Extended Abstract
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Paper/Poster Title	Distances to climate targets 2030 in EU-27 agriculture: explorative analysis

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Abstract	200 words max

Agriculture is considered as an essential contributor to climate change mitigation. Yet, progress monitoring and cross-country comparisons of climate change mitigation in agriculture is rather limited. We fill the gap by conducting explorative analysis of the progress towards climate targets in agriculture in EU, which is, among others, documented in the UNFCCC biannual projection reports (BR). For each EU Member State, we derived a so-called 'distance to climate targets for 2030' and applied Jenks natural breaks classification to it to reveal classes among Member States. We also compared a range of variables among classes using the Mann-Whitney-U test. We revealed remarkable heterogeneity across Member States in terms of their distance to targets and defined two classes: (i) with low; and (ii) with high distances to climate targets. We also found statistical difference between classes in a range of other variables. We conclude that the current distribution of targets put a special responsibility on the EU Member States with high GDP per capita and high share of agricultural emissions to develop and implement mitigation options in agriculture. Furthermore, our results hint that the EU Member States with large distance to climate targets might face higher greenhouse gas abatement cost.

Keywords	Climate change mitigation; EU Green Deal; latent class analysis; effort-sharing sectors
JEL Code	Q180 Agricultural Policy; Q540 Climate

Introduction	100 – 250 words

Climate change mitigation is one of the major global challenges, especially in agriculture, since it both suffers from and contributes to climate change. In order to reach national and sectoral greenhouse gas (GHG) targets, constant progress monitoring, as well as cross-country and cross-sectoral comparisons are crucial. The latter is rather limited, especially for agriculture, since there is no formulated EU-wide GHG target specifically for agriculture; instead, agriculture is currently considered as a part of the so-called Effort Sharing Sector, i.e., sectors beyond the EU Emission Trading Scheme and LULUCF. The EU Effort Sharing Regulation sets binding national emission targets for 2030, expressed as percentage changes from 2005 levels and assigned to each Member State (MS) based on its gross domestic product (GDP) per capita. Although these climate targets hold for all effort-sharing sectors together, for this analysis we only consider agriculture and assume that every sector within the Effort Sharing Regulation aims to contribute to GHG targets proportionally. It is important to highlight that this assumption implies high heterogeneity in terms of required efforts from the agricultural sector. In particular, the higher the contribution

of agriculture to total national GHG emissions (Fig. 1), the more difficult it is for the agricultural sector to ensure a proportional contribution.
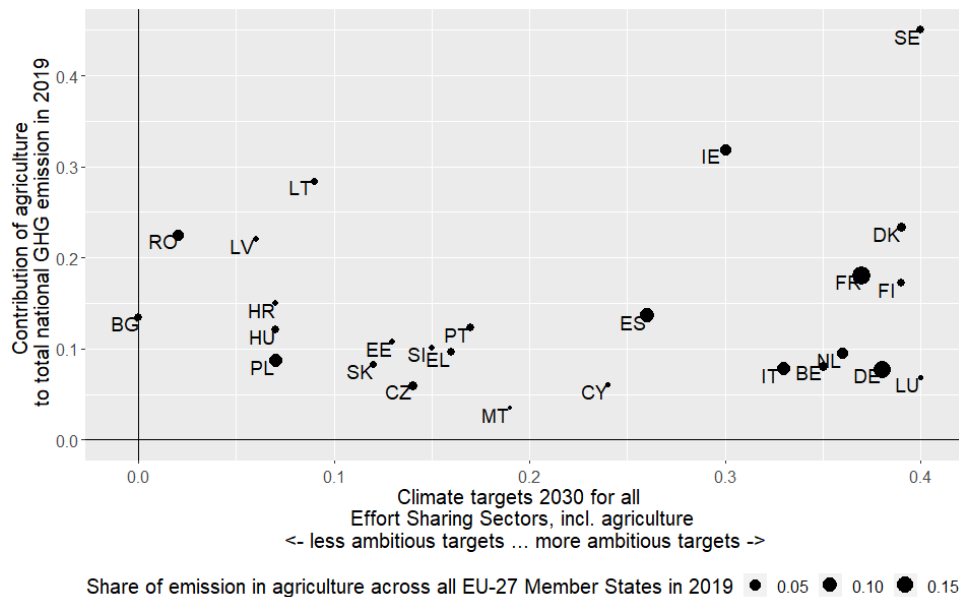

Figure 1. Targeted reduction of greenhouse gas emission for Effort Sharing Sectors by 2030 and contribution of agriculture to national GHG emission in 2019

Methodology	***100 – 250 words***

The theoretical background of climate change mitigation is twofold. On the one hand side, climate change is a global public bad, characterized by marginal social costs being higher than marginal private costs. This leads to an optimal level of climate change mitigation being higher than the one that the markets determines. On the other hand, since nations aim to decrease GHG emission beyond the level that would be achieved due to a decrease of associated output, the concept of total factor productivity could be applied to analyse national performance in terms of climate targets.

The progress towards climate targets is, among others, documented in the UNFCCC biannual projection reports (BR). For each EU MS, we derived a so-called 'distance to climate targets for 2030', i.e., the relative difference between the targeted GHG emission in agriculture and the projected one:

$$Distance\_to\_targets = \frac{Projected\_CO_2eq - Targeted\_CO_2eq}{Targeted\_CO_2eq}$$

where $Projected\_CO_2eq$ stays for GHG emission from agriculture projected for 2030 in the latest UNFCCC biannual report; and $Targeted\_CO_2eq$ stays for GHG emission from agriculture in 2030, according to the EU Effort Sharing targets proportionally inferred on agriculture.

To this end, we proceeded in two steps. First, we applied Jenks natural breaks classification to reveal classes among MSs in terms of distance to climate targets

2030 in agriculture. Second, we compared a range of variables selected on the basis of the theoretical background among classes using the Mann-Whitney-U test.

Results	*100 – 250 words*

The revealed heterogeneity across MSs is remarkable: while Malta and Croatia are going to reach their 2030 targets very well, ten MSs, including Germany, France, and Denmark, are expected to emit in 2030 over 50% more GHG in agriculture than targeted. Employing the Jenks natural breaks classification, we assigned each EU MS to one of the two classes: (i) with low; and (ii) with high distances to climate targets (green and red colours respectively on Fig. 2).
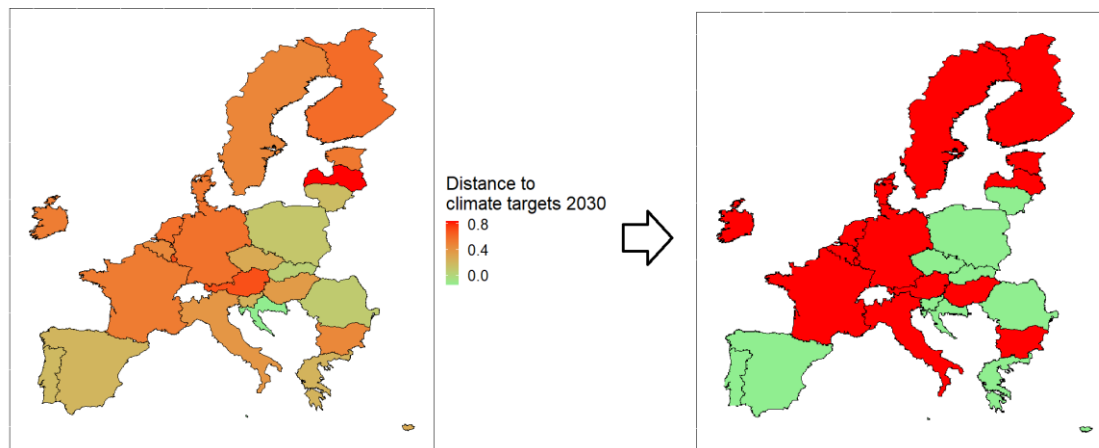

Figure 2. Two classes based on distances to climate targets 2030 for agriculture, defined according to the Jenks natural breaks classification

We furthermore discovered that despite their low distance to climate targets, MSs from this class reported higher agricultural emission per capita and higher total emission per GDP. These countries also invested substantially less in mitigation measures, even if compared per euro of GDP or per tonne of GHG emission. At the same time, no difference across classes was revealed in the number of implemented measures, in the agricultural GDP per capita, or in the share of agriculture in total GDP.

Discussion and Conclusion	*100 – 250 words*

Our conclusions are twofold. On the one hand side, distribution of targets 2030 across the EU MSs is based on the Effort Sharing Regulation and with this on GDP per capita; yet, there is no significant difference in GDP from agriculture per capita between the two classes. The targets put a special responsibility on the EU MSs with high GDP per capita and high share of agricultural emissions to develop and implement mitigation options in agriculture. In this case, the current distribution of targets might hit agriculture particularly hard. On the other hand, large positive distance to climate targets is associated with significantly higher investments into climate change mitigation, as well as lower difference between mitigation costs under the baseline scenario and under maximum feasible technological GHG reduction. This result can hint that the EU MSs with large distance to climate targets might face higher abatement cost. These hypotheses should be tested in follow-up research. Another promising avenue for further research is a cross-country analysis of mitigation measures.