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CORRECTIVE ACTIONS AND PROPERTY RIGHTS IN THE EU EMISSIONS TRADING SYSTEM: A PIGOUVIAN AND COASIAN APPROACH

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Abstract

This article critically examines the European Union Emissions Trading System (EU ETS) and explores how Pigouvian and Coasian approaches influence and constrain its design. While the EU ETS incorporates both corrective measures for environmental externalities (Pigouvian logic) and negotiated allowance exchanges (Coasian logic), its operation is mainly shaped by regulatory decisions on allowance allocation, ongoing adjustments, and interactions with other legal instruments. Therefore, the article argues that the EU ETS cannot be fully understood through classical theoretical models alone; rather, its logic arises from the legal-institutional and governance framework that guides its real-world implementation.

Keywords

European Union Emissions Trading System; Arthur Cecil Pigou; Ronald Coase; Property rights; Externalities

1. Introduction

In a context marked by regulatory imbalances and increasing links between trade and environmental protection, states and international organisations now rely more on market-based environmental measures. These complement efforts to reduce greenhouse gas (GHG) emissions. Within this framework, the European Union Emissions Trading System (EU ETS) stands out as a tool to encourage economic agents to internalise environmental costs resulting from their productive activities.

Established by Directive 2003/87, the EU ETS is a cap-and-trade system designed to limit GHG emissions by economic agents. It sets a quantitative emissions cap and converts this cap into tradable allowances, establishing a carbon price. This price reflects, albeit indirectly, the social costs of emissions in the decisions of regulated operators. Emissions thus become part of the cost structure of economic activities, encouraging agents to internalise the environmental impacts of atmospheric pollution when making technological and productive choices.

The issue of internalising GHG emission costs relates to the traditional debate on externalities and market failures. Different theoretical approaches propose various normative and institutional solutions. In this debate, Arthur Cecil Pigou's perspective is notable: he contends that the social costs of polluting

activities are not reflected in market prices, justifying government intervention through corrective measures. Conversely, Ronald Coase focuses on institutional design, emphasising the importance of defining and allocating property rights and analysing how transaction costs affect the internalisation of damages. Considering these viewpoints, the EU ETS offers a pertinent example for analysing how different ideas of externalities and the internalisation of social costs are implemented in a specific carbon-pricing regulation.

From this perspective, carbon pricing in climate policy continues to provoke debate on how to address the social costs of GHG emissions. In this context, the Pigou and Coase frameworks provide tools for understanding how to internalise these costs and the role of institutions in correcting market failures. Analysing the EU ETS places the system within a broader theoretical context, emphasising how its regulatory scope interacts, if not explicitly, with these economic traditions. By exploring these connections, this study offers a critical theoretical perspective on the EU ETS's foundations and examines its limitations and potential as a legal-economic instrument for regulating emissions.

The proposed study recognises that, although the EU ETS is often seen as a tool for internalising the costs of greenhouse gas emissions, its institutional design involves regulatory choices that do not fully conform to traditional theories of externalities. These choices include combining market mechanisms with state intervention, setting the emissions cap centrally, and allocating allowances in a differentiated manner, including free allocations. Such elements raise questions about the relationship between private and social costs and the effectiveness of negotiation among agents in high transaction cost environments. By analysing the EU ETS through the lenses of Pigou and Coase, the study aims to identify areas of conceptual agreement with these traditions and to highlight where the European system diverges, thus demonstrating the inherent limitations and adaptations involved in regulating emissions within a complex legal, economic, and political framework.

In light of the previous highlights, this study aims to address the following question: How can the European Union Emissions Trading System be understood, from Pigouvian and Coasian perspectives, as a tool for internalising the social costs of greenhouse gas (GHG) emissions? The study examines the EU ETS through classical externality theories to illustrate how its design incorporates social costs from activities related to GHG emissions. First, it explores the theoretical foundations of social costs and the correction of externalities, as outlined by Pigou and Coase. Then, it analyses the functioning of the EU ETS within this framework, evaluating how its design facilitates and constrains the internalisation of social costs from GHG emissions.

Methodologically, the article employs a qualitative, descriptive-analytical approach based on bibliographic and documentary research. The analysis first reconstructs Pigou’s and Coase’s classical theories on externalities and the internalisation of social costs. Then, the study examines the European Union Emissions Trading System to demonstrate how its institutional design relates, in a non-literal sense, to these theories. The analysis adopts a theoretical-normative perspective, focusing on the relationship between economic and legal dimensions. It does not empirically evaluate environmental or economic effectiveness but instead explains the conceptual foundations shaping its regulatory structure.

2. Internalising Social Costs from the Perspectives of Pigou and Coase

Climate change is a global issue. It manifests as rising sea levels, droughts, heavy rainfall, desertification, and higher average temperatures (SILVA, 2025). Mainly caused by GHG emissions, these changes seriously affect society. Impacts include damage to agriculture and related sectors, more frequent extreme weather events such as floods, species extinction, and increased risks to human health.

These effects create social costs, primarily from firms' polluting activities during production. These costs are transferred to society without appearing in final prices. Pigou and Coase suggest different solutions: negative externalities for Pigou, and ill-defined property rights for Coase. This chapter briefly highlights the main points of each, without a detailed analysis of their theories.

2.1 State Intervention as a Corrective Mechanism

In environmental protection, state intervention plays a vital role in correcting distortions caused by economic activities whose costs are not properly accounted for in the market. When the market cannot incorporate these externalities through the price system, Pigou considers this to be market failure. This situation requires analysing the criteria that influence a firm's production decisions and determining the socially optimal level of production and emissions (PIGOU, 1932).

In this context, a firm's production decision is guided by the private marginal net product (PMNP), which only considers benefits and costs directly appropriated by the economic agent. Consequently, the firm tends to expand its activities until the PMNP equals the internal cost of production, overlooking negative impacts on third parties, such as pollution. Conversely, the social marginal net product (SMNP) incorporates, alongside private costs and benefits, the external effects of production, reflecting the total cost to society. As shown in the table below, the socially optimal level of production — the level that maximises economic welfare by accounting for all social costs and benefits — is reached when the SMNP equals the corresponding social cost (PIGOU, 1932).

Table A1 – Private Marginal Net Product (PMNP) versus Social Marginal Net Product (SMNP)

Element	Firm Perspective (Private)	Social Perspective
Decision criterion	Private Marginal Net Product (PMNP)	Social Marginal Net Product (SMNP)
Costs considered	Production costs (raw materials, energy, labor, and others)	Private costs plus external costs imposed on society
Treatment of pollution	Ignored in production decisions	Incorporated as social damage
Decision outcome	Expansion of production up to the point of private benefit maximization	Determination of the socially optimal level of production and emissions
Identified problem	Divergence between private and social costs	Negative externality
Theoretical interpretation	Normal market functioning for the individual agent	Market failure (social costs not reflected in the final price of the good)
Corrective instrument	Absent in a pure market	Pigouvian tax – state intervention
Role of the tax	—	Internalize external costs by adjusting the cost perceived by the firm
Effect of the tax	Changes the firm's economic calculation	Aligns private incentives with social welfare
Expected outcome	—	Convergence between private decision and socially optimal level

Source: Own elaboration based on Arthur Cecil Pigou, *The Economics of Welfare* (1932), 4th edition.

Therefore, in The Economics of Welfare, Pigou identifies the divergence between private and social marginal net products as a market failure that may justify government intervention. Although the author does not formalise a corrective taxation model, he recognises that fiscal and regulatory tools can be employed to align private decisions with social welfare. In this context, as noted by Rabbani (2017), a firm tends to base its production decisions solely on the benefits and costs it internalises, expanding its activity until the private marginal benefit equals the private marginal cost, regardless of the environmental damage caused by pollution related to the production process. Correcting this divergence, therefore, involves including external costs in the firm's economic calculations, so that production decisions consider not only private interests but also the social costs borne by society.

Although this understanding was established in the first half of the twentieth century, it still guides governments in using environmental taxes as tools to reduce environmental impacts. In this regard, it is important to note that such taxes go beyond mere revenue generation; they also aim to encourage firms to adopt more sustainable practices and consumers to choose fewer polluting products. In this way, fiscal policy acts as a mechanism for promoting behavioural change, helping to lessen pressure on ecosystems (MANTA et al., 2023).

According to Storrosten (2020), the effectiveness of a Pigouvian emissions tax relies not only on the proper internalisation of environmental harm but also on the intertemporal factors influencing firms' decisions. When the private discount rate aligns with the social discount rate, the emissions tax is adequate to prompt a socially optimal adjustment path. However, if firms assign less importance to the future, that is, to forecasting future scenarios, the adjustment of productive capacity tends to be too slow. In such

cases, the author contends that additional measures, such as investment taxes or subsidies, become necessary to attain a temporally efficient trajectory, making it acceptable to implement temporary emission taxes set above the social marginal damage to speed up technological transition when firms have a high intertemporal discount rate (STORROSTEN, 2020).

In practice, this perspective shows that internalising externalities associated with greenhouse gas emissions extends beyond merely setting a price that reflects social marginal damage, particularly in sectors with high carbon intensity and long-term investment considerations. When firms undervalue the future, relying solely on carbon pricing may not be enough to promote the prompt replacement of GHG-intensive technologies with cleaner options. In such circumstances, a temporary rise in emission costs can speed up the productive transition, encourage faster decarbonisation decisions, and decrease the future emissions stock.

This approach thereby facilitates operationalisation through taxes imposed above the strict Pigouvian level and combined with subsidies to encourage investment in low-carbon technologies. It, therefore, represents a modern application of Pigouvian principles, tailored to the intertemporal specifics of GHG emission mitigation and the need for a more effective alignment of private incentives with collective climate policy objectives. However, this view is not confined to environmental taxation alone and can be realised through alternative regulatory mechanisms that assign economic value to GHG emissions and influence firms' behaviour based on this cost signal.

The same economic principle is clear in regulatory tools that do not involve taxes, such as the European Union Emissions Trading System, which aims to encourage the internalisation of GHG emissions. In a hypothetical scenario of carbon-intensive industrial production, like a steel plant located in a European Union Member State, a company tends to base its production decisions mainly on private costs, often ignoring the environmental harm caused by the emissions. State intervention in this case occurs through the EU ETS, which imposes an economic cost on emissions and requires firms to consider this in their decision-making, thus aligning private actions with the social costs faced by society.

By emphasising the divergence between private and social costs associated with greenhouse gas emissions, the Pigouvian approach offers a classical framework for understanding market failure caused by environmental externalities and for justifying government intervention to address these distortions. Within the context of the European Union, this rationale supports employing regulatory instruments to internalise environmental costs both domestically and internationally, aiming to align private economic incentives with collective welfare goals. Nevertheless, while its analytical importance is clear, this approach does not fully encompass the economic-legal debate regarding the efficient allocation of social costs, which permits alternative interpretations about how such costs can be managed within economic relations.

2.1 Social Cost as an Issue in Property Rights Definition

Unlike the Pigouvian perspective, Ronald Coase in his "The Problem of Social Cost" (1960) offers a reinterpretation of the social cost issue by arguing that the damages from certain economic activities are reciprocal, since both the agent causing harm and the recipient are part of the relationship that creates the conflict. In this view, social costs do not primarily stem from an externality in the traditional sense but from unclear or poorly assigned property rights, which hinder the efficient coordination of economic and legal interactions.

The traditional approach has tended to obscure the nature of the choice that has to be made. The question is commonly thought of as one in which A inflicts harm on B and what has to be decided is: how should we restrain A? But this is wrong. We are dealing with a problem of a reciprocal nature. To avoid the harm to B would inflict harm on A. The real question that has to be decided is: should A be allowed to harm B or should B be allowed to harm A? The problem is to avoid the more serious harm (COASE, 1960, p. 2)

For Coase, the central issue is not just the existence of harm, but the institutional decision regarding which activity to limit or preserve, considering the social costs and benefits involved. The theorist provides examples where economically legitimate activities result in reciprocal harm, so that eliminating the loss to one party naturally involves restricting another's activity. Such scenarios occur in conflicts over the use of scarce resources, such as between productive pursuits and nearby professional practices, between livestock farming and agricultural exploitation[3], or between different economic and environmental uses of the same watercourse[4](COASE, 1960).

In the specific case of the farmer and the livestock owner, the author emphasizes that the relevant choice is not merely to prevent harm, but to assess which combination of activities provides the greatest

added value. The main argument is that, with suitable institutional conditions and low transaction costs, the parties can modify their behaviour through negotiation so that relevant costs and benefits are included in economic decisions. Consequently, different initial arrangements can result in the same efficient outcome in terms of resource allocation, even if they involve different distributions of costs and benefits.

From this perspective, the main issue is not only preventing harm but also assessing whether the benefits of continuing a specific activity outweigh the costs of restricting the competing alternative. In this context, the problem of social costs mainly arises not from harm or externalities themselves but from how the institutional framework defines rights to utilise scarce resources. According to Coase (1960), productive conflicts generally involve reciprocal harm, as restricting one activity to prevent harm to third parties also entails limiting another economically legitimate activity.

As a hypothetical example, imagine a steel plant near an urban area that emits GHGs. If these emissions directly impact the local population's quality of life, a conflict arises between two legitimate activities: industrial production, which creates economic value, and residential use of space, related to the population's well-being and health. In Coasean terms, if usage rights are clearly defined—whether the company's right to emit GHGs during production or the residents' right to a less polluted environment—and transaction costs are low, the parties could negotiate directly.

In this scenario, for example, residents could accept financial compensation in exchange for continuing operations, or the company could be encouraged to invest in less polluting technologies if the cost of such measures was lower than the value of the proposed compensation. In both cases, the decision would involve the steel plant internalising the emission costs, leading to an efficient allocation of resources, regardless of the initial distribution of rights. However, such a scenario is unrealistic and could only be possible in a context where transactions occur without costs. As Coase (1960) emphasises, various factors must be considered that prevent the simple allocation of property rights[5], such as the parties involved in the negotiation, the terms of the negotiation, and the drafting of contracts, among others.

Nevertheless, considering the example mentioned, the presence of many affected individuals, the difficulty in accurately measuring the damage caused by emissions, the high coordination costs among residents, and the information asymmetry between the parties significantly increase transaction costs. In such circumstances, direct negotiation between the parties no longer remains an effective tool for internalising social costs, as the costs of enforcing an agreement may outweigh the benefits of cooperation. Faced with this challenge, Coase recognises the need to resort to legal means, with one option being the adoption of government regulation[6] (COASE, 1960). Therefore, depending on the social relationship established, the parties may negotiate directly, or the government may intervene to allocate property rights appropriately.

Higher transaction costs complicate defining property rights, especially in resource-rich regions like the atmosphere or oceans, where direct negotiations are hindered. The diversity of jurisdictions also prevents policies from fully internalising global externalities like GHG emissions (LIBECAP, 2014). One proposed solution is multilateral agreements among states, but these face high transaction costs due to differing interests, uneven cost-benefit distribution, and long-term uncertainties.

These factors elucidate the recurring difficulty in establishing and maintaining effective international environmental protection regimes. In this context, the Kyoto Protocol exemplifies the inherent challenges in developing and sustaining effective international environmental frameworks, particularly regarding greenhouse gas emission reductions. Although designed to impose legally binding targets on industrialised countries, based on a distinction between Annex I and non-Annex I states, the regime demonstrated structural weaknesses from its implementation, evidenced both by the non-ratification by major emitters, such as the United States, and by the subsequent withdrawal of significant parties, including Canada, Japan, and New Zealand (GODOY; SAES, 2015).

Given this context, it becomes clear that, considering the complexity surrounding environmental problems—particularly greenhouse gas emissions—the internalisation of environmental damages must consider various factors and approaches. In this sense, the divergence between the perspectives of Coase and Pigou does not merely lie in the importance of social costs but mainly in the diagnosis of their origin and the role assigned to state intervention.

On one hand, Pigou assumes that the market fails to adequately internalise externalities, thus justifying the state's adoption of corrective measures. On the other hand, Coase shifts the focus to the institutional structure that shapes economic choices, emphasising that inefficiency mainly arises when transaction costs prevent effective negotiation between parties. It is within this analytical space, therefore, that the responses implemented by the European Union—particularly through the EU ETS—can be

understood as efforts to structurally organise the pricing system and the allocation of emission rights in an environment characterised by high transaction costs and global climatic impacts.

3. Pigou and Coase Perspectives: An Analysis of the European Union Emissions Trading System

Regarded as a key element of the European Union's climate policy, the European Union Emissions Trading System is a crucial approach for decreasing greenhouse gas emissions. Developed under Directive 2003/87/EC, it functions as a cap-and-trade system to help companies reduce GHG emissions. In this context, it aims to include the costs of air pollution in operators' economic assessments by setting a universal emissions cap and establishing a market for the associated allowances, which can be exchanged among regulated entities.

Under this approach, as Stavins (2019, p. 4) highlights, "an allowable overall level of pollution is established by the government (not necessarily at the efficient level) and allocated among firms in the form of tradable allowances". Therefore, the EU ETS, which commenced operation in January 2005, aims to "promote the reduction of greenhouse gas emissions under conditions that provide good cost-effectiveness and are economically efficient" (EUROPEAN UNION, 2003, Directive 2003/87, art. 1).

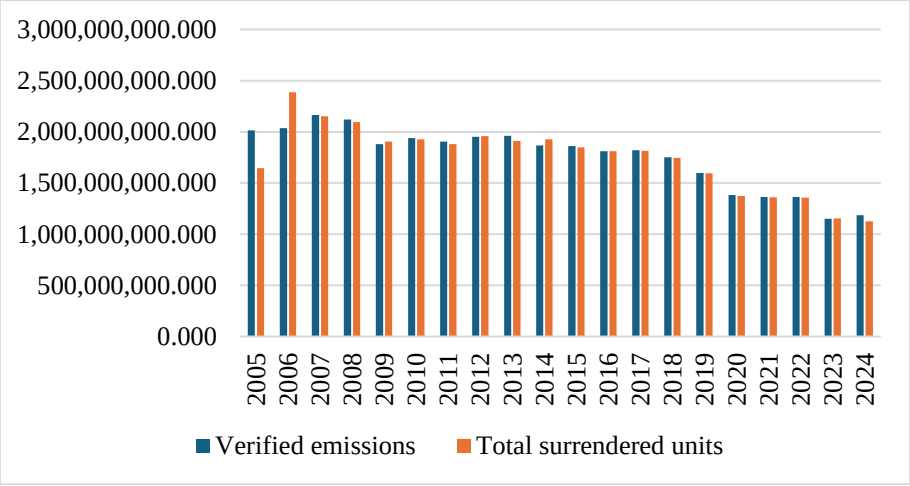
Considering these points, the EU ETS acts as a key tool for examining how different theoretical ideas about internalising environmental externalities are reflected in specific regulatory measures. In this context, it offers an analytical view of the system from the perspectives of Pigou and Coase, not as a detailed account of its technical and operational features, but as a legal-economic framework that allows the assessment of various institutional structures within the emissions market. The goal is to establish whether the EU ETS aligns more closely with a Pigouvian approach, which focuses on state intervention to correct market failures, or with a Coasean perspective, which emphasises the definition of rights, the organisation of incentives, and the reduction of transaction costs.

3.1 The European Union Emissions Trading System

Designed to assign value to carbon emissions as a strategy to combat climate change, the EU ETS is not solely based on the principles of an environmental instrument but primarily relies on an economic system. Its institutional framework is built on establishing a global emissions cap for regulated installations, which is gradually reduced over time, thereby progressively limiting the supply of allowances to emit.

In this context, operators must monitor and periodically report their emissions and, at the end of each compliance cycle, surrender a quantity of allowances equivalent to the recorded emissions, under penalty of sanctions. Therefore, as illustrated in the chart below, the link between reported emissions and surrendered allowances acts as a measure to evaluate compliance with regulatory obligations and the system's practical functioning.

Figure A1 – Relationship between verified emissions and surrendered allowances under the EU ETS (2005–2024)



Source: Prepared by the authors, based on data from the European Environment Agency (EEA, 2025).

Note: The chart displays both aggregated and raw data on verified emissions and the total number of surrendered allowances under the EU ETS, without specifying the origin of the allowances used for compliance. As a result, surrendered allowances may include permits that are freely allocated and credits from international flexibility mechanisms established under the Kyoto Protocol, such as Certified Emission Reductions (CERs), the Clean Development Mechanism (CDM), and Emission Reduction Units (ERUs) linked to Joint Implementation (JI). Additionally, there are units originating from other systems connected to the EU ETS, particularly the Swiss Emissions Trading System (Swiss ETS), under the terms of the linking agreement. Moreover, the data reflect changes in the system's geographical scope over time, notably the United Kingdom's exit from the European Union in 2021, which affects the coverage of installations and the total volume of emissions and allowances considered.

Figure A1 shows a consistent decline in both verified emissions and the total volume of surrendered allowances over the analysed period, indicating a gradual internalisation of the EU ETS constraints. In this context, it is clear that, over the years, the amount of surrendered allowances has increasingly matched verified emission levels, reflecting improved regulatory compliance and market maturity. However, in the early years of the system, more significant differences between the two indicators are evident, highlighting structural limitations during the initial implementation phase, such as information gaps, ongoing regulatory adjustments, and greater flexibility in compliance tools.

This trend is especially evident in 2005 and 2006: in 2005, approximately 2.01 billion tonnes of CO_2 were emitted, compared to about 1.65 billion allowances surrendered; in 2006, roughly 2.035 billion tonnes of CO_2 were emitted, versus around 2.384 billion allowances surrendered. In subsequent years, however, these figures became more closely aligned, indicating a gradual convergence between verified emissions and surrendered allowances, which suggests improvements in the operational, procedural, and normative effectiveness of the EU ETS. Nevertheless, as noted in the explanatory note related to Figure A1, the "total surrendered allowances" indicator does not specify the source of the allowances used, including both freely allocated permits and those acquired through auctions, derived from international credit mechanisms, or originating from emissions trading systems linked to the EU ETS, such as the Swiss ETS.

The European emissions trading system targets GHG-intensive sectors such as energy, industry, maritime transport, and parts of aviation, which together account for roughly 40% of the EU's total emissions, making the mechanism highly relevant to European climate policy. The cap-and-trade approach, in this context, ensures a decreasing emissions trajectory by imposing a progressively stricter overall cap, while the carbon price, established in the market, incentivises regulated entities to adjust their production and investment decisions according to cost-effectiveness and technological neutrality criteria (EUROPEAN COMMISSION, 2024). It is, therefore, an institutional arrangement that aims to balance environmental objectives with economic incentives, assigning the pricing system the role of signalling the environmental scarcity associated with emissions.

3.2 Practical Application: How Are Social Costs Embedded in the EU ETS?

Considering the discussion in the previous section, a convergence of objectives between the EU ETS and the Pigouvian approach can be observed, albeit with certain caveats. Although Pigou did not conceive of market-based mechanisms for correcting externalities, the European system functions as an institutionalised mechanism for internalising the social costs of emissions by imposing, through a regulatory decision, a quantitative limit on emissions and assigning an economic burden to their use. From Pigou's perspective, therefore, the EU ETS can be understood as an institutional tool aimed at correcting the divergence between the private marginal cost of production and the social marginal cost associated with GHG emissions.

Therefore, without regulation, a firm's decision tends to focus solely on its direct production costs, viewing emissions as a costless byproduct, which results in emissions surpassing socially optimal levels. In this context, the European Union, as a governing authority, alters this incentive structure through the EU ETS by establishing an emissions cap and assigning a market price to each additional unit of carbon, so that emissions are no longer economically neutral and become part of the regulated entity's cost considerations. Consequently, when a firm considers expanding production or adopting more carbon-intensive technologies, its decision is shaped by the allowance price and the emission limit set by the regulator, which serve as institutional benchmarks for the social cost of pollution.

In this setup, however, the Pigouvian adjustment does not occur by imposing a tax equal to the social marginal damage, but by establishing a regulatory framework where the carbon price results from the interaction between the scarcity created by the cap and the decentralised choices of economic agents. This scarcity does not relate to a specific environmental resource but stems from the need, through regulation, to address the absence of a private cost associated with the social damage caused by GHG emissions. Therefore, the EU ETS artificially limits the number of emission rights, whose economic value leads to the internalisation of this damage in business decisions.

From this perspective, the internalisation of damage occurs as the marginal cost of emissions approaches the allowance price, prompting firms to reduce emissions when the abatement cost is lower than the cost of emitting. In this way, the EU ETS, by requiring polluters to internalise the cost of pollution, aims to achieve an economic outcome similar to that proposed by Pigou but does so through a regulated market for allowances. This approach is especially necessary due to the technical, informational, and technological complexity of GHG emissions, which would make the practical calculation and implementation of an optimal tax unfeasible.

Unlike the Pigouvian approach, Coase argues that the issue of GHG emissions is not primarily a market failure caused by overlooked externalities, but rather a matter of rights allocation within a context of scarcity and competing uses. To the theorist, pollution does not solely represent harm caused unilaterally by a single agent, but rather a situation of mutual effects, where one actor's economic activity impacts the interests of others. The analytical focus therefore shifts from the abstract measurement of marginal damage to the institutional framework that governs the use of natural resources.

So, when there is no clear definition of property or usage rights over this resource, emissions tend to occur in an uncoordinated manner, as no agent is legally responsible for internalising the harm imposed on third parties. Within this framework, the EU ETS can be understood as an institutional arrangement that transforms the atmosphere into an object of legally defined rights, making GHG emissions an activity contingent on the ownership of scarce, tradable allowances. In this regard, under ideal conditions, as discussed in the previous section, Coase prioritises a direct-negotiation approach when property rights are clearly defined and transaction costs are absent.

In such circumstances, efficient resource allocation can be achieved regardless of who initially holds the rights, through private bargaining that minimises the total costs of harm. However, for GHG emissions, this solution is impractical due to the multiplicity of emitters involved, an indeterminate number of affected parties, high informational asymmetry, and extremely high coordination costs. In this context, the intervention of the European Union becomes necessary, not to replace the market but to facilitate it by defining initial emission rights and creating an institutional environment that reduces transaction costs. In this sense, the EU ETS operates as a mechanism approximating the Coasian logic by centralising the definition of rights while allowing negotiation to occur indirectly and in a decentralised manner within the allowances market.

According to Libecap (2014), cap-and-trade systems should be understood as legal tools for creating and distributing environmental use rights, designed to facilitate the internalisation of externalities in contexts characterised by high transaction costs and the inability to directly exclude polluting agents. Within this framework, the author states that the mechanism's efficiency depends on a clear, stable, and legally protected definition of tradable allowances, as well as regulatory predictability concerning allocation rules, transfers, banking, and potential cap revisions.

Applying this perspective to the European Union Emissions Trading System, the EU ETS can be seen as a hybrid institutional arrangement from a Coasian viewpoint. Although it relies on decentralised trading of emission allowances in a market, the rights traded do not constitute fully defined and stable property rights, but rather permits subject to periodic revisions, temporal limitations, and regulatory adjustments resulting from the European Union's enhanced climate targets[7]. This system maintains elements of market-based coordination, allowing the buying and selling of emission permits, while also ensuring significant government intervention, which directly affects transaction costs and the predictability of exchanges.

In this context, the regulatory flexibility characteristic of the EU ETS, although useful for adapting the regime to the European Union's climate targets, can be seen as a factor that increases transaction costs associated with trading emission allowances. Consequently, the normative instability caused by periodic revisions to the cap and changes in allocation rules can affect the predictability and legal security of the traded rights, influencing the strategic behaviour of market participants. From this perspective, the European experience demonstrates that, from a Coasean viewpoint, the effectiveness of a cap-and-trade

system depends not only on the formal creation of a market for allowances but also on the clarity, stability, and institutional consistency of emission rights, without which decentralised trading tends to be incomplete or inefficient.

Observing the distinction between the approaches of Pigou and Coase, it can be seen that the theoretical difference does not lie in their intended economic outcomes but in the basis of intervention, as both aim to reduce emissions and internalise the social costs of pollution. While Pigou justifies state action based on correcting a divergence between private and social costs, presuming the market's structural inability to handle externalities, Coase highlights that inefficiency stems from the absence or inadequacy of property rights and high transaction costs. Therefore, from a Coasean perspective, the EU ETS does not serve as a strict corrective mechanism but rather as an institutional solution that organises the allocation of emission rights and creates conditions for private decisions to minimise social costs associated with emissions.

4. Limitations of the Pigou and Coase approaches in the context of the EU ETS

Although the approaches of Pigou and Coase provide relevant theoretical bases for understanding the internalisation of environmental externalities, their application to the functioning of the European Union Emissions Trading System highlights key areas for focus. The EU ETS does not entirely conform to either the classical Pigouvian model or the strict Coasean solution, thereby forming a hybrid institutional arrangement shaped by technical, distributive, and political-economic constraints that fall outside the core assumptions of both theorists.

From the Pigouvian viewpoint, a key limitation is the practical difficulty in setting an optimal tax level that matches the social marginal damage from GHG emissions. This challenge arises from the complexity of assessing climate impacts, technological differences across sectors, and uncertainty about long-term effects, making it unfeasible to establish a tax that accurately reflects the social marginal cost of pollution. In response, the EU ETS avoids this problem by replacing the tax approach with a quantitative system, where the regulator sets a fixed emissions cap and allows the carbon price to emerge naturally in the market. However, it is important to recognise that the license price should not be regarded solely as a representation of social harm, but also as an economic signal influenced by political decisions, agent expectations, and market forces.

This deviation from the Pigouvian model becomes even more evident with the free allocation of allowances. Within the EU ETS, this measure aims to decrease economic risks associated with carbon leakage in sectors competing in the global market, thereby preventing the relocation of productive activities to countries with less stringent environmental rules. These allowances are primarily allocated to industrial installations based on benchmarks established at the Union level, which mirror the performance of the most efficient installations in terms of emissions intensity per unit of product. The amount of free allowances allocated to each operator is calculated from a combination of these benchmarks, historical activity levels, and relevant correction factors for the period, and is subject to revision in cases of substantial changes in production or facility closure (EUROPEAN COMMISSION, 2025).

The consolidation of the free allocation regime within the EU ETS emerged, among other reasons, from the Court of Justice of the European Union's ongoing interpretative efforts to clarify ambiguities in the system. One example, among several, is case C-540/14 P DK Recycling und Roheisen GmbH v. European Commission. In its decision, the Court recognised that the free allocation of allowances constitutes a structural element of the system, integrated into the normative framework outlined by Directive 2003/87/EC and subsequent implementing acts. This aims to maintain the regulatory coherence of the regime and reduce risks of competitive distortions, such as carbon leakage. By reaffirming the broad discretion given to the legislator and the Commission in defining the criteria for free allocation, the Court contributed to legally stabilise this mechanism, preventing interpretations that would treat it as a mere temporary exception to the principle of carbon pricing and reinforcing its alignment with the system's climate and economic goals.

Although legally equivalent to auctioned allowances at the time of compliance, freely allocated allowances do not entail a direct financial outlay, which tends to reduce operators' effective exposure to the carbon price and, consequently, the strength of the economic signal intended by the mechanism. In these circumstances, even though economic logic indicates that the decision to emit involves an opportunity cost—related to forgoing alternative uses of the emission rights, such as their sale or future use—this internalisation occurs in a less transparent and potentially unequal manner among agents,

weakening the link between private marginal cost and social marginal cost that underpins Pigouvian correction of externalities. In this sense, free allowances reveal the inherently imperfect nature of internalisation promoted by the EU ETS, which prioritises political feasibility and the protection of competitiveness over comprehensive compliance by all polluting agents.

From Coase's perspective, the divergence from the EU ETS manifests in a different manner. The traditional Coasian approach presumes that direct negotiation between affected parties is feasible, as property rights are well-defined and transaction costs are low (COASE, 1960). However, in the case of GHG emissions, these assumptions are evidently unrealistic. The widespread and global nature of climate damage, the numerous involved agents, and informational asymmetries obstruct any form of decentralised bargaining between polluters and those affected.

The EU ETS implicitly acknowledges this limitation by replacing private negotiations with state intervention, leaving the regulator to unilaterally define emission rights and establish a market where these rights can be traded among regulated entities. In this context, Coasian logic is only partially preserved, as negotiation occurs exclusively among emitters, not between polluters and society, shifting the focus from correcting the externality to achieving allocative efficiency among agents under the same regulatory constraints. However, it should be noted that state intervention in this process is not limited to the initial definition of rights but also involves setting the cap, establishing monitoring, reporting, and verification rules, and enforcing relevant sanctions. Therefore, rather than representing a strict application of the Coasian solution, the EU ETS underscores the importance of a robust institutional framework in the face of high transaction costs, reaffirming the vital role of public authority in climate governance.

Regarding the free allocation of emission allowances, the EU defines property rights by specifying which sectors will receive them. In the Coasian model, as previously mentioned, allocative efficiency does not depend on who initially holds the rights, provided they are clearly established and transaction costs are sufficiently low to enable negotiation between the parties. In this sense, the free allocation of allowances does not, by itself, constitute an economic distortion, as long as the assigned rights are fully transferable and agents can adjust them through trades in the secondary market.

However, this reasoning faces notable limitations when applied to GHG emissions. Although the EU ETS establishes a formal marketplace for trading emission allowances among regulated entities, free allocation does not remove the transaction costs needed for efficient redefinition of these rights and can sometimes even heighten them. In this context, the complexities of administrative rules, sector-specific benchmarks, activity-level adjustments, and post-trade correction mechanisms can create informational asymmetries and increase coordination costs, hindering effective negotiation among agents. As a result, even with legally defined rights, the institutional environment governing allowance transactions does not fully adhere to the Coasian model of negotiation.

Nonetheless, Coase's approach emphasises that the aim of institutional choice is not to eliminate damage but, rather, to minimise the overall social cost resulting from conflicting activities coexisting. From this standpoint, the free allocation of allowances can be viewed as a practical response by the European regulator to the high transaction costs faced by sectors exposed to international competition. In this context, by reducing the risk of production relocation and carbon leakage, free allowances aim to prevent additional social costs associated with the loss of economic activity, employment, and revenue, even if this leads to a less consistent price signal across different agents.

Unlike the Coasian solution and as explained with the Pigouvian approach, the EU ETS restricts emission rights to regulated emitters, excluding society impacted by climate issues from negotiations. Consequently, Coasian logic is only partly applied and mediated by the state, which sets initial rights and governs their redistribution, monitoring, and enforcement. In this scenario, free allowances are less a direct application of Coase's theory and more a result of suboptimal institutional structures constrained by structural factors, where economic efficiency is sought amid high transaction costs and political limitations.

Given the above, it is clear that the scenarios previously presented underline the ambiguities of Coase's perspective when applied to complex environmental issues, such as the climate agenda. In this context, depending on the emphasised point, the Coasian argument can both question the use of Pigouvian instruments—by suggesting that simply defining property rights might be sufficient to achieve efficient outcomes—and defend them, recognising the unavoidable presence of transaction costs.

From this perspective, it is reasonable to interpret that Coasian bargaining concerning the definition of property rights and Pigouvian taxation through corrective state action should not be viewed as mutually exclusive options but as potentially complementary mechanisms, whose appropriateness depends

on the characteristics of the externality in question (DERYUGINA et al., 2021). In this sense, in situations characterised by many agents and diffuse damages, direct negotiation between the parties becomes operationally unfeasible, whereas Pigouvian instruments demonstrate greater coordination capacity. Conversely, in highly localised and specific situations, the imposition of taxes may prove disproportionate or inefficient.

Based on the analysis in this chapter, it is clear that both the Pigouvian and Coasian approaches provide valuable insights into the economic foundations of the EU ETS, but they also have limitations when faced with the legal and institutional complexity of the European emissions trading regime. The Pigouvian logic, which concentrates on correcting externalities by accounting for the social costs of pollution, offers a coherent framework for justifying state intervention in environmental matters but demonstrates limited analytical coverage when applied to complex regulatory systems like the EU ETS. Conversely, the Coasian perspective, which emphasises the definition of rights and transaction costs, encounters practical challenges in a context characterised by global externalities, sectoral heterogeneity, and ongoing regulatory interventions. In this regard, it becomes evident that the design of the EU ETS, as a market-based mechanism, does not strictly conform to pure theoretical models, thus requiring hybrid arrangements shaped by different approaches.

5. Final Considerations

In light of the analysis developed throughout the article, the study shows that although the European Union Emissions Trading System (EU ETS) has important conceptual roots in the classical ideas of Pigou and Coase on correcting externalities, its normative and operational setup reflects an institutional dynamic that cannot be fully explained by either approach in their original form. Pigou provides the economic framework for understanding the need to internalise the social cost of emissions through government intervention, while Coase emphasises the importance of defining rights and enabling direct negotiations among parties, especially considering the transaction costs involved.

Nevertheless, the EU ETS does not simply apply these theories directly; instead, it reinterprets them within a complex legal-regulatory framework characterised by ambitious climate targets, distributive choices, and high transaction costs. In this context, the primary contribution of the study is theoretical, aiming to demonstrate that adapting Pigou's and Coase's analytical categories to regulated carbon markets requires a contextual approach, attentive to the specificities of European Union environmental law and the central role of regulatory governance. The EU ETS does not function solely as a Pigouvian tool for price correction through EU intervention, nor as a purely Coasian market with clearly defined and stable property rights, but as a hybrid system in which the creation, management, and revision of emission rights are intertwined with political and normative decisions.

This finding, however, does not imply that classical theories are inadequate; rather, it underscores their limitations in explaining modern climate regimes. By emphasising factors such as the free allocation of allowances, coexistence with parallel regulatory instruments, and the inherent dynamism of periodic adjustments to the system's design, the article demonstrates that the practical functioning of the EU ETS is influenced less by abstract notions of economic efficiency and more by the consistency, predictability, and credibility of the legal-institutional framework that underpins it. In this way, the study contributes to the academic debate by clarifying that the relevance of Pigou and Coase within the context of the EU ETS lies less in their direct application and more in their ability to illuminate structural tensions between economic theory, environmental regulation, and climate governance.

Despite the theoretical contributions outlined, the study recognises relevant limitations arising from its methodological and scope-related choices. Firstly, the analysis focuses solely on the EU ETS, which limits the direct applicability of its conclusions to other carbon markets or emission pricing instruments, as their institutional structures, levels of regulatory maturity, and political-economic contexts can vary considerably. Secondly, the study mainly adopts an economic-conceptual and legal-analytical approach, without performing empirical assessments of the EU ETS's effects on specific sectors, Member States, or measurable patterns of investment and mitigation. This restricts the ability to compare the real impacts of the regulatory options examined.

Furthermore, the analysis does not fully examine the dynamic interaction between the EU ETS and climate instruments outside the European Union, nor the intra- and inter-sectoral distributive effects caused by allowance allocation and system revisions. These limitations, rather than undermining the study's conclusions, emphasise the need for future research that combines theoretical analysis, empirical

evidence, and international comparisons, thereby fostering a more comprehensive understanding of the role of regulated carbon markets within the framework of classical economic theories.

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[3] Coase (1960) illustrates the issue of externalities through the example of livestock farming, where enabling cattle to roam freely causes damage to crops on neighbouring land. The author uses this example to show that the loss cannot be solely attributed to the livestock owner, as restricting the

farming activity would also lead to economic losses, highlighting a conflict between two legitimate uses of the land.

[4] Coase (1960) describes situations where an upstream activity—such as an industry discharging waste into a river or a plant changing the flow regime—negatively impacts downstream activities, such as irrigated agriculture, domestic water supply, or fishing. Coase notes that eliminating or restricting the polluting activity also involves economic costs, which is why the issue cannot be viewed as harm caused unilaterally, but rather as a relationship of interdependence between agents. The economically efficient solution, in this case, would depend on the prior definition of water use rights and the possibility of negotiation between the parties, influenced by the transaction costs involved.

[5] Property rights refer to the socially established rules that define who may use, control, and dispose of a resource, as well as who bears the costs and appropriates the benefits associated with its use, playing a central role in managing economic decisions and the allocation of scarce resources.

[6] Coase, however, argues that government intervention should not be unrestricted and will not always produce efficient results, depending on the institutional administrative structure. In this regard, the theorist provides, among other examples, the case of vibration and noise from government-managed railway operations, which interferes with individuals' rest (COASE, 1960).

[7] The European Union has outlined strategies to reach climate neutrality by 2050 and has committed to cutting greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels (EUROPEAN COMMISSION, 2024).