critical data for policymakers, illustrating how carbon taxation policy alters firm returns, which allows governments to balance industrial productivity with green transition mandates (Gormsen et al., 2024).

Firm value may be described as market-appraised valuation of a firm's total economic capital, reflecting the strategic premium or discount that capital markets assign to its net assets based on its future growth prospects, risk profile, and regulatory resilience. To capture this accurately, Tobin’s Q is employed as the empirical proxy for firm value. The utilisation of Tobin’s Q as a market-based valuation metric as opposed to accounting-based alternatives such as Return on Assets (ROA), Return on Equity (ROE), or Earnings Per Share (EPS) is highly significant. Traditional accounting metrics are backward-looking indicators confined to historical transactions values. Also, traditional accounting measures are subject to changing tax laws, management manipulation, and varying accounting policies (Vo & Ellis, 2023). Tobin’s Q is calculated as addition of Book Value of Total Assets and Market Value of Equity divided by Book Value of Total Debt.

Tobin’s Q provides distinct advantages by looking forward to capture the market’s valuation of unobservable intangible capital, strategic positioning, and future investment opportunities (Ishaq et al., 2026). Furthermore, because accounting-based measures fail to adjust for variations in systematic risk or inflation, Tobin’s Q serves as a superior proxy in environmental policy research; it reflects how market forces value a firm's long-term viability and regulatory compliance, translating climate-related risks directly into an investor-driven credibility signal (Chen, Wang, & Zhang, 2025).

Carbon Taxation

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Carbon taxation is conceptualised as an environmental fiscal instrument anchored on the polluter-pays principle, aimed at correcting market externalities by internalising the social cost of carbon. Stretton (2020) defines the mechanism as a price-based macro-fiscal tool where fixed rates alter relative fuel prices to explicitly model downshifts in industrial energy usage and aggregate emissions. Muhammad (2022) defines a carbon tax as a fixed economic charge levied directly on the carbon content of fossil fuel supplies measured in metric tons of carbon dioxide equivalent at the node of production, refining, or processing. Wang (2025) describes carbon taxation not merely as a cost-imposition metric, but as an institutional distributive mechanism whose operational definition is strictly tied to public trust, procedural justice, and the socio-economic equity of its implementation layout. From a behavioural and corporate alignment perspective, Mwang'Onda (2026) views carbon taxation as a structural regulatory pressure that compels companies to adopt strategic low-carbon transitions or risk losing social legitimacy and facing civil liability.

Carbon taxation has emerged a market-based decarbonisation policy for reducing greenhouse gas emissions, drive eco-innovative technologies, and promote sustainable business model particularly in the manufacturing sector which is considered major carbon emitter (Senna & Moxoto, 2024). Carbon taxation represents one of the most direct, market-based instruments deployed by governments to internalise the negative externalities of greenhouse gas (GHG) emissions. For heavy industries, such as listed manufacturing companies within transitioning economies such as BRICS bloc, the introduction or escalation of a carbon tax alters the traditional corporate financial model. It forces an immediate repricing of industrial inputs, assets, and future economic benefits. Beyond immediate cash flow reductions, carbon taxation introduces substantial systematic regulatory risk. In modern capital markets, institutional investors actively price climate policy exposures and penalise firms with unmitigated carbon footprints by demanding a higher carbon risk premium (Gormsen et al., 2024).

Carbon taxation accelerates the economic obsolescence of carbon-intensive machinery, structurally altering value of total assets which is the denominator of Tobin’s Q. Under aggressive carbon pricing, traditional manufacturing installations degrade into reducndant assets, suffering accelerated depreciation and impairment losses (Abbas et al., 2024). However, this capital destruction can be countered if the tax framework successfully signals the market to reward long-term viability. When carbon taxes are structured predictably, they act as an incentive for forward-looking growth. Investors reallocate capital toward companies with high eco-innovation potential, assigning a valuation premium to unobservable intangible assets such as proprietary green technologies, energy-efficient operational structures, and environmental credibility. This ultimately lifts firm value/Tobin's Q above that of inefficient competitors (Chao, 2026; Ishaq et al., 2026).

Effective carbon tax framework is its forward-looking rate transparency allowing corporate entities to align their capital allocation cycles without facing sudden economic shocks (Mwang'Onda, 2026). Revenue recycling allows governments to redirect collected carbon proceeds into green innovation subsidies, renewable energy infrastructure, or direct corporate tax reliefs, thereby mitigating initial contractionary impacts on industrial productivity (Muhammad, 2022; Mwang'Onda, 2026). Economically, an unmitigated carbon tax exhibits a naturally regressive attribute in which burden of the tax tends to pass forward into final consumer prices unevenly (Wang, 2025).

The study will examine carbon taxation (CT) through carbon tax pricing level (CTP), revenue recycling mechanism (RRM), and share of emissions price (SEP) and their implications on Tobin’s Q. CTP is a fixed charge set by a government per metric ton of carbon dioxide equivalent emitted SEP represents the internalised financial exposure an enterprise faces relative to its overall operational cost structure and its capacity to transfer those costs along the supply chain. RRM functions as an institutional cushioning variable that alters how capital markets interpret the severe operational shocks linked to carbon regulations. This conceptualisation also distinguishes the study from prior works that treat carbon taxation as a single contruct (Ridwan, 2026). By disaggregating the construct, the study is able to isolate which specific dimension or dimensions of carbon taxation matter most for Tobin’s Q among listed manufacturing entities in the BRIC Bloc.

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Carbon Tax Pricing Rate

Carbon Tax Pricing (CTP) rate is a fixed charge set by a government per metric ton of carbon dioxide equivalent emitted (Muhammad, 2022). CTP rate operates as a primary regulatory shock that directly impacts on the numerator of the Tobin's Q equation (market value of equity and debt). Critically analysing this measure reveals a dual, non-linear transmission mechanism into firm value. In high-emission manufacturing environments like the BRICS bloc, a high explicit CTP rate instantly expands operational liabilities (Adedeji & Olayinka, 2025). Capital markets absorb this information and apply a structural valuation discount. This occurs because elevated carbon pricing levels heighten expected cash flow volatility, limit short-term profitability, and compress standard corporate margins (Liu, 2025). This institutional pressure creates a strict carbon risk premium where financial institutions and capital markets reprice equity risk upward, directly reducing Tobin's Q (Khan & Ibrahim, 2024; Liu, 2025).

Conversely, a low or stagnant CTP rate sends a weak environmental signal. As investors increasingly use forward-looking climate metrics to assess long-term sustainability, an inadequate pricing baseline may fail to encourage efficiency and leave firms vulnerable to future policy shifts, thereby weakening market valuation (Saini, 2023). Thus, CTP functions as a direct measure of compliance cost and regulatory discipline that investors use to discount or reward a firm's prospects.

From a traditional corporate finance perspective, carbon taxation acts as an immediate regulatory drain on working capital. For manufacturing enterprises reliant on fossil-fuel energy or carbon-intensive supply chains, CTP functions as an inescapable variable operational cost (Park & Kim, 2026). The magnitude of CTP operates as a primary signal of environmental strictness, directly altering how investors value carbon-intensive assets. In transitioning BRICS markets, deciding an optimal pricing level is a critical structural hurdle. Establishing a nominal CTP rate fails to provide a distinct financial incentive to drive deep decarbonization or organizational adjustments. Conversely, an aggressive increase in the CTP level generates sudden financial shocks by inflating energy and raw material overhead. In industrial sectors reliant on fossil-fuel inputs, changes in the CTP level are rapidly incorporated by investors into equity risk premiums (Santos & Silva, 2024). When expected future cash flows contract because a firm must satisfy massive carbon liabilities, capital markets reprice the firm's equity downward, which directly compresses its Tobin's Q.

Revenue Recycling Mechanism

Revenue Recycling Mechanism (RRM) functions as an institutional cushioning variable that alters how capital markets interpret the severe operational shocks linked to carbon regulations. Critically, while CTP acts as a regulatory drain on corporate cash reserves, the structural framework of the RRM determines whether that capital is permanently lost to the state or returned to the private sector. When governments establish targeted recycling channels such as green investment subsidies, emission reduction incentives, or matching funds for clean technology the financial burden of the tax is minimised. This provides manufacturing firms with alternative capital pools to fund expensive asset replacement programs (Al-Balushi & Taylor, 2024; Xu, 2025). A predictable, supportive RRM directly influences the denominator of Tobin's Q (book value of total assets) by encouraging firms to transition away from high-emission, vulnerable machinery. For manufacturing firms within the BRICS economies, access to recycled environmental funds lowers systematic operational risks, coordinates lower borrowing costs via green financial streams, and shields overall profitability (Mendoza et al., 2025; Xu, 2025).

Therefore, a transparent RRM reassures investors, lowers equity risk premiums, and helps protect or enhance a firm's market value. If a manufacturing company operates in a jurisdiction with high carbon tax volatility and lacks access to an efficient RRM such as state-backed green subsidies or technology matching funds, its systematic risk profile rises. Consequently, banks and equity investors demand a higher required rate of return. This inflates the firm's Weighted Average Cost of Capital (WACC), driving down the discounted present value of its long-term corporate assets and severely depressing its market valuation (Gomez & Tan, 2026; Xu, 2025).

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The final financial and operational impact of carbon pricing schemes depends heavily on how collected revenues are allocated by the state. The RRM functions as a vital fiscal balancing tool meant to neutralise the financial distortions levied on heavily regulated manufacturing firms (Zhou & Mwangi, 2024). If carbon tax collections are dynamically recycled back to the private sector via capital subsidies or structural corporate tax cuts, the operational damage inflicted by carbon policies can be effectively minimised.

For listed companies, an established RRM provides alternative capital pathways to finance expensive energy-efficiency transitions and structural upgrades. When international and domestic investors observe a predictable, supportive fiscal recycling environment, the systematic risk premiums associated with climate compliance drop. Effective revenue recycling therefore helps stabilise future corporate earnings and preserves market-based valuations by bolstering investor confidence.

Share of Emissions Price

Share of Emissions Price represents the internalised financial exposure an enterprise faces relative to its overall operational cost structure and its capacity to transfer those costs along the supply chain. The critical linkage between SEP and Tobin's Q relies heavily on market positioning and the price elasticity of product demand. Manufacturing entities in emerging markets often operate in highly competitive sectors with low cost-pass-through capability. When a firm cannot transfer the carbon tax burden to buyers, it must absorb the SEP internally. This leads to an explicit drop in return profiles and an increase in debt default probabilities, which equity markets quickly penalize (Zhang & Al-Malki, 2025; Wang, 2026). As the internalised share of emissions pricing escalates without immediate technological upgrades, investors treat the unmitigated SEP as a threat to corporate survival. To counter this, vulnerable firms may alter their supply chains, a practice known as carbon leakage to temporarily protect margins, though this often triggers future disclosure and compliance penalties (Metwalli, 2025; Schmidt & Rossi, 2024).

Consequently, a high internalized SEP compresses operating cash flows and shifts investor sentiment, leading to a visible drop in a firm's market-to-book valuation ratio. When a firm's SEP increases it internalises a higher proportion of its carbon liabilities because it lacks the market power to pass those costs onto consumers with its net operating cash flows contract. Capital markets quickly price this structural margin compression into equity values. As investors adjust their expectations for future dividends downward, the market value of equity falls, driving a direct contraction in the numerator of Tobin's Q (Kumar & Das, 2026; Liu, 2025). SEP represents the exact proportion of carbon liabilities that an enterprise internalizes within its operational cost structure, directly reflecting its ability to transfer environmental costs along its value chain. In exposed manufacturing sub-sectors, a steep SEP exposes firms to competitive erosion, especially when competing with foreign entities unencumbered by equivalent domestic carbon regulations (Chen & Tanaka, 2024).

The structural impact of SEP on a company's market worth is fundamentally tied to its market power and product price elasticity. Firms operating with limited cost-pass-through capabilities must absorb the carbon emissions cost within their core operating margins. This dynamic creates an explicit drag on return profiles, which public equity markets quickly penalize. As the internalized share of emissions pricing escalates without immediate technological countermeasures, investors discount the firm's long-term viability, resulting in a lower market-to-book asset ratio.

THEORETICAL REVIEW

This study employs Environmental Kurznet Curve and Institutional Theory as theoretical underpinnings to explore the relationship between carbon taxation and firm value of listed manufacturing entities in the BRIC bloc.

Environmental Kuznets Curve Hypothesis

Environmental Kuznets Curve hypothesis was originally propounded and popularized by Grossman and Krueger (1991) and later expanded in their seminal empirical work in 1995, which drew heavily from Simon

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Kuznets' 1955 inverted-U-shaped income inequality model. The foundational premise of the EKC hypothesis is that the relationship between economic development traditionally measured by Gross Domestic Product (GDP) per capita and environmental degradation follows a non-linear, inverted-U-shaped trajectory.

The model relies on three fundamental assumptions. Firstly, In the pre-industrialisation phase, economic expansion accelerates pollution because manufacturing output demands intensive fossil fuel consumption and raw material extraction, placing a higher premium on output growth than on environmental quality. Secondly, as an economy transitions past a critical industrial turning point into a service- and knowledge-driven post-industrial economy, the industrial composition cleaner, naturally downshifting local emission intensities. Lastly, at higher income levels, a nation acquires the financial capacity and technological infrastructure necessary to develop and adopt green innovations. This effect assumes that clean air and water are "luxury goods," meaning that as citizens grow wealthier, societal demand and public policy shift toward stringent environmental regulations, eventually decoupling economic growth from environmental degradation.

The dynamic validity of the EKC hypothesis remains a central focus particularly regarding the high-emission trajectories of emerging economies. Kayani et al. (2023) tested the EKC framework by exploring the interplay between foreign direct investment (FDI), technological innovations, and carbon footprints in BRICS. Their findings confirmed that while initial economic and industrial expansions worsen the ecological footprint, targeted investments in renewable energy and green technologies eventually trigger the downward slope of the curve, aiding carbon mitigation. Examining the broader friction within these emerging economies, Manjengwa (2025) incorporated Environmental, Social, and Governance (ESG) performance metrics into a dynamic ARDL panel framework for BRICS nations. This application revealed an initial short-term negative relationship between sustainable mandates and corporate economic performance, highlighting a harsh "transitional shock." However, it validated the long-term EKC premise by showing that structural sustainability interventions ultimately stabilize economic output and manage climate risks effectively over time. Similarly, Silva (2026) applied the EKC hypothesis to evaluate the structural determinants of renewable energy consumption among the founding BRICS members. The study demonstrated that although economic growth initially relies heavily on fossil-fuel-driven industrialization, the onset of trade openness and improved governance quality helps validate the EKC trajectory by accelerating the transition toward clean energy sources.

The EKC hypothesis is highly relevant to investigating how carbon taxation affects the firm value of listed manufacturing companies across the BRICS nations. Manufacturing firms represent the highly carbon-intensive core driving the upward, pre-industrial peak of the Kuznets curve in emerging economies. When governments introduce price-based climate policies, such as carbon taxation, they artificially accelerate the "technological effect" of the EKC at the corporate level. According to Xu (2025), market-based environmental protection taxes alter relative prices, forcing heavy industries to systematically internalize their social externalities and transition toward green production modes. Consequently, this regulatory shock directly influences corporate financial architecture. As Hussain et al. (2025) observe within the BRICS framework, a firm's capacity to navigate these environmental pressures and disclose its climate transitions is heavily rewarded by modern capital markets, directly influencing long-term market valuation and stakeholder legitimacy. Thus, the EKC provides the ideal macroeconomic backdrop for this study. It illustrates how a manufacturing firm's short-term compliance costs (which depress accounting-based firm value) serve as the mandatory operational catalyst required to achieve long-term carbon efficiency and market-driven intrinsic firm value.

The main strength of the EKC hypothesis is its clear and measurable explanation of economic transition. It presents environmental degradation as a developmental phase that can be reduced through financial progress and technological advancement rather than as a permanent condition. However, the theory has been widely criticised for being overly deterministic because it assumes that economic growth will naturally lead to environmental improvement. In practice, many developing countries experience a persistent lock-in effect, where weak environmental regulations make them pollution havens for foreign capital. In addition, the EKC

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is mainly a macroeconomic framework and does not adequately explain the internal corporate mechanisms, power relations, and compliance strategies that shape how individual firms respond to carbon taxation.

This analytical gap justifies adopting Institutional Theory as a complementary framework. While the EKC maps the broad economic trajectory, Institutional Theory explains why and how firms adapt to carbon taxes. It posits that a manufacturing firm's response to carbon pricing is not merely an automated financial calculation, but a strategic effort to survive within an institutional environment governed by coercive isomorphism, mimicry and normative pressures.

Institutional Theory

Institutional Theory, particularly its prominent "neo-institutional" variant was propounded and advanced by Meyer and Rowan (1977) and later refined by DiMaggio and Powell (1983) and Scott (1995). The foundational premise of the theory is that organisations do not operate merely within a vacuum of technical and economic efficiency but are deeply embedded within social and regulatory structures. To survive, corporate entities must conform to environmental rules, social belief systems, and institutionalised scripts to secure organisational legitimacy which is vital for ensuring long-term resource accumulation and market survival.

The framework relies on three fundamental assumptions. Firstly, institutional environments are governed by a triad of pressures regulatory/coercive, normative, and cultural-cognitive. Secondly, over time, organisations facing similar institutional conditions structurally converge, a phenomenon known as institutional isomorphism. This assumption implies that corporate behaviours are frequently driven by the desire to look right to outsiders rather than by purely rational cost-minimization logic. Lastly, to manage internal operational friction, firms often decouple their formal, highly visible structures constructed to satisfy external watchdogs and maintain symbolic compliance from their actual, everyday technical work.

Applying the theory to the financial and corporate ecosystems, Mallarino (2024) explored how green investing and standardized climate disclosure guidelines (such as GRI and TCFD) spread globally. His work showed that institutional setups stabilize emerging green markets by forcing firms to follow specific regulatory requirements to remain legitimate in the eyes of international investors. Al-Hiyari and Kolsi (2025) examined the drivers of sustainability performance across listed companies. Guided by institutional pillars, their empirical findings demonstrated that companies do not adopt environmental, social, and governance (ESG) practices solely for direct profit; rather, they do so to proactively mirror industry leaders and comply with rising regional standards, thereby reducing risk. Focusing on clean energy transitions, IRENA (2024) utilized an institutional framework to examine how predictable governance structures, rule trajectories, and field capacity alter corporate expectations. The study showed that when state institutions provide stable, long-term regulatory frameworks, it lowers structural uncertainty and transaction costs, prompting asset-heavy industries to shift their capital away from fossil fuels.

Institutional theory is highly relevant to this study because it explains how the introduction of a carbon tax transforms from a basic line-item expenditure into a critical driver of the market value of manufacturing firms listed in BRICS nations. Manufacturing firms in these developing regions operate under intense institutional scrutiny due to their heavy carbon footprints. When a BRICS government enforces a carbon tax pricing level, it activates severe coercive isomorphism, directly threatening a firm’s financial resources if its production methods remain unchanged. As Hussain et al. (2025) observe, when manufacturing firms actively respond to environmental mandates and disclose their climate adjustments, financial markets actively reward them with higher valuations. Furthermore, Mwang'Onda (2026) demonstrates that a firm's willingness to accept and adapt to carbon taxes is not merely an automated financial calculation; it is a strategic effort to satisfy normative and social expectations to maintain its operational legitimacy. The theory allows this study to go beyond simple accounting metrics. It illustrates that a carbon tax does not just mechanically drain cash flow; rather, it reshapes the entire institutional environment, where a firm's capacity to build social legitimacy directly influences its long-term market-based firm value.

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The primary strength of institutional theory lies in its comprehensive, sociological perspective on corporate strategy. It explains how non-market factors such as state regulations, consumer ethics, and global ESG frameworks influence corporate behaviour, successfully demonstrating that long-term firm value is deeply linked to societal legitimacy. However, the theory faces significant criticisms. Critics argue that classic institutionalism is overly passive, portraying firms as compliant puppets that blindly surrender to external pressures while ignoring managerial agency and strategic choice. Additionally, it historically downplays internal resource constraints, assuming that all firms have equal capacity to satisfy institutional demands.

EMPIRICAL REVIEW

This section presents a systematic review of empirical studies relating to the four research objectives: the influence of carbon tax pricing level on firm value, the effect of revenue recycling mechanism on firm value, the influence of share of emission price on firm value and the influence of carbon tax pricing, revenue recycling mechanism and share of emission price on firm value. Studies span 2022–2026, with emphasis on 2023–2026 evidence and are organised sequentially. Each study is examined with focus on objective, purpose, research approach, data source, data analysis technique and results.

Carbon Tax Pricing Rate and Firm Value

Shanyu (2021) evaluated the relationship between corporate social responsibility and sustainable business performance. The purpose of the study was to ascertain the influence of CRS on sustainable business performance in BRICS countries. The study adopted quantitative methods, collected secondary data from financial statements and CSR reports of high-rated listed companies. Data was analysed using random effect model and generalised method of moments (GMM). Results revealed that CSR significantly positively influenced sustainable business performance in BRICS countries.

Asyifa and Burhany (2022) examined the interaction between carbon emission disclosure, environmental performance and firm value. The purpose of the study is to assess the effect of carbon emission and environmental performance on firm value. The study employed quantitative methods. Study sample consists of seven firms drawn from SRI-KEHATI index for a five-year period from 2016 to 2020. Data was collected from published annual reports, financial reports and sustainable reports were analysed using multiple linear regression techniques. Results revealed that carbon emission disclosure has no effect on firm value while environmental performance has positive influence on firm value.

Khan and Ibrahim (2024) investigate the repricing of equity risk and the generation of carbon risk premiums under stringent regulatory environments in developing markets. A quantitative empirical study pooling capital market transaction records, asset pricing portfolios, and climate risk disclosure indexes. Using multi-factor asset pricing models, results reveal that severe carbon taxes create a steep risk premium, directly depressing Tobin's Q. The study recommends that financial institutions should adjust their equity valuation metrics to incorporate carbon premiums, while firms should intensify green governance to protect market values.

Santos and Silva (2024) investigate the transmission mechanisms through which sudden carbon taxation shocks travel directly into industrial equity risk premiums. Usung a quantitative event-study and time-series design, the study captures daily stock returns, macroeconomic announcements, and sector-specific emissions data. With the aid of generalized autoregressive conditional heteroskedasticity (GARCH) modeling, the study reveals that tax increases compressed expected cash flows and elevated equity premiums. The study recommend that governments should pair aggressive tax adjustments with forward guidance to prevent capital flight and allow industrial sectors sufficient time to implement structural adjustments.

Sadiq et al., (2024) examined the interaction between green finance, eco-innovation, renewable energy, and carbon taxes on carbon emission in BRICS countries. The purpose of the study was to ascertain the impact of green finance, eco-innovation, renewable energy and carbon taxes on carbon emissions. The study collected data spanning 2001 to 2020 was analysed using CS ARDL technique. Findings reveal that green finance, eco-innovation, renewable energy, and carbon taxes exhibit negative impact on carbon emissions.

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Park and Kim (2026) evaluate how carbon tax magnitudes act as a regulatory drain on corporate working capital and alter asset valuations for carbon-intensive firms. A quantitative archival evaluation sourcing quarterly working capital metrics, energy expenditure ledgers, and institutional investment holdings (2017–2025). Utilising a dynamic generalised method of moments (GMM) framework, the study reveals that high tax levels become inescapable variable costs that restrict liquidity. Corporate managers should adjust cash management protocols to buffer against tax payments and allocate capital to decouple operations from fossil fuel inputs.

Adedeji and Olayinka (2025) examine explicit carbon pricing and operational liability expansions in heavy manufacturing to understand how rising carbon tax levels threaten emerging economy businesses. A quantitative panel design collecting annual financial statements and national environmental tax registries from 450 industrial firms (2018–2024). Using fixed-effects panel regression, the study proved that aggressive CTP spikes instantly amplify operational liabilities, causing markets to apply an immediate valuation discount. The study recommends that industrial firms must systematically map their transition risk exposures, and policymakers should structure predictable tax trajectories to protect enterprise viability.

Gao and Martinez (2025) investigate multi-variable policy interactions and structural margin constraints to understand how unfavorable regulatory combinations worsen investor risk anxiety. A quantitative empirical study collecting institutional equity transaction logs, environmental policy stringency indicators, and corporate asset-utilization data. Using multi-level structural equation modeling, the study reveals that high taxes paired with exclusive recycling and unmanageable emission pricing cripple capital efficiency. The study recommends that regulators must coordinate environmental fiscal tools to avoid compounding financial distress, while firm executives must revise risk-management frameworks.

Schneider and Fischer (2026) analyse the corporate cost of uncoordinated climate policy mixes by evaluating structural asset utilization under hostile fiscal and tax regimes. The study employs a quantitative policy-evaluation framework sourcing historical industrial capacity utilization rates, carbon ledger accounts, and listed company market records (2018–2025). Utilizing a difference-in-differences (DiD) approach, the analysis confirmed that conflicting policy design drops operating cash flows and intensifies investor capital discounting. Finally, the study recommends that governments should synchronize emissions pricing with broad-based industrial tax cuts to stabilize market expectations and sustain continuous corporate investment.

Li and Takahashi (2024) examine eco-innovation as a structural buffer to determine how green capabilities moderate the financial shocks of interacting carbon constraints. A quantitative archival evaluation drawing from international patent classification databases, corporate R&D ledgers, and standard Tobin's Q valuation panels. Using dynamic panel GMM estimations, the research established that strong corporate eco-innovation serves as a critical moderating variable that helps absorb regulatory forces. Finally, the study recommends that corporate managers should aggressively reallocate internal capital toward green technology development to shield overall long-term market worth from overlapping policy stresses.

Senna and Moxoto (2025) examine the interaction between carbon emission and financial performance of companies listed in Carbon Efficient Index in Brazil. The purpose of the study is to ascertain the effect of carbon emission of financial performance measured by earnings per share, return of asset and return on equity. The study employes quantitative research methods using OLS and GLS techniques with Gretl software for regression analysis of cross-sectional data obtain from 73 companies in 2021. Findings reveal that carbon emissions have a positive significant influence on financial performance measured by EPS and ROE. Study further reveal that location of the company, regulation and economy influence the relationship between carbon emissions and financial performance.

Revenue Recycling Mechanism and Firm Value

Al-Balushi and Taylor (2024) investigates capital substitution and asset replacement pathways under corporate carbon constraints to understand how fiscal recycling minimizes tax burdens. The adopted quantitative empirical design tracking firm-level CapEx databases and green fiscal recycling records across 1,200

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manufacturing entities (2016–2023). Using dynamic panel GMM estimation, the study found that targeted recycling channels provide crucial alternative capital pools that encourage structural transitions away from high-emission machinery. The study recommends that policymakers should build predictable green funding channels to help listed firms insulate their book value and reduce asset vulnerability.

Okafor and Al-Mansour (2024) explore the joint effects of carbon tax levels and revenue recycling structures on manufacturing firm values to evaluate policy interaction mechanics. A quantitative panel design analyzing macroeconomic carbon registries and corporate accounting indices across 22 countries from 2015 to 2023.

Using fixed-effects interaction models, the study proved that aggressive pricing does not erode firm value if paired with transparent, highly liquid recycling channels. The study recommends that policymakers should bundle environmental tax hikes with dedicated green capital deployment channels to shield industrial market valuations from compliance damage.

Mendoza et al. (2025) explores the role of supportive revenue recycling in mitigating systematic climate transition risks and protecting corporate profitability within BRICS economies. Using a quantitative approach, the study conducts a cross-country analysis utilising national environmental registries, central bank green lending streams, and corporate financial statements. Using fixed-effects panel regression, the study reveals that access to recycled funds lowers borrowing costs and systematic operational risks. It advocates that BRICS governments must coordinate environmental tax regimes with green financial streams to shield industrial sectors from structural compliance shocks.

Gomez and Tan (2026) examine the financial impact of carbon tax volatility and institutional revenue recycling architectures on the weighted average cost of capital (WACC). The study uses a quantitative archival approach collecting capital market indices, institutional governance datasets, and fiscal policy tracking across listed manufacturers. Through structural equation modeling, results show that absent efficient recycling mechanisms, tax volatility raises equity risk premiums and deflates long-term asset values. The advocates that managers should hedge against regional regulatory volatility by lobbying for transparent state-backed technology matching funds.

Zhou and Mwangi (2024) analyse dynamic revenue recycling via capital subsidies or corporate tax cuts as a fiscal balancing tool to neutralize climate policy distortions. A quantitative policy evaluation collecting comprehensive taxation files, listed company market valuations, and industrial subsidy registries. Difference-in-differences (DiD) estimations revealed that recycling tax collections back to the private sector effectively stabilizes future corporate earnings and preserves market-based valuations. The study recommends that jurisdictions introducing carbon pricing schemes should concurrently roll out corporate tax cuts to sustain investor confidence and market worth.

Share of Emission Price and Firm Value

Kumar and Das (2026) explore the connection between corporate carbon exposure and Tobin's Q. The study explores how internalized corporate carbon exposure and the resulting margin compression influence equity market discounting behavior. It specifically investigates the financial mechanisms through which unpassable carbon liabilities degrade long-term market valuations. The study adopts quantitative approach and collects panel data spanning 2018 through 2025. Data sources included firm-level financial disclosures, carbon accounting databases, and capital market performance metrics for publicly traded manufacturing firms. Utilizing a fixed-effects panel regression model alongside structural equation modeling (SEM), the analysis revealed that firms unable to pass emissions costs to consumers suffer a substantial, direct contraction in the numerator of Tobin’s Q. This compression is heavily driven by downward revisions in investor expectations regarding future dividend payouts. The study recommends that vulnerable firms prioritize immediate energy-efficiency upgrades and that managers improve explicit carbon risk disclosures to transparently mitigate market anxiety over internalized liabilities.

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Zhang and Al-Malki (2025) explore Internalized Carbon Liabilities and Credit Risk. The study investigates the nexus between an enterprise's internalized carbon liabilities, core return profiles, and corporate credit risks within developing financial markets. Using quantitative archival approach with sample draws upon corporate balance sheets, national carbon tax registries, and credit default swap (CDS) pricing data across major emerging market economies from 2019 to 2024. The study employes multivariate regression analysis and survival analysis models. Findings demonstrate that high shares of internalized emissions pricing act as an explicit drag on firm return profiles. This financial strain directly accelerates corporate debt default probabilities, triggering sharp equity market penalties. Policymakers are urged to design regional carbon frameworks with transitional relief windows, while firm executives must aggressively integrate environmental management into core corporate capital structure decisions.

Chen and Tanaka (2024) examine the intersection between regulatory asymmetry and cost pass-through. The study evaluates the strategic impact of domestic environmental regulations on the cost-pass-through capabilities and competitive erosion of manufacturing firms operating under asymmetric international policies. This study adopts a quantitative comparative design. Data collection integrated corporate financial statements, product-level pricing indices, and international trade data matching highly exposed domestic industries against unencumbered foreign competitors. Data analysis is through difference-in-differences (DiD) estimation and price elasticity modeling. Findings confirmed that restricted cost-pass-through capabilities under unilateral carbon pricing led to severe margin erosion. This operational vulnerability severely damages international market share when facing unregulated foreign entities. The study highlights the critical need for governments to implement carbon border adjustment mechanisms (CBAM) to level the industrial playing field, advising exposed companies to proactively diversify supply chain structures.

Schmidt & Rossi (2024) explores supply chain reconfiguration and carbon leakage. The study examines the strategic deployment of corporate carbon leakage via supply chain reconfiguration and its subsequent consequences on regulatory compliance and disclosure penalties. The paper relies on a quantitative research approach, aggregating global logistics data, corporate geographic footprint tracking, historical environmental enforcement and regulatory fine registries.

The study employes a combined framework of logistical network optimization modeling and longitudinal panel regressions. Results reveal that while supply chain relocations provide temporary protection for corporate operating margins, they systematically trigger severe future regulatory disclosure penalties and subsequent long-term institutional investor divestment. The study advocates that firms should jetison short-term geographic shifting strategies, advising institutional investors to apply stricter forensic auditing methods to evaluate multinational supply chain transition risks.

Gap in Literature

An evaluation of empirical literature reveals a critical conceptual and geographic disconnection regarding how environmental regulations transmit into corporate market-based valuations. First, a significant thematic gap exists concerning the inconsistent use of proxy variables for firm performance. While the foundational framework focuses heavily on market-to-book ratios via Tobin’s Q to capture forward-looking capital market expectations, several studies (e.g., Shanyu, 2021; Asyifa & Burhany, 2022; Senna & Moxoto, 2025) pivot arbitrarily toward historical accounting metrics like Return on Assets, Return on Equity, and Earnings Per Share, or generic sustainability performance indices.

This introduces structural measurement friction across the literature, as accounting-based profitability indicators reflect backward-looking historical costs, failing to capture the real-time asset pricing changes, systematic risk premiums, and investor discounting mechanics that directly dictate a firm's long-term market valuation.

Second, are contextual and geographic limitations leading to institutional asymmetry within the samples. Most contemporary literature targeting deep carbon constraints is heavily clustered around either the BRICS bloc (Shanyu, 2021; Sadiq et al., 2024; Mendoza et al., 2025) or highly specified manufacturing cohorts in broader

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developing financial markets. This concentration creates an external validity deficit, as it overlooks the institutional heterogeneity of individual emerging markets. For instance, the structural capacity of a firm to pass through carbon costs or access liquid state-backed revenue recycling mechanisms differs drastically between an export-driven manufacturing framework and a localised industrial economy. By relying on broad regional aggregations, the current literature fails to isolate how country-specific market power, local currency volatility, and varying domestic tax architectures uniquely alter the vulnerability of corporate working capital.

Third, the literature shows a clear temporal and structural mismatch in data integration. Although the policy debates and theoretical frameworks are situated within the contemporary regulatory period of 2022–2026, several foundational studies rely on historical datasets that predate major changes in global carbon markets. For example, Sadiq et al. (2024) used data from 2001 to 2020, while Asyifa and Burhany (2022) relied on data from 2016 to 2020.

These older datasets do not adequately capture the severe margin compression, intensified risk repricing, and stricter disclosure penalties that modern capital markets now attach to carbon liabilities. In addition, although recent studies have modelled multi-variable interactions (Okafor & Al-Mansour, 2024; Gao & Martinez, 2025), empirical consensus remains limited on the specific operational threshold at which corporate eco-innovation shifts from a short-term cost burden to a structural buffer that protects firm market value.

Research Hypothesis

Following conceptual and empirical review in line with the four specific objectives, the underlisted null hypothesis hypotheses are formulated to guide the study:

H_{01}:Carbon tax pricing level has no significant effect on firm value of listed manufacturing companies in BRICS countries;

H_{02}:Revenue recycling mechanism has no significant effect on firm value of listed manufacturing companies in BRICS countries;

H_{03}:Share of emission price has no significant effect on firm value of listed manufacturing companies in BRICS countries; and

CONCEPTUAL FRAMEWORK

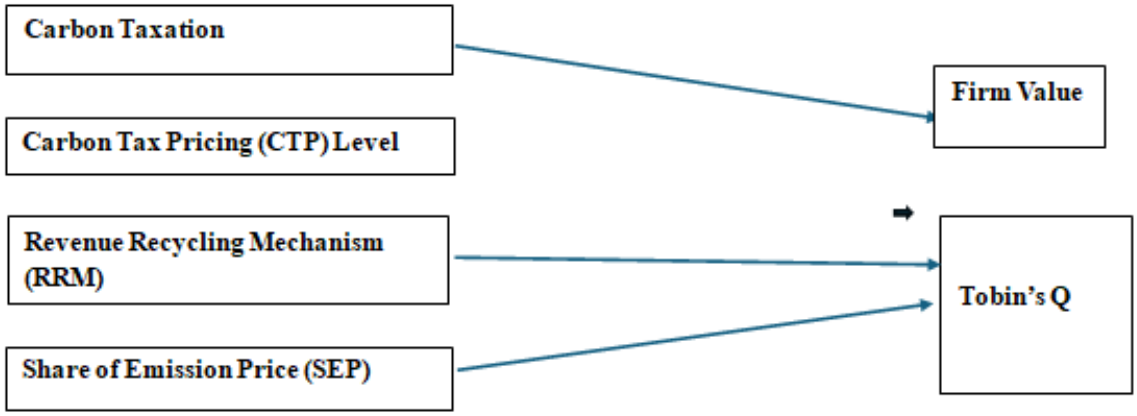
The conceptual framework is the diagrammatic illustration of the relationship between carbon taxation as the independent variable and firm value as the dependent variable. Carbon taxation is measured by three proxies namely carbon tax pricing level, revenue recycling mechanism and share of emission price, each hypothesised to exhibit a positive influence on firm value measured by Tobin's Q. Underpinned by EKC hypothesis and institutional theory, the framework explains how non-market factors such as environment, state regulations, consumer ethics, and global ESG frameworks influence corporate behaviour, successfully demonstrating that long-term firm value is deeply linked to societal legitimacy. The framework is illustrated in Figure 1.

The framework is deliberately structured to mirror the analytical sequence developed in the conceptual review: Carbon Tax Pricing Level is a fixed charge set by a government per metric ton of carbon dioxide equivalent emitted; Share of Emissions Price represents the internalised financial exposure an enterprise faces relative to its overall operational cost structure and its capacity to transfer those costs along the supply chain;

Revenue Recycling Mechanism (RRM) functions as an institutional cushioning variable that alters how capital markets interpret the severe operational shocks linked to carbon regulations. The three constructs are theorised to operate through a related but distinct mechanism. Carbon taxation is expected to have a long-term positive influence of market valuation of companies.

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Figure 1 Conceptual Framework



Source: Author's Design (2026)

METHODOLOGY

The study adopted quantitative ex-post facto and longitudinal panel research design. An ex-post facto design was considered suitable because the events under investigation have already occurred and were not subject to manipulation by the researcher (Turay, 2025). The longitudinal panel design was selected because it tracks multiple firms across countries (Tavares, 2025). The study total population comprised of 4260 manufacturing companies listed on the stock exchanges of BRICS countries. The target population 1390 was determined based on predefined filtering criteria. The firm must be classified as manufacturing; actively listed; publicly traded; and have complete, uninterrupted financial, environmental, and annual report disclosures for all variables of interest. Taro Yamane model was used to determine sample size. A non-probabilistic purposive sampling technique was used to select a sample of 310 firms from target population 1390. See Table 1. This study relied on secondary data collected from reputable global databases between 2016 and 2025: S&P Capital IQ and Bloomberg databases for Tobin's Q; and World Bank's Carbon Pricing Dashboard and OECD Environmental Policy Tools database for Carbon Taxation metrics data such as Carbon Tax Pricing Level, Revenue Recycling Model, and Share of Emission Price.

Table 1 Determination of Target Population and Sample Size

Stock Exchange	Total Population	Excluded: Inactive, Delisted or Post-2016 Listing	Excluded: Incomplete Financials, ESG, Annual Reports	Target Population Based on Criteria	Sample Size
Brazil (B3)	110	(45)	(25)	40	9
Russia (MOEX)	70	(30)	(20)	20	4
India (BSE / NS)	1200	(450)	(350)	400	89
China (SSE & SZSE)	2800	(800)	(1100)	900	201
South Africa (JSE)	80	(30)	(20)	30	7
Total	**4260**	**(1355)**	**(1515)**	**1390**	**310**

Source: Author's Compilations (2026)

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Model Specification

This study is based on the model developed by Asyifa and Burhany (2022) who used a regression model to evaluate the effect of carbon emission disclosure and environmental performance on firm value using legitimacy theory, signaling theory, and triple-bottom-line theory. The model is suitable for the present study because it provides an empirical basis for examining the relationship between carbon taxation and firm value.

The current study adopts Environmental Kuznet Curve Hypothesis and Institutional Theory to interrogate the interplay between carbon taxation and firm value. The two theories are considered appropriate because while EKC hypothesis asserts that improving financial, economic and technology capacities lead to cleaner environment; Institutional Theory explained why firms must comply with eco-regulations due to coercive, mimic, and normative pressures.

The model specified by Asyifa and Burhany (2022) is presented by:

$$TBQ = \alpha + \beta 1 CED + \beta 2 EP + e \ldots\ldots\ldots\

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Table 2 Summary of Variable Measurement

S/N	Variable	Description	Measurement	Source
1	Firm Value (Dependent)	Market perception of a firm's operational efficiency and ability to generate future economic returns while mitigating risks.	Tobin's Q: Addition of Book Value of Total Assets and Market Value of Equity divided by Book Value of Total Debt.	Asyifa & Burhany (2022); Gidage, Gyamfi &Asongu (2024)
2	Carbon Tax Pricing Level (Independent)	A fixed charge set by a government per metric ton of carbon dioxide equivalent emitted	Carbon Tax Pricing Level: Statutory Rate per tCO_2e in Country i at Year t	Adedeji & Olayinka (2025); Park & Kim (2026).
3	Revenue Recycling Mechanism (Independent)	Institutional cushioning variable that alters how capital markets interpret the severe operational shocks linked to carbon regulations	Revenue Recycling Mechanism: Carbon Tax Revenues Earmarked for Green Subsidies & Corporate Reliefit divided Total Carbon Tax Revenue Collectedit	Al-Balushi & Taylor (2024); Santos & Silva (2024) Mendoza et al. (2025).
4	Share of Emission Price (Independent)	Internalised financial exposure relative to overall operational cost structure and capacity to transfer those costs along the supply chain	Share of Emission Price: Percentage of a nation's total domestic GHG emissions that fall under the mandate of an active Carbon Tax.	Schmidt & Rossi (2024); Zhang and Al-Malki (2025).

Source: Author's Compilations (2026)

DATA ANALYSIS AND DISCUSSION OF FINDINGS

This section includes descriptive statistics and normality tests conducted to examine the distribution and behaviour of the study variables. Spearman correlation analysis is conducted to determine the direction and degree of association and panel regression analysis to ascertain relationship among variables. The section also presents the tests of hypotheses and discusses the findings in relation to the underpinning theories and previous empirical studies.

Descriptive Statistics

Table 3 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
fv	3384	2.059	0.441	0.719	3.258
crp	3384	4.825	2.684	0.81	12.39
rrm	3384	0.222	0.087	0.054	0.455
sep	3384	0.305	0.114	0.105	0.613
fsiz	3384	21.208	0.922	18.434	23.931
lev	3384	0.55	0.05	0.404	0.69

Source: Author's Computation (2026)

Table 3 above presents the descriptive statistics for 3,384 firm-year observations used in the study. Firm value

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(FV), measured by Tobin's Q, recorded a mean value of 2.059, with a standard deviation of 0.441. The minimum and maximum values were 0.719 and 3.258, respectively. The mean indicates that the sampled listed manufacturing companies generally maintained relatively strong market valuations during the study period, although the range shows noticeable differences in firm value across companies over the years. The comparatively low standard deviation relative to the mean further suggests that firm value did not fluctuate excessively around its average within the sample.

Regarding carbon taxation measures, carbon tax pricing rate (CRP) had a mean of 4.825 and a standard deviation of 2.684, with values ranging from 0.810 to 12.390. The relatively large standard deviation and wide range indicate considerable variation in carbon tax pricing across the BRICS countries and years of study. The revenue recycling mechanism (RRM) recorded a mean of 0.222, implying that, on average, approximately 22.2% of carbon tax revenue was associated with the applicable revenue-recycling measure. Its values ranged from 0.054 to 0.455, with a standard deviation of 0.087, showing moderate variation across the observations.

Similarly, the share of emissions price (SEP) had a mean of 0.305, indicating an average emissions-pricing coverage of approximately 30.5%. The minimum value of 0.105, maximum value of 0.613, and standard deviation of 0.114 suggest meaningful differences in the proportion of emissions covered by carbon-pricing arrangements across the sampled countries and periods.

The control variables also display important characteristics. Firm size (FSIZ) recorded a mean of 21.208 and a standard deviation of 0.922, while its minimum and maximum values were 18.434 and 23.931, respectively. This indicates that the sampled manufacturing companies differed in size, although the relatively small standard deviation suggests that most observations were concentrated around the average firm size. Leverage (LEV) had a mean value of 0.550, showing that debt represented approximately 55% of the relevant financing or asset measure employed in the study. Its values ranged from 0.404 to 0.690, with a standard deviation of 0.050, indicating relatively limited variation in leverage among the sampled firms. Furthermore, the equal number of observations reported for all the variables suggests that the dataset used for the analysis contains no missing observations for the variables included in the estimated model.

Data Normality

Table 4 Normality Test

Variable	Obs	W	V	z	Prob>z
fv	3,384	0.991	17.117	7.359	0.000
crp	3,384	0.958	80.309	11.364	0.000
rrm	3,384	0.976	46.394	9.942	0.000
sep	3,384	0.973	51.420	10.209	0.000
fsiz	3,384	0.996	7.524	5.229	0.000
lev	3,384	0.994	10.871	6.182	0.000

Source: Author's Computation (2026)

One assumption of regression analysis is that the residuals are normally distributed. The null hypothesis states that the residuals follow a normal distribution, while a significant test result indicates non-normality. Given the study's 3,384 observations, the Jarque–Bera test is used to assess normality based on the skewness and kurtosis of the residuals.

Table 4 shows that all the study variables have probability values of 0.000, which are below the 5% significance level. Consequently, the null hypothesis of normal distribution is rejected, indicating that firm value, carbon tax pricing rate, revenue recycling mechanism, share of emissions price, firm size, and leverage are not normally distributed. However, the non-normality of the individual variables does not necessarily invalidate the regression analysis, particularly given the large sample of 3,384 observations. The large sample

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size reduces concerns about non-normality, although robust estimation techniques should be applied to address possible violations of the classical regression assumptions.

Data Analyses

To examine the effect of carbon taxation on the firm value of listed manufacturing companies in BRICS countries, the study first estimates a pooled ordinary least squares regression model. Thereafter, relevant diagnostic tests are conducted to determine whether the model satisfies the underlying regression assumptions, particularly the absence of multicollinearity and heteroscedasticity.

Before the regression analysis, the study applies Spearman's rank correlation to assess the direction and strength of the relationships among firm value, carbon tax pricing rate, revenue recycling mechanism, share of emissions price, firm size, and leverage. Spearman's correlation is considered appropriate because the normality test indicates that the study variables are not normally distributed. The results are presented in the table below.

Correlation Analysis

Table 5 Correlation analysis

Variables	-1	-2	-3	-4	-5	-6
(1) fv	1					
(2) crp	0.207	1				
(3) rrm	0.421	0.91	1			
(4) sep	0.371	0.957	0.982	1		
(5) fsiz	-0.08	0.308	0.201	0.256	1	
(6) lev	-0.333	0.145	0.02	0.068	0.326	1

Source: Author's Computation (2026)

In examining the association among the variables, we employed the Pearson Correlation Coefficient (correlation matrix), and the results are presented in the table below. Table 5 above shows that firm value has positive relationships with carbon tax pricing rate, revenue recycling mechanism, and share of emissions price.

The correlation coefficients of 0.207, 0.421, and 0.371, respectively, indicate weak to moderate positive associations. This suggests that increases in the carbon taxation measures are generally associated with higher firm value among the sampled listed manufacturing companies in BRICS countries.

Firm size has a weak negative relationship with firm value, with a coefficient of −0.080, while leverage has a moderate negative relationship with firm value, with a coefficient of −0.333. These results imply that larger firm size is only slightly associated with lower firm value, whereas greater reliance on debt financing is more strongly associated with reduced firm value.

However, the correlations among the carbon taxation variables are extremely high. Carbon tax pricing rate correlates with revenue recycling mechanism and share of emissions price at 0.910 and 0.957, respectively, while the correlation between revenue recycling mechanism and share of emissions price is 0.982. These values exceed the commonly accepted threshold of 0.80, indicating a serious possibility of multicollinearity. Consequently, a variance inflation factor test is conducted before estimating the regression model to determine whether the explanatory variables can be included simultaneously without distorting the regression coefficients.

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Regression Analyses

Table 6 Regression Result

	-1	-2	-3
VARIABLES	Pool OLS	FE	RE
crp	-0.2949***	0.0036	-0.1101***
	-0.009	-0.014	-0.011
rrm	-1.1877***	0.9068**	1.6476***
	-0.35	-0.366	-0.319
sep	9.1667***	0.1927	2.3586***
	-0.397	-0.366	-0.35
fsiz	-0.0349***	0.1633***	-0.0054
	-0.007	-0.051	-0.013
lev	-2.4509***	-3.6737***	-3.3345***
	-0.119	-0.193	-0.161
Constant	3.0380***	0.3399	3.4545***
	-0.139	-1.066	-0.276
Observations	3,384	3384	3,384
Year FE	Yes	Yes	Yes
p(F-Stat)	0	0	
R-Squared	0.491	0.396	0.382
Adj R-squared	0.491		
Mean VIF	4.59		
Breuch-Pagan	0		
Chow F-Test		0	
Hausman Test		0	
p(Chi2)			0
LM Test			0

Note: (1) bracket () are standard errors; (2) **, ***, implies statistical significance at 5% and 1% levels respectively

To examine the cause-and-effect relationship between carbon taxation and firm value and to test the formulated hypotheses, the study employs panel regression analysis because the data comprise firm-level observations across BRICS countries over the period 2016–2024. The pooled ordinary least squares and panel regression results are presented and discussed in the following subsections.

The results presented in Table 4 show the pooled ordinary least squares, fixed-effects, and random-effects regression estimates used to examine the effect of carbon taxation on the firm value of listed manufacturing companies in BRICS countries. The pooled OLS model produced an R-squared value of 0.491, indicating that carbon tax pricing rate, revenue recycling mechanism, share of emissions price, firm size, and leverage jointly explain approximately 49.1% of the variations in firm value.

The remaining 50.9% is attributable to other factors not included in the model and the stochastic error term. The probability value of the F-statistic is 0.000, showing that the pooled OLS model is jointly significant at the 1% level and is statistically suitable for inference. However, diagnostic tests for multicollinearity and heteroscedasticity were conducted to assess the reliability of the pooled OLS estimates.

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Multicollinearity Test

Multicollinearity was assessed using the variance inflation factor. The result in Table 6 shows a mean VIF of 4.59, which does not exceed the conventional threshold of 10. This indicates the absence of serious multicollinearity among the explanatory variables.

Heteroscedasticity Test

The Breusch–Pagan test was conducted to determine whether the variance of the regression error term was constant across the observations. The test produced a probability value of 0.000, which is below the 5% significance level. Therefore, the null hypothesis of homoscedasticity is rejected, indicating that the pooled OLS model is affected by heteroscedasticity.

This violation may result in unreliable standard errors and statistical significance tests. Accordingly, heteroscedasticity-robust or firm-clustered standard errors should be employed when interpreting the preferred panel regression model.

Panel Fixed and Random Effect Regression

The fixed-effects model produced an R-squared value of 0.396, indicating that the explanatory and control variables account for approximately 39.6% of the within-firm variations in firm value. The probability value of the F-statistic is 0.000, showing that the fixed-effects model is jointly significant at the 1% level. The random-effects model recorded an R-squared value of 0.382, implying that the variables included in the model explain approximately 38.2% of the variations in firm value. Its probability value of 0.000 also confirms that the random-effects model is jointly statistically significant.

The Chow test produced a probability value of 0.000, leading to the rejection of the null hypothesis that pooled OLS is more appropriate than the fixed-effects model. Similarly, the Lagrange Multiplier test recorded a probability value of 0.000, indicating that the random-effects model is preferable to pooled OLS. These results establish the presence of significant firm-specific effects and confirm that a panel regression model is more appropriate than the pooled OLS model for the study.

Hausman Specification Test

The Hausman specification test was conducted to select the more appropriate model between the fixed-effects and random-effects estimators. The null hypothesis states that the random-effects model is appropriate and consistent, while the alternative hypothesis supports the fixed-effects model. The Hausman test produced a probability value of 0.000, which is statistically significant at the 1% level.

The null hypothesis is therefore rejected, indicating that the fixed-effects model is preferred to the random-effects model. Consequently, the fixed-effects regression results should form the basis for testing the study's hypotheses, drawing conclusions, and making recommendations concerning the effect of carbon taxation on the firm value of listed manufacturing companies in BRICS countries.

Test of Hypotheses

Table 7 Summary of Hypotheses Testing

Hypothesis	Coefficient	z-Statistic	p-value	Decision
$H0_1$: Carbon tax pricing rate has no significant effect on the firm value of listed manufacturing companies in BRICS countries	0.0036	0.014	0	Accepted
$H0_2$: Revenue recycling mechanism has no significant effect on the firm value of listed manufacturing	0.9068	0.366	0	Rejected

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companies in BRICS countries				
$H0_3$: Share of emission price has no significant effect on the firm value of listed manufacturing companies in the BRICS countries	0.1927	0.366	0	Accepted

Source: Author's Computation (2026)

Following the selection of the fixed-effects regression model, the results of the model are used to test the hypotheses formulated for the study. The decision to accept or reject the null hypotheses was based on estimated probability value. Carbon tax pricing rate recorded a positive coefficient of 0.0036 with a standard error of 0.014. However, the result is not statistically significant. Therefore, the study fails to reject the null hypothesis that carbon tax pricing rate has no significant effect on the firm value of listed manufacturing companies in BRICS countries.

Revenue recycling mechanism recorded a positive coefficient of 0.9068 with a standard error of 0.366 and was statistically significant at the 5% level. Consequently, the null hypothesis is rejected. This indicates that the revenue recycling mechanism has a positive and significant effect on the firm value of listed manufacturing companies in BRICS countries. Share of emissions price recorded a positive coefficient of 0.1927 with a standard error of 0.366. The result is not statistically significant. Therefore, the study fails to reject the null hypothesis that share of emissions price has no significant effect on the firm value of listed manufacturing companies in BRICS countries. This implies that changes in the proportion of emissions covered by carbon pricing did not significantly affect the firm value of the sampled companies during the study period of 2016 to 2024.

DISCUSSION OF FINDINGS

This study provides empirical evidence on the effect of carbon taxation on the firm value of listed manufacturing companies in BRICS countries during the period 2016–2024. The findings demonstrate that the different dimensions of carbon taxation do not exert uniform effects on firm value. While the revenue recycling mechanism significantly enhances firm value, carbon tax pricing rate and share of emissions price have positive but statistically insignificant effects. This confirms the importance of disaggregating carbon taxation into distinct components rather than treating it as a single policy construct.

The finding on carbon tax pricing rate reveals a positive but insignificant effect on firm value, measured by Tobin's Q. This implies that changes in the statutory carbon tax rate did not produce a substantial change in the market value of the sampled manufacturing companies during the period under review. The result may be attributed to differences in carbon tax implementation, regulatory enforcement and industrial structures across the BRICS countries. It may also indicate that the applicable carbon tax rates have not reached the threshold required to induce significant green investment or market valuation effects. This finding is inconsistent with Khan and Ibrahim (2024), who reported that stringent carbon taxes increase equity risk premiums and reduce Tobin's Q. It also differs from Santos and Silva (2024) and Adedeji and Olayinka (2025), who found that carbon tax increases compress expected cash flows, expand operational liabilities and cause an immediate valuation discount. Park and Kim (2026) similarly established that high carbon tax rates restrict corporate liquidity by increasing operating costs. However, the insignificant result supports the argument that the effect of carbon taxation may depend on the stage of environmental transition and the strength of the regulatory signal, as predicted by the Environmental Kuznets Curve hypothesis.

The result relating to the revenue recycling mechanism shows a positive and significant effect on firm value. This implies that recycling carbon tax revenue through green subsidies, corporate tax reliefs, renewable-energy support and clean-technology financing enhances the market value of listed manufacturing companies. Revenue recycling reduces the net financial burden of carbon taxation, provides alternative funding for replacing carbon-intensive assets and lowers the risks associated with environmental compliance. This finding agrees with Al-Balushi and Taylor (2024), who found that targeted revenue-recycling channels provide alternative capital for replacing high-emission machinery. It is also consistent with Mendoza et al. (2025),

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who established that access to recycled funds reduces borrowing costs and operational risks in BRICS economies. Similarly, Zhou and Mwangi (2024) reported that recycling carbon tax revenue through subsidies and corporate tax reductions stabilises future earnings and preserves market-based valuations. The finding supports Institutional Theory because a transparent and supportive institutional framework reduces regulatory uncertainty, strengthens investor confidence and improves corporate legitimacy.

The share of emissions price has a positive but insignificant effect on firm value. This suggests that an increase in the proportion of emissions covered by carbon pricing does not independently produce a significant improvement in the market value of listed manufacturing companies. The positive direction may indicate that broader emissions coverage signals stronger environmental commitment and encourages firms to improve their production processes. Nevertheless, the insignificant effect suggests that emissions coverage alone may be insufficient to influence investors where firms can transfer carbon costs to customers, obtain regulatory concessions or delay technological adjustments. The finding is consistent with Asyifa and Burhany (2022), who reported that carbon-emission disclosure had no significant effect on firm value. However, it is inconsistent with Kumar and Das (2026), who found that firms unable to transfer emissions costs to consumers experience a contraction in Tobin's Q. It also differs from Zhang and Al-Malki (2025), Chen and Tanaka (2024), and Schmidt and Rossi (2024), whose findings showed that internalised carbon liabilities reduce returns, increase credit risk, weaken competitiveness and expose firms to regulatory penalties.

Finally, the joint significance of the fixed-effects model indicates that carbon tax pricing rate, revenue recycling mechanism and share of emissions price, together with the control variables, collectively influence the firm value of listed manufacturing companies in BRICS countries. The findings generally demonstrate that the effect of carbon taxation depends not only on the tax imposed or the proportion of emissions covered but also on how the revenue generated is subsequently applied. Therefore, a carbon taxation system supported by transparent revenue recycling is more likely to enhance corporate market value than one that merely imposes additional compliance costs on manufacturing companies.

CONCLUSION AND RECOMMENDATION

This study examined the effect of carbon taxation on the firm value of listed manufacturing companies in BRICS countries over the period 2016–2024. Carbon taxation was measured using carbon tax pricing rate, revenue recycling mechanism and share of emissions price, while firm value was measured using Tobin's Q. Firm size and leverage were included as control variables. The study adopted quantitative ex-post facto and longitudinal panel research design and employed pooled ordinary least squares, fixed-effects and random-effects regression techniques. Based on the Hausman specification test, the fixed-effects model was selected as the appropriate model for testing the hypotheses. Findings revealed that carbon tax pricing rate and share of emissions price recorded a positive coefficient of 0.0036 and 0.1927 respectively but had no significant effect on the firm value of listed manufacturing companies in BRICS countries. However, revenue recycling mechanism recorded a positive coefficient of 0.9068 and had a significant effect on the firm value of listed manufacturing companies in BRICS countries. The study concludes that carbon taxation can influence firm value more effectively when carbon tax revenue is transparently and productively returned to the private sector rather than being treated solely as an additional fiscal burden on manufacturing companies.

The study recommends that governments and environmental regulatory authorities in BRICS countries should ensure that carbon tax pricing rates are predictable, gradual and aligned with the technological and financial capacities of manufacturing companies. Sudden or excessive increases in carbon tax rates should be avoided because they may increase operating costs without generating a corresponding improvement in firm value. Governments should strengthen revenue recycling mechanisms by dedicating a substantial proportion of carbon tax revenue to green subsidies, renewable-energy infrastructure, clean-technology financing and corporate tax relief for compliant manufacturing companies. The significant positive effect of revenue recycling indicates that this approach can reduce transition costs and improve market valuation. Policymakers should complement broader emissions-pricing coverage with practical incentives that enable manufacturing firms to adopt energy-efficient machinery and cleaner production technologies. Expanding the share of

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emissions covered by carbon pricing without providing technological and financial support may not significantly improve firm value. Also, management of listed manufacturing companies should incorporate carbon taxation into long-term investment, financing and risk-management decisions. Firms should utilise available green subsidies and recycled carbon-tax funds to replace carbon-intensive assets, improve energy efficiency and strengthen their environmental credibility.

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