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Assessing the Rise of Organic Farming in the European Union: Environmental and Socio-economic Consequences

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Abstract

Although organic farming is considered the poster child of rural development in Europe, there is little empirical evidence assessing its success in achieving the ambitious environmental and socio-economic objectives that it is purported to assist. This paper presents empirical evidence from the growth of organic farming in Europe over the past two decades that questions the highly optimistic claims of policy makers. Although policies in support of organic impact have had an overall positive environmental impact, their social impact is ambiguous, as organic farming appears to have grown more in areas with larger average farm sizes. Additionally, contrary to what is often assumed, organic farms in Europe display larger average sizes and lower rates of labor intensity than their conventional counterparts, casting doubts on the efficacy of organic farms to allow family farmers to remain in the countryside as high-value producers. I assert that this this development should be viewed as evidence of the "conventionalization" of organic farming, and suggest that policy makers take into account the transformations of the structures of production, which benefit from the support for organic farming. Treating the experience of organic farmers in the EU as a lesson for schemes paying for environmental services, I suggest that the success of organic farming should be evaluated by the numbers of participating farmers, rather than by area covered, as has been the predominant approach so far. Finally, I assert that strong agricultural cooperatives are necessary to secure a long-lasting passage of small farmers to organic methods of production.

1 Introduction

Since the 1992 MacSharry reforms, the European Union has modified its agricultural policy so as to include payments to farmers for the provision of environmental services and the preservation of nature. Among agri-environmental measures, payments to the farmers producing under organic methods constitute a major component of the Second Pillar of the Common Agricultural Policy (CAP), which explicitly focuses on Rural Development and has been becoming more significant over the last years. Organic production fulfills environmental demands by creating less pressure on the ecosystems because of its less intensive methods, while it contributes to the preservation of the rural landscapes which European urban dwellers view as precious. It also satisfies consumer concerns around food quality and public health and has positive implications for animal welfare.

Over the past 20 years, organic farming has experienced rapid growth, transforming the European countryside. Apart from its health and environmental benefits, it is often viewed as a potential solution for keeping rural residents in the countryside. Organic farmers receive direct income support for converting conventional land into organic and (in most countries) even for maintaining it as such. Additionally, high prices for niche organic commodities are thought of as a way to boost small farmers' incomes without relying on traditional price supports. Thus, aside from being an attractive solution to the problem of rural development in the eyes of environmentalists, organic farming promises to relieve the budgetary pressures of the CAP, fulfilling the wishes of the fiscal conservatives within the EU.

The current paper examines whether these promises are actually being fulfilled. Its structure is as follows: The second section traces the changes of the CAP, from a set of traditional protectionist measures towards a document that promotes environmental policy and analyzes the central discursive role of organic farming in the arsenal of the European Commission for addressing a variety of environmental and social problems. The third section lays out the data and the empirical methodology, whereas the two subsequent sections present the necessary statistical evidence in order to commence the process of evaluating the degree to which these policies have borne fruit for environmental protection and for achieving the social goals of the CAP. Since the results do not confirm the high expectations surrounding organic farming, especially in achieving the protection of small farmers, I attempt in the sixth section to place the evidence in context, extending the discussion of the "conventionalization" of organic farming. The seventh section offers some concluding remarks.

2 Agricultural policy in the European Union

2.1 Establishing the industrial mode of agriculture

After WWII, most European government pursued protectionist agricultural policies in order to achieve self-sufficiency and to tackle balance of payments difficulties[1] (Hoggart et al., 1995; Tracy, 1989). In 1955, West Germany's Agricultural Act codified the country's attempts to raise productivity and farm incomes through the stabilization of agricultural prices and supplies. This latter codification provided the framework for Article 39 of the Treaty of Rome in 1957, which signified the creation of the European Economic Community (EEC)(predecessor of the European Union) by Germany, France, Italy, Belgium, Luxembourg, and the Netherlands (Hoggart et al., 1995, 114-115).

The agricultural sector already held a predominant position in this inaugural document, as can be easily demonstrated by the fact that it lays out the original objectives of the CAP of the EEC. These were:

- to increase agricultural productivity
- to ensure a fair standard of living for the agricultural community
- to stabilize markets
- to assure the availability of supplies
- to ensure reasonable prices for consumers (European Union, 2006, 54).

In order to achieve these goals, the CAP implemented significant payments to support agricultural production, in the form of subsidies to direct producers. Price supports were implemented for products in which the EEC wanted to achieve self-sufficiency, whereas tariffs and levies were imposed on imported products: 72% of agricultural production was receiving both price supports and external protection, whereas 25% was solely enjoying external protection (Sampson and Yeats, 1977; Commission of the European Communities, 1975).

However, the policies of the CAP led to a series of problems. Subsidies led to mounting agricultural surpluses in Europe and were primarily channeled towards the largest and most productive arable farms, creating a highly unequal situation within the agricultural sector. Thus, the initial agricultural policies, which didn't specifically target regional imbalances, failed to allow rural residents to participate in the welfare boost that urban residents experienced after WWII (Joossens and Raw, 1991; Grafen and Schramek, 2000; Groier and Loibl, 2000; Weis, 2007).

[1] The only exception to the protectionist rule was provided by Denmark, which attempted to win markets through diversification of its farm exports and free-trade.

Since the CAP embraced the productivist logic of the early era of industrial agriculture, it encouraged specialization and monocropping, which sacrificed natural resistance for productivity. Additionally, genetic homogeneity decreased the resources and opportunities for natural enemies of pests, increasing reliance on pesticides. As a large portion of the target weeds, insects and other pests became resistant to the chemicals used, the need arose for the development of newer pesticides, putting the farmer on a "pesticide treadmill" (Altieri, 2000).

Intensive agricultural methods led to decreased soil fertility. The answer to that problem was found in the application of synthetic fertilizers. The latter became available in the global North at very low prices after WWII, thus permitting farmers to diverge from the use of legume crops for converting atmospheric nitrogen into forms that plants could use, and thus supplying non-legumes with sufficient fertility (Foster and Magdoff, 2000, 51-52).

Beyond the private costs of pesticide acquisition, the indirect costs to the environment and public health have to be taken into account when assessing pesticide and fertilizer use. Groundwater and fishery contamination, impacts on wildlife and other foods, farmers' poisoning, as well as higher cancer rates are among the ramifications of higher pesticide use (Altieri, 2000; Allen and Kovach, 2000; Foster and Magdoff, 2000; Edwards, 1993; Culliney et al., 1993). With respect to fertilizers, one has to point out the high energy intensity of their production process[2]. Beyond turning agriculture into a high carbon-footprint sector, inorganic fertilizers were responsible for groundwater and surface water contamination. Since a large amount of nitrogen fertilizers is not recovered by the crops, it ends up in the water in nitrate forms, causing eutrophication (a population explosion of algae, which depletes the oxygen in water systems and upsets ecosystem balance) and putting human health at risk[3]. Additionally, nitrogen fertilizers should be viewed as air pollutants, as they contribute to the destruction of the ozone layer (Altieri, 2000, 82-83).

2.2 The rise of agri-environmental measures

In the 1970s, the "intensive use of certain types of fertilizer and the misuse of pesticides" began to be viewed in Europe as a source of pollution, especially as pesticide intensification impacted water sources, with serious consequences for public health (Council of the European Communities, 1973; Andersen et al., 2000; Buller and Brives, 2000; Louloudis et al., 2000). In the early 1980s, various countries, such as Denmark, the Netherlands, Austria and the UK, implemented programs which paid farmers for environmentally friendly methods of

[2]Foster and Magdoff claim that in the US cornbelt, nitrogen fertilizer production accounts for 40% of the necessary energy to produce an acre of corn (Foster and Magdoff, 2000, 54).

[3]Several types of cancer, as well as methamoglobinemia (low blood oxygen levels) in children, have been linked to nitrate uptake (Conway and Pretty, 1991; Altieri, 2000).

production. The policy targets included promotion of organic farming, reduction of inputs, preservation of biodiversity, conversion of arable land to grassland and rotation measures, set-aside, landscape preservation etc[4] (Grafen and Schramek, 2000; Groier and Loibl, 2000; Hart and Wilson, 2000).

By 1985, the European Commission would explicitly acknowledge that modern agricultural techniques were responsible for the extinction of species and for the destruction of valuable ecosystems, while increasing the risks of ground and surface water pollution (European Commission (1985, 50) as quoted in Lynggaard (2006, 107)). During the McSharry reform of the CAP in 1992, the above mentioned agri-environmental schemes, set up by Member States on their own initiative, became "accompanying measures" to the more traditional price support policies of the CAP. This meant that every country was now required to design and implement measures for environmental protection in its respective territory, apart from and parallel to its support for agriculture. Then, in 1999, when the "Agenda 2000" reform of the CAP was implemented, Rural Development was explicitly designated as the Second Pillar of Agricultural Policy (the First Pillar being traditional price supports); agri-environmental measures were incorporated into the Second Pillar, so as to achieve coherence with the other rural development policies, and began to constitute a major component in the rhetoric of European policymakers regarding the revitalization of the countryside[5] (European Commission, 2005, 4-8).

The move towards agri-environmental measures was also in line with supporting marginalized communities, thereby remedying the inequality created by the previous CAP, which favored large arable producers over small, low-income farmers (Buller et al., 2000, 5). Rural development (independent of agriculture) had become a prominent policy concern in the European Union after the inclusion of the UK and Denmark in the EEC, two countries which already had policies in place to address inequality between their regions (Shucksmith et al., 2005; Buller et al., 2000). Thus, subsidizing farmers for being "good stewards of the countryside" and providing society with public goods, such as a clean environment and beautiful rural landscapes, was viewed as a way of conforming to the guidelines of the General Agreement on Tariffs and Trade (GATT), which stipulated the abandonment of protective policies in agriculture, while helping small farmers to stay in the countryside and, thereby, reversing rural depopulation[6] (Louloudis and Maraveyas, 1997;

[4]For a more complete list, see European Commission, 2005.

[5]Although a complete list of rural development projects would be impossible, some examples of Second Pillar measures would be subsidies to agro-tourist enterprises, funding for agricultural processing, and payments for preservation of biodiversity. For examples of rural development projects that were co-financed by the EU, see European Commission (2006).

[6]Pressure from the farmers themselves to maintain their standard of living should also not be underestimated in the forming of agricultural policy(van der Ploeg, 2009; Grafen and Schramek, 2000; Buller and Brives, 2000; Groier and Loibl, 2000; Schermer, 2003). However, it should be noted that among farmers, it was farmers in the North, rather than in the South, who were more present in setting the goals of the revised CAP. As Buller claims, agri-environmental payments benefited primarily farmers in Germany and Austria, with Sweden, Finland and France close behind. In countries, such as Spain, Italy or Greece, farmers were mostly "policy-takers" rather than "policy-makers" (Buller, 2000, 244-249).

Carlsen and Hasund, 2000; Buller and Brives, 2000; Peco et al., 2000; van der Ploeg et al., 2002; Kasimis and Papadopoulos, 2005).

2.3 Organic farming as *Deus ex machina*

Organic farming occupies a central position among the different tools of rural development, as it seems capable of addressing different problems with the CAP. Organic farming was viewed as a solution to intensive agricultural production and its effects on groundwater pollution or acid rain in various European countries (e.g. the Netherlands, the UK, Denmark) (Lynggaard, 2006, 134-135). Furthermore, organic farming reduces the use of energy and agro-chemicals, and contributes to the restoration of an economic and ecological balance, with favorable implications for human health (Lynggaard, 2006, 113).

In addition to the direct environmental and health benefits, organic farming confered other social benefits. It was seen as protecting rural landscapes, while providing producers with an attractive niche market opportunity. Hence, the position of the agricultural community wouldn't deteriorate in an environment of decreasing public support (European Parliament, 1991; van der Ploeg et al., 2002). Since small farms were viewed as less likely to implement intensive methods of production, and were in some cases, even already following them without being recognized as organic producers[7], they were viewed as natural candidates for inclusion into the schemes of organic farming. Hence, organic farming was directly linked by the European's Parliament Committee on Agriculture to the support and protection of small-scale farming (Lynggaard, 2006, 127).

Support for organic farming is achieved through legal, communicative and financial instruments[8]. The latter include payments to organic farmers for converting their land into organic production, and also, in most countries, for continuing organic production (that is for maintaining their land under the organic stipulations). Hence, every organic farmer receives an annual payment for converting their land and, in most countries, also for maintaining their farm under the organic regulations[9].

[7]This is the type of producers which Altieri calls "organic by default"(Altieri, 1987).

[8]The array of legal instruments refers to the shifting of the power to define organic farming from the private sector to government authorities. Hence, the meaning of *organic* has become disputed and regulated through the use of organic logos, certification agencies, etc. Communicative instruments are made up of the ways, including research, training, advice, and promotional campaigns, which support organic producers. Financing expositions of organic products or research on organic farming, particularly in public universities, would be two examples of the second group of instruments (Stolze and Lampkin, 2009)

[9]For example, organic farmers growing permanent crops in Germany and in Italy could receive an annual payment of 1,080-1,440 euros per ha (Stolze and Lampkin, 2009, 240).

2.4 Towards the "conventionalization" of organic farming?

Although these policies receive general support in Europe, not everybody has joined in the optimism about the transformative character of organic farming. In fact, the "conventionalization" of organic farming has been highly debated in the literature on organic farming (which mostly comes from the fields of rural sociology, geography and anthropology). The main pieces in the relevant literature were written by Tovey (1997) and Buck et al. (1997). Tovey traces the ways through which EU agricultural policy leads organic agriculture to increasingly resemble conventional processes in Ireland (Tovey, 1997). Buck et al., on the other hand, claim that the organic farming sector has created an opportunity for agri-business, which can extract rents and accelerate the process of accumulation through investing in organic farming. Through regulation (which involved registration with the state and third-party certification), the right to market produce organically conferred a rent to those having it. Hence, organic farming displays characteristics that were traditionally associated with conventional forms of agriculture, such as monocultures and long-distance trading, while labor practices also became increasingly more and more alike. Thereby, "“organic” becomes an industry rather than a different philosophy (Buck et al., 1997).

Despite being confirmed by several case studies[10], the conventionalization thesis hasn't become universally accepted. A special issue of the journal *Sociologia Ruralis* (Winter 2001) was dedicated to proving it either false or associating its existence with specific exceptional cases. In order to rebut the claims of conventionalization, its opponents sought to highlight the characteristics of organic farming as a social movement. Hence, Michelsen claims that both the Californian and the Irish case are associated with a small share of organic agriculture, rendering generalizations "heroic" (Michelsen, 2001, 6). In the case of New Zealand, Campbell and Liepins (2001) claim that the development of "organic" as an industry is contested by organic growers, thereby challenging its potential linear development, whereas Kaltoft (2001) draws similar results by examining the case of the Danish organic movement.

3 Empirical questions

3.1 Questions and data description

In line with the questions and the promises of organic farming, I proceed to estimate the environmental and the socio-economic effects of organic farming in the European Union, after almost two decades of policy

[10]Research by Guthman (1998, 2004) and Allen and Kovach (2000) provided additional evidence to its support.

support. I suggest that one way of estimating the environmental impact of organic farming would be to examine the impact of a country's organic share of agriculture on the country's pesticide and fertilizer intensity. I believe that the socioeconomic effects of organic farming can be evaluated by examining the relation between different socio-economic indicators and the rise in organic farming and also by estimating the impact of organic farming on agricultural labor intensity.

Starting with the environmental questions, I inquire whether the increase in organic farming in a country has led to lower rates of pesticide and fertilizer application per unit of land. Organic farmers are not allowed to use pesticides or inorganic fertilizers; however, this positive impact would be lessened, if the conventional farmers were to apply pesticide and fertilizer more intensively than before. Two possible explanations can be given for such an outcome. First, the splitting of the agricultural sector into conventional and organic farming could lead the two branches to drift further apart, making conventional farmers care even less than before about their environmental impact[11]. Such an effect would also be accelerated by less interactions between conventional and organic farmers (e.g. by not participating in the same associations, the two types of farmers would be less likely to influence each other). A second explanation could be that pests might be reappearing in areas where organic farming is rising in popularity. Conventional farmers in those areas might apply more pesticide to face reappearing problems or even do so preemptively, because of the lack of spillover effects from their neighbors. Thus, I am interested in the combined direct and spillover effects of organic farming for an agricultural sector's pesticide and fertilizer use.

Turning to the social implications of organic farming, I am interested in pinning down the factors that predict the rise of organic farming. If organic farming were to be associated with the more affluent regions of Europe, its impact as a catching-up device would undoubtedly be put into question. Furthermore, I am interested in the impact of organic methods for labor intensity, in order to evaluate its potential for employment generation. Since higher labor intensity in the agricultural sector would lead to higher demand for agricultural labor, it becomes imperative in order to substantiate the claim that organic farming can act as a device for strengthening rural communities and economies, both through direct employment generation and through indirect multiplier effects.

I have compiled the dataset by

1. using publicly available data from the Eurostat website (accessed in the Spring of 2011).

2. augmenting the publicly available data with data from the Farm Structure Surveys conducted between

[11]However, if "organic" becomes visible and respectable, one could imagine a scenario in which even conventional farmers would be influenced in a positive manner, even though they would not be willing to follow the strict organic regulations.

2000 and 2007 (acquired through private correspondence with Eurostat in the Spring of 2010).

Unfortunately, for reasons of data availability, I am forced to use a different level of analysis for the two types of questions. The section which deals with the environmental questions will rely mostly on the publicly available data, which are predominantly country-level data. The section which deals with the social consequences of organic farming will rely on the Farm Structure Survey data, which is district-level data[12].

3.2 Methodology

The first way of assessing the environmental effectiveness of organic farming is to look at the impact of the share of organic land on a country's pesticide intensity. The latter is measured by the sales of pesticide (in tonnes of active ingredient) per hectare of national utilized agricultural area. In order to express changes in percentage terms, I apply a logarithmic transformation to pesticide intensity. Hence, I proceed to estimate the following equation, where subscripts t and k denote year and country respectively:

$$\begin{aligned} logPesticideIntensity_{kt} = {} & \beta_0 + \beta_1 \times OrganicShare_{kt} + \beta_2 \times Year_{kt} \\ & + \beta_3 \times logGDP_{kt} + \beta_4 \times logGDPsquare_{kt} \\ & + \beta_5 \times EUmembership_{kt} + \beta_6 \times SecondaryEducation_{kt} \\ & + \beta_7 \times Gini_{kt} + \beta_8 \times RegionalImbalances_{kt} \\ & + \beta_9 \times \%PermanentCrops_{kt} + ... + \beta_{17} \times \%NonClassifiedHoldings_{kt} \\ & + b_{k0} + b_{k1} \times Year_{kt} + \epsilon_{kt} \end{aligned} \tag{1}$$

with k=1,...,27 countries and t=2000,...2007. Using vector and matrix notation, the model can be expressed as

$$\text{log Pesticide Intensity}_k = \mathbf{X_k}\beta + \mathbf{Z}_k b_k + \epsilon_k \tag{2}$$

This is a mixed linear model: the regressors $\mathbf{X_k}$ include an intercept and I include both fixed parameters β and zero-mean random parameters b_k. I am allowing both for random intercepts and random slopes on year, to allow for differences among different countries in their paths of pesticide use, rather than assuming

[12]The European Commission uses the NUTS (Nomenclature of Territorial Units for Statistics) classification for dividing up the territory of the EU for statistical purposes. The current NUTS classification divides the European territory into 97 regions at the NUTS-1 level, 271 regions at the NUTS-2 level and 1303 regions at the NUTS-3 level (Eurostat, 2007, 10-11).

the same rate of change overtime for all countries in my sample[13].

I control for gross domestic product per capita (measured in 2000 prices) and also allow for a non-linear relationship between pesticide intensity and GDP per capita by including a squared-GDP term. The rationale for this inclusion is that, initially, as a country's income grows, the intensity of pesticide use will increase, as part of the process of catching-up. However, as the Environmental Kuznets Curve literature argues[14], after the attainment of a certain standard of living, environmental concerns will become more prominent, leading to a decrease in the intensity of the environmentally harmful activity (pesticide use, in this case).

I decided to include a dummy variable for EU membership. This is possible since our data begins a few years before some of the newer member states entered the EU[15]. Since the EU prides itself for its environmental consciousness, it is interesting to check whether entering the EU *per se* has a significant impact on environmental indicators[16].

Following James Boyce's work (Torras and Boyce, 1998; Boyce, 2002, 2006), I also assert that inequality should play a key role in explaining environmental issues. I am going to use two separate (but obviously related) indicators in order to capture inequality. The first one is the well-known Gini coefficient; the second indicator captures regional imbalances, as measured by the sum of the absolute difference between regional and national GDP per inhabitant, weighted by the share of population and expressed in percent of the national per capita GDP[17]. Higher inequality could presumably lead to more intensive use of pesticides and fertilizer in agriculture, both because of shorter planning horizons of the poor and of more industrial modes of agriculture of the rich (easier mechanization, more use of pesticide rather than weeding).

I believe that it is also important to control for education (measured by the percentage of the population which has finished secondary education). My hypothesis is that a more educated population will be less willing to tolerate high rates of pesticide use. I also control for the share of different types of crops or activities taking place in a given region, in order to capture crop-related differences in pesticide intensity. For this purpose, I follow the categorizations employed by Eurostat in the Farm Structure Survey which classifies agricultural holdings into the following activities: specialist fieldcrops, specialist horticulture, specialist

[13] Note that u_{0k} has a similar interpretation to what econometricians refer to as fixed effects: it is the time invariant effect for every different country.

[14] See Torras and Boyce (1998); Dinda (2004).

[15] The European Union grew from 12 to 27 members with subsequent enlargements in 1995, 2004 and 2007.

[16] There is hardly anything more striking than the following quote from an official document of the European Commission: "Were we to represent Europe by a colour, that colour would undoubtedly be green"(European Commission, 1992, 7).

[17] Increases in both the Gini coefficient and the indicator of regional imbalances mean increases in inequality. However, the country's regional imbalances indicator can be zero if the regional income per capita is equal across all the country's regions. On the other hand, the Gini coefficient will also capture on the distribution of income within every region, hence differentiating between two regions which report the same average income as a result of either equal or unequal distributions. Similarly, the Gini coefficient doesn't capture the geographical dimension of inequality among regions within a country, which we hope to derive through the use of the regional imbalances indicator.

permanent crops, specialist grazing land, specialist granivorous holdings, mixed cropping, mixed livestock, mixed cropping and livestock, and non-classifiable holdings. In all the estimations to follow, specialist grazing land will be the omitted activity (as it is the most common use of agricultural land in the EU).

The second environmental indicator that I am going to use is fertilizer intensity. I employ the same methodology, utilizing a similar mixed linear model, in order to estimate the impact of a country's share of organic agriculture on fertilizer intensity. I expect the impact of organic farming on fertilizer intensity to be negative, whereas I expect all other control variables to have the same sign as in the case of pesticide use, for the reasons that have been outlined above:

$$
\begin{aligned}
logFertilizerIntensity_{kt} = {} & \beta_0 + \beta_1 \times OrganicShare_{kt} + \beta_2 \times Year_{kt} \\
& + \beta_3 \times logGDP_{kt} + \beta_4 \times logGDPsquare_{kt} \\
& + \beta_5 \times EUmembership_{kt} + \beta_6 \times SecondaryEducation_{kt} \\
& + \beta_7 \times Gini_{kt} + \beta_8 \times RegionalImbalances_{kt} \\
& + \beta_9 \times \%PermanentCrops_{kt} + ... + \beta_{17} \times \%NonClassifiedHoldings_{kt} \\
& + b_{k0} + b_{k1} \times Year_{kt} + \epsilon_{kt}
\end{aligned} \tag{3}
$$

Turning to the socio-economic results of organic farming, I use a hierarchical linear model with four levels in order to estimate the determinants of a region's share of organic agriculture. I make use of the fact that each NUTS-2 region is nested within a NUTS-1 region, which in turn is nested within a country. Hence, the share of organic farming in each of the different Farm Structure Surveys is the level 1 unit, NUTS-2 regions are the level 2 units, NUTS-1 regions are the level 3 units and countries are the level 4 units. I am accounting for this clustering by introducing random effects at every level in the hierarchy. I am also allowing the marginal effect of time on the dependent variable to vary randomly across different NUTS-2 regions, thus allowing every NUTS-2 region to have both random intercept and slope. Equation 4 presents the general form of the estimated equation, whereas equation 5 presents the specification which includes all control variables.

$$
\text{Organic Share}_{ijkt} = \mathbf{X_{ijkt}}\beta + \mathbf{Z}^{(4)}_{ijkt} b^{(4)}_{k} + \mathbf{Z}^{(3)}_{ijkt} b^{(3)}_{jk} + \mathbf{Z}^{(2)}_{ijkt} b^{(2)}_{ijk} + \epsilon_{ijkt} \tag{4}
$$

$$
\begin{aligned}
OrganicShare_{ijkt} = {} & \beta_0 + \beta_1 \times Year_{ijkt} + \beta_2 \times logAverageFarmSize_{ijkt} \\
& + \beta_3 \times \%LFA_{ijkt} + \beta_4 \times logGDP_{ijkt} + \beta_5 \times logGDPsquare_{ijkt} \\
& + \beta_6 \times \%RuralPopulation_{ijkt} + \beta_7 \times \%UrbanPopulation_{ijkt} \\
& + \beta_8 \times \%PermanentCrops_{ijkt} + ... + \beta_{16} \times \%NonClassifiedHoldings_{ijkt} \\
& + b_k^{(4)} + b_{jk}^{(3)} + b_{ijk0}^{(2)} + b_{ijk1}^{(2)} Year_{ijkt} + \epsilon_{ijkt}
\end{aligned} \tag{5}
$$

where t=2000, 2003, 2005, 2007, i=1,..., 271 NUTS-2 regions, j=1,..., 97 NUTS-1 regions, and k=1,...., 27 countries.

I proceed to ask what determines the share of organic farming in a region. If policy makers are right to emphasize the connection between organic and small-scale farming, we should find a negative relationship between a region's average farm size and the region's organic share of agriculture[18]. To capture potential relationships between income and organic share, I control for the logarithm of GDP per capita - I am also including a squared term to allow for non-linearities. In addition to income, I also control for a region's utilized agricultural area (UAA) that is classified as Least Favored (LFA). My initial hypothesis is that the share of UAA which gets classified as LFA will have a positive impact on a region's organic share: the reason for this hypothesis is that LFAs are less likely to have undergone the transition to industrial forms of agriculture. Hence, the transition towards organic methods might be easier from a technical standpoint. I also control for the share of population living in rural and urban areas, omitting the share of population living in intermediate areas. Finally, I control for crop and activity patterns, since some activities might be more easily convertible into organic farming.

$$
\begin{aligned}
logLaborIntensity_{ijkt} = {} & \beta_0 + \beta_1 \times Year_{ijkt} + \beta_2 \times logOrganicShare_{ijkt} \\
& + \beta_3 \times AverageFarmSize_{ijkt} + \beta_4 \times \%logGDP_{ijkt} \\
& + \beta_5 \times \%RentedLand_{ijkt} + \beta_6 \times \%LFA_{ijkt} \\
& + \beta_7 \times \%PermanentCrops_{ijkt} + ... + \beta_{15} \times \%NonClassifiedHoldings_{ijkt} \\
& + b_k^{(4)} + b_{jk}^{(3)} + b_{ijk0}^{(2)} + b_{ijk1}^{(2)} Year_{ijkt} + \epsilon_{ijkt}
\end{aligned} \tag{6}
$$

[18]The connection between small farms and organic agriculture is taken, more or less, as given in much of the literature. See Altieri (1987); Lynggaard (2006); van der Ploeg (2009).

Finally, I want to estimate the impact on organic share on a region's average labor intensity. I utilize a similar hierarchical linear model in order to estimate the impact of a region's organic share on the average labor intensity of that region's agricultural sector, hypothesizing that the share of organic land will have a positive impact on labor intensity. Again, I control for the percentage of Least Favored Area and income[19], as well as for the region's crop mix and the country, in which the specific region is located. I also control for the average farm size and the percentage of rented land, as these might be indicators of structural differences in the agricultural sectors of different regions (such as the extent of agricultural wage labor).

4 Environmental dimensions

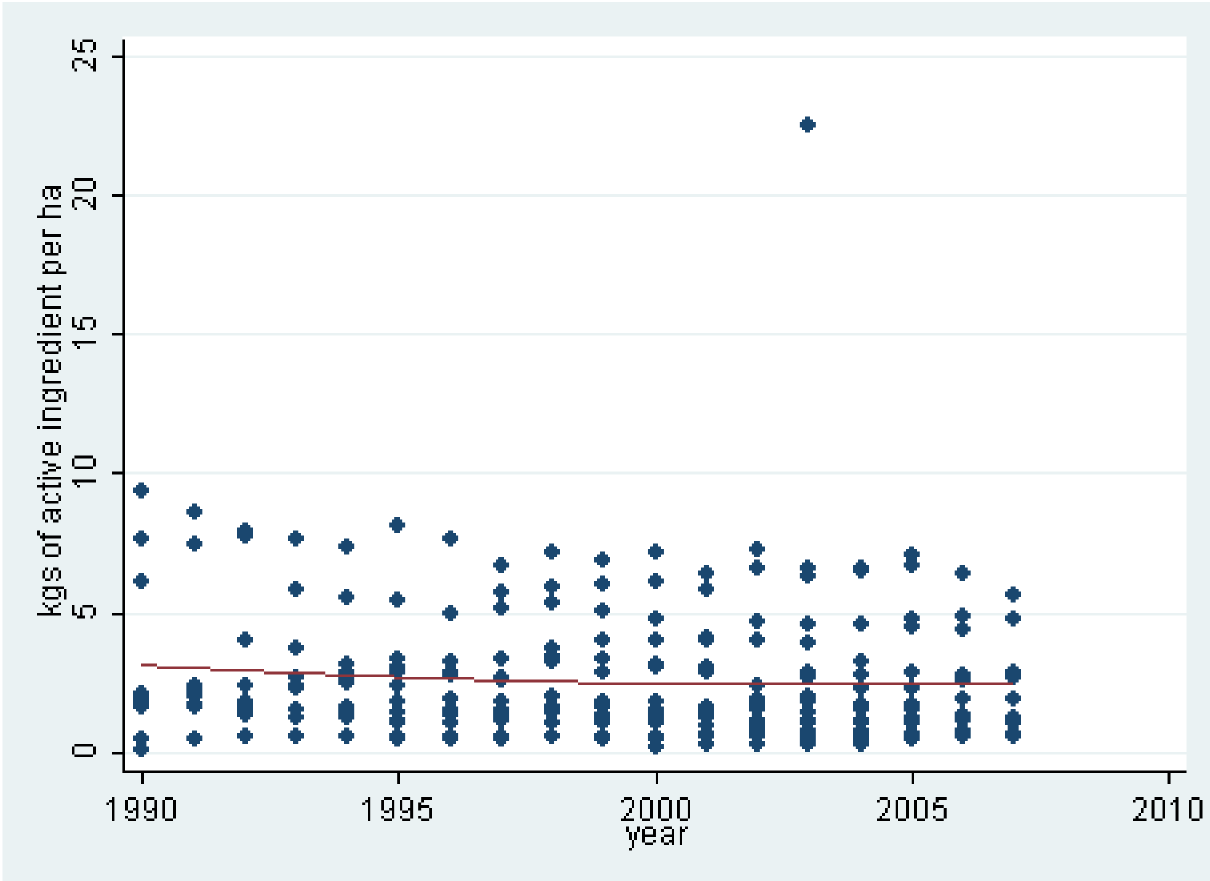
4.1 Pesticide intensity

Figure 1 shows the development of pesticide intensity (measured as kilograms of active ingredient per hectare of utilized agricultural area) in various European countries over the past two decades, whereas figure 2 shows the relationship between the logarithm of pesticide intensity and GDP per capita. We notice that pesticide intensity displays an inverted U-shape, which is consistent with the hypothesis of the environmental Kuznets curve (see Boyce and Torras etc).

Table 1 presents our estimation results. We notice that the organic share of utilized agricultural land in a country appears initially to have a positive impact on a country's pesticide intensity: a 1% increase in the country's share of organic agriculture is related with an increase in pesticide application by 0.04-0.06%, *ceteris paribus*. However, when I control for GDP per capita and GDP per capita square, this impact ceases being statistically different from zero, even though it remains positive in all specifications. The year variable is also positive, and statistically significant in specifications 2-5, showing an increase in pesticide intensity over time. The regressions also point to the existence of an environmental Kuznets curve for pesticide intensity, since the estimates for GDP and GDP-squared are positive and negative respectively, in addition to being statistically significant at the 5% level in most specifications. There is no conclusive evidence regarding the impact of EU membership and education. Interestingly, the Gini coefficient is associated with more intensive pesticide use: this is a first indication that more unequal societies will demonstrate more intensive pesticide use. On the other hand, the coefficient on regional imbalances doesn't yield statistically significant estimates. Finally, the presence of horticulture, permanent crops, and integrated cropping-livestock activities increases

[19] In this estimation, I do not include a squared term for income. There seems to be no theoretical reason why the relationship between labor intensity and GDP would change direction after some level of income.

Figure 1: Pesticide intensity in Europe, 1990-2007

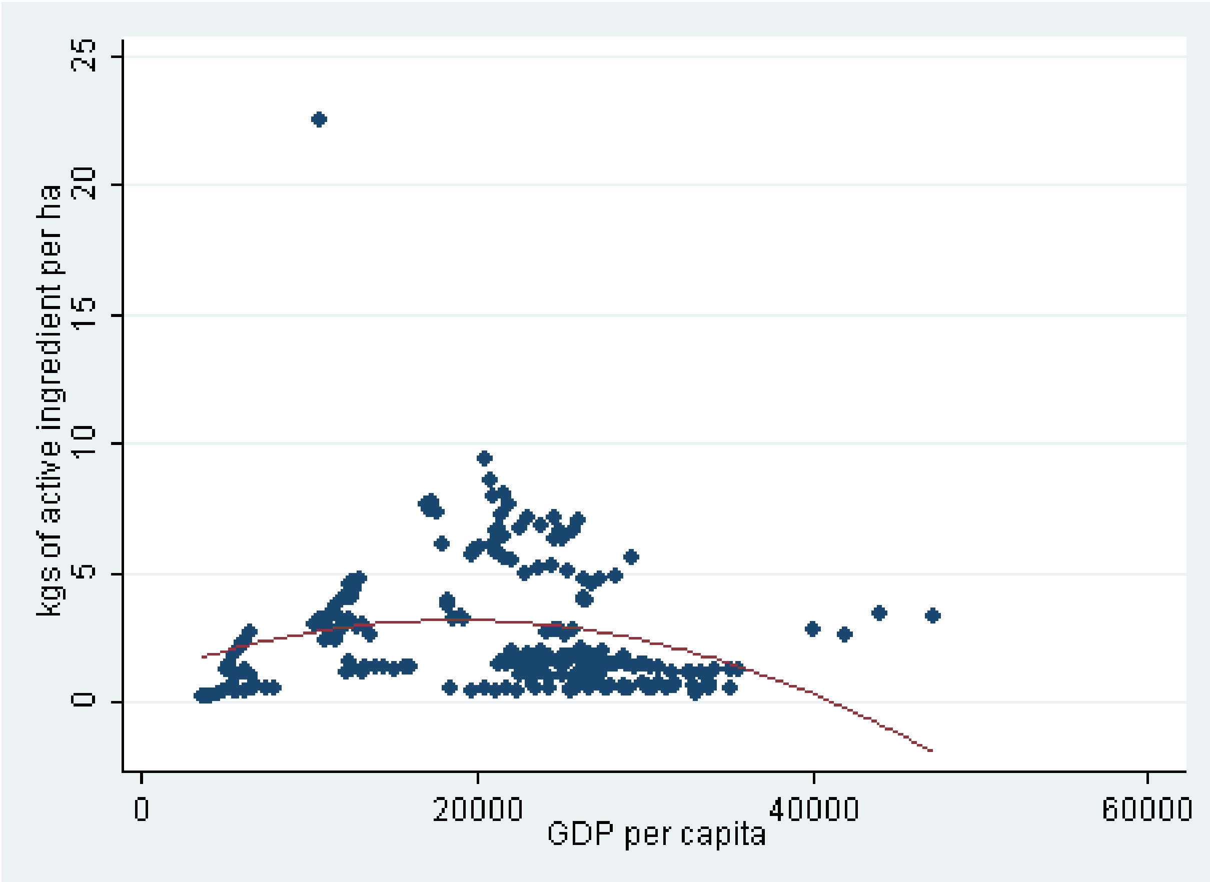


Source: Eurostat

pesticide application *ceteris paribus*.

The positive relationship between organic share and pesticide intensity is puzzling. One plausible explanation could be that conventional farmers use pesticides more intensively if their neighbors go organic, either because they have to deal with more pests, or even preemptively, if they think that their neighbors switch to organic might make them more vulnerable to pests. Hence, the negative direct impact of organic farming on a country's pesticide intensity (positive impact in environmental terms) is counterbalanced by an indirect effect, which is negative in environmental terms. Another explanation could be that organic farming is one among several options in the arsenal of environmental policy-makers for reducing pesticide intensity. It is possible that there is some substitutability between those projects (in the sense that participation in multiple programs requires going through different hoops of paperwork, control, etc,). Thus, it might be

Figure 2: Pesticide intensity and GDP per capita



Source: Eurostat

the case that participation in organic schemes is, in some cases, the “low-hanging fruit”, and that higher reductions in a country’s pesticide intensity can be achieved through programs directly targeting pesticide use, even if they do not banish pesticides altogether, as organic farming does.

Table 1: Determinants of pesticide intensity - Mixed Effects Regression

	Reg11	Reg12	Reg13	Reg14	Reg15	Reg16	Reg17	Reg18
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of Organic Land	.055 (.015)***	.043 (.016)***	.006 (.017)	.014 (.017)	.019 (.018)	.010 (.020)	.006 (.022)	.038 (.025)
Year		.016 (.008)*	.025 (.010)**	.019 (.011)*	.033 (.012)***	.018 (.013)	.021 (.014)	.010 (.016)
Log(GDP)			14.994 (3.795)***	11.842 (4.297)***	10.570 (4.369)**	6.973 (4.927)	7.473 (5.236)	13.602 (6.010)**
Log(GDP)-sq			-.767 (.202)***	-.602 (.228)***	-.540 (.231)**	-.344 (.259)	-.372 (.274)	-.668 (.309)**
EU membership				.154 (.112)	.193 (.115)*	.001 (.156)	-.008 (.171)	-.170 (.178)
Education					-.015 (.007)**	-.009 (.008)	-.010 (.009)	-.003 (.009)
Gini coefficient						.034 (.011)***	.035 (.012)***	.046 (.012)***
Regional Imbalances							-.002 (.014)	5.50e-06 (.013)
% Fieldcrops								.370 (.952)
% Horticulture								52.128 (17.301)***
% Permanent Crops								5.115 (3.042)*
% Granivorous Crops								-3.922 (4.522)
% Mixed cropping								-2.449 (3.753)
% Mixed livestock								3.711 (4.124)
% Mixed crop-livestock								6.672 (2.526)***
% Non-classifiable								-.037 (3.144)
N	110	110	110	110	110	89	86	86
χ^2	13.796	17.683	41.267	43.749	48.293	26.978	26.519	51.042

Table 2: Determinants of fertilizer intensity - Mixed Effects Regression

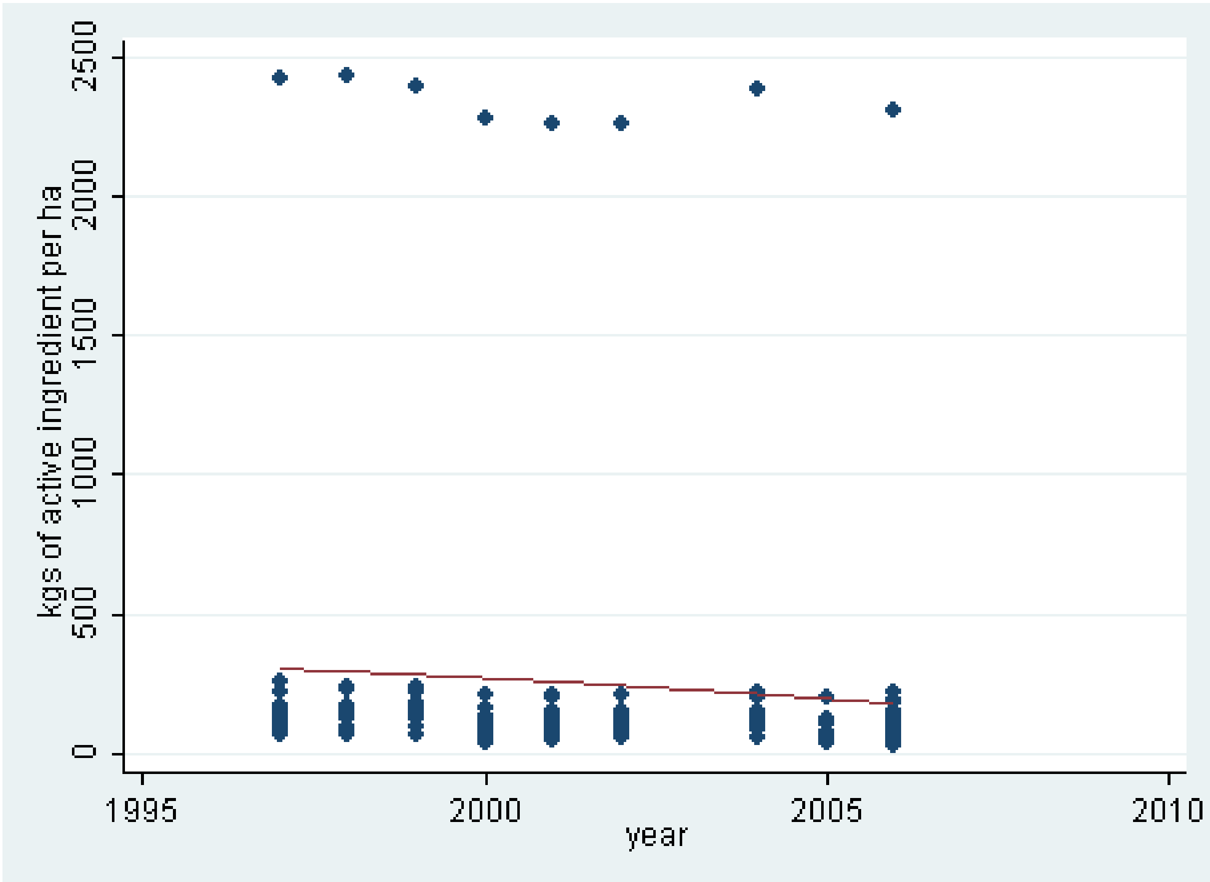
	Reg21	Reg22	Reg23	Reg24	Reg25	Reg26	Reg27	Reg28
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of Organic Land	-.029	-.012	-.016	-.014	-.015	-.015	-.035	-.034
	(.007)***	(.008)	(.008)*	(.009)	(.009)*	(.010)	(.011)***	(.011)***
Year		-.018	-.028	-.029	-.031	-.030	-.021	-.026
		(.004)***	(.006)***	(.006)***	(.008)***	(.009)***	(.008)**	(.011)**
Log(GDP)			-.577	-2.324	-2.095	-2.850	6.744	4.863
			(2.247)	(2.747)	(2.786)	(3.098)	(3.535)*	(3.926)
Log(GDP)-sq			.060	.147	.136	.176	-.336	-.246
			(.119)	(.143)	(.145)	(.161)	(.185)*	(.205)
EU membership				.676	.640	.713	-.209	.130
				(.626)	(.636)	(.657)	(.508)	(.608)
Education					.002	.001	.008	.009
					(.005)	(.005)	(.004)*	(.006)
Gini coefficient						-.002	-.004	.001
						(.008)	(.008)	(.008)
Regional Imbalances							-.0007	-.0007
							(.007)	(.007)
% Fieldcrops								.047
								(.536)
% Horticulture								22.008
								(9.057)**
% Permanent Crops								.081
								(1.542)
% Granivorous Crops								1.472
								(2.780)
% Mixed cropping								-.509
								(2.024)
% Mixed livestock								-2.564
								(2.109)
% Mixed crop-livestock								.224
								(1.212)
% Non-classifiable								-.556
								(1.005)
N	93	93	93	93	93	79	70	70
χ^2	16.175	38.035	56.945	58.385	57.893	48.589	66.872	73.806

4.2 Fertilizer intensity

Figures 3 and 4 present the development of fertilizer intensity after 1997, as well as its relationship with GDP per capita. The obvious outlier is Luxembourg, which illustrates the logic of industrial agriculture at its extreme. Luxembourg has also been recently condemned by the European Court of Justice for not complying with the EU's Nitrates Directive (European Commision, 2010).

Table 2 presents the results of the regression estimating the impact of organic farming on fertilizer use. We notice that the share of land under organic methods of production has a negative impact on

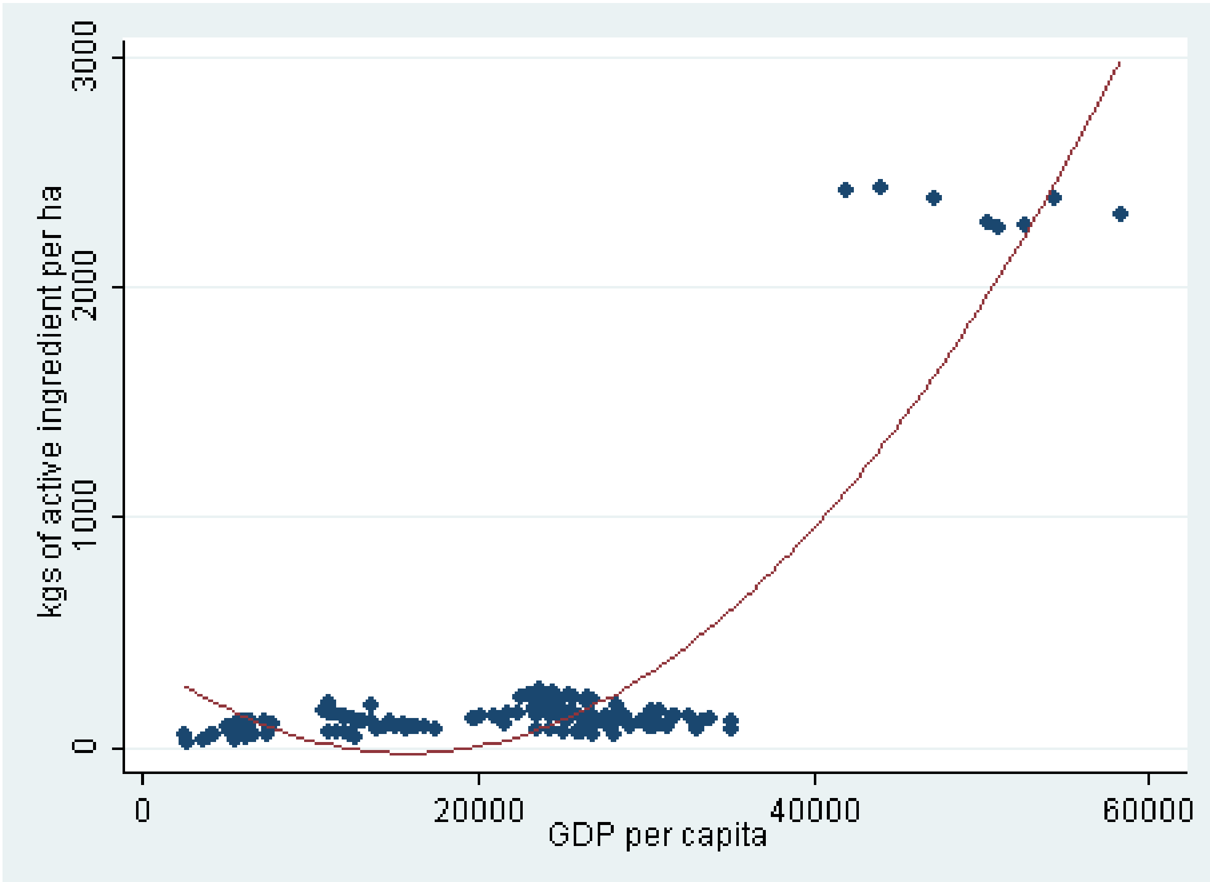
Figure 3: Fertilizer intensity in Europe, 1997-2006



Source: Eurostat

fertilizer intensity, statistically significant in most specifications. A 1% increase in a country's organic share is associated with a fall in its overall fertilizer intensity by 0.02-0.04%. The coefficient of the time variable is negative and statistically significant, suggesting a decrease of fertilizer intensity over time. The coefficients on GDP per capita and GDP per capita squared are inconclusive: they are statistically significant in only one out of six specifications and they suggest an inverted U-shape between fertilizer intensity and per capita income; however, this result cannot support any strong claims about a relationship between income and fertilizer intensity. The same holds for the other controls: EU membership, and the two measures of inequality are not statistically significant in any estimations, whereas the percentage of population having completed secondary education is positive and statistically significant in only one specification. Finally, the only agricultural activity which shows a statistically significant impact on fertilizer intensity is horticulture:

Figure 4: Fertilizer intensity and GDP per capita



Source: Eurostat

a 1% increase in the share of land devoted to horticulture would increase fertilizer intensity by 22%.

Interpreting the results of the regression from an environmental standpoint, it is encouraging that the impact of organic share on fertilizer intensity is negative: this means that the growth in organic farming does in fact have an environmentally beneficial impact on the country's fertilizer intensity, beyond and in addition to the overall trend of limiting fertilizer use. Such a result can also be explained by the lack of obvious spillover effects: compared to pesticides, it is more unlikely that a farmer will apply more fertilizer because her neighbor switched to organic methods of production. Among the different impacts of farming activities on the environment, I would like to point out the impact of horticulture on fertilizer (and pesticide) intensity. Welcome though it may be, the switch to organic methods is hardly a panacea for environmental problems, especially if organic farming is associated with the least intensive activities, such as grazing. Hence, in order to tackle the environmental problems of European agriculture, it becomes imperative to lessen the ramifications of the most intensive agricultural activities (such as European horticulture).

5 Socioeconomic dimensions

5.1 Where does organic farming become prominent?

As figure 5 shows, the area under organic methods has grown rapidly in the European Union during the first decade of the 21st century. However, a look at table 3 reveals that the number of organic farms hasn't followed the same path. At least in several EU countries, the number of organic farmers has stagnated, or even decreased as compared to 10-15 years ago.

Figure 5: Organic area in the EU - 2000 to 2007 (Source: Eurostat)

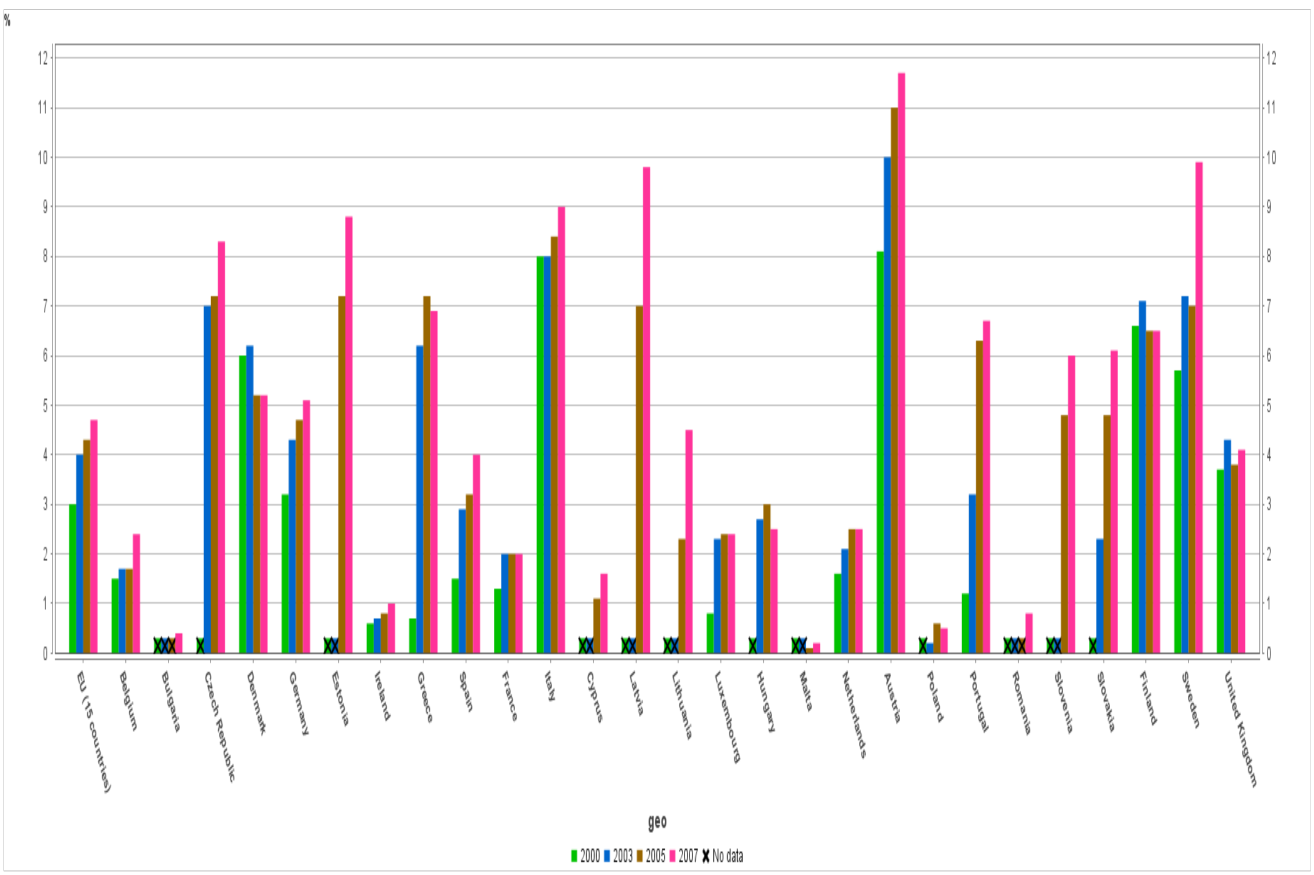


Table 3: Number of organic farms, by country

	1985	1990	1993	1995	1997	2000	2003	2005	2007
AT	420	1539	9713	18542	19996	18880	17880	18760	18200
BE	50	160	160	193	291	580	530	550	490
CZ	NA	30	132	187	192	NA	510	600	750
DK	130	523	640	1050	1617	2520	2600	2440	2110
FI	60	671	1599	2793	4381	4900	4280	4020	3620
FR	2500	2700	3231	3538	4784	7060	8610	9010	8910
DE	1610	4188	11248	15055	12368	9570	11420	13480	13580
EL	NA	25	165	568	2514	1460	7550	9610	27700
IR	8	150	162	378	808	1560	670	590	610
IT	600	1500	4656	10630	30844	45710	38470	41000	39140
LU	10	10	12	19	23	20	40	50	50
NL	215	399	455	561	810	710	1140	1190	1160
PT	1	50	90	331	278	810	900	880	1190
ES	264	350	753	1042	3526	17160	10270	14450	15920
SE	150	1859	1876	4206	10869	9040	15040	2810	2940
UK	300	700	655	828	1026	1690	2750	2900	3210

Source: Michelsen (2001), Eurostat

As explained in section 3, I utilize a hierarchical linear model in order to estimate the determinants of the share of organic farming in the different regions of Europe. Since the Farm Structure Survey has included questions about organic farming only since 2000, I only have relevant regional data from the last 4 surveys, which were conducted in 2000, 2003, 2005 and 2007.

The main relationship of interest in my analysis is between the share of organic land and the average farm size of the region. The estimation results point to a positive relationship between organic share and average farm size (statistically significant in all but one specification). Hence a 1% increase in average farm size is associated with a rise in organic share by about 0.01%; a doubling in the average farm size is related with an increase in the share of organic land by approximately 1%, *ceteris paribus*. As one can see, the coefficient on the year variable is positive and statistically significant in the first four specifications, but its impact becomes less clear when I add controls for the percentage of rural and urban population in a region. The percent of least favored area in a region doesn't seem to have a significant impact on a region's organic share. Neither per capita income nor the breakdown of rural/urban breakdown of population seems to have a strong relationship with the popularity of organic. Finally, a higher share of permanent crops in the region's agricultural area seems to be correlated with a higher share of organic farming (a 1% increase in the share of permanent crops is correlated with a rise in organic land by 0.05%, *ceteris paribus*), whereas field crops seem to be correlated with less organic farmland (a 1% increase in the share of field crops is related with a drop in organic land by 0.02%).

Table 4: Determinants of organic share - Hierarchical model

	Reg31	Reg32	Reg33	Reg34	Reg35	Reg36	Reg37
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average Farmsize	.010	.009	.009	.008	.008	.005	.009
	(.003)***	(.003)***	(.003)***	(.003)***	(.003)***	(.003)	(.004)**
Year		.002	.002	.002	.002	-.0002	-.0005
		(.0004)***	(.0004)***	(.0004)***	(.0004)***	(.0007)	(.0007)
% LFA				.011	.009	-.002	-.0003
				(.019)	(.019)	(.021)	(.021)
Log(GDP)					.100	.119	.093
					(.074)	(.080)	(.082)
Log(GDP)-sq					-.005	-.006	-.005
					(.004)	(.004)	(.004)
% Rural population						.012	.011
						(.008)	(.008)
% Urban population						-.008	-.006
						(.007)	(.008)
% Fieldcrops							-.020
							(.012)*
% Horticulture							-.056
							(.113)
% Permanent Crops							.054
							(.025)**
% Granivorous Crops							-.140
							(.114)
% Mixed cropping							.026
							(.053)
% Mixed livestock							-.084
							(.068)
% Mixed crop-livestock							-.033
							(.029)
% Non-classifiable							.016
							(.057)
N	975	975	975	953	951	709	709
χ^2	13.807	31.504	31.504	30.455	33.079	14.203	31.539

Obviously, it is difficult to find some all-encompassing variables that explain the rise of organic farming in places with very diverse political, economic, and specifically agricultural, histories. However, the fact that regions with a larger average farm size are more likely to have a higher share of organic agriculture disproves the assumed association of organic farms with small farm size and presents us with a more complicated reality than what policy makers or environmentalists often assume to exist. If organic farming is more prevalent in regions with larger average farm size, the association between small farms and organic methods doesn't seem to be as natural as often assumed.

5.2 Labor intensity

Organic farming is often assumed to be inextricably interwoven with high labor intensity[20]. Thus, organic farming is presented as a tool for keeping people in the countryside. Whether the switch towards organic practices actually has a significant impact on a region's agricultural employment needs to be shown. Hence, it becomes necessary to inquire whether organic farming does impact a region's agricultural labor intensity in a positive manner.

Table 5 provides a first approximation of the research question, by comparing labor intensity at the country level (measured as annual work units per hectare) for conventional and organic farms. We notice that organic farms display higher labor intensity than conventional farms only in the cases of France and Luxembourg (in Austria, Cyprus and Ireland that ceased to be the case during the last decade). Hence, I proceed to examine the relationship between labor intensity and organic share of agriculture at the regional level, while controlling for other characteristics.

Table 6 presents the results of the estimated hierarchical linear model. Contrary to my hypothesis, we notice the persistence of a strong negative relation between a region's organic share and its average agricultural labor intensity (a 1% increase in organic share is related with a drop in a region's agricultural labor intensity by 0.28-0.77%). Any negative effects of the year coefficient disappear when controlling for GDP per capita. As expected, there is a strong negative relationship between a region's average farm size and its average labor intensity; smaller farms are more likely to apply labor more intensively (a 1% decrease in average farm size is related with a rise in labor intensity by approximately 0.62-0.68%). Additionally, the coefficient on GDP per capita shows that richer areas will display lower agricultural labor intensity. The extent of rental arrangements on land increases average labor intensity, probably because less land is idle, whereas more Least Favored Agricultural Area means less intensively used land. Finally, horticulture, permanent crops, granivorous cropping and mixed livestock activities mean a more intensive use of land than grazing land.

[20]See van der Ploeg et al. (2002) or van der Ploeg (2009) for illustrations of analysis which equates organic farming with peasant processes.

Table 5: Labor intensity per hectare, by type of farm

	2000		2003		2005		2007	
	Conv	Org	Conv	Org	Conv	Org	Conv	Org
EU-27							0.064	0.033
EU-25					0.057	0.034	0.054	0.033
EU-15	0.045	0.034	0.046	0.032	0.044	0.034	0.042	0.032
Austria	0.052	0.056	0.053	0.055	0.050	0.049	0.050	0.049
Belgium	0.052	0.042	0.050	0.041	0.048	0.037	0.046	0.026
Bulgaria			0.26		0.22		0.15	0.11
Cyprus			0.18	0.20	0.17	0.22	0.17	0.14
Czech Rep.			0.043	0.016	0.040	0.015	0.038	0.017
Denmark	0.024	0.022	0.022	0.019	0.022	0.019	0.020	0.019
Estonia			0.046	0.024	0.043	0.023	0.035	0.022
Finland	0.044	0.037	0.041	0.034	0.035	0.030	0.030	0.026
France	0.031	0.040	0.030	0.034	0.028	0.031	0.026	0.032
Germany	0.035	0.033	0.038	0.032	0.035	0.029	0.033	0.029
Greece	0.14	0.16	0.13	0.087	0.13	0.079	0.12	0.079
Hungary			0.12	0.035	0.11	0.032	0.092	0.028
Ireland	0.037	0.040	0.037	0.039	0.035	0.033	0.035	0.030
Italy	0.092	0.050	0.10	0.055	0.097	0.060	0.092	0.046
Latvia	0.10	0.14	0.092	0.052	0.079	0.044	0.059	0.039
Lithuania			0.087	0.065	0.077	0.042	0.067	0.027
Luxembourg	0.034	0.039	0.030	0.033	0.030	0.031	0.028	0.034
Malta			0.41		0.39		0.41	
Netherlands	0.095	0.067	0.086	0.050	0.082	0.062	0.079	0.072
Poland			0.15		0.15	0.077	0.14	0.062
Portugal	0.12	0.016	0.11	0.013	0.10	0.014	0.091	0.018
Romania			0.18		0.17	0.017	0.15	0.057
Slovakia	0.061	0.027	0.054	0.020	0.051	0.021	0.045	0.020
Slovenia	0.21	0.16	0.19		0.19	0.11	0.16	0.085
Spain	0.033	0.021	0.032	0.016	0.032	0.021	0.032	0.018
Sweden	0.023	0.021	0.022	0.021	0.021	0.016	0.020	0.015
UK	0.021	0.013	0.021	0.016	0.020	0.014	0.020	0.016

Source: Eurostat

Table 6: Determinants of average labor intensity - Hierarchical model

	Reg41 (1)	Reg42 (2)	Reg43 (3)	Reg44 (4)	Reg45 (5)	Reg46 (6)	Reg47 (7)
% Organic area	-.767	-.488	-.279	-.285	-.321	-.310	-.282
	(.133)***	(.121)***	(.116)**	(.111)**	(.111)***	(.113)***	(.112)**
Year		-.018	-.004	-.0004	-.0003	8.89e-06	-.002
		(.001)***	(.001)***	(.002)	(.002)	(.002)	(.002)
Average Farmsize			-.680	-.643	-.649	-.657	-.624
			(.022)***	(.023)***	(.023)***	(.023)***	(.024)***
Log(GDP)				-.222	-.229	-.198	-.172
				(.042)***	(.041)***	(.042)***	(.041)***
% Rental arrangements					.140	.140	.188
					(.058)**	(.060)**	(.059)***
% LFA						-.241	-.174
						(.075)***	(.075)**
% Fieldcrops							.034
							(.073)
% Horticulture							3.566
							(.539)***
% Permanent Crops							.449
							(.148)***
% Granivorous Crops							1.537
							(.440)***
% Mixed cropping							-.121
							(.218)
% Mixed livestock							.700
							(.259)***
% Mixed crop-livestock							-.031
							(.118)
% Non-classifiable holdings							-.430
							(.128)***
N	966	966	966	964	964	942	942
χ^2	33.082	213.111	1200.276	1122.941	1132.656	1132.714	1376.803

6 Discussion

The preceding sections cast doubt on the effectiveness of organic farming for achieving both the environmental and the socio-economic objectives that they are purported to assist. Our analysis shows that there is a strong relationship between a higher share of organic farming and lower application of fertilizer in a country. However, the picture is less clear when it comes to pesticides, as a higher share of organic land is not correlated with less intensive pesticide use in our sample. Pesticide intensity seems to have a relationship with income which follows the patterns of the Environmental Kuznets Curve, where more unequal countries display higher rates of pesticide use (controlling for income). Finally, among the various agricultural activities, horticulture has the most stark results on both pesticide and fertilizer intensity.

I believe that these environmental results point to the limitations of organic farming as a transformative force. Beyond the need for further-reaching policies which would include addressing inequality, they invite us to rethink the level at which sustainability is to be conceptualized. The European agricultural policies have so far focused on convincing individual farmers to switch to organic methods; however, if the actions of conventional farmers effectively counteract the positive environmental impact of organic farmers, the pressure on a region's ecosystems will hardly be lessened. Thus, I argue that the question of transition towards organic farming (and towards more sustainable production processes, in general) needs to treat entire regions, rather than individual farmers, as subjects[21].

Even if we consider the environmental results to be mixed, the socio-economic results portray an even less optimistic picture. The data points to a positive relationship between a region's share of organic land and the region's average farm size. This result, which disproves the idea that organic farming is "naturally" intertwined with small-scale farming, can be explained in a variety of ways. Even if small producers are less likely to follow intensive methods of production, their transition towards certified organic methods requires a series of conditions that they cannot necessarily secure as easily as larger farms (such as access to markets or credit). Additionally, since agricultural officials are measuring the success of agri-environmental projects by land coverage as a share of utilized agricultural area, it is easier and faster to achieve their targets by the transition of a few large producers, rather than by many small ones. Hence, organic farms are not representative farms, which might be why agricultural labor intensity does not increase as a result of the rise in the share of organic land. Instead, as I show, labor intensity is lower in regions which have larger organic sectors, controlling for a series of other factors.

What the previous statistical analysis does not (and possibly cannot) show, is the transformations which occur in rural Europe. The growth of organic farming, in many cases, does not result from farmers deciding to switch into organic. It comes through the consolidation of holdings which were previously conventional and the exit of farmers from production.

Table 7 displays the trends in the numbers of organic producers and organic land in Europe during the 2000s. The elements on the diagonal represent regions which experienced a positive relationship between the number of producers and their land, whereas the upper off-diagonal elements represent regions in which organic farmers are under pressure. The lower off-diagonal elements display the existence of an unambiguous

[21] The *Bioregionen* in Austria are good examples of cases where each farmer's decision to switch towards organic farming is treated as part of a larger plan of the community to achieve sustainability. For more on these initiatives, see Schermer (2003, 2008).

process of concentration of organic land[22]. Thus, in 30 regions the number of organic farmers decreases while organic land increases, whereas in 7 other regions organic land either increases with the number of organic producers unchanged or the number of organic farmers decreases with organic area unchanged. Hence, in a significant number of regions, "rise in organic farming" means a rise in the organic share of agricultural land, without a rise in the number of organic producers. Such a development puts in question the longevity of the "organic movement" and its potential for influencing agricultural practices. Contrary to popular misconception which equates organic with "doing nothing" (because nature presumably does everything), organic farming is a knowledge-intensive activity, which is based on constant experimentation (Kummer and Vogl, 2009; Milestad et al., 2010). Hence, the proliferation and the deepening of organic practices become precarious unless they are widespread among a large number of farmers.

Table 7: Regional trends, 2000-2007

	Organic land		
Organic producers	Increase	Unchanged	Decrease
Increase	161	1	4
Unchanged	4	17	5
Decrease	30	3	43

Table 8 shows the rapid changes that occurred in the agricultural sectors of selected regions of Europe, which experienced an increase of organic land during the first years of the 21st century. We notice that in all these areas, there is a dramatic decrease in the numbers of conventional producers and in the area taken out of conventional production. However, the number of organic producers does not increase significantly (and in some cases even goes down) in those areas. Hence, part of the area taken out of conventional production is converted into organic land; however, that process is concomitant with a process of concentration of land into fewer hands.

I present more evidence of the discrepancy between conventional and organic farms in the statistical appendix, in tables A.1, A.2 and A.3. Whereas the average organic farm size in the EU-27 is 40.4 ha, the average conventional farm size is 12.3 ha, a pattern which is present in all European countries. Additionally, organic farms are more likely than conventional farms to assume a corporate legal status (5.2% of organic farms are corporate entities, compared to only 1.9%), and to rent land additionally to the land they own

[22] Such a process can be occurring even if both organic producers and organic land are moving in the same direction, as is the case in most regions.

Table 8: Changes in selected regions, 2000-2007

Region	Change in Organic Producers	Change in Organic Land	Change in Conventional Producers	Change in Conventional Land
Luxembourg (BE34)	10	2,500	-990	-1,940
Yugozoitchen (BG34)	20	1,220	-33,530	-21,440
Central (CZ06)	10	16,790	-2,080	-21,500
Freiburg (DE13)	-90	6,240	-5,360	-22,080
Kassel (DE73)	-10	4,410	-3,460	-3,210
Hovedstaden (DK01)	10	2,200	-220	-5,340
Castile-La Mancha (ES42)	-260	7,990	-25,010	-105,480
Extremadura (ES43)	-1,360	39,850	-12,540	-259,330
Balearic Islands (ES53)	-10	3,960	-1,920	-30,000
Brittany (FR52)	-50	7,120	-13,510	-50,580
Auvergne (FR72)	10	4,860	-5,780	-16,300
Central Hungary (HU10)	-170	8,290	-19,660	-19,610
Northern Great Plain (HU32)	-150	27,550	-71,280	-57,010
Southern Great Plain (HU33)	-290	9,950	-74,880	-113,320
Southern and Eastern (IE02)	0	1,870	-2,670	32,330
Sicily (ITG1)	-1,980	57,230	-56,400	-61,290
Flevoland (NL23)	40	4,690	-380	-7,910
Alentejo (PT18)	30	18,690	-17,370	-269,310
Eastern Slovakia (SK04)	60	38,660	-490	-128,830
Northern Ireland (UKN0)	-40	560	-3700	-36,420

(42.1% of organic farms rent land, whereas only 16.9% of conventional farms do), both of which are elements associated with a capitalist organization of production. Finally, as table A.4 shows, average labor power (measured in terms of annual full-time equivalent) is larger in organic farms, despite the lower labor intensity per hectare. Interestingly, these differences are present in all countries of Europe. Hence, the assertion that the results are driven by either the former socialist countries, which experienced structural transformations in the 1990s, or by countries, with a feudalist agrarian past, is rendered highly improbable.

There are several ways to interpret these results. One way, which is consistent with Marxist literature, is to speak of a phenomenon that points to concentration and centralization of capital (Panitsidis, 1992; Liodakis, 1994; Economakis, 2000; Tolios, 2009). Basically, the claim made by these authors is that the CAP attempts to facilitate the penetration of capital in the agricultural sector, a phenomenon predicted by Kautsky (1988) and Lenin (2004). Consequently, even if they assert the protection of the family farm as their political priority, all policies falling under the CAP ultimately support capitalist structures and attempt to create these, when they don't exist. Hence, the support for organic farms should be considered, more or less, a pretense for the further intrusion of capital in the agricultural sector.

Another way, which is consistent with development literature and which avoids attributing bad intentions to those designing and implementing the CAP, would be to think in terms of technology diffusion[23]. Drawing lessons from the Green Revolution, one could argue that, for reasons of higher income, access to credit, political power, education, and ability to take risks, large farmers are more likely to differentiate partly or to transition wholly to organic production earlier than small farmers. Institutional biases, such as minimum land requirements for a holding to be certified as organic, might accentuate those biases and, by conferring first-mover advantages to the large farmers, exclude the smaller farmers from switching over to organic production, even after the removal of those obstacles.

In fact, these two approaches, are in some ways not completely antithetical; one could argue that the characteristics of the large farmer, described by the development literature, could accelerate the processes of concentration and centralization. In the absence of strong farmers' associations or local food networks, small organic farmers cannot establish their position as easily as larger ones. Certification is more expensive for smaller farms in comparison to larger ones, allowing them to retain a smaller part of the subsidy they receive. If they do not associate with other organic farmers, they still have to pay high interest rates to banks, and high procurement prices to input providers, while their access to the markets is not guaranteed, because of their small volume of production. To give an example of the latter, Greek organic farmers often resort to selling their organic production as conventional, because the small number of organic merchants in the country do not want to deal with small volumes of products. Furthermore, larger farms are more likely to be able to afford the services of agronomists specialized in tackling production problems associated with organic farming. In the absence of the technical (and even psychological) support of a community of other organic farmers, the small producers are likely to be discouraged, exiting production and selling their land(Konstantinidis, 2011). The fact that several regions experience either a decrease or stagnation in the number of organic farmers points to the inability of the adoption/diffusion framework, while the persistence of significant differences in the economic characteristics of the different types of farms, points to institutional factors that act as barriers to entry for smaller farmers.

I believe that the results presented in the previous sections confront European policy-makers with a serious problem. They challenge the idea that small farms, who theoretically should be presented with fewer problems than larger farms for the transition to (certified) organic processes, actually take advantage of the new policies. Hence, it becomes difficult to articulate the claim that the discrepancy between organic and conventional farms is a temporary phenomenon, happening for reasons advanced by the adoption/diffusion

[23]See, for example, Feder and O'Mara (1981) or Albrecht (1974).

framework, which would be ameliorated over time with the growing appearance of organic methods. The same institutional factors allow larger farms to generate super-profits and also to receive surplus transfers in the form of pecuniary transfers for the provision of environmental services. Thus, the organic sector develops forms of production which deviate more and more from the social and environmental ideals of the more radical segments of the organic movement. Hence, the creation of large farms which specialize in monocultures and sell in distant markets, but abstain from using chemicals and pesticides, is evidence of the "conventionalization" of organic farming.

7 Concluding remarks

Industrial agriculture proved to be incompatible with citizens' demand for quality of life and provision of safe food. Organic agriculture can provide society with a solution to many of the problems created by intensive methods of agricultural production. However, and despite the strong support of European agricultural policies, my analysis shows that the rise of organic agriculture in Europe has fallen short of producing the socio-economic benefits which policy-makers and environmentalists generally associate with it. Organic methods seem to be connected with larger farms, both in terms of land size and in terms of labor, disproving the association between small-scale, family farming and organic methods, which is often held as an axiomatic truth. Finally, organic farming in Europe has not contributed to increases in the labor intensity of the agricultural sector, casting doubts on the efficacy of organic farming for increasing labor demand in marginalized communities and acting as an effective tool for keeping rural residents in the countryside.

The problem, however, does not lie in organic farming *per se*. European agricultural policies have measured success in a region's transformation towards "greener" methods in agriculture by the share of organic land in its utilized agricultural area, while treating social dimensions as mechanically derivative of the growth in organic farming. Thus, the failure of these rural development policies to fulfill their social goals is unsurprising. One element that these policies failed to recognize is the significance of strong agricultural cooperatives and other effective forms of farmers' associations. The latter would empower small farmers, helping them to avoid paying large rents to certifiers, finance and input providers and merchants, while providing them with the economic and technical support to compete effectively against larger-scale farms. At the same time, these forms of organization could effectively enforce high standards in the treatment of labor, while moving towards more ecologically sustainable methods of production.

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A Statistical Appendix

Table A.1: Size of average farm

	2000		2003		2005		2007	
	Conv	Org	Conv	Org	Conv	Org	Conv	Org
EU-27							12.3	40.4
EU-25					15.7	42.4	16.4	40.6
EU-15	18.4	33.4	19.3	40.1	20.5	39.8	21.2	38
Austria	16.7	20.0	18.4	21.3	18.7	22.9	18.9	22.3
Belgium	22.4	43.0	25.2	43.8	26.7	45.3	28.4	52.9
Bulgaria			4.4		5.1	64.3	6.2	84.7
Cyprus			3.5	5.6	3.3	6.2	3.6	8.0
Czech Rep.			75.7	402.6	79.7	398.6	84.5	334.6
Denmark	45.3	56	54.2	63.3	52.0	61.5	59.2	68.3
Estonia			21.1	86.6	28.9	70.2	37.4	73.3
Finland	27.1	31.4	29.7	34.2	31.8	36.3	33.3	39.7
France	41.9	46.9	45.1	56.5	48.5	60.2	52.0	59.8
Germany	36.0	51.1	40.8	55.2	43.2	56.4	45.2	58.5
Greece	4.4	4.8	4.7	11.7	4.7	12.9	4.5	10.7
Hungary	4.6	68.8	5.4	197.6	5.7	193.0	6.5	350.3
Ireland	31.5	26.8	31.7	29.3	31.8	34.2	32.2	38.3
Italy	5.8	18.0	6.4	19.6	7.0	21.5	7.2	24.3
Latvia	10.3	7.6	11.6	36.3	13.0	64.8	15.7	44.8
Lithuania			9.1	90.6	10.9	41.7	11.1	71.0
Luxembourg	45.3	51.5	52.3	52.8	52.6	58.2	56.8	63.8
Malta			1.0		0.9		0.9	
Netherlands	19.9	30.7	23.0	58.4	23.7	40.4	24.7	42.8
Poland					5.9	23.0	6.4	25.4
Portugal	9.0	145.8	10.0	157.7	10.9	172.0	12.1	127.1
Romania			3.1		3.3	143.2	3.5	19.0
Slovakia	29.7	854.8	28.6	1402	26.7	737.4	26.5	588.1
Slovenia	5.6	8.6			6.2	13.9	6.3	15.9
Spain	20.1	40.1	21.7	67.8	22.6	55.2	23.3	57.9
Sweden	36.0	51.4	44.7	50.8	40.3	89.9	40.6	97.4
UK	66.6	222.1	56.1	187.6	54.4	177.9	52.7	154.0

Table A.2: Percent of corporate farms

	2000		2003		2005		2007	
	Conv	Org	Conv	Org	Conv	Org	Conv	Org
EU-27							1.9	5.2
EU-25					2.4	5.4	2.5	5.2
EU-15	2.7	4	2.9	4.7	3.5	5.3	3.7	5.2

Table A.3: Percent of farms renting land

	2000		2003		2005		2007	
	Conv	Org	Conv	Org	Conv	Org	Conv	Org
EU-27							16.9	42.1
EU-25					22.6	42.4	23.6	42.5
EU-15	24.9	37.2	27.5	46.3	22.6	42.4	23.6	42.5

Table A.4: Average labor (annual full time equivalent), by type of farm

	2000		2003		2005		2007	
	Conv	Org	Conv	Org	Conv	Org	Conv	Org
EU-27							0.78	1.32
EU-25					0.89	1.44	0.89	1.32
EU-15	0.84	1.12	0.89	1.30	0.90	1.37	0.88	1.23
Austria	0.88	1.12	0.97	1.18	0.93	1.13	0.95	1.1
Belgium	1.17	1.56	1.27	1.74	1.29	1.55	1.30	1.42
Bulgaria			1.15		1.12	2	0.95	3
Cyprus			0.64	1.1	0.56	1.38	0.60	1.14
Czech Rep.			3.37	6.4	3.33	6.22	3.36	5.73
Denmark	1.1	1.23	1.2	1.23	1.13	1.14	1.2	1.26
Estonia			0.99	1.97	1.28	1.59	1.33	1.59
Finland	1.21	1.16	1.23	1.14	1.11	1.10	0.99	1.03
France	1.28	1.87	1.33	1.90	1.34	1.90	1.35	1.92
Germany	1.26	1.66	1.56	1.77	1.51	1.66	1.49	1.68
Greece	0.63	0.74	0.62	1.02	0.61	1.02	0.56	0.84
Hungary			0.65	6.91	0.63	6.91	0.62	9.52
Ireland	1.16	1.06	1.16	1.15	1.12	1.12	1.13	1.16
Italy	0.53	0.91	0.67	1.08	0.70	1.30	0.69	1.11
Latvia	1.01	1.06	1.07	1.86	1.03	2.86	0.94	1.76
Lithuania			0.79	5.64	0.85	1.77	0.76	1.89
Luxembourg	1.55	2	1.58	1.75	1.58	1.80	1.59	2.20
Malta			0.41		0.37		0.38	
Netherlands	1.91	2.06	2.02	2.89	1.95	2.48	1.95	2.97
Poland				0.89	1.77	0.92	1.57	
Portugal	1.14	2.34	1.16	2.08	1.14	2.35	1.14	2.29
Romania			0.56		0.57	2.29	0.52	0.87
Slovakia	1.85	20	1.58	21.8	1.38	15.6	1.24	12.2
Slovenia	1.20	1.36			1.16	1.45	1.06	1.36
Spain	0.66	0.83	0.70	1.06	0.74	1.16	0.75	1.04
Sweden	0.86	1.08	0.98	1.05	0.88	1.41	0.85	1.47
UK	1.43	2.90	1.17	3.06	1.10	2.49	1.04	2.45

Source: Eurostat