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# Optimal monitoring and offset prices in voluntary emissions markets

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ABSTRACT

Carbon offset markets are modeled as an uninformed regulator who wishes to use a voluntary price instrument to reduce harmful emissions under varying degrees of private information. Regulators offer agricultural producers payments to reduce their emissions for some price per ton relative to the social price of carbon. Abstracting from distributional concerns or costly transfers, we derive optimal contracts for offsets contracts, minimizing welfare losses from adverse selection. The model shows how the level of monitoring and the prices offered should vary depending on the regulator's information. Although existing and proposed policies discount the price that offset producers receive relative to the social cost of carbon to account for the adverse selection, our model argues that optimal offset prices may be above the social cost of carbon for sufficiently high levels of monitoring. Our model also identifies and quantifies the types of firms that produce additional offsets for a given contract, offering guidance on how regulators might better target offset contracts.



## 1. Introduction

According to the United Nations IPCC, agriculture and deforestation together account for a quarter of global anthropogenic greenhouse gas emissions. However, under most proposals to cap emissions

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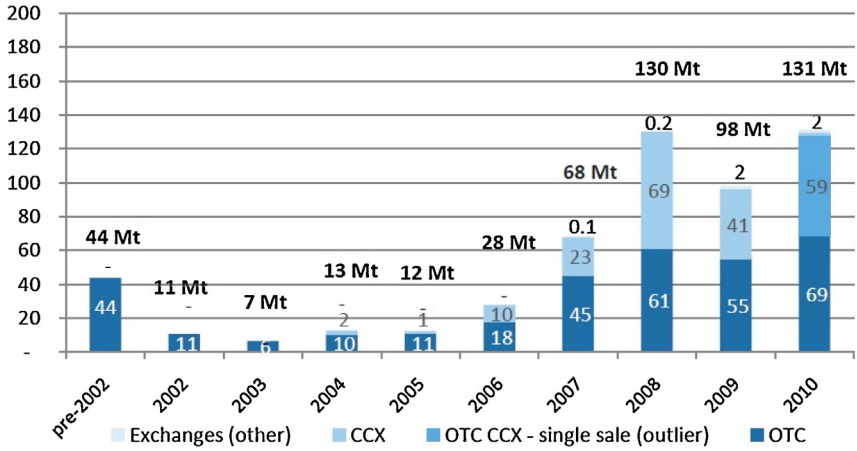


**Fig. 1.** Historic volume growth of the voluntary carbon offset markets.

(such as Kyoto or the Waxman–Markey Bill in the United States), emissions from sources such as deforestation or agriculture are not capped. Instead, emissions reductions in these sectors are normally incentivized as carbon offset programs where firms receive payments in exchange for agreements to reduce, i.e., offset, emissions. Furthermore, a small but growing part of global climate mitigation efforts is in voluntary offsets markets which allow individuals or organizations to pay offset originators to make carbon reductions in their name. By observing Fig. 1, from Ecosystem Marketplace and Bloomberg New Energy Finance, we can appreciate the size and growth of these markets. Before the "Great Recession" of the late 2000s, purchases of voluntary offsets more than doubled in volume annually, and the value of these markets grew at an even faster rate. As the global economy recuperates, that trend is expected to continue for the foreseeable future.

However, there is still a general distrust of whether the greenhouse gas reductions from offset projects are "real" and many have expressed concern that allowing firms in capped sectors to use offsets to reduce their obligations threatens the integrity of cap and trade policies.

The U.S. Government Accountability Office (GAO, 2008) and the Congressional Research Service (CRS), among others, have identified permanence, leakage and additionality (collectively known as PLA) as the primary concerns that threaten the integrity of carbon offsets:

*Permanence*: Issues of permanency arise when some carbon reductions (such as afforestation) may be reversed at some point in the future (e.g., if the trees get cut down).
*Leakage*: The problem of leakage occurs when emissions reductions by one firm or industry indirectly cause emissions from another firm or industry to inefficiently increase.
*Additionality*: An offset is said to lack additionality if the carbon reduction would have happened anyway, without the payments from the offset purchaser.

Together, these three problems undermine the credibility of offsets markets and highlight the necessity of developing efficient strategies to deal with imperfect information.

The key insight is that the PLA concerns all arise from the inherent difficultly in measuring greenhouse gas emissions from sources like agriculture or deforestation. The difficulties in policy design arise due to asymmetric information, in other words, regulators have less accurate information about emissions than the offset originators. If the uncertainty were symmetric, then mismeasurements should average out; however, asymmetric information introduces the possibility of systemic biases. In this paper, we design a model of asymmetric information in which a regulator wishes to design a price instrument in order to incentivize the efficient production of carbon offsets by land owners that have