Extended Abstract
Please do not add your name or affiliation

Paper/Poster Title	**Weather conditions and the effects of CAP subsidies on the technical efficiency of French dairy farms**

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***

Several studies have concluded that CAP subsidies have a negative impact on the technical efficiency of farms. However, in the context of climate change, none of these studies took into account weather variations. The aim of our work is therefore to study the effect of these subsidies on French dairy farms' technical efficiency between 2002 and 2017, when weather conditions are taken into account. To do this, we used different models of stochastic frontier analysis in which the weather conditions are modelled differently. Our results show that, as in the literature, CAP subsidies have a negative impact on our sample farms, but that this effect is greatly reduced when weather conditions are taken into account.

Keywords	Dairy farms, technical efficiency, Common Agricultural Policy, Weather conditions, Subsidies, Stochastic frontier
JEL Code	C46, D24, Q10 see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	***100 – 250 words***

The Common Agricultural Policy (CAP) is an important tool used by the European Union to support agricultural production. The CAP is the EU's biggest expenditure item, accounting for around 30% of the total budget, and on average represents 84% of French farmers' income. But over the last few decades, the CAP has come in for a lot of criticism, accused of leading to overproduction, contributing to environmental deterioration and generating economic inefficiencies. Indeed, in theory, decoupled aids can modify producers' behaviour by reducing their effort or changing their risk management, leading to poor management decisions and reduced technical

efficiency. Technical efficiency is a producer's ability to produce a maximum level of output with a given level of inputs. To assess this technical efficiency, stochastic production frontier analysis (SFA) can be used. However, to the best of our knowledge, no study on the link between subsidies and technical efficiency takes into account the weather risks associated with recent climatic variations. Yet the direct and indirect effects of weather on agricultural production are important for assessing technical efficiency. Indeed, agricultural production is the most climate-dependent human activity, and recent climatic changes are the most significant risk factors facing farms. Our contribution in this article is to determine whether the negative impact of agricultural subsidies on technical-economic performance, widely revealed in the literature, is verified when weather variations are taken into account.

Methodology	***100 – 250 words***

We use the SFA method developed by (Aigner et al., 1977), which estimates technical efficiency using a production frontier with a double error term. The production frontier represents the theoretical maximum that a farm can produce with a given level of input. The SFA method makes it possible to evaluate and explain the gap between this frontier and observed production by the two error terms. An error term that represents all stochastic shocks not controlled by the producer (e.g. environmental shocks, market shocks, political shocks, etc.) and a random term that represents the producer's inefficiency. The SFA approach allows this technical inefficiency to be explained by exogenous factors, such as subsidies. To carry out this work, we used the Réseau d'Information Comptable Agricole (RICA) to obtain structural and accounting data on a representative panel of 3197 dairy farms observed between 2002 and 2017. As the aim of this work is to integrate meteorological variables into the classic production frontier, we use meteorological data provided by Météo France. This includes data such as rainfall, sunshine, temperature and relative humidity, all at a daily frequency across the 96 départements of mainland France. These new data can be used to construct degree days. The second indicator we have constructed is the THI.

Results	***100 – 250 words***

The average inefficiency scores obtained in each model are similar, at around 86%. This means that, on average, producers can increase their overall production by around 16% while maintaining the same level of inputs. As for the determinants of

this inefficiency, we find a significantly negative (positive) effect of subsidies on technical efficiency (inefficiency), as in most of the literature. The proportion of leased land has a positive impact on the farm's technical efficiency. On the other hand, the proportion of employees on the farm had no significant effect on technical efficiency. Finally, as expected, low educational attainment (i.e. lack of secondary education) has a negative effect on technical efficiency. Models that take weather conditions into account also confirm the previous results. The negative effect of subsidies per hectare also remains significant, but the level is halved in this model which takes weather data into account, compared with models without weather conditions. As for the weather conditions themselves, they have a significant impact on production, mainly in the hot season. During this period, DD and rainfall have a slightly negative effect on production, while THI has a positive effect.

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

This work represents a first step towards understanding the role played by climate in the link between subsidies and technical efficiency. We propose here some avenues for future research to improve the methodology we have used. First and foremost. Secondly, we constructed highly synthetic economic indicators, which enabled us to make rapid estimates, avoiding zero values while providing a better understanding of the major trends in production mechanisms, but losing precision. In concrete terms, all our estimates confirm the strong impact of intermediate consumption on milk production, but it is impossible for us to know to what extent this impact is linked to the use of concentrates, fertilizers, pesticides or antibiotics. Yet these inputs are important adjustment variables for farmers in the face of weather variations. What's more, the reallocation of inputs in response to a subsidy differs depending on whether the input increases production risk (like fertilizers) or decreases it (like crop protection products). Another limitation is that the SFA model does not allow us to take precise account of production risk. This classic SFA model could therefore be refined to evaluate public policies that affect production risk by modifying input allocations, using more flexible models to take production risk into account. Models could also be developed to estimate the effect of CAP subsidies and the role of weather on both technical and environmental efficiency.