Extended Abstract
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Paper/Poster Title	**Assessing marginal abatement costs for agricultural greenhouse gas emissions across diverse nations**

Abstract prepared for presentation at the 98th Annual Conference of The Agricultural Economics Society will be held at The University of Edinburgh, UK, 18th - 20th March 2024.

Abstract	***200 words max***
This paper identifies the possibilities for mitigating agricultural GHG emissions in deriving marginal abatement costs (MACs). The MAC is computed as the minimum of GHG emission shadow prices associated with livestock, fertilizer, feed, and machinery reduction. Our application is on a sample of 52 countries from 1990 to 2020. The MACs are estimated using the by-production approach (multiple equations representation of the technology). Our results reveal a MAC of about $0.62 per tonne of GHG emissions associated with livestock reduction. Moreover, while an increasing tendency has been observed in the second decade, the MAC has decreased over the last decade.	
Keywords	GHG emissions, marginal abatement costs, shadow pricing
JEL Code	D24, Q10, Q50 see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	***100 – 250 words***
In the face of escalating climate change concerns, the agricultural sector has come under heightened scrutiny for contributing to greenhouse gas (GHG) emissions. As nations strive to meet ambitious sustainability targets, understanding the Marginal Abatement Costs (MAC) associated with mitigating these emissions becomes paramount. This research delves into a comprehensive analysis of agricultural GHG emissions' Marginal Abatement Costs (MACs), exploring variations and similarities across multiple countries. By unraveling the intricate dynamics of these costs, we aim to inform policy decisions, foster global collaboration, and pave the way for more effective strategies to mitigate the environmental impact of worldwide agricultural practices. We conducted our analysis on a sample of 52 countries between 1990 and 2020.	

Methodology	***100 – 250 words***
Following the theoretical results of Murty et al. (2012), a polluting technology lies at the intersection of two sub-technologies: one that produces marketed outputs and the other that generates pollution. The derivation of the MAC is associated with the shadow price of pollution, as the MAC is obtained as the minimum of all possible shadow prices. Empirically, we assume a Translog specification function for each technology. Each function is estimated using constrained least squares to impose monotonicity properties, and year and country fixed effects are also included. The MAC is estimated for the case of 52 countries between 1990 and 2020. One output and six inputs are considered to represent the good output technology: total agricultural	

production (crop, animal, and fish), land, labor, machinery, livestock, fertilizers, and feed. Four inputs are considered polluting: machinery, livestock, fertilizers, and feed. This implies that farmers have four strategies to mitigate GHG emissions. The MAC is then estimated considering these four strategies and given the agricultural output price.

Results	***100 – 250 words***

Our preliminary results reveal a MAC for agricultural GHG emissions of about $623 per thousand tonnes. This level of MAC is very low compared to the price of carbon in the EU Emission Trading System (EU-ETS)[1] and the average carbon price worldwide[2], which are between $73 and $25 per tonne of CO_2.

Reducing the number of livestock appears to be the cheapest among the four strategies to mitigate GHG emissions. As enteric fermentation is the major contributor to agricultural GHG emissions, reducing livestock appears to be the best strategy. Nevertheless, the shadow price associated with fertilizers and feed amounts to $1,041 and $41,651 per thousand tonnes of GHG emissions, respectively. For machinery, this shadow price is prohibitive on average (a few billion).

The evolution of the MAC shows an increasing trend between 1990 and 2014, with a steep increase between 2001 and 2014. From 2015 onwards, the MAC exhibits a decreasing trend.

Discussion and Conclusion	***100 – 250 words***

This paper examines the question of agricultural GHG emissions MAC estimation in the case of several countries over three decades. The results reveal a meager price compared to the worldwide carbon market. While the latter focuses on the whole economy, our estimations are only based on the agricultural sector. The first implication of this work is that the price associated with carbon markets seems to be compensative enough. This lower MAC is associated with the reduction of the number of livestock. However, this strategy might face strong opposition in different countries. Other mitigating strategies are possible, and reducing for instance the feed might bring the MAC within the range of the carbon market prices.

Murty, S., Russell, R. R., Levkoff, S. B., 2012. On modeling pollution-generating technologies, *Journal of Environmental Economics and Management.* **64**, 117-135.

[1] EU Carbon Permits - Price - Chart - Historical Data - News (tradingeconomics.com)
[2] Carbon Pricing Dashboard | Up-to-date overview of carbon pricing initiatives (worldbank.org)