SGA Newcomer Award 2020

1st rank

European Union Membership and its Effects on Agricultural Land Use Intensity

Dennis Engist

Agricultural land use change has societal, economic and environmental impacts. Understanding the drivers of agricultural land use change is important to formulate economically and environmentally sustainable policy. With this study, I contribute to the research field by examining the effect of European Union membership on agricultural land use change. I apply a regression-discontinuity model to land classification data, in order to determine intensification and extensification on agricultural land along the border regions of new member states. I find that there is no uniform development to be observed across all countries. In Estonia, Latvia, Lithuania, Bulgaria and Croatia, EU accession leads to an intensification in agriculture. In Hungary, Romania and Slovakia, no change is visible, while Poland, the Czech Republic and Slovenia are extensifying. I argue that the effect depends on countries' comparative advantage in agriculture.

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2nd rank

Economic impact of weather extremes at the milk production in Switzerland – A regionally differentiated analysis on the farm level

Mélissa Uldry

Abstract

The dairy sector constitutes the most important branch of agriculture in Switzerland. In recent times, an increase in the frequency of weather extremes, such as droughts and heatwaves, has been monitored and attributed to climate change. Pasture-based dairy farming systems are particularly vulnerable to drought events, which reduce fodder growth, and to heat stress periods, affecting animals' productivity. This study investigates the financial impacts of both heat and drought periods on dairy farms in Switzerland during the period 2003–2015, by using a fixed effects model applied to a sample of over 4000 farms from the Swiss FADN dataset. Our results show that dairy farms in Switzerland are affected differently by drought periods, depending on their production area and specialization. A lack of forage due to a drought period could force dairy farmers to buy additional feed or to reduce their cow herd in the following year in the plain region. On the other hand, we find that drought periods in the mountain region are beneficial for biomass productivity since they reduce feed expenses and lead to higher milk revenues in the following year. However, our results do not provide significant evidence of adverse economic impact of heat stress for dairy farms in Switzerland in general.

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Spatio-temporal patterns in the adoption of organic agriculture in Switzerland

Marc Chautems

Summary

From nowadays 14%, Bio Suisse has the ambitious target to reach 25% of organic farms in Switzerland by 2025. This will require a well-though promotion strategy in regions with a low density of organic farms. The heterogenous distribution of organic farms can be explained either by spatially heterogenous locational factors (e.g. disadvantageous climate) or by the role of spatial dependence (interactions with neighbours). This study investigates the evolution of those two effects for 40'000 Swiss farms over 18 years.

Our econometric model shows that spatially heterogenous factors such as the climate and the demographic situation, significantly lose importance in the last 18 years. While most conversions used to happen in the mountainous and urban regions, the rural lowland is now experiencing a similar rate of conversion. However, the role of spatial dependence remains stable over all the observed periods. Those results indicate that supporting the creation of peer networks is a valuable strategy to promote organic farming.

Introduction

The pressure against synthetic inputs is rising in Switzerland and organic is again high in trend (after a slowdown between 2005 and 2010). With their new initiative «Avanti 2025», Bio Suisse has the ambitious target to reach 25% of organic farm in Switzerland by 2025 (Bärtschi, 2017). From 14.3% in 2017 this represents an enormous effort that could only be reached by alleviating the actual barriers to the conversion toward organic farming.

Through farmers interviews Home et al. (2018) identify that an important barrier to the conversion to organic in Switzerland is the lack of delivery points and peer networks in regions with low density of organic farms.

The density of organic farms is namely very heterogenous across Switzerland, with some regions having over 40% of organic farms while other regions have barely any (Figure 1).
With regards to this spatially heterogenous distribution of organic farms, the findings of Home et al. (2018) and the target of Bio Suisse, it becomes clear that the underlying mechanisms that lead to the large regional differences in organic should be better understood.
If (1) the spatially heterogeneous distribution of organic farms is due to spatial dependence (i.e. interactions between neighbouring farmers), then supporting the creation of peer networks and densifying the delivery points (as proposed by Home et al. (2018)) are likely to be the right strategies to promote organic farming.
However, if (2) the spatially heterogeneous distribution of organic farms is due to spatially heterogenous factors (such as the climate of certain regions being less suitable to organic), such strategies are likely to fail since they would try to promote organic in regions that are only poorly suitable for organic agriculture.

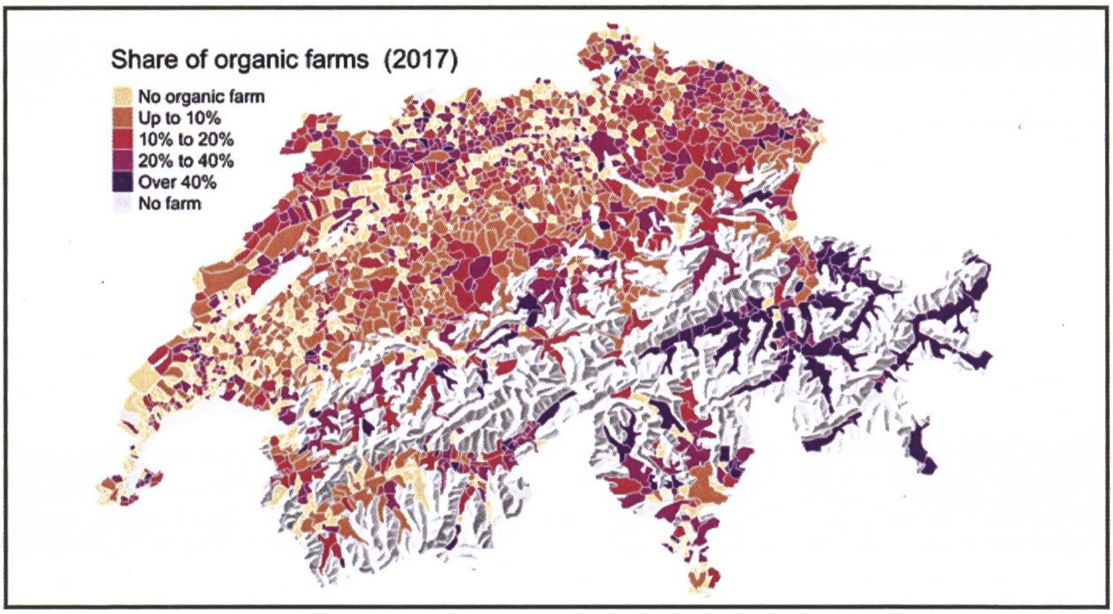

Figure 1: Choropleth map of the share of organic farms per municipality in 2017.

Research question and contribution

In this thesis, we try to better understand the role of spatial dependence (interactions between neighbouring farmers) and spatially heterogenous locational factors (such as the climate, demography, culture, etc.) in the decision to convert to organic farming.

In simple terms our research question could be formulated as:

Are areas with lower organic farms density «naturally» less suitable for organic farming or is the lower density of organic farms itself the reason for the lower organic density?

Further, we are also studying if how those effects evolved over the last 18 years (1999-2017).

Spatial dependence in organic farming has been widely studied in the recent years, for example by Schmidtner et al. (2012), Läpple and Kelley (2015) and Lewis et al. (2011). However, our study differentiates itself in at least three major aspects.

First, we use a clear strategy do deal with omitted but spatially correlated variables that could potentially lead to a biased estimation (following the intuition of Storm and Heckelei (2018)). Second, we focus on the conversion decision instead of the final distribution in order to know when there was spatial dependence in the adoption. Third, this is the first quantitative study (40'000 farms over 18 years) that focus on the Swiss context.

Theoretical framework

From a theoretical point of view Schmidtner et al. (2012) and Läpple and Kelley (2015) argue that the decision to convert to organic farming can be seen as an investment problem. A farmer converts to organic when the net present value of being organic exceed the net present value of being conventional.

In Switzerland we observe that organic farms are more often surrounded by other organic farms than conventional farms (Figure 1). This heterogenous distribution is called spatial autocorrelation and can be the results of two different types of effect. Anselin (1988) differentiates between «spatial heterogeneity» and «spatial dependence» (Figure 2).

Spatial heterogeneity (and spatially heterogenous factors) impacts the decision to convert by making a region more or less suitable to organic, for example because the climate in a region is more suitable. For this reason, Ellison and Glaeser (1997) refer to those favourable local conditions as «natural advantages». Natural advantages are not necessarily related to nature and can also be institutional advantages (such as different subsidy schemes in different regions). In the case of organic farming those spatially heterogenous factors are for example, the climate, the soil, the culture, the demography, the agricultural structures, the farm characteristics, etc.

Spatial dependence relates to the fact that «what is observed at one point is determined (in part) by what happens elsewhere in the system (Anselin, 1988)». Läpple and Kelley (2015) break this spatial dependence in two further terms. The neighbourhood effect that refer to the dependence in farmer decision (Did the fact that my neighbours are organic impact my decision to be organic?) and the spatial spill over that refers to the impact of the change of the explanatory variables of a neighbour (Is the fact that my neighbours have a lot of cattle impacting my decision to convert to organic?).

Organic farming specifically is an information intensive farming technique (Läpple & Kelley, 2015), and therefor particularly susceptible to the «neighbourhood effect» since exchange with peer is the primary information source for farmers.

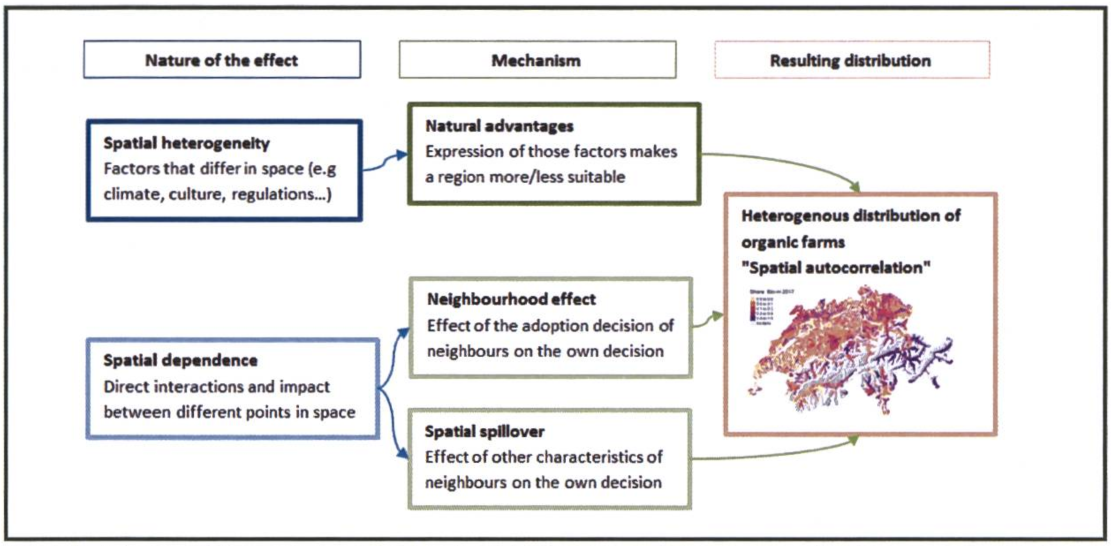

Figure 2: Scheme of the underlying mechanisms that lead to an heterogenous distribution of organic farms (Anselin, 1988; Ellison & Glaeser, 1997; Läpple & Kelley, 2015). Some authors use a different wording; Manski (1993) uses the term endogenous effect (=Neighbourhood effect), exogenous effect (=Spatial spillover) and correlated effect (= Natural advantage). Nyblom et al. (2003) use «geographic suitability» (= Natural advantage).

Empirical framework

Classical econometric models assume that observations are independent from each other (Maddala & Lahiri, 2009; Stock & Watson, 2015). With spatial heterogeneity or spatial dependence, the important assumptions of uncorrelated errors and independent observations are violated and estimators are biased (Bjørkhaug & Blekesaune, 2013). If spatial dependence is present, a different set of econometric models should be used. Those models contain the so-called neighbouring matrix W that describe how the different observations are related to each other's (Elhorst, 2014). The choice of the most appropriate model for a particular situation is not trivial and still highly discussed in the literature. Due to the so called Manski (1993) reflection problem, Gibbons and Overman (2012) claim that a spatial lag of X (SLX) model is superior to other models in most case. For those reasons, most recent spatial econometric studies (Saint-Cyr et al., 2018; Storm et al., 2015) privilege the SLX specification. In this study we also follow this argumentation and use a SLX model.

Methods and data

Our econometric model is inspired from the reflexion of Storm and Heckelei (2018) and is reflecting the fact that spatial dependence is based on direct interactions happening at rather small «local» scale whereas spatially heterogenous factors vary at a larger «regional» scale. For this reason, we use two different neighbouring matrix W. W_{loc} and θ_{loc} capture the local interactions (spatial dependence) whereas Wreg and θ_{reg} capture the regional interactions and act as a control for omitted but spatially correlated variable.

We observe the farms over a certain number of years («the observation period») and look if they convert to organic farming during this period (yes/no; logistic regression).

Our model takes the form of a spatial lag of X (SLX) model and is represented by the equation below. A detailed explanation of the terms can be found in the full text.

$$Y= \alpha+ X_{hetero}\beta+W_{loc} X_{org} \theta_{loc} +W_{reg} X_{org} \theta_{reg}+ \varepsilon$$

We use data containing the organic status and different characteristics (size, farm type, age of farmer, municipality) of almost all Swiss farms between 1999-2017. The data were provided by the Federal Office for Agriculture (FOAG). We then combined this dataset with different spatially explicit datasets (population density, precipitation, soil, etc.). We apply our econometric model on the conversion decision of all non-organic Swiss farms (≈40'000) for 3 different periods (1999-2005,2005-2011,2011-2017).

Results and discussion

Figure 3 shows the results of our regression model for the periods 1999-2005 and 2011-2017. The effect of a variable is significant if the error bar does not cross the zero line (red dashed). Terms left from the zero line indicate a negative effect on the decision to convert to organic, terms right a positive effect. The stars indicate if the change between both periods is significant. The farm type was used as a further control variable but is not shown here.

The reference farm for the categorical variables is a German speaking milk producing farm in the rural lowland. This type of farm is by far the most representative of the Swiss farms landscape.

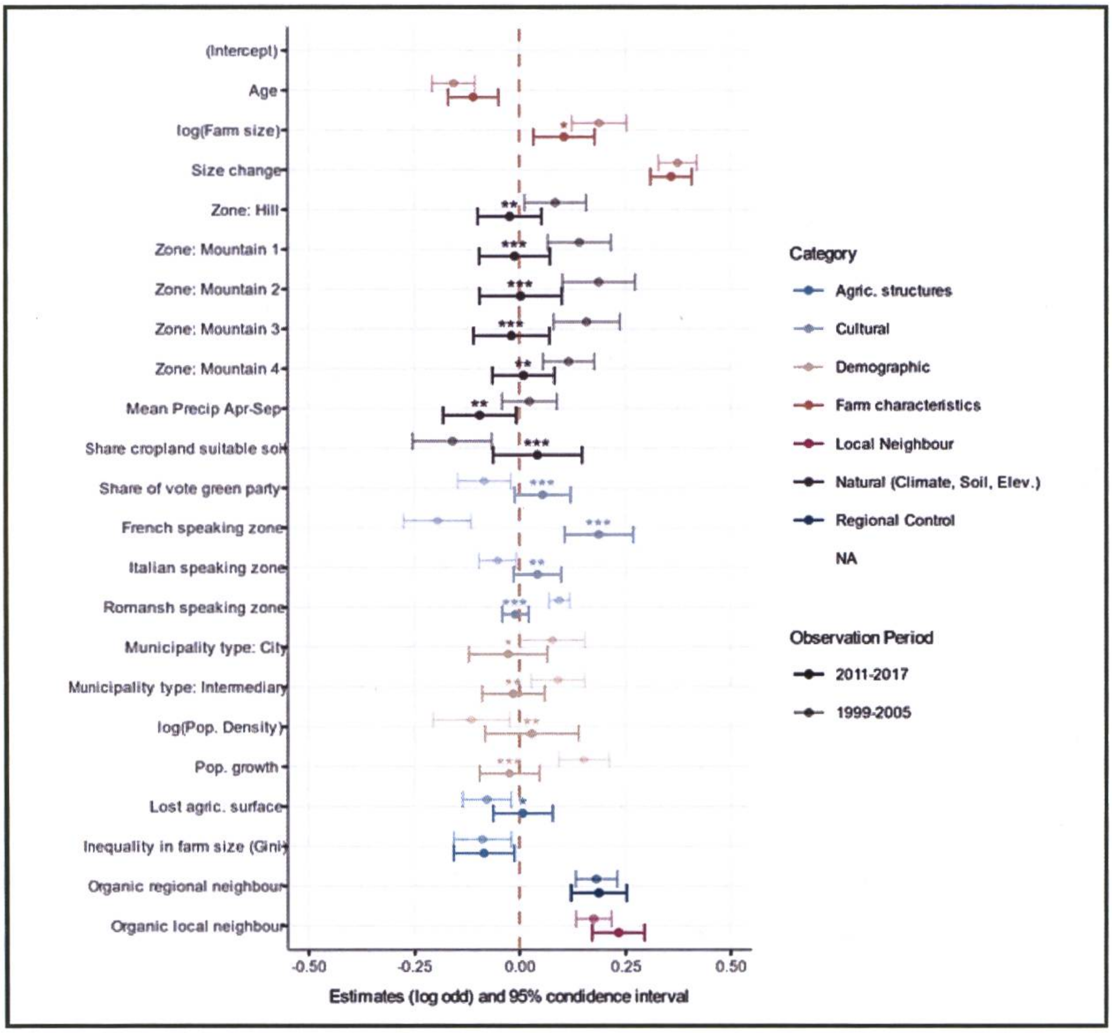

Figure 3: Change of the coefficient estimates between the 1999-2005 and 2011-2017 periods. Coefficients are given as standardized coefficients, which mean that their unit is standard deviation. 95% confidence intervals are given in term of Wald confidence intervals (based on the assumption of normal distribution of the parameters). Coefficients are significant on the 95% confidence interval if their confidence interval does not overlap with the orange dotted line (0). The significance of the change between the two periods is indicated by the stars scale. Detailed p-value about the change can be found in the full text, Table 21, annex 10.13. The same plot for the farm types is presented in Figure 29, annex 10.12.

In term of the impact of spatially heterogenous factors, the situation substantially changes between those two periods. Natural and demographic factors lose in importance; all of them are not significant anymore in the

2011-2017 period. The role of farm characteristics and agricultural structures remained rather stable while the role of the cultural factors radically changed. For example, French speaking use to be a barrier but is now increasing the likelihood to convert. The effect of the farm type is less marked in the 2011-2017 period (this figure is only shown in the full text), meaning that organic farming is not limited to only specific type of farms any more.

All those results are multiple indices suggesting that organic farming is moving from mountainous and urban areas toward the rural lowland and that the types of farms converting are getting more diverse.

In term of spatial dependence (captured in the term «local organic neighbours»), we see that the effect is quite strong and remain stable over both period (no significant change). A numeric interpretation shows that a farm with 5 more organic neighbours (out of 20 neighbours) is 1,7 times more likely to convert than a farm with 0. This value is lower than the value found by Lewis et al. (2011) in their study of dairy farms in Wisconsin but still indicate that farmer interactions with their neighbours definitely plays a role in the decision to convert to organic farming.

The term «regional organic neighbours» is acting as a control and captures the mixed effect of unobserved spatial heterogeneity and large-scale spatial dependence. This large-scale spatial dependence would typically come from the effect of a densification of the delivery points. Unfortunately, the mixed nature of this term makes it impossible to interpret it as part of the result.

Conclusion

Our findings show that the role of spatially heterogenous locational factors decreases dramatically over the last 18 years. Mountainous and urban areas used to be major hotspots of conversion to organic farming, but nowadays the rural lowlands are also experiencing a similar rate of conversion. However, while the role of locational factors decreased, the role of spatial dependence remains constant.

Our interpretation of those findings is that farms in regions where the conversion to organic farming require less investments (and is therefore less risky) convert first. Those regions are mainly regions where the production systems are based primarily on grassland. Later, driven by a steadily growing market, increasing subsidies and maybe even by the increasing criticism toward pesticides, farms with more complex production systems started to become confident enough to undertake the high investments bound to a conversion.

Consequently, the role of spatially heterogenous locational factors decreases as farms that convert to organic start to be more diverse than before. But the role of spatial dependence remains constant during this period of changes. The information requirement for farms with «traditionally non-organic» production systems is high, and the outcome of the conversion is still subject to uncertainty. Therefore, it is likely that the farmer interactions with their neighbours remain at least as important as they were before. Supporting those interactions with the creation of peer networks and events as proposed by Home et al. (2018) seems therefore an appropriate way to further promote the diffusion of organic farming in Switzerland. Such events could be focused on «traditionally non-organic» production systems and regions in order to further speed up the conversion rate. Integrating those findings in the strategy of Bio Suisse (Bärtschi, 2017) to promote organic farming could help to reach the ambitious target of 25% of organic farms in Switzerland by 2025.

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