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CARBON CREDITS AS FINANCIAL INSTRUMENTS: IMPLICATIONS FOR INVESTMENT DECISIONS

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ABSTRACT

Carbon pricing has emerged as one of the most viable policy instruments to cut GHG emissions and meet global climate goals. Carbon tax and cap-and-trade systems are the two most used pricing mechanisms among various pricing instruments. This article conducts an in-depth comparative analysis of the different models by assessing their performance along key dimensions: emission reduction performance, cost efficiency, administrative feasibility, innovation incentives, revenue use, and sectoral coverage. The study leverages a review of global case studies, policy reports, and empirical research to appraise the strengths of each instrument. It seems clear that carbon taxes guarantee price certainty, administrative simplicity, and predictable revenue streams, while cap-and-trade systems provide certainty in emissions, market flexibility, and cost-effective compliance options. While they have their respective merits, there is a shocking lack of integrated comparative frameworks and evidence from developing and coal-dependent countries in the literature. This paper fills these knowledge gaps by synthesizing multi-disciplinary insights and identifying contextual conditions when each of these mechanisms performs best. From this rationale, it is observed that no single instrument works as universally better but, instead, depends on economic structure, regulation capacity, and political acceptance. The paper finds that a hybrid carbon pricing approach-a combination of the stability that carbon taxes provide with the flexibility of cap-and-trade-offers the most balanced solution for countries pursuing long-term decarbonization.

KEYWORDS

1. *Carbon pricing*
2. *Carbon tax*
3. *Cap-and-trade*
4. *Emission reduction*
5. *Climate policy*
6. *Environmental economics*

JEL Classification Codes

- ***Q54-*** *Climate; Natural Disaster and their Management; Global Warming*
- ***Q58-*** *Government Policy; Regulatory Policy*
- ***H23-*** *Externalities; Redistributive Effects; Environmental Taxes and Subsidies*
- ***Q52-*** *Pollution Control Adoption and Costs; Distributional Effects;*
- ***Q48-*** *Energy; Government Policy*

INTRODUCTION

Climate change has established itself as one of the main global challenges that urge governments, international institutions, and industries to take up effective mechanisms or schemes liable for GHG emissions reduction. Among many policy tools, carbon pricing has emerged as a leading strategy owing to its capability of making economic incentives tally with environmental objectives by placing a price on carbon emissions. Two key carbon pricing models prevail in contemporary climate policy debates: the carbon tax and cap-and-trade systems. Though both aim to bring about emission reductions efficiently, they differ significantly in design, implementation, and market functioning, and in the ensuing economic outcomes.

Where a carbon tax fixes one price per unit of carbon emitted and thus provides cost certainty and administrative simplicity, cap-and-trade sets an allowable limit-a cap-on emissions and allows trading between entities to achieve it, and thus it is flexible, has the potential for cost-effectiveness, and achieves emission targets. In fact, the various

models have been adopted by countries or regions like Sweden, Canada, the European Union, and California with results very different from each other, based on local policy contexts, economic structure, and political environment.

Despite the considerable volume of carbon pricing research, there has been a comparative analysis of strengths and limitations in respect to real-world performance regarding both carbon tax and cap-and-trade schemes. Many existing studies focus on one or another model or region-specific outcomes, leaving gaps in knowledge regarding how these instruments match up with each other in terms of economic efficiency, environmental effectiveness, generation of revenue, and political feasibility.

This paper, therefore, tries to fill this gap by systematically comparing carbon tax and cap-and-trade models. The article points out the variabilities in policy design, behavioral responses, market dynamics, and overall impact on emission reduction through a literature review and case examples.

REVIEW OF LITERATURE

1. *Lawrence H. Goulder August (2013) We examine the relative attractions of a carbon tax, a "pure" cap-and-trade system, and a "hybrid" option (a cap-and-trade system with a price ceiling and/or price floor). We show that the various options are equivalent along more dimensions than often are recognized. In addition, we bring out important dimensions along which the approaches have very different impacts. Several of these dimensions have received little attention in prior literature.*

2. *Shourya Dewangan June (2025) This study compares the effectiveness of carbon taxes and cap-and-trade systems in reducing greenhouse gas emissions. Using qualitative analysis and international case studies, it evaluates each mechanism's impact on cost-efficiency, innovation, revenue generation, and* policy adaptability. Findings suggest that carbon taxes offer price certa*inty and simplicity, while cap-and-trade ensures emissions limits and industry flexibility. The research concludes that a hybrid approach combining both tools provide the most effective and balanced strategy for climate policy.*

3. *You-hua Chen March (2020) Both carbon tax and cap-and-trade systems are widely applied to reduce emission. This article compares the clean innovation effects of carbon tax with cap-and-trade systems by a static optimal model. Firstly, both cap-and-trade system and carbon tax stimulates clean innovation and reduce emission. Secondly, cap-and-trade system is more efficient to reduce emission and to promote clean innovation than carbon tax. Finally, firms undertake a loss under carbon tax, while the effects of cap-and-trade system on firms' profits are uncertain, which depends on the carbon cap. In summary, this article supports cap-and-trade system to cope with global climate change, but the regulator should choose the suitable emission cap and carbon trading price to guarantee the efficiency of cap- and-trade system. So, different purposes match with different carbon emission tax policies*

4. *C We investigate the current use of public revenues which are generated through both carbon taxes and cap-and-trade systems. More than $28.3 billion in government "carbon revenues" are currently collected each year in 40 countries and another 16 states or provinces around the world. Of those revenues, 27% ($7.8 billion) are used to subsidize "green" spending in energy efficiency or renewable energy; 26% ($7.4 billion) go toward state general funds; and 36% ($10.1 billion) are returned to corporate or individual taxpayers through paired tax cuts or direct rebates. Cap-and-trade systems ($6.57 billion in total public revenue) earmark a larger share of revenues for "green" spending (70%), while carbon tax systems ($21.7 billion) more commonly refund revenues or otherwise direct them towards government general funds (72% of revenues). Drawing from an empirical dataset, we also identify various trends in systems' use of "carbon revenues" in terms of the total revenues collected annually per capita in each jurisdiction and offer commensurate qualitative observations on carbon policy design choices.*

5. *Juris Justitio Hakim Putra July (2021) Due to the high utilization of carbon results to environmental problems in most provinces in Indonesia, it can be concluded that Indonesia in urgently requires mechanism to solve environmental issues. Many attempts have been conducted by Government of Indonesia to solve the issues such as ratification of Kyoto Protocol and Paris Agreement, further the proposal on Nusantara Carbon Scheme (Skema Karbon Nusantara abbreviated as "SKN"). Unfortunately, the proposal has not adopted yet up to 2021. Calculating based on current situation, Indonesia's greenhouse gas emissions are predicted to increase to 1.573 and 1.751 MtCO2e in 2030, which contrary to the commitment under Nationally Determined Contribution (NDC). There are several options of mechanism to be adopted, the most popular mechanism that deems highly effective are cap and trade as*

well as carbon tax. Many mechanisms adopted in different countries, it is important to assess which mechanism is more effective to be applied in Indonesia.

6. *Irina Taranova Dec (2024) Carbon taxes and trading schemes are pivotal instruments in the fight against climate change, aimed at reducing CO2 emissions by providing economic incentives for emission reductions. This paper examines the effectiveness of these mechanisms in various contexts, analyzing their design, implementation, and outcomes across different regions and industries. Carbon taxes impose a direct cost on carbon emissions, encouraging businesses and consumers to reduce their carbon footprint, while cap-and-trade systems set a limit on total emissions and allow for the trading of emission permits. The analysis highlights the strengths and weaknesses of each approach, including their economic impacts, environmental effectiveness, and equity considerations.*

7. *CORSO DI LAUREA June (2020) We hear the term climate change everywhere, we watch documentaries, we constantly talk about it, and join climate movements worldwide. The problem is that we talk about it without a deep understanding of the issue. I hope to make this topic accessible to everyone with the plain language of a youngster that still has much to learn. The dissertation is divided into three chapters. Chapter 1 provides data about the science behind climate change analyzing the relationship between the emissions of carbon dioxide and the increase in global average temperature with a focus on the tipping points and the effects on human health. Chapter 2 analyzes the main strategies to fight climate change. The last chapter starts a comparison between a price and a quantity regulatory approach to reduce the emissions of pollutants. Through the analysis of the relevant literature, I'll provide evidence on the superiority of a price regulatory approach to limit the temperature rise.*

8. *SAMUEL DRAPEAU Octomber 2025 Carbon pricing has become a central pillar of modern climate policy, with carbon taxes and emissions trading systems (ETS) serving as the two dominant approaches. Although economic theory suggests these instruments are equivalent under idealized assumptions, their performance diverges in practice due to real-world market imperfections. A particularly less explored dimension of this divergence concerns the role of financial intermediaries in emissions trading markets. This paper develops a unified framework to compare the economic and environmental performance of tax- and market-based schemes, explicitly incorporating the involvement of financial intermediaries. By calibrating both instruments to deliver identical aggregate emission reduction targets, we assess their economic performance across alternative market structures.*

9. *ROBERT M. ANDERSON March (2025) We propose two general equilibrium models, quota equilibrium, and emission tax equilibrium. Government specifies quotas or taxes on emissions, and then refrains from further action. All results remain valid regardless of how government chooses its emissions target. Quota equilibrium exists; the allocation of emission property rights impacts the distribution of welfare. If the only externality arises from total net emissions, quota equilibrium is Pareto optimal among all feasible outcomes with the same total net emissions. For certain tax rates, emission tax equilibrium may not exist. Every quota equilibrium can be realized as an emission tax equilibrium and vice versa. However, different quota prices may arise in equilibrium from a single quota, and different emission levels may arise in equilibrium from a single tax rate. This leads to inequivalence between quota and emission tax equilibria.*

10. *Saptorshee Kanto Chakraborty April (2020) Carbon taxation has been suggested among the market based policies to tackle climate change since the early 90's, often associated to ecological tax reforms rationales. Before the advent of emission trading in the EU, some countries introduced forms of carbon taxation, which is still used to deal with non EU ETS sectors. Due to this historical evolution of environmental policies over the last decades, in presence of a 'federal system' that assigns to EU countries the governance of energy and fiscal issues, an heterogeneous set of country driven carbon/energy policy settings is present, which can determine effects on growth and trade. We investigate the possible existence of asymmetries among the European Carbon area countries reaction to the policy adoption responsible to combat climate change via carbon usage reduction.*

11. *Jing Shen August (2022) To solve the environmental problems caused by climate change, the Paris Agreement urges China to accelerate the pace of CO_2 emission reduction. Carbon trading and carbon tax have been considered the key instruments in reducing CO_2 emissions. The focus of this article is not only to examine the impact of carbon trading and the carbon tax policy on China's macroeconomy but also to study the "carbon trading–carbon tax" mixed policy and make a comparative analysis based on the computable general equilibrium (CGE) model. We found that the mixed policy is more favorable to*

China's macroeconomy than a single carbon emission reduction policy and is conducive to improving people's welfare. If a carbon tax is carried out, a relatively mild and low carbon tax rate should be adopted to achieve China's carbon emission reduction goal and have a favorable impact on the macroeconomy. The main purpose of this article is to provide a theoretical basis and policy advices for the Chinese government in formulating innovative carbon reduction policies.

12. *Wanli Ma (2023) Under the Paris Agreement's goal of limiting global warming to 1.5 degrees by 2100, nations are taking steps to reduce carbon emissions. Carbon pricing is a popular policy instrument to mitigate carbon emissions. This paper presents a comparative analysis of carbon pricing policies in China and Scandinavian countries (Norway, Denmark, and Sweden), focusing on their impacts on the transportation, industrial, and building sectors. The study highlights that both regions have successfully implemented carbon pricing policies, combining carbon taxes with emissions trading systems, resulting in significant emissions reductions and decoupling of economic growth from greenhouse gas emissions. In the transportation sector, carbon pricing policies have driven the adoption of electric vehicles and cleaner fuels. In the industrial sector, these policies have led to investments in energy efficiency, fuel switching, and low-carbon technologies. In the building sector, carbon pricing has encouraged energy efficiency improvements and the adoption of low-carbon heating technologies. The paper underscores the importance of integrating carbon pricing policies with other energy and environmental policies, fostering public engagement, and designing robust monitoring, reporting, and verification systems to ensure their effectiveness in promoting low-carbon development.*

13. *Goran Dominioni May (2022) 'Green recovery' is one of the key themes of the stimulus packages implemented around the world in response to the Covid-19-related economic downturn. Recent research points to the potential role of regulation that becomes less stringent during recessions (ie countercyclical regulation) as an instrument to stimulate a quicker recovery. When this argument is put in the context of a green recovery, two key questions arise: should we implement countercyclical environmental regulation? If yes, what environmental instruments are better suited to stimulate the economy in periods of economic downturn? This article addresses these questions by discussing the risks of countercyclical environmental regulation and comparing the countercyclical effects of two critical environmental instruments: carbon taxes and cap-and-trade. The article argues that policymakers should be cautious in implementing countercyclical environmental regulation because the benefits of this practice are uncertain and it entails various risks.*

14. *Isabelle Dao August (2024) This study provides an introduction to carbon pricing mechanisms through microand macro-based empirical analysis. The first part provides an overview of existing market-based regulations, comparing instruments in terms of emissions coverage, price structures, and revenue generation. The statistics show that the implementation of regulations follows a positive trend worldwide but remains far below the level required to initiate the transition to carbon neutrality. The heterogeneity of carbon prices and coverage underscores the need to increase the stringency of these policies. In the second part, we examine firm-level carbon pricing data from the Carbon Disclosure Project (CDP) database. Most companies have less than 10% or more than 90% of their Scope 1 emissions covered by regulation. Among respondents, 27% are subject to an external carbon price, 26% have an internal carbon price (ICP), and only 13% use both, suggesting that companies generally do not fully internalize carbon costs. Adjusting for survival and universe biases, we find that ICP adoption has been limited in recent years. Many companies committing to future adoption are not taking action, raising concerns about greenwashing.*

15. *Simon Black July (2022) Carbon pricing should be a central element of climate mitigation strategies, helping countries rapidly transition to "net zero" greenhouse gas emissions. Policymakers considering carbon pricing face choices between carbon taxes and emissions trading systems (ETSs) and in their design. This includes administration, price levels, emissions coverage, relation to other mitigation instruments, use of revenues to address efficiency and distributional objectives, supporting measures to address competitiveness concerns, political economy aspects, and coordination at the global level. This paper discusses these issues, providing guidance on the choice between carbon taxes and ETSs and their design. Overall, carbon taxes have significant practical, environmental, and economic advantages (especially for developing countries) due to ease of administration, price certainty which promotes investment, the potential to raise significant revenues, and coverage of broader emissions sources. However, ETSs provide more certainty over emissions levels, can be implemented by environment*

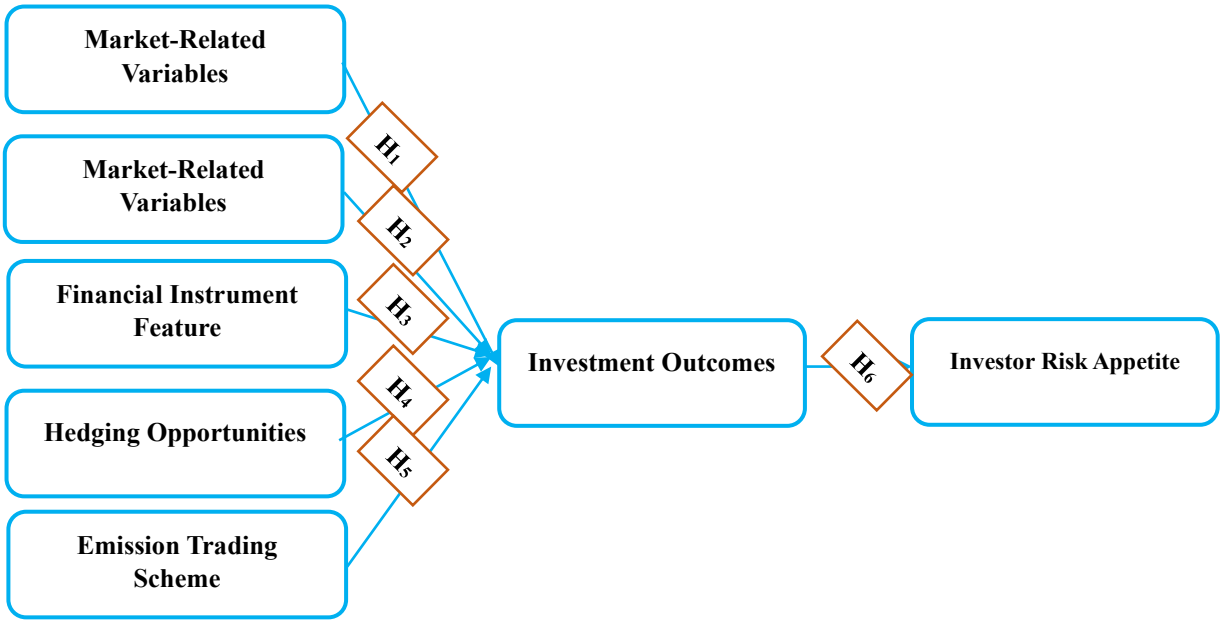
ministries, and some free permit allocations might garner political support from affected firms (at a fiscal cost).

16. *Wahri Sunanda (2025) The Indonesian power sector is predominantly dependent on coal and vital to the net-zero emissions (NZE) goals of the country. Therefore, this study examined the efficiency of carbon tax and trading mechanisms in mitigating CO_2 emissions. This assessment employed the Integrated MARKAL-EFOM System (TIMES) model to explore three carbon tax scenarios [USD 2/tCO_2 (CT-2), USD 63/tCO_2 (CT-63), and USD 127/tCO_2 (CT-127)] and two emissions trading schemes (conditional and unconditional caps) following the Indonesian Enhanced Nationally Determined Contribution (ENDC).*

17. *Jeremy Carl SEPTEMBER (2016) We investigate the current use of public revenues which are generated through both carbon taxes and cap-and-trade systems. More than $28.3 billion in government "carbon revenues" are currently collected each year in 40 countries and another 16 states or provinces around the world. Of those revenues, 27% ($7.8 billion) are used to subsidize "green" spending in energy efficiency or renewable energy; 26% ($7.4 billion) go toward state general funds; and 36% ($10.1 billion) are returned to corporate or individual taxpayers through paired tax cuts or direct rebates. Cap-and-trade systems ($6.57 billion in total public revenue) earmark a larger share of revenues for "green" spending (70%), while carbon tax systems ($21.7 billion) more commonly refund revenues or otherwise direct them towards government general funds (72% of revenues). Drawing from an empirical dataset.*

RESEARCH METHODOLOGY

- **Conceptual Model**



Statement of the Problem

The absence of holistic analyses that connect carbon pricing mechanisms and carbon credit market trends and investment choice-making embodies a pressing research void. In the absence of any concrete comprehension about carbon tax and cap-and-trade system influences on carbon credit financial assets, policymakers are vulnerable to designing inefficient pricing tools for carbon credits, and investment parties are prone to increasing risks associated with risk-return trade-offs. This paper aims to meet the pressing knowledge gap by making analyses on carbon tax and cap-and-trade systems and identifying the implications of carbon credit financial assets on investment-making for carbon credits.

Research Gap

- There appears to be a lack of empirical and theoretical studies that examine challenges linked with either carbon tax or cap and trade from an institutional perspective.
- There is no robust cross-country/cross-context analysis available for emerging nations with comparable economic/institutional characteristics.

- Uncertainty about how hybrid systems compare in performance with carbon tax systems and cap-and-trade systems.
- There has been a lack of exploration of both short-term and long-term risks of price/emissions under each mechanism.
- There seems to be a lack of analysis of political economy issues in the carbon tax and cap and trade debate.

Objectives of the Study

- To investigate the role of carbon pricing mechanisms (Carbon Tax and Cap-and-Trade System) in the generation, valuation, and trading of carbon credits. Comparing the two models concerning their environmental effectiveness in reducing the emission of greenhouse gases.
- Investigating the effect of carbon price signals on financial results and stock market value of carbon credits.
- To explore the relationship between carbon price volatility and investment risks associated with carbon credits.
- To analyze the effectiveness of carbon pricing in enhancing the market liquidity and financial attractiveness of carbon credits.

Hypothesis of the Study

- **Hypothesis(H1)**
  Carbon credits have a positive effect on sustainable and ESG-focused funds if there are strong and stable carbon prices.
- **Hypothesis(H2)**
  The carbon price signal has a highly positive effect on the financial performance of carbon credits, making them more attractive as investment tools.
- **Hypothesis(H3)**
  Liquidity enhancements and transparency of prices for carbon credits have a positive impact on investment choices and diversification of portfolios.
- **Hypothesis(H4)**
  Increased volatility of carbon prices has a negative effect on investor confidence and risk-adjusted returns from investing in carbon credits.
- **Hypothesis(H5)**
  Well-designed carbon pricing systems lead to improved market liquidity in carbon credits, thus enhancing the use of carbon credits as financial instruments.

Financial instruments of carbon credit

- Spot Carbon Credits
- Carbon Credit Futures
- Carbon Credit Options
- Carbon Swaps
- Carbon Exchange-traded Funds (ETFs)

RESULT & DISCUSSION

The results of the study reveal that carbon pricing mechanisms play a decisive role in shaping carbon credits as financial instruments and influencing investment decisions. Cap-and-trade systems directly generate tradable carbon credits, leading to better price discovery, higher market liquidity, and increased participation by financial intermediaries, whereas carbon tax systems influence carbon credit markets indirectly by increasing the cost of emissions and encouraging offset purchases. While cap-and-trade mechanisms provide certainty in emission reductions and promote market-based efficiency, carbon taxes offer price certainty, administrative simplicity, and predictable revenue streams. The findings suggest that neither mechanism is universally superior; instead, their effectiveness depends on institutional capacity, economic structure, and policy design.

The study further demonstrates that carbon price stability positively influences ESG-focused and sustainable investment funds, while excessive price volatility undermines investor confidence and reduces risk-adjusted returns from carbon credit investments. Enhanced market liquidity and transparency significantly improve the financial attractiveness of carbon credits by supporting diversification benefits and informed investment decision-making. Overall, the results confirm that carbon credits increasingly function as alternative financial assets, but their investment viability is highly sensitive to regulatory certainty and market design. The analysis concludes

that hybrid carbon pricing frameworks, combining the stability of carbon taxes with the flexibility and emissions certainty of cap-and-trade systems, offer the most balanced approach for achieving environmental objectives while supporting efficient carbon credit markets and long-term investment stability.

CONCLUSION

Carbon credits are no longer traditional instruments of compliance but are now developing into significant financial assets that are finding increased prominence in investment decisions. The study makes it clear that the value of carbon credits is ultimately dependent on the price of carbon. A stable price of carbon will increase investor interest and bring sustainable investment funds to the table, which will ensure that carbon credits are firmly established in the global markets.

The results also show that while carbon taxes offer certainty of price, as well as administrative ease, cap-and-trade systems encourage flexibility, certainty regarding emissions, as well as an active carbon credit market. Yet again, no system or approach is completely superior or optimal. Volatility in carbon prices can severely impact returns as well as infrastructure investment, emphasizing the need for sound policy formulation. Thus, for an optimal approach to carbon credit pricing, there should ideally be a combination or convergence of both carbon taxes, as well as cap-and-trade systems, to create a hybrid system for maximum potency as well as effectiveness. Market liquidity as well as financial innovation can then be greatly encouraged, with carbon credit instruments becoming highly effective as financial instruments.

FURTHER RESEARCH

Future areas of research could develop from this work and include the use of real-world data from the world of carbon compliance and voluntary carbon markets. This work could evaluate the risk/return profile of carbon credits for investment purposes compared with conventional financial securities. The scope for country-level and cross-national analysis is extensive for new work related to the developing world and transitioning economies heavily reliant on coal. In this work, researchers could evaluate the impact of institutional factors, the ability of regulation and politics, and the effectiveness of carbon pricing frameworks. The future work could include further investigation related to the influence of carbon-related derivatives and the efficiency of carbon-related financial innovations for carbon credits. The influence of the financial sector on carbon price volatility could also be explored. Another area of work for further research includes the integration of finance and sustainability aspects related to carbon credits.

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