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Article

Promoting organic food production through flagship regions

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Abstract

Mitigating the environmental impact of agriculture is a major issue in negotiations on the future of the European Union's Common Agricultural Policy. Organic farming is commonly put forward in these discussions as a promising way to reduce the negative environmental impact of agriculture. Consequently, different promotional strategies aiming at the adoption of organic farming practices have been developed. In 2013, the German federal state of Bavaria initiated an innovative programme that resulted in 'organic flagship regions' being appointed in the years that followed. These regions are allocated support with the main goal of motivating farmers to switch to organic production. By applying a difference-in-differences estimator, we evaluate whether the programme has achieved its aims, i.e. whether more farmers have adopted organic farming practices within the flagship regions as compared to farmers outside such regions. The Theory of Planned Behaviour provides the conceptual framework to identify the main factors influencing a farmer's decision to go organic. Our results suggest that the programme fails to motivate farmers to switch to organic production and that there is a need to more effectively target decision-influencing factors.

Keywords: Policy evaluation, Organic farming, Agricultural policy, Theory of planned behavior, Choice modelling.

JEL codes: Q12, Q18

1. Introduction

The past six decades have seen a rapid increase in worldwide agricultural production. Advances in crop cultivation and livestock breeding as well as in the application of mechanization and innovative agricultural practices, mineral fertilizers and pesticides have resulted in a dramatic boost in productivity. While this development has helped to strengthen global food security, it has also placed a serious burden on the environment and continues to do so through modern, intensive agriculture (Matson et al. 1997; Tilman et al. 2001; Foley et al. 2005; Pingali 2012; Smith et al. 2013; Bowler et al. 2019). The more evidence scientists around the world have gathered on the environmental footprint of this type of farming over the years, the faster consumer concerns regarding food safety and environmental pollution caused by intensive land-use have grown. In the late 1980s, the agricultural sector and policy makers in Europe reacted by rediscovering, developing, and promoting food production practices that are less harmful to the environment. Organic farming[1] is one of these practices, and it has gained considerable attention thanks to the holistic approach that it takes. The

1992 MacSharry reform of the Common Agricultural Policy (CAP) eventually made it an essential element of European agricultural policy, which since then grants financial support to organic farms through member states' agri-environment programmes.[2] In stimulating the uptake of organic farming, European decision-makers draw upon research promoting it, under certain assumptions, as a solution to sustainable food security challenges (Badgley et al. 2007; Erb et al. 2016). It is indeed the case that organic agriculture performs better than conventional farming with regard to water protection (van Huylenbroek et al. 2009; Benoit et al. 2015), soil fertility (Gomiero, Pimentel, & Paoletti 2011; Crittenden & Goede 2016), biodiversity (Bengtsson, Ahnström, & Weibull 2005; Crowder et al. 2012) and resource efficiency (Lin et al. 2017; Thünen-Institut 2019), at least per unit of area. However, in terms of product units, organic farming practices do not necessarily have a lower environmental impact than conventional methods (Tuomisto et al. 2012; Seufert & Ramankutty 2017). It is this finding, in combination with the yield gap of 20–25 per cent between organic and conventional systems (Ponti, Rijk, & van Ittersum 2012; O. M. Smith et al. 2020) that has brought authors like Reganold and Wachter (2016) or Seufert and Ramankutty (2017) to the conclusion that a mix of organic and other innovative agricultural systems is needed in order to safely feed the planet.

Organic farming thus seems to represent an important element of a group of strategies designed to improve the sustainability of both current and future food systems. Naturally, its promotion remains high on agri-environmental policy agendas—especially as only 1.5 per cent of the world's farmland is organically managed (Schlatter et al. 2020, p. 36). In the European Union (EU), this share reaches 7.5 per cent (Eurostat 2020c). In line with the EU's current plans to adjust the profile of the CAP towards increased care of the environment, climate change action, and preservation of landscapes and biodiversity (European Commission 2018a, 2018b, 2018c), this share is set to rise to 25 per cent by 2030, according to the *Farm to Fork Strategy* (European Commission 2020). One step has already been taken towards stimulating both the supply of and demand for organic products, by putting new organic regulations in place that are effective from 1 January 2022. These regulations apply in all EU member states. EU-wide efforts to promote organic farming are and have been in many cases accompanied by national or regional programmes. One such regional programme was the Bavarian agenda, 'BioRegio Bayern 2020'. Initiated in 2012 by the Bavarian State Ministry of Food, Agriculture, and Forestry (StMELF), it aimed at doubling organic production in Bavaria by 2020, accompanied by continuous enhancement of the entire organic sector. The aim was for both goals to be achieved through a holistic approach that combines measures in education, consulting, funding, marketing, and research (StMELF 2017). A particularly innovative scheme among those is the organic flagship region programme ('Staatlich anerkannte Öko-Modellregionen in Bayern'). In this programme, 12 municipal associations were selected as organic flagship regions from a competition organized in 2013 and 2014 by the StMELF. The competition was open to all Bavarian municipalities, who could cooperatively submit innovative projects and concepts aiming at expanding organic production and consumption within their region. All submissions had to clearly describe how local authorities, producers, processers, retailers, consumers, and other local actors could be involved in and contribute to the expansion of (certified) organic farming. The 12 municipal associations with the most convincing concept notes appointed as organic flagship regions receive support from the StMELF in various ways, the main element being the creation and public financing of a project manager position in each region for five years.[3]

Wherever public funds are used to finance policy measures, as is the case with the organic flagship region programme, governments must show that resources are being spent sensibly. Consequently, every intervention needs to be accompanied by monitoring and evaluation in order to promote learning and enhance policies' effectiveness and efficiency. We conducted such monitoring and evaluation for the Bavarian organic flagship region programme, analyzing the extent to which its primary goal of extending organic food production by convincing farmers to switch to organic practices was reached. To this end, we measure both actual and intended behavioural change using survey data from inside and outside the organic flagship regions prior to the start of the programme and two years after its implementation. Before applying this difference-in-differences (DiD) method, we identify factors that influence the decision of Bavarian farmers to adopt organic farming, to assess whether they have been taken into consideration by the organic flagship region programme. Our study combines elements of social-psychology (theory of planned behaviour (TPB)) and behavioural economics (discrete choice experiment) with the classical impact evaluation method DiD,[4] first to understand factors underlying the adoption of organic farming practices in Bavaria, and second to investigate whether the programme reasonably addressed these factors.

The former—the organic farming adoption process—has been studied thoroughly by several authors applying different methods for various farm types and regions (see e.g. Padel (2001); Pietola and Lansink (2001); Burton, Rigby, and Young (2003); Flaten et al. (2005); Knowler and Bradshaw (2007); Serra, Zilberman, and Gil (2008); Läpple and Kelley (2013); Läpple and Kelley (2015); Andow et al. (2017); Lampach, Nguyen-Van, and To-The (2019)). They identified a range of factors that have impacted the decision to convert from conventional to organic farming. The most relevant ones include, as already listed by Kallas, Serra, and Gil (2010, pp. 411–412), farmer characteristics, farm structure, farm management, and exogenous parameters, as well as attitudes and opinions. Especially the social-psychological factors referred to above have been identified as crucial elements in the formation of behavioural intent, an example being a farmer's decision to pursue organic farming (Toma & Mathijs 2007; Läpple & Kelley 2013; Issa & Hamm 2017). Therefore, for any organic farming programme to be effective, particularly in the short-run, it needs to be designed in such a way that it does not neglect these influenceable factors. Current support measures for organic farming are mainly framed in an incentive-based manner, providing subsidies under Pillar II of the CAP based on income foregone and cost incurred as well as investment allowances and aid for marketing and promotion of organic products (European Commission 2019). Alongside such EU aid, most EU countries develop their organic sectors with additional programs. Germany, for example, launched an organic action plan in 2017, which contains a mix of measures relating to consumption, production, administration, and research, in five fields of action, these being the formation of a future-oriented and coherent legal framework, facilitating access to organic farming, exploiting and expanding current demand, improving the performance of organic agricultural systems, and properly rewarding the provision of ecosystem services (BMEL 2019). Despite the large number of comparable organic action plans in Europe and the long history of support for organic agriculture, little literature has been devoted to a systematic analysis of the degree to which organic food and agriculture policies affect participation in organic farming. Analyses of organic policy instruments or labelling often provide comprehensive reviews of the instruments applied, yet only a few theoretically sound considerations of the policy tools that actually lead to growth of the organic sector exist (Daugbjerg & Halpin 2008). One of these studies is a paper by Daugbjerg et al. (2011) in which the authors examine whether Danish and UK organic farming policy measures between 1989 and 2007 have affected participation, using a piece-wise linear representation of policy. They found that six out of the fourteen policy measures in the two study countries, primarily direct supply-side instruments, significantly influenced the uptake of organic farming practices. Similarly, in his qualitative analysis covering various European countries, Michelsen (2002) detected a positive effect of policy instruments toward organic agriculture on organic sector size, but noted that 'they were far from decisive for the development' (Michelsen 2002, p. 132). While these authors analyzed supply-side (targeting producers, processers, distributors) and demand-side (targeting consumers) organic policy measures covering legal, financial, and communicative approaches, others such as Lesjak (2008) and Chabé-Ferret and Subervie (2013), Lindström, Lundberg, and Marklund (2020) focussed on either demand-side or supply-side measures. Concerning demand-side instruments, Green Public Procurement has been found to have a positive impact on the size of organic agricultural land in Sweden (Lindström et al. 2020), and providing product-specific information (actionable labelling) increases consumer willingness to purchase organic food (Aitken et al. 2020), which might have an indirect effect on the area of organically managed land. Generally, though, the supply-side instrument of area support payments is considered the major driver behind the increase in land area devoted to organic farming (Pietola & Lansink 2001; Sanders, Stolze, & Padel 2011; Chabé-Ferret & Subervie 2013). This might explain why policy efforts tend to be directed at conversion subsidies for organic farming, despite some authors stressing the importance of a mix of measures (Sanders et al. 2011; Daugbjerg & Sønderskov 2012).

The Bavarian organic flagship region programme attempts to respond to calls for a mix of supply-side and demand-side measures by targeting suppliers, farmers, processers, retailers, consumers, and authorities alike. However, to achieve the overall programme goal, farmers are the ones who primarily need to adopt a new type of behaviour. Our study therefore explores whether the programme has encouraged farmers to switch to organic production, which would result in increased organic output irrespective of productivity growth, given that both conventional and organic farmers display similar growth patterns in terms of agricultural land (StMELF 2018). We contribute to the existing literature in the following ways. First, our analysis provides empirical evidence of the impact of this innovative policy tool and may help decision-makers in adapting their promotion of organic farming against the background of the need to efficiently spend public funds. It is, to the best of our knowledge, the first in-depth study of this type of policy measure. Second, our mixed methods approach extends existing studies on the impact of organic farming promotion measures by linking social-psychology, behavioural economics, and impact evaluation and thus providing a holistic picture on the connection between farm-level decision-making and programme success. Third, our study region is more representative for the actual EU agricultural structure than the ones used in previous studies with Bavaria being diverse in natural conditions, production systems, land use, farming practices, and structure.

The remainder of this article is structured as follows: Section 2 outlines the theoretical concept underlying the uptake of organic farming, Section 3 gives a brief overview of the organic sector in Bavaria and of the organic flagship region programme. Section 4 describes the dataset and empirical methodology, followed by a presentation and discussion of the results in Section 5. Finally, Section 6 presents some concluding remarks.

2. Theoretical framework

The transition to organic farming can be challenging for a farmer and depends on the site and pre-conversion market conditions, the farm structure, and the level of intensity of the farming system. It requires a lot of learning, involves financial investments and necessitates overcoming bureaucratic obstacles. (Expected) Utility theory suggests that a farmer will accept these challenges if the expected utility to be had from organic farming (U_O) is greater than the expected utility of continuing with conventional practices (U_C). Formally, this relation can be expressed by the following expected utility function for a utility-maximizing farmer, including financial and non-financial factors (Läpple & Kelley 2015):

$$E\left[U_O\left((\pi_O - G + S_O) + A + SN + PBC\right)\right] - E\left[U_C\left(\pi_C + A + SN + PBC\right)\right] > 0, \quad (1)$$

where $\pi_k (k = O, C)$ is the farm profit from organic or conventional production, respectively, G represents the cost of converting to organic farming, which is linked to the farm structure, farm management, and exogenous parameters, and includes additional investment, learning-related costs, and income losses resulting from lower yields (Lampkin & Padel 1994).

S_O are organic farming subsidies, which in Europe are higher during the conversion period, when organic production methods need to be used but the resulting product cannot be sold as organic until after transition. A, SN, and PBC represent attitude, subjective norm, and perceived behavioural control, the psychological constructs underlying the intention to adopt a specific behaviour according to the TPB (Ajzen 1991), which will be explained in the next paragraph. Farm profit π_k in Equation (1) can be further analyzed as follows:

$$\pi_k = p_k q\left(f_k, F\right) - c_k f_k + s, \tag{2}$$

where p_k represents the output prices depending on farm type, q refers to the output quantity, a function of input factors f_k, and F stands for production relevant factors, such as quality of land or distance to markets. c_k are the farm-type-specific input prices and s are subsidies received by each farmer. Hence, profit is directly linked to management practices and the type of management. As it hinges on factors like prices, the uptake of organic farming is also influenced by these external parameters. Further parameters that influence utility and, consequently, a farmer's decision-making process are, as mentioned earlier, attitude, subjective norm, and perceived behavioural control.

These three constructs form the main building blocks of the TPB, which evolved from Ajzen's and Fishbein's theory of reasoned action (1980; 1975). It assumes that intention is an appropriate predictor of actual human behaviour. Intention, in turn, is based on beliefs concerning attitude, subjective norm, and perceived behavioural control held by people towards a specific behaviour (Ajzen 1991). Attitude refers to an individual's positive or negative evaluation of the behaviour of interest and is linked to the idea he or she has about how good or bad the outcome is. Subjective norm describes the perceived social pressure or influence from others on carrying out the behaviour, while perceived behavioural control refers to the perceived ability to perform the behaviour. These three constructs have been used extensively in social-psychology research to explain and understand human behaviour. Studies analyzing the intentions and behaviour of farmers applying the TPB include those by Sutherland (2010), Hansson, Ferguson, and Olofsson (2012), Daxini et al. (2018) and Despotović, Rodić, and Caracciolo (2019). There are four reasons why the theory is well-suited to examining the adoption of organic farming: First, it enables the study of decisions that involve intensive planning (Krueger, Reilly, & Carsrud 2000), such as the conversion from conventional to organic farming. Second, it controls for difficulties that farmers might face before and during the adoption process (Läpple & Kelley 2013, p. 12), third, the TPB has a high explanatory value (Fielding, McDonald, & Louis 2008) and fourth, it provides the possibility of studying internal and external factors as well as the flexibility to include additional variables (van Dijk et al. 2016).

While the TPB is applied to assess factors driving the adoption of organic farming in Bavaria, a combination of two other theories (consumer theory, random utility theory) comes into play when measuring the success of the organic flagship region programme in terms of changes to farm practices. One intended effect of the programme is that it should increase the number/share of organic farms inside the flagship regions after a certain time. In our DiD setting, we therefore consider outcome variables not only in relation to farm type, but also to the likelihood of a farmer switching to organic production. We estimated this likelihood in a discrete choice experiment (DCE), in which farmers were asked to choose a farm type that promises the highest overall utility from a set of alternatives. Discrete choice experiments are based on Lancaster's consumer theory (Lancaster 1966) and the random utility theory proposed by Luce and McFadden (Luce 1959; McFadden 1974). Lancaster's consumer theory suggests that individuals derive utility not directly from goods but from the characteristics, or attributes, of these goods. Assuming that the decision-makers operate rationally, each then maximizes utility relative to their potential. According to random utility theory, decision-maker i, when making such choices, considers m_i alternatives, which form a choice set I^i. Each alternative j is assigned a perceived utility U_j^i. When trying to model choices of decision-makers, external observers cannot predict this utility with any certainty, which is why U_j^i is represented by a random variable. However, it is possible to estimate the probability p^i that decision-makers will choose a certain alternative given a set of choices:

$$p^i(j|I^i) = \Pr[U_j^i > U_k^i \ \forall k \neq j, \ k \in I^i]. \tag{3}$$

Perceived utility U_j^i, which explains the probability of an alternative being selected, consists of two terms: systematic utility V_j^i and a random residual ε_j^i. The systematic utility describes the mean utility derived by all individuals facing the same choice situation as a decision-maker i. The random residual on the other hand represents the (unknown) deviation of the utility of a specific decision-maker from this mean value. It captures different personal and situational elements of uncertainty. Perceived utility can therefore be formulated as follows:

$$U_j^i = V_j^i + \varepsilon_j^i, \ \forall j \in I^i. \tag{4}$$

For the purpose of this paper, it is sufficient that—rather than capturing all components that affect individual utility levels—systematic utility, perceived utility, and the probability of a particular alternative being chosen can be estimated econometrically. The latter, which in our case refers to the probability of a farmer choosing an organic farm type, is included in the second stage DiD estimation, which measures the effect of the organic flagship region programme.

3. The organic flagship region programme and organic farming in Bavaria

Located in southeast Germany, the federal state of Bavaria is one of Europe's core agricultural and food regions. Its share of gross value added in agriculture, forestry, and fishing within the European Union is around 2.3 per cent (Eurostat 2020a, 2020b), putting it ahead of some important agricultural producers in the EU, such as Denmark, Ireland, and Austria. It is especially the well-developed Bavarian dairy sector that contributes to this figure. In 2017, around 1.2 million cows were kept on 30,489 dairy farms, producing roughly 8.2 million tons of milk. This corresponds to 4.8 per cent of the total raw milk production in the EU (Eurostat 2018, p. 57; LfL 2018, p. 10). In the same year, 6 per cent of all Bavarian milk was produced organically. This share has been increasing steadily over the years, partly as a result of volatile prices for conventional milk and low conversion costs in southern and eastern Bavaria, where extensive and largely grass-based systems are common. Farm types other than dairy have, however, also been shifting towards organic production. Overall, around 10,500 out of 105,000 Bavarian farms apply organic practices on roughly 11 per cent of the total utilized agricultural area (UAA) (StMELF 2020a).

As was the case in 2013 and 2014, when the first call for proposals of the organic flagship region programme was made, demand for organic products continues to exceed production in Bavaria (StMELF 2020b). However, the organic sector has experienced rapid growth in recent years. The societal trend towards organically produced food coupled with the Bavaria-wide policy measures in terms of education, financial support, marketing and research, advisory services, and knowledge transfer are likely to have contributed to this growth. Furthermore, the organic flagship region programme is hypothesised to have stimulated the uptake of organic farming, at least in certain areas, namely within the flagship regions. In two competition rounds (2013 and 2014), the StMELF selected 12 municipal associations on the basis of the quality of their proposals on ways of strengthening the

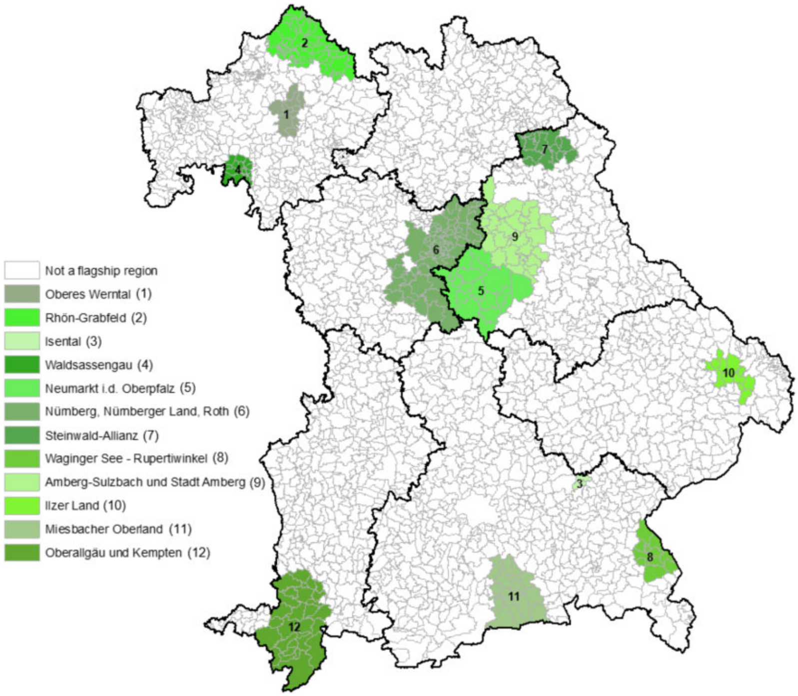

Figure 1. Organic flagship regions in Bavaria.

organic sector within the respective region. Both competitions were open to all Bavarian municipalities. Proposals were typically developed by a team of local players, including municipal decision-makers, activists, and actors along the food value chain. Farmers, though, were involved in only a few cases.

The twelve winning municipal associations are presented in Fig. 1. Some of the regions are pioneers in organic farming and wish to reinforce their leading role, while others have a less developed organic sector. Once they had been appointed organic flagship regions, they all began to implement the projects and ideas outlined in their proposals, for the most part in 2016. For this purpose, each flagship region appointed a project manager, whose salary was covered to 75 per cent by the StMELF and to 25 per cent by the respective region. Additional consultancy support is granted to all organic flagship regions by various Bavarian authorities and associations working in the areas of agriculture and rural development. They also advise the project manager about projects and initiatives in each region. These vary from one flagship region to another, but the aim is for them to cover aspects relating to production, processing, marketing, and consumption in equal measures, as the purpose of the organic flagship region programme is to try to enhance organic production by creating an impact along the food value chain, exploiting existing potential on a local level and raising consumer awareness concerning organic food. Example projects include collaborations between organic producers and restaurants, thematic cooking courses, the creation of regional organic value chains, and the establishment of organic farmer's markets.[5]

In the next section, we describe how we estimate the effect of such projects on farmers' intentions of adopting organic farming and how we identify factors that affect their decision-making.

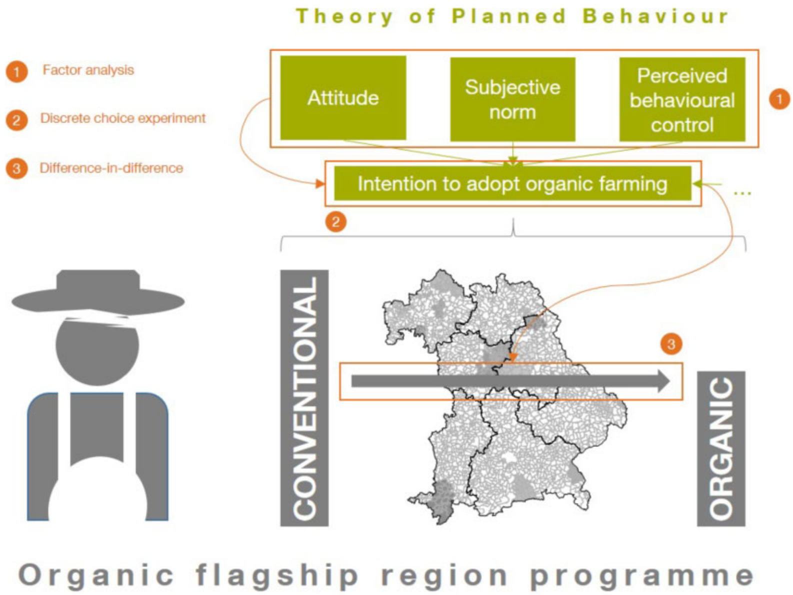

Figure 2. Conceptual framework used for this study.

4. Materials and methods

Our econometric analysis comprises three parts, which are highlighted in orange in Fig. 2 (underlying theory is marked in green). In part one, we use factor analysis to obtain measures of latent, non-observable constructs that, along with other determinants, are expected to influence the uptake of organic farming. The second part addresses farmer preferences concerning conventional and organic farm types using a DCE, while the third part focuses on DiD-based impact evaluation, making use of estimation results from the DCE.

4.1 Data and data collection

All of these analyses are based on data from two farm surveys, the first conducted in 2016, when the majority of the organic flagship regions began to operate, and the second in 2018 (descriptive statistics are reported in the Appendix, Tables 7–9). Response rates did not vary substantially between rounds. Repeated surveys including a baseline before or at the programme start as well as a post-intervention period are a key requirement of double-difference methods. Another requirement is the existence of a treatment and a control group. For this reason, both surveys were carried out in nine organic flagship regions (Oberallgäu und Kempten, Miesbacher Oberland, Ilzer Land, Amberg-Sulzbach und Stadt Amberg, Waginger See—Rupertiwinkel, Steinwald-Allianz, Nürnberg—Nürnberger Land—Roth, Neumarkt i.d. Oberpfalz, and Waldsassengau) and in neighbouring, non-treated municipalities in these regions. Since farmers in their capacity as research objects did not considerably influence the proposals each region submitted and as treated and neighbouring non-treated municipalities did not differ significantly in their organic sectors in the pre-treatment period, we treat programme assignment as random, which is of significance to our DiD setting. This setting, together with our interest in farmers' opinions and knowledge of organic agriculture, determined the design of the farm surveys, which were conducted in written form. Farmers in selected municipalities both within and outside the nine organic flagship regions were chosen at random and sent a questionnaire containing questions relating to their farm structure and management, exogenous parameters, socio-economic conditions, the organic flagship region programme (only for farmers located within flagship regions), information provision, collaboration behaviour and social-psychological factors. The DCE indicated the end of the questionnaire. Out of 3,002 questionnaires sent out in May 2016, 423 were completed and returned. In the second round in March/April 2018, the same questionnaire was sent to the same farmers, of whom 403 returned a completed questionnaire. Due to data protection regulations, it was not possible to identify farmers who participated in both rounds. Consequently, the data had to be treated as repeated cross-section data.

Organic flagship region programmes have not been introduced in Bavaria only, but also in other German Federal States and possibly other countries. Investigating the Bavarian case among existing programmes seems valuable for the following reasons. Bavaria belongs to the core regions of agricultural production within the EU. Its heterogeneous natural conditions are well-suited for various conventional and organic agricultural production systems such as crop farming, intensive and extensive dairy farming, pig and cattle fattening and breeding, poultry farming, vegetable farming, orcharding, hop production, and viticulture. As the organic flagship regions are evenly spread in Bavaria, this heterogeneity of farming systems, which represents to some extent the European agricultural sector, is well captured.

4.2 Factor analysis

For part one of our analysis, we pooled the data from both surveys and used the TPB to explain how underlying psychological constructs influence farmers' decisions to adopt organic farming. While they are not the only factors driving the adoption decision, the TPB constructs of attitude, subjective norm, and perceived behavioural control are expected to a great extent to be able to explain farmer behaviour. In order to measure them, several statements were developed for each of the constructs—keeping in mind the principle of compatibility (Ajzen 1988)—and utilized as indicators. Following related agricultural literature (e.g. Gorton et al. (2008), Hansson et al. (2012)), the statements were formulated in a way that made it possible to gauge respondents' implicit beliefs. They were asked to express their opinions and perceptions by indicating on Likert scales the extent to which they agreed with the proposed statements. All statements were carefully formulated, to ensure that every farmer was able to answer them. The questions used in the analysis are given in the Appendix.

In order to summarize the statements into the underlying constructs of interest (attitude, subjective norm, perceived behavioural control), factor analysis, a method of reducing a large number of variables to a small number of factors that adequately describe the variation in the data, was applied. The assumption behind factor analysis is that each observable variable x_{ij}, in our case statements j answered by farmer i, is a linear function of q independent factors p and error terms e_{ij}, which can be written as:

$$x_{ij} = a_{j1}p_{i1} + a_{j2}p_{i2} + \ldots + a_{jq}p_{iq} + e_{ij}. \tag{5}$$

Both the factor loadings a and the factors (or rather factor scores) were estimated econometrically using principal component analysis (PCA). This method seems better suited in our case than common factor analysis,[6] given that we assume that besides common variance, unique and error variance also define the structure of the variables in our dataset. Furthermore, PCA does not suffer from factor indeterminacy concerning the factor scores to be calculated. This fact is crucial to our study, as we use the factor scores in the subsequent statistical analysis. Factor scores are a composite measure of each factor, calculated for each individual. Conceptually, they represent the extent to which each individual scores highly on a group of variables with high loadings on a factor, i.e. on an underlying construct. The number of such constructs to be retained from our data was based on several considerations, particularly theoretical ones, and the meanings of the factors. In our case,

Table 1. Attributes and levels in the DCE.

Attribute	Level
Choice and statement	
Profit fluctuation	–10%, –5%, +5%, +10%
Yearly profit fluctuations compared to current profit fluctuations	
Marketing/distribution of products	0% regional, 50% regional, 100% regional
Farm type	- Conventional - Conventional with participation in agri-environment schemes - Organic (according to EU regulation) - Organic (according to the guidelines of the German organic farming associations Bioland or Naturland) - Organic (according to the guidelines of the German organic farming association Demeter)
Profit	No change, –5%, +5%, +10%
Yearly profit compared to current profit.	

the TPB constructs of attitude, subjective norm, and perceived behavioural control were of particular interest.

4.3 Discrete choice experiment

The TPB suggests that behavioural intention is the central factor when it comes to human actions, since it is regarded as the direct precursor of any behaviour. In the case of the organic flagship region programme, the behaviour that programme planners intend to influence concerns the choice of farming practices. With our data, this choice, and given the data structure as repeated cross-sections, possible changes can be observed directly. However, switching from conventional to organic farming is a step which requires careful planning. It can thus be assumed that a period of two years, the interval between both surveys, is rather short for measuring actual changes in farming practices. Indeed, a DiD estimation on actual conversions to organic farming did not show a significant program effect. For this reason, behavioural intention rather than actual choice of farm type was chosen as the outcome variable in the following DiD analysis. It is measured with a DCE, which can be applied for statistically-validated analyses of non-directly-observable, latent preference structures and allows various attributes to be combined in a decision model (Colombo, Hanley, & Louviere 2009). A detailed description of this method can be found in Hensher, Rose, and Greene (2005). Just like that of the overall survey, the design of our decision model was preceded by optimization considerations,[7] expert interviews and pre-tests with farmers to ensure the validity and clarity of the questions. The main element of the model was a preference for a farm type (conventional/organic). Respondents were asked to choose hypothetical alternatives from six choice sets. Individual characteristics were assumed to affect the likelihood of an alternative being chosen; however, given the balance of our samples (inside/outside an organic flagship region), we did not include them in our model estimation. The estimation was thus based on the key elements of each DCE. i.e. attributes and their levels.

Following Bateman et al. (2002) and Bennet and Blamey (2001), each attribute was chosen on the basis of its relevance to the research questions, the needs of policy makers and its meaningfulness to the respondents. Their selection was further influenced by previous studies on farmers' preferences (e.g. Jaeck and Lifran (2014), Pröbstl-Haider et al. (2016)). Ultimately, four attributes were chosen to form a hypothetical farm type (Table 1). They varied in the choice-sets according to the range of their levels.

In the DCE, different combinations of attribute levels were presented to the respondents. They were asked to select their preferred alternative from each choice set. There were three options to choose from in each choice-set: farm type 1, farm type 2 or the alternative 'Neither of the farm types presented'. The choice-sets were preceded by a brief introductory text presenting the hypothetical scenario. In doing this, we tried to minimize hypothetical bias, a type of bias all stated preference techniques are at risk of (Carlsson et al. 2005). Other forms of bias, including attribute non-attendance (Scarpa et al. 2009), anchoring (Luisetti, Bateman, & Turner 2011), status quo bias (Boxall, Adamowicz, & Moon 2009), and decoy bias (Bateman, Munro, & Poe 2008) were mitigated by careful pre-testing and by integrating specific design elements.

The attribute- and level-dependent farm type choices by the farmers in our sample were analyzed on the basis of Equation (4). Systematic utility V_j^i in this equation is assumed to be a linear function of attributes $\boldsymbol{X}_{kj}^i$ relative to the alternatives and the respondent. Equation (4) can thus be rewritten as:

$$U_j^i = \sum_k \beta^i X_{kj}^i + \varepsilon_{kj}^i, \tag{6}$$

where β^i represents a vector of coefficients[8] capturing the characteristics of farmer i and ε_{kj}^i is an unobserved, independent, and identically distributed random term. With the choice attributes from our DCE equation, (6) translates into:

$$U_j^i = \beta_0^i + \beta_1^i \, profit\_fluctuation_j^i + \beta_2^i marketing_j^i + \beta_3^i \, farm\_type_j^i + \beta_4^i \, profit_j^i. \tag{7}$$

The researcher does not know the β coefficients of an individual farmer. They are estimated based on the unconditional choice probability, i.e. the mixed logit probability, which is represented by the integral of conditional probabilities over all possible values of β:

$$P_j^i = \int \frac{e^{\beta^i X_j^i}}{\sum_k e^{\beta^i X_k^i}} * f(\beta, \theta)\, d\beta. \tag{8}$$

In order to obtain the expected value of the random β coefficients, the mean of R draws on its distribution is calculated.

4.4 Difference-in-Differences estimation

In the third step of our analysis, we applied a DiD estimator to assess whether farmers' behavioural intentions of adopting organic farming, measured as the probability of choosing an organic farm type in the DCE, had changed in the organic flagship regions between 2016, defined as the pre-treatment period, and 2018 as a result of the flagship region programme. The DiD methodology suits our research question well, as it addresses the fundamental impact evaluation problem, namely the impossibility of observing the difference between a treated unit's outcome with and without treatment. It involves comparing a treatment group (in our case farmers in organic flagship regions) and a control group, with similar characteristics (farmers in neighbouring regions) before and after an intervention (organic flagship region programme). Estimating the average difference of an outcome variable Y which is related to the intervention (behavioural intention of going organic) separately for the treatment (T) and control group (C) over both periods (time $t = 0$ and $t = 1$) and then taking the difference between the average changes in this variable for both groups gives, under assumptions that we specify hereafter, the programme impact (DiD):

$$DiD = E(Y_1^T - Y_0^T \mid T_1 = 1) - E(Y_1^C - Y_0^C \mid T_1 = 0). \tag{9}$$

In this equation, $T_1 = 1$ denotes the presence of the programme in the post-implementation period $t = 1$, $T_1 = 0$ marks untreated areas. Typically, the *DiD* estimate is calculated within a regression framework. We followed this approach using the subsequent equation:

$$Prob_{org} = \beta_0 + \beta_1 D_{post} + \beta_2 D_{flagship-region} + \beta_3 D_{post} D_{flagship-region} + \gamma X + \varepsilon, \qquad (10)$$

where $Prob_{org}$ is the DCE-based probability that a particular farmer chooses a given alternative if the farm type is organic, indicating farm type preferences. D_{post} is a dummy variable that takes the value of one if the observation comes from 2018, when the organic flagship region programme had been running for some time, $D_{flagship-region}$ is a dummy variable that takes the value of one if the respective farm is located inside a flagship region, X is a vector of control variables with associated vector of parameters γ, and ε is the regression error term. To enhance clarity, we suppressed subscripts that would have referred to each farmer in the regression equation above. Of the parameters to be estimated, β_3 is the one we are particularly interested in, as it represents the DiD estimator.

This estimator is only expected to give valid results if unobserved heterogeneity is time-invariant or follows a similar time trend, if it is uncorrelated with the treatment over time and if the treatment is not related to distributional changes in covariates.[9] Only the latter condition lends itself to meaningful testing. To verify whether the first two assumptions hold, we examined the distribution of covariates for farms inside and outside the flagship regions prior to treatment exposure. A comparison shows that the two groups were similar, providing support (i) for our assumption that for farmers, the organic flagship region programme is placed randomly and (ii) for the notion that unobserved variables are similar as well and follow a parallel trend in both groups in case they are not variables to be influenced by the program.

5. Results

This section presents empirical findings on farmer preferences and the actual impact of the organic flagship region programme. The TPB analyses (factor analysis) are given in the Appendix.

5.1 Discrete choice experiment

Our results of the DCE are presented in Tables 2 and 3 for the survey years 2016 and 2018. In both years, the whole sample was used to estimate the choice model, i.e. treatment status did not play a role in the first step. The model we chose is a mixed logit model with randomised parameters,[10] which allows to account for heterogeneity in farmers' preferences. It was estimated using Stata 15.1 and the *mixlogit* command (Hole 2018) with 1,000 random draws according to the Halton sequence method. In 2016, 2255 choice-sets answered by 397 farmers formed the estimation basis, while two years later the respective figures were 2,062 and 357. As expected, results do not vary strongly comparing 2016 with 2018. In both years, the likelihood of a farm type being chosen increases if the profit compared to the farmer's current situation rises. Another factor positively influencing selection probability is regional marketing. Farmers in our sample thus show a clear preference towards selling their products on regional rather than national or international markets. They also seem generally to prefer conventional farm types to organic ones, with all organic farm types showing a negative sign ('conventional' being the reference category). As for the profit fluctuation attribute, the picture is less clear. A negative coefficient in 2016 indicates that farmers appreciate stability, while in 2018, the profit fluctuation coefficient is insignificant.

Overall, the farmers' stated preferences are not surprising, and their attitude especially towards organic farm types seems plausible given that there are more conventional farms

Table 2. Results of the mixed logit model, 2016.

Attributes	Mean		Standard deviation	
	Coefficient	Standard error	Coefficient	Standard error
Profit	0.190***	0.021	0.181***	0.027
Profit fluctuation	–0.025***	0.008	0.030	0.022
Marketing 50% regional	1.496***	0.180	–0.507	0.433
Marketing 100% regional	2.063***	0.217	1.763***	0.296
Farm type 'Conventional with AES'	0.018	0.233	1.007	0.792
Farm type 'Organic (EU regulation)'	–1.746***	0.354	2.230***	0.515
Farm type 'Organic (Bioland or Naturland)'	–1.211***	0.302	3.389***	0.432
Farm type 'Organic (Demeter)'	–3.498***	0.476	3.984***	0.511
None	1.554***	0.241	2.788***	0.256
Log likelihood	–1772.173			
AIC	3580.346			
BIC	3703.097			
Number of observations	6,765			

Note: *, **, *** represent significance level at 10, 5, and 1 per cent, respectively.

Table 3. Results of the mixed logit model, 2018.

Attributes	Mean		Standard deviation	
	Coefficient	Standard error	Coefficient	Standard error
Profit	0.136***	0.019	0.126***	0.030
Profit fluctuation	0.014	0.019	–0.106***	0.039
Marketing 50% regional	0.902***	0.198	1.018***	0.334
Marketing 100% regional	1.131***	0.237	2.096***	0.383
Farm type 'Conventional with AES'	–0.424	0.307	2.774***	0.542
Farm type 'Organic (EU regulation)'	–1.467***	0.378	2.109***	0.535
Farm type 'Organic (Bioland or Naturland)'	–1.626***	0.307	2.851***	0.422
Farm type 'Organic (Demeter)'	–3.542***	0.522	3.042***	0.504
None	1.594***	0.285	3.207***	0.310
Log likelihood	–1556.360			
AIC	3148.719			
BIC	3269.860			
Number of observations	6,186			

Note: *, **, *** represent significance level at 10, 5 , and 1 per cent, respectively.

than organic ones in the sample. An indication of certain conditions that are necessary for switching from a conventional to an organic farm type is extracted from a willingness-to-accept (WTA) assessment. Assuming profit to be a fixed parameter, we calculated the profit premium that farmers would wish to have in order to adopt organic farming, making use of the convenient result that WTA for any attribute k equals $-\frac{E(\beta^k)}{\beta^{profit}}$. In 2018, for example, farmers would have been willing to adopt organic farming according to EU standards if the profit needed to remunerate the factors of production had been around 11 per cent higher than had they used conventional practices. Adopting organic farming in line with the stricter Demeter regulations would have necessitated a profit premium of 26 per cent compared to conventional farming. These results are in line with the findings on factor costs for conventional and organic farms calculated by the Bavarian State Research Centre for Agriculture (LfL 2020).

WTA estimations relate preferences to a monetary value and thus give a variable that is easy to interpret. So do the calculations we conducted to understand how the

Table 4. Predicted probabilities of choosing an alternative depending on farm type (reference farm type 'Conventional').

Attribute level	Predicted probability, 2016	Predicted probability, 2018
Farm type 'Conventional with AES'	0.0032	0.0074
Farm type 'Organic (EU regulation)'	–0.0508	–0.0364
Farm type 'Organic (Bioland or Naturland)'	–0.0276	–0.0494
Farm type 'Organic (Demeter)'	–0.1768	–0.1956

probability of an alternative being chosen changes if the farm type is an organic one. Their estimates were used as outcome variables in the DiD regression in the last part of our analysis. Table 4 presents these estimates with reference to the 'Conventional' farm type for 2016 and 2018. Choice probabilities seem relatively stable over the years. As with WTA estimates, the results suggest a general preference for conventional farm types, with all organic farm types showing a negative sign. The higher the organic farming standards, the less likely are farmers to select corresponding farm types. In 2018, for example, the probability of an alternative being selected decreased by 3.6 per cent if the farm type was 'Organic (EU regulation)', while it decreased by around 20 per cent if it was 'Organic (Demeter)'.

5.2 Difference-in-Differences estimation

The farm-level probability estimates from the DCE were used as the dependent variable in the OLS DiD regression to assess the impact of the flagship programme. As described in the Methodology section, Equation 9 was estimated to measure the difference in the probabilities of an alternative being selected for organic farm types during the 2018 post-intervention period between farms inside a flagship region and comparative farms in neighbouring regions relative to the probabilities observed in the 2016 pre-intervention period. The coefficient of interest, the DiD estimate, is the coefficient on $D_{post}D_{flagship-region}$. It is presented together with the other regression coefficients in Table 5. Specification (1) was used to perform the basic DiD estimation without any control variables. In specifications (2) to (6), control variables were added one at a time. These comprised some of the most frequently used variables in the literature on the uptake of sustainable agricultural practices (Foguesatto, Borges, & Machado 2020). Table 5 shows the results for the probability of choosing an organic farm type according to EU regulations being the dependent variable. Similar results were obtained for the categories 'Bioland or Naturland' and 'Demeter' (see Appendix, Tables 12 and 13).

In all specifications, the DiD coefficient is statistically insignificant, indicating that the organic flagship region programme did not have an effect on the probability of farmers choosing an organic farm type. The programme thus did not, as intended, encourage farmers to adopt organic farming practices. As Table 5 shows, only the post-intervention coefficient is significant in the base specification. Its value of 0.017 implies that there is a general positive trend towards choosing an organic farm type according to EU regulations. Compared to 2016, the likelihood of choosing this farm type increased by 1.7 percentage points in 2018. Unlike the time coefficient, the treatment parameter is insignificant in all but the last specification, where a value of −0.002 implies that the probability of selecting the EU organic farm type was 0.2 percentage points less for farmers in a flagship region than for farmers outside, prior to the intervention.

These results are robust to the inclusion of a number of control variables. In fact, the time, treatment, and DiD coefficients remain stable. Of all covariates, only the dairy farm dummy variable is (marginally) significant. Its negative sign indicates that dairy farms are less likely to adopt organic farming according to EU standards, which seems plausible given that

Table 5. Difference-in-Differences estimation for the outcome variable probability organic farm type EU regulation.

	(1)	(2)	(3)	(4)	(5)	(6)
Post-intervention (PI)	0.017 (0.001)***	0.017 (0.001)***	0.017 (0.001)***	0.017 (0.001)***	0.017 (0.001)***	0.017 (0.001)***
Organic flagship region (OFR)	–0.001 (0.001)	–0.001 (0.001)	–0.001 (0.001)	–0.001 (0.001)	–0.002 (0.001)	–0.002 (0.001)*
PI*OFR	–0.001 (0.001)	–0.001 (0.001)	–0.001 (0.001)	–0.001 (0.002)	–0.001 (0.002)	–0.000 (0.002)
Farm size		–0.000 (0.000)	–0.000 (0.000)	–0.000 (0.000)	–0.000 (0.000)	–0.000 (0.000)
Age			–0.000 (0.000)	–0.000 (0.000)	–0.000 (0.000)	–0.000 (0.000)
Education				–0.001 (0.001)	–0.001 (0.001)	–0.001 (0.001)
Gender					0.000 (0.001)	0.001 (0.001)
Dairy farm						–0.001 (0.001)*
Constant	–0.052 (0.001)***	–0.051 (0.001)***	–0.050 (0.002)***	–0.049 (0.002)***	–0.049 (0.002)***	–0.048 (0.002)***
N	711	682	590	525	520	516
R^2	0.463	0.462	0.465	0.469	0.467	0.480

Note: *, **, *** represent significance level at 10, 5 , and 1 per cent, respectively.

Table 6. Region-specific DiD estimates based on predicted probabilities of choosing an alternative with the farm type ‘Organic (EU regulation)’ (reference farm type ‘Conventional’).

	2016		2018		
	treated	**control**	**treated**	**control**	**DiD (percentage points)**
Oberallgäu und Kempten/control region	–5.24% (64)	–5.16% (37)	–3.82% (49)	–3.21% (36)	–0.53
Miesbacher Oberland/control region	–5.31% (24)	–5.42% (21)	–3.66% (18)	–3.57% (12)	–0.20
Ilzer Land/control region	–5.96% (10)	–5.03% (6)	–3.40% (9)	–3.61% (10)	1.14
Amberg-Sulzbach und Stadt Amberg/control region	–4.95% (21)	–5.41% (11)	–3.53% (26)	–3.43% (12)	–0.55
Waginger See—Rupertiwinkel/control region	–5.15% (15)	–4.98% (8)	–3.96% (15)	–3.54% (4)	–0.25
Steinwald-Allianz/control region	–5.51% (10)	–7.23% (1)	–3.77% (8)	–4.02% (2)	–1.47
Nürnberg—Nürnberger Land—Roth/control region	–5.22% (39)	–5.04% (34)	–3.82% (43)	–3.54% (30)	–0.10
Neumarkt i.d. Oberpfalz/control region	–5.31% (16)	–5.21% (2)	–3.23% (20)	–3.93% (3)	0.80
Waldsassengau/control region	–5.20% (5)	–5.49% (4)	–3.12% (4)	–3.85% (4)	0.44

Note: Number of observations in parentheses.

conventional dairy farms clearly dominate and that around 75 per cent of all Bavarian organic farms follow the guidelines of organic farming associations like Bioland or Naturland in addition to following the EU regulation on organic production (StMELF 2018).

In addition to treating the DCE probabilities as DiD outcome variables, we estimated the model using the individual TPB components, linking all three modelling exercises and trying to identify programme impacts on at least one of the constructs. However, no significant effect was found.

In the DiD results presented so far, we treated all nine organic flagship regions considered for the analysis and all nine neighbouring regions as one entity, respectively. However, the nine regions and their controls are located in different parts of Bavaria, characterized by different natural and socio-economic conditions. Treating them as one ignores heterogeneity, which might affect DiD estimates. In an extreme case, a positive programme effect in one region could be offset by a negative effect in another region. For this reason, we present the mean values of the DCE probability estimates for each region and year and the corresponding DiD estimate in Table 6. Due to the limited number of observations for each flagship and control region, no tests of statistical significance could be performed. Still, region-specific calculations seem to confirm the results presented earlier. While compared to a conventional farm type an alternative was less often selected if the farm type as ‘Organic (EU regulation)’ in 2016 and 2018 inside and outside the flagship regions, this likelihood developed positively from 2016 to 2018.

However, DiD estimates show that there is practically no programme impact over time and between treated and control regions. Only in one region with a reasonable number of observations (Ilzer Land) was a change higher than one percentage point observed.

6. Discussion and conclusions

The aim of this study was to investigate the effects of an innovative policy instrument for promoting the adoption of organic farming. Unlike other organic farming programmes, the measure takes a holistic approach and appoints selected municipal associations as organic flagship regions. Within each region, a project manager organizes various events in the areas of organic production, processing, value chain enhancement, marketing, education, administration, and awareness raising, in order to reach consumers, producers, processers, and public officials alike. As the whole programme is funded by public money, there is also a public interest in its impact.

Using two surveys from 2016 and 2018, each comprising more than 400 farms located inside organic flagship regions and in non-treated neighbouring regions, we investigated the impact against the background of the stated programme goals. To this end, we combined a DiD estimator with the results of a DCE assessing the likelihood of farmers to select organic farm types. Choosing probabilities based on stated preferences as DiD outcome variables rather than the observed conventional/organic variable makes it possible to account for the difficulties of switching to organic production within two years. Moreover, we thereby follow the TPB, which postulates that the intention to perform a specific behaviour is a predictor of actual behaviour. It also states that intention is the outcome of three psychological constructs, namely attitude, social norm, and perceived behavioural control. Assuming that these behaviour-governing constructs equally influence Bavarian farmers’ decisions to adopt organic farming, we further used a modelling technique combining factor and non-linear regression analysis to explore their importance in going organic. Such an exercise seems crucial given that the organic flagship region programme—with its limited budget and by the way it is designed—can only influence attitudes, opinions and farm management, but not (or only slightly) other factors of adoption, such as farmer characteristics, farm structure, and exogenous parameters such as prices.

The results of our investigation show that the adoption of organic farming in Bavaria is indeed influenced by psychological constructs, which is in accordance with both theory and findings relating to the adoption of conservation practices reported in previous studies (Mzoughi 2011; Läpple & Kelley 2013; Sulemana & James 2014; Cullen et al. 2020). Programmes promoting organic farming thus need to be designed in a manner that addresses these factors. The results we obtained from the DiD estimation, however, indicate that the organic flagship region programme with its mix of supply-side and demand-side measures did not properly target the psychological constructs underlying farmers' decisions on whether to adopt organic farming. It did though, as preliminary results of a consumer study suggest (Maier 2020), have the intended effect on the demand-side. These findings are in line with results reported by Michelsen (2002) and Daugbjerg et al. (2011), who found mixed success of policy instruments aimed at promoting organic farming. They also match conclusions that can be drawn from the aforementioned and further authors' studies (e.g. Chabé-Ferret and Subervie (2013), Lindström et al. (2020)) pointing towards organic farming policy instruments to be the more effective the clearer measures are formulated and the better they target either producers or consumers. One possible avenue in which policymakers might improve the programme could therefore be to approach farmers more directly and to adjust the ratio of events and measures offered inside the flagship regions for farmers and consumers. The measures offered could focus on nudges, which have been shown to influence environmental attitudes in experimental settings (Kuhfuss et al. 2016; Barnes et al. 2013). Given that social norm and perceived behavioural control play an especially important role in the decision to adopt organic farming, nudges related to these constructs can be a powerful tool. Recent studies by Banerjee (2017) and Chabé-Ferret et al. (2019) have shown the potential of nudges related to social norm in an agricultural context. Perceived behavioural control, on the other hand, can possibly be influenced by altering constraining beliefs through the provision of specifically targeted information and technical advice (Genius, Pantzios, & Tzouvelekas 2006; Cullen et al. 2018). Of course, ethical issues also have to be considered in this context, as there is a fine line between public authorities acting rationally and being paternalistic (Thaler & Sunstein 2008).

Looking at the factors affecting the adoption of organic farming, influencing psychological constructs is not the only way of increasing uptake rates, as is also recognized by the organic flagship region programme officials. Programme managers therefore also try to strengthen the organic sector by bringing key actors together to create new market opportunities for organic products inside the flagship regions. It is beyond doubt that such a venture takes longer than two years, the time span between our first and follow-up surveys. While psychological constructs, if they are not strong attitudes (Petty & Krosnick J. A. 1995), can change within two years, a lack of sales opportunities and/or other farm-specific or external factors might still limit the probability of farmers to switch to organic production. However, considering the farm-structure in Bavaria and the growth of the organic sector in recent years, we believe that non-psychological factors were not an obstacle. However, it is necessary to bear in mind that the TPB and its constructs deal with intentional behaviour only, thus they do not take into account any non-intentional or routine behaviour. This may be relevant in the Bavarian case, where the agricultural practices of many farmers, especially dairy farmers, are already close to the regulations of organic farming, without the farmers being aware of it or planning to adopt organic farming.

In interpreting our results, three further aspects need to be considered. First, we concentrated on a limited number of factors affecting the adoption of organic farming and the likelihood of choosing an organic farm type, respectively, in an attempt to keep the survey questionnaire as short as possible. Second, the approach of choosing controls for a DiD estimation in neighbouring regions might suffer to some extent from spillover effects. Third, potential programme effects might only show in the long-run. The two year time span between programme implementation and evaluation might be too short.

Studies on the comparable EU rural development policy instrument LEADER have shown that such programmes often suffer from short-termism (Kranberg, Andersson, & Kovach 2018). Nonetheless, given the EU's focus on sustainable agriculture, our findings are of value to policy makers when it comes to designing agri-environmental policy, as it is essential both to understand the factors that influence farmers' decision-making and to evaluate the effects of new programmes. In the case of the organic flagship region programme, follow-up surveys and studies can give further insights into the effects of factors related to the market environment that can influence the adoption of organic farming in the long-run. It would also be worthwhile investigating which of the broad range of measures and events offered inside the flagship regions have the greatest effect on farmers' behaviour.

End Notes

1 'Organic farming' is a term that has many explanations and definitions, which all converge to state that '[o]rganic production means a sustainable agricultural system respecting the environment and animal welfare, but also includes all other stages of the food supply chain' (European Parliament 2021). In the context of this study, we conceptualise it as farming that meets at least the requirements of the European Union's agreed Council Regulation 834/2007 and complemented Commission implementing acts (Commission Regulation (EC) No 889/2008, Commission Regulation (EC) No 1235/2008) on the production, distribution, and marketing of organic goods.

2 In 2016, the EU's organic farms received on average 139€/ha of CAP support and 75€/ha national co-financing (European Commission 2019).

3 Annual direct programme costs per region and year amount to around 45,000€. In 2016, all 12 flagship regions were home to 18,626 farms (Bayerisches Landesamt für Statistik 2020). For a comparison, Bavarian organic farming support through agri-environment schemes in 2018 was around 86,000,000€ for around 8,800 farms (ART 2019, p. 206). Funding for the Bavarian flagship region programme is thus relatively small as opposed to other sources of organic farming support in the state and targets a comparatively large number of farms.

4 The paper's theoretical foundation thus consists of the theory of planned behaviour, consumer theory, and random utility theory, with the latter two underlying discrete choice experiments.

5 A complete list of all projects carried out in the flagship regions was not available at the time when our analyses were performed. More detailed information about the overall programme and specific projects can be found at https://www.oekomodellregionen.bayern/. Public direct funds for the whole programme are limited to expenses for the project manager positions for two years.

6 There is considerable debate over whether common factor analysis or PCA is the more appropriate method for extracting factors. While common factor analysis is often considered more theoretically sound, it has certain drawbacks concerning the calculation of the estimated communalities used to represent the shared variance and factor score estimation (Hair Jr et al. 2014, p. 106). Discussions about factor model choice are likely to continue, empirical research, however, shows that in many instances both methods lead to essentially identical results if the number of variables exceeds 30 (Gorsuch 1983) or the communalities are higher than 0.6 for most variables (Hair Jr et al. 2014, p. 106), which is the case in our study.

7 According to Bliemer and Rose (2010) and Huber and Zwerina (1996), optimized designs for discrete choice experiments meet the following criteria: (1) orthogonality, i.e. minimum correlation of the attributes, (2) numerical balance of the levels within the choice-sets, (3) minimal overlapping of the expressions in a common choice-set, (4) utility balance, i.e. utility values of the alternatives of a choice-set are as similar as possible and (5) exclusion of dominant alternatives.

8 β^i is unobserved and, in our model, varies from farmer to farmer in a population with density $f(\beta|\theta)$. The density function is characterized by the parameters θ.

9 The conditions necessary for the validity of DiD are accurately described in Wing, Simon, and Bello–Gomez (2018).

10 Significant outcomes of a Hausman test (Hausman and McFadden 1984) showed that the Independence of Irrelevant Alternatives (IIA) assumption, a key concept behind choice models, is violated. In such cases, random coefficient models are a way around the IIA assumption.

11 In order to perform factor analysis, the sample size should be 100 or larger and the data should contain at least five times as many observations as the number of variables considered in the analysis. Each proposed factor should be assigned at least five variables Hair Jr et al. (2014).

Supplementary material

Supplementary data are available at *Q Open* online.

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Appendix

Factor analysis

The analysis of Bavarian farmers' views on organic farming as determined by their responses to the Likert scale questions in the survey resulted in a factor solution with three factors, retained on the basis of the TPB. Prior to factor extraction, tests were undertaken to assess the suitability of the data for factor analysis. They showed that the sample size was sufficient[11] and that the set of variables had the conceptual foundation to support factor analysis, with the Kaiser-Meyer-Olkin measure of sampling adequacy (MSA) having a value of 0.814 and the Bartlett Test of Sphericity (p-value 0.000) indicating that the variables were intercorrelated. The MSA was further applied to individual variables. Those with values of less than 0.5 were omitted one at a time, starting with the smallest. It is worth noting that due to the ordinal nature of the Likert statements used, polychoric rather than Pearson correlations were used in the analysis (Holgado—Tello et al. 2010).

The three-factor solution, which is linked to our research objectives, is justified by the interpretation of the Kaiser's criterion and the scree-plot. Table 10 displays the factors or underlying constructs and the factor loadings acquired via PCA. Since the factors are likely to be correlated with each other, oblique rotation was used to obtain a theoretically more meaningful pattern of underlying constructs (Hair Jr et al. 2014, p. 111).

The first factor reflects the attitude construct. It comprises statements about the farmer's sense of themself and their disposition towards performing a specific behaviour. Factor two, subjective norm, is highly loaded by statements relating to the farmer's perception of how others judge their behaviour. The perceived behavioural control factor ultimately has a high loading on assertions about the individual farmer's perception of their ability to manage and adapt his business. Only this latter component has comparatively low loadings and a Cronbach's alpha value of below 0.7, indicating that the statements or measurement scales might not perfectly capture the perceived behavioural control construct.

The results of the factor analysis were used to obtain factor scores by applying the Regression method to include them along with other explanatory variables in a follow-on organic farming adoption logistic regression. As determinants of behavioural intention, the factor scores are thought to considerably influence the uptake decision. Table 11 presents the results of the binomial logistic regression on organic farming adoption, where

Table 7. Descriptive statistics for the pooled sample.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Land (hectares)	775	30.7	42.4	0.49	680
Arable land (hectares)	778	12.3	24.4	0	320
Grassland (hectares)	778	17.9	25.2	0	360
Family labour (man-work units)	766	2.1	1.0	0	7
Conventional/organic (1 = conventional, 0 = organic)	763	0.78	0.42	0	1
Farm profit class (1 = no profit, 2 = 1–20k €, 3 = 20k–40k €, 4 = 40k–60k €, 5 = 60k–80k €, 6 = 80k–100k €, 7 = >100k €)	757	2.5	1.4	1	7
Age (years)	679	51.0	10.1	18	80
Experience (years)	758	21.5	11.1	0	68
Gender (1 = male, 0 = female)	775	0.91	0.29	0	1
Participation in agri-environment measures (1 = yes, 0 = no)	622	0.64	0.48	0	1
Dairy farm (1 = yes, 0 = no)	772	0.44	0.50	0	1
Farm successor ‘yes’	777	0.28	0.45	0	1
Farm successor ‘no’	777	0.18	0.38	0	1
Farm successor ‘unsure’	777	0.27	0.44	0	1
Farm successor ‘not relevant’	777	0.27	0.45	0	1
Off-farm employment (1 = yes, 0 = no)	788	0.61	0.49	0	1
Agr. education ‘vocational training’	695	0.47	0.50	0	1
Agr. education ‘master’s certificate’	695	0.32	0.47	0	1
Agr. education ‘university degree’	695	0.15	0.36	0	1
Agr. education ‘other’	695	0.07	0.25	0	1
Flagship region (1 = inside, 0 = outside)	720	0.56	0.50	0	1

Note: The year 2016 was marked by low milk prices, which in combination with the large number of dairy farms and the comparatively small farm sizes in our sample explains low farm profits.

the dependent variable is assigned a value of 1 for conventional farms and 0 for organic farms. While an interpretation of the coefficients of the psychological constructs is not straightforward due to the complex inter-statement relationships involved, the statistical significance of subjective norm and perceived behavioural control and the almost significance of attitude show that these factors do affect the process of conversion to organic farming. Further significant coefficients were obtained for the variables farm size, grassland share, experience, and the dummy variable dairy farm. Their signs indicate that large dairy farms with a high share of grassland are more likely to adopt organic farming, which is in line with the findings of previous studies on organic farming in Bavaria (ART 2013).

After having identified psychological constructs as critical factors in the adoption of organic farming, the next section presents the results of the DCEs conducted in 2016 and 2018. These give an indication as to whether the TPB components have been addressed by the organic flagship region programme.

Table 8. Descriptive statistics, 2016 survey.

Variable	Inside flagship region		Outside flagship region	
	Obs.	Mean	Obs.	Mean
Land (hectares)	194	28.3	168	30.0
Arable land (hectares)	194	10.5	170	12.3
Grassland (hectares)	195	16.5	170	17.3
Family labour (man-work units)	192	2.1	169	2.1
Conventional/organic (1 = conventional, 0 = organic)	191	0.75	161	0.80
Farm profit class (1 = no profit, 2 = 1–20k €, 3 = 20k-40k €, 4 = 40k-60k €, 5 = 60k-80k €, 6 = 80k-100k €, 7 = >100k €)	192	2.5	165	2.4
Age (years)	170	50.2	157	51.1
Experience (years)	191	20.8	167	21.7
Gender (1 = male, 0 = female)	199	0.90	168	0.92
Dairy farm (1 = yes, 0 = no)	188	0.51	169	0.53
Farm successor 'yes'	197	0.24	169	0.26
Farm successor 'no'	197	0.15	169	0.17
Farm successor 'unsure'	197	0.33	169	0.25*
Farm successor 'not relevant'	197	0.28	169	0.33
Off-farm employment (1 = yes, 0 = no)	199	0.58	173	0.61
Agr. education 'vocational training'	183	0.48	162	0.46
Agr. education 'master's certificate'	183	0.26	162	0.35*
Agr. education 'university degree'	183	0.16	162	0.09**
Agr. education 'other'	183	0.10	162	0.09

Significantly different means between observations inside and outside the flagship regions in a t-test for equality of means at the 10 (*), 5 (**), and 1 (***) level are indicated. The German 'master's certificate' in agriculture is comparable to a university degree in agricultural sciences.

Table 9. Descriptive statistics, 2018 survey.

	Inside flagship region		Outside flagship region	
Variable	**Obs.**	**Mean**	**Obs.**	**Mean**
Land (hectares)	190	31.6	138	34.3
Arable land (hectares)	190	13.5	138	14.8
Grassland (hectares)	190	18.0	138	18.9
Family labour (man-work units)	182	2.0	140	2.1
Conventional/organic (1 = conventional, 0 = organic)	190	0.78	140	0.75
Farm profit class (1 = no profit, 2 = 1–20k €, 3 = 20k-40k €, 4 = 40k-60k €, 5 = 60k-80k €, 6 = 80k-100k €, 7 = >100k €)	187	2.6	135	2.5
Age (years)	166	51.6	125	50.6
Experience (years)	183	22.9	134	20.2
Gender (1 = male, 0 = female)	190	0.92	137	0.88
Dairy farm (1 = yes, 0 = no)	192	0.35	137	0.37
Farm successor ‘yes’	186	0.31	142	0.28
Farm successor ‘no’	186	0.19	142	0.20
Farm successor ‘unsure’	186	0.24	142	0.25
Farm successor ‘not relevant’	186	0.26	142	0.27
Off-farm employment (1 = yes, 0 = no)	190	0.62	142	0.66
Agr. education ‘vocational training’	161	0.40	117	0.50
Agr. education ‘master’s certificate’	161	0.34	117	0.34
Agr. education ‘university degree’	161	0.24	117	0.14
Agr. education ‘other’	161	0.02	117	0.03

Table 10. Factor solution of the theory of planned behaviour statements.

	Factor 1 *Attitude*	Factor 2 *Subjective norm*	Factor 3 *Perceived behavioural control*
Statement			
I realize new market opportunities very quickly.	0.7148		
I am confident that I will run my farm profitably in the next ten years.	0.7009		
I am always one of the first to adopt new methods of production.	0.6102		
In ten years, the share of products I sell on regional markets will have changed considerably.	0.4546		
I am actively looking for new information.	0.4767		
Optimizing the economic performance of my farm is very important to me.	0.6671		
In ten years, the profitability of my farm will have changed considerably.	0.6785		
I can easily adapt my farm business to new market situations.	0.5048		
In ten years, the amount of goods I produce will have changed considerably.	0.6092		
Enlarging my farm secures the continued existence of my farm.	0.4978		
In ten years, the amount of labour needed on my farm will have changed considerably.	0.5185		
Organic farming is well-accepted in society.		0.6454	
Colleagues doing organic farming convinced me that organic agriculture is beneficial.		0.7255	
Organic products are easier to market than conventional products.		0.6257	
Organic farming is environmentally friendly.		0.8611	
Organic farming promotes animal welfare.		0.8318	
Switching to organic farming is a way to secure the continued existence of my farm.		0.7480	
If I adopt organic farming, I am less vulnerable to changes in prices of the means of production.		0.7373	
I like new challenges like for example adopting organic farming.		0.5369	
Organic farming is less risky in terms of my health and that of my family.		0.8209	
I would adopt organic farming if it were the wish of my farm successor.		0.6318	
Organic production should be increased.		0.7517	
My products should be sold on regional rather than on international markets.		0.5216	
Agricultural policy should strive to improve sales opportunities for organic products.		0.8226	
Public money the agricultural sector receives should always be linked to the provision of ecosystem services.		0.5620	
One argument for going organic is that the CAP greening requirements are easier to fulfil.			0.5669
Direct payments should not be linked to environmental management requirements.			0.6155
Organic production guarantees a higher producer price.			0.5285
I am very often worried about the future of my farm business.			0.4650

Table 10. Continued

	Factor 1 *Attitude*	Factor 2 *Subjective norm*	Factor 3 *Perceived behavioural control*
It would be good to have more sales opportunities outside Germany and the EU.			0.4509
The organic farming subsidy is a good argument for adopting organic practices.			0.4725
Explained variance	4.3376	7.8640	3.0496
Cronbach's alpha	0.7593	0.8809	0.5785

Notes: Blanks represent loadings of <0.45. Statements that did not load significantly on any factor were excluded from the final analysis. The three factors or components explain 49.2 per cent of the overall variance.

Table 11. Logistic regression for adoption of organic farming.

	Estimated coefficient	(z-value)
Attitude	0.575	1.24
Subjective norm	2.734***	5.72
Perceived behavioural control	–2.021***	–4.99
Farm size	–0.019*	–1.62
Education	0.678	1.23
Age	–0.0060	–1.44
Grassland share	–3.076***	–3.49
Experience	0.066*	1.65
Dairy farm	–1.168***	–1.89
Constant	1.743	0.74
Log likelihood	–58.239	
Pseudo-R^2	0.540	
Observations	203	

Note: *, **, *** represent significance level at 10, 5 , and 1 , respectively.

Table 12. Difference-in-Differences estimation for the outcome variable probability organic farm type Demeter (no covariates added).

Variable	Coefficient	Std. Err.	t-statistic
Post-intervention (PI)	–0.011***	0.003	–3.16
Organic flagship region (OFR)	–0.004	0.003	–1.23
PI*OFR	–0.000	0.005	–0.06
Constant	–0.178***	0.002	–75.98
R^2	0.037		
Prob > F	0.000		
N	711		

Table 13. Difference-in-Differences estimation for the outcome variable probability organic farm type Bioland or Naturland (no covariates added).

Variable	Coefficient	Std. Err.	t-statistic
Post-intervention (PI)	–0.020***	0.002	–15.05
Organic flagship region (OFR)	–0.002	0.001	–1.15
PI*OFR	0.001	0.002	0.57
Constant	–0.028***	0.001	–25.50
R^2	0.305		
Prob > F	0.000		
N	711		

Table 14. Difference-in-Differences estimation for the outcome variable probability organic farm type Conventional with AES (no covariates added).

Variable	Coefficient	Std. Err.	t-statistic
Post-intervention (PI)	0.004***	0.000	9.88
Organic flagship region (OFR)	–0.000	0.000	–0.10
PI*OFR	0.000	0.001	0.82
Constant	0.003***	0.000	12.12
R^2	0.263		
Prob > F	0.000		
N	711		

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