Extended Abstract

Paper/Poster Title	**Resilience to weather shocks in Italian agriculture: evidence on the effectiveness of crop diversification**

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Abstract	***200 words max***

Climate change is expected to increase both the frequency and intensity of extreme weather events. The agricultural sector is especially vulnerable to these weather shocks. In order to safeguard farmers' income and food security, climate adaptation measures are required. The goal of this research is to examine the effectiveness of crop diversification as an adaptation measure.

For this, we use a control function approach to estimate the impact of crop diversification on the response of farmers' welfare to weather shocks. Crop diversification is proxied by the Shannon index which is modelled endogenously using a CRE tobit model. With this method, both the factors influencing crop diversification, and the influence of crop diversification on farmers' crop income and their sensitivity to weather shocks can be determined. Data are drawn from a large Italian farm panel dataset.

We expect to find that past drought events influence farmers' crop diversification strategy. Furthermore, crop diversification is expected to reduce sensitivity of farmers' income to weather shocks. While monoculture can lead to specialisation and increase income, crop diversification reduces the risk of crop loss following weather shocks. These results can help policymakers choose adaptation strategies and target farmers to increase the adoption of these strategies.

Keywords	Climate change, climate variability, climate change adaptation, Italian agriculture, crop diversification, endogenous switching regression model
JEL Code	Q12 Micro Analysis of Farm Firms, Farm Households, and Farm Input Markets Q15 Land Ownership and Tenure; Land Reform; Land Use; Irrigation; Agriculture and Environment Q54 Climate; Natural Disasters and Their Management; Global Warming

Introduction	***100 – 250 words***

Crop growth is directly affected by climatic conditions, making the agricultural sector vulnerable to climate change. Studies show that the Mediterranean region is likely the most climate-vulnerable in Europe. Soil quality will deteriorate as the southern climate gets warmer and drier, water shortages will increase, and growing seasons will shorten. These changes are detrimental to the agricultural sector in southern Europe. Yields will diminish, become more variable and the surface area suitable for traditional crop growth will become smaller. Various strategies of climate adaptation exist to increase resilience against climate change and weather shocks. One of these strategies is crop diversification. Growing a mixture of crops can preserve productivity of cropping systems and reduce vulnerability to weather shocks.

We hypothesize that farmers engaging in crop diversification are more resilient to weather shocks. While farmers with higher crop diversification lose the benefits of specialisation, their risk of crop loss is reduced. One main research question forms the basis of this paper: 'Are farms with higher degrees of crop diversification more resilient to weather shocks?' By comparing the gross margin of Italian crop farms with different diversification intensities, we evaluate the effectiveness of crop diversification as an adaptation strategy. We use the Shannon diversity index (SDI) applied to plot surface areas as a proxy for crop diversification and define weather shocks as yearly deviations from the 20-year mean climate. Consequently, we expect the gross margins of farms with higher SDI values to be less sensitive to these deviations.

Methodology

100 – 250 words

To answer the research question, we adopt a control function approach for panel data inspired by the endogenous switching regression by Murtazashvili and Wooldridge (2016). This approach solves for the selection bias which would occur if we would simply compare the climate response of diversified and non-diversified farms.

First, we have a selection equation which models SDI as a function of meteorological and control variables. For this we use a CRE tobit model. We choose a tobit because the SDI can only take positive semidefinite values and there are many zero values (monoculture).

As a second step, we model crop income (and variability in a second model) as a function of meteorological and control variables, both as a main effect and as an interaction with SDI. For this we use a pooled OLS model, with Mundlak device. The residuals from the selection equation are added to account for endogeneity of the diversification decision. The coefficients on the meteorological variables interacted with SDI tell us whether diversified farms are more resilient to weather shocks than non-diversified farms.

For both steps we use the same set of independent variables, except for the exclusion restrictions. These instruments occur only in the selection equation and are assumed to influence the outcome only through crop diversification. As exclusion restriction we choose past droughts. Further instruments are still to be added.

We use a farm-level unbalanced panel dataset from the Italian FADN (2008-2020). The meteorological variables come from ERA5 and are merged with the farm-level data.

Results

100 – 250 words

At the time of writing, we are still in the process of constructing the models, so we have not obtained any final results yet. Based on preliminary descriptive statistics, we find that it is mainly larger farms and farms located in warmer areas that diversify. An important consideration is also the implementation of the CAP 2014-2020 reform. We find that the average SDI increases and the number of non-diversified farms drops as of 2015, the year in which the first greening payments are made (Figure 1).

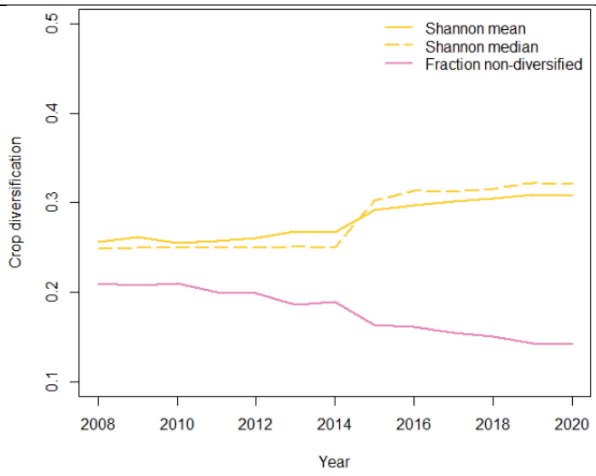

Figure 1: Evolution of the SDI

From the first part of the methodology—the selection equation—we expect to find that the adoption of a crop diversification strategy is influenced by the climate and weather shocks which a farmer has experienced. Also other factors like the farm head's educational level or the fraction of their land which is owned can play a role.

From the second part—the outcome equation—we expect to find that farmers who choose to diversify are more resilient to weather shocks than farms that do not diversify. We expect this to be visible mainly in their income variability rather than in their expected crop income.

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

Please note that we are currently working on the selection of instrumental variables and on the construction of the models. We expect a full paper (draft to be ready by the deadline of March 1st.

The methods used here can provide interesting results in two distinct manners. The selection equation gives us insight into which factors influence the decision to diversify. Through this, profiles of farmers can be made that are more likely to engage in crop diversification. These results can be useful by policy makers in encouraging crop diversification as an adaptation strategy. Through these results, they can decide which types of farms to target and which instruments to use.

The outcome equation, on the other hand, provides useful information on the effectiveness of crop diversification as an adaptation strategy. If we find that farmers with higher degrees of diversification are more resilient to weather shocks, then this provides intrinsic motivation for them to diversify. In case the selection equation shows that farmers do not diversify in response to experienced droughts, but the outcome equation proves it to be an effective measure to improve resilience to weather shocks, policy interventions are needed.