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How much green for the buck? Estimating additional and windfall effects of French agro-environmental schemes by DID-matching

Sylvain Chabé-Ferret [a,b,*], Julie Subervie [a,c]

[a] Irstea, UMR 1273 Métafort, F-63170 Aubière, France
[b] Yale University, Department of Economics, Cowles Foundation, New Haven, CT, USA
[c] INRA, UMR 1110 MOISA, F-34000 Montpellier, France

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ABSTRACT

Agro-environmental schemes (AES), which pay farmers to adopt greener practices, are increasingly important components of environmental and agricultural policies both in the US and the EU. Here we study the French implementation of the EU AES program. We estimate additional and windfall effects of five AESs for a representative sample of individual farmers using difference-in-difference (DID) matching. We derive the statistical assumptions underlying DID-matching from a structural household model and we argue that the economics of the program make it likely that these assumptions hold in our data. We test the implications of the identifying assumptions, provide a lower bound using triple-difference matching, test for crossover effects and insert our estimates of both additionality and windfall effects into a cost-benefit framework. We find that the AESs promoting crop diversity have inserted one new crop into the rotation but on a small part of the cropped area. We also find that the AES subsidizing the planting of cover crops has increased cover crops by 10 ha on the average recipient farm at the expense of almost 7 ha of windfall effect. This AES does not appear to be cost effective. In contrast, we find that the AES subsidizing grass buffer strips could be socially efficient despite large windfall effects. We finally estimate that the AES subsidizing conversion to organic farming has low windfall effects and high additionality.

1. Introduction

Payments for environmental services are widely used to improve environmental outcomes. Agro-environmental schemes (AESs), which pay farmers for adopting greener practices, are increasingly important components of environmental and agricultural policies both in the US and the EU. In this paper, we study the French implementation of the EU AES program. The AESs that we study aim to alter agricultural practices in order to improve the environment. Two of the AESs aim to increase crop diversity, which in turn may increase the diversity of habitats, and thus biodiversity. Increased crop diversity may also reduce the resistance of weeds to pesticides by diversifying rotations on the same field. Another AES that we study subsidizes the planting of cover crops during the winter, which curbs erosion and prevents nitrogen leaching into groundwater. We also study an AES that subsidizes the planting of grass buffer strips along rivers and streams. Grass buffer strips contribute to the

* Corresponding author at: Toulouse School of Economics, Lerna Manufacture des Tabacs, Bâtiment S, 21 allée de Brienne, 31015 Toulouse Cedex 6, France. Fax: +33 5 61 12 85 20.
E-mail address: sylvain.chabe-ferret@toulouse.inra.fr (S. Chabé-Ferret).

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improvement of surface water quality by curbing nitrogen, phosphorus, and pesticide runoff from fields. Finally, we study an AES that subsidizes conversion to organic farming. Organic farming bans the use of chemical fertilizers and pesticides, thereby reducing the transmission of pollutants into ground and surface water.

Cost-benefit analysis of these programs hinges on the relative extent of their additional and windfall effects. An AES has an additional effect if it encourages farmers to adopt environmentally friendly practices, i.e. if it has a positive causal effect on practices that favor the environment. An AES suffers from windfall effects if it pays for practices that would have been adopted in its absence. Higher additionality improves the efficiency of the program and thus increases the benefit/cost ratio. Higher windfall effects, on the contrary, tend to decrease the efficiency of the program by using resources to pay for practices that would have been adopted anyway, and thus decreases the benefit/cost ratio. Because AESs are voluntary programs and requirements and per-hectare payments are constant for all farmers, the potential for adverse selection is very high: farmers with the lowest costs of complying with the requirements of a given AES are the most likely to enter it. Thus, it is very likely that farmers who self-select into an AES would in any case have adopted the subsidized green practice to some extent had the AES not been implemented. In this paper, we estimate additional and windfall effects of the five AESs described above for a representative sample of French farmers. We use a detailed sample of individual farmers for whom we have data on practices related to the AESs under study (crops planted, area under cover crops, grass buffer strips, and organic farming) recorded in 2005, five years after the beginning of the program. We also have data on farm and farmers' characteristics and practices before the program started. Finally, we have detailed and disaggregated information from administrative sources on the AESs that each farmer has entered.

Determining the average level of a given practice for recipient farmers had the AES not existed, i.e. the counterfactual level, is key to the estimation of both additional and windfall effects. The windfall effect is identical to the counterfactual level. The average treatment effect on the treated (ATT) - the relevant causal effect measuring additionality - is the difference between the average level of a practice in the presence of the AES and the counterfactual level of the same practice. Unfortunately, we cannot observe the counterfactual situation. This is an instance of the fundamental problem of causal inference [16]. If we try to approximate the counterfactual level for recipient farmers by using non-recipient farmers, our estimates of the ATT are likely to be affected by selection bias. As a consequence, we may overstate the true level of additionality. Profit-maximizing farmers self-selecting into an AES indeed have lower costs of complying with the AES requirements. It is therefore likely that farmers who choose to enter an AES would in any case have adopted greener practices than farmers not entering it, had the AES not been implemented.

We use difference-in-difference (DID) matching [2,15] to eliminate selection bias and to estimate the ATT. DID-matching combines a non-parametric matching procedure with first-differencing with respect to a pre-treatment period. Matching eliminates selection bias due to observed covariates by comparing recipient farmers to similar non-recipients. First-differencing eliminates selection bias due to time-invariant unobservable factors. The validity of DID-matching relies on three assumptions. First, the absence of diffusion effects of the AESs on non-recipient farmers. Second, the existence of non-recipient farmers similar to recipient farmers in terms of observed covariates. Third, in the absence of any AES, the difference in practices between recipient and similar non-recipient farmers is constant over time. We derive the statistical assumptions underlying DID-matching from a structural household model and we argue that the economics of the program make it likely that the identifying assumptions of DID-matching hold in our data. Moreover, we test the validity of various implications of these assumptions and find evidence in their favor. We test for the presence of diffusion effects by inserting the initial average level of a given practice among neighboring farmers as a control variable. We find no difference in estimated treatment effects with or without this additional control variable suggesting that diffusion effects are absent. We test for the existence of similar farmers by using Smith and Todd [32]'s common support estimation procedure. We generally find that non-recipient farmers do exist for most of our treated farmers. Finally, we test for the constancy of the average difference in practices between recipients and non-recipients in the absence of the program by implementing a placebo test. We compare future recipients to future non-recipients at two different dates. We find effects of smaller magnitude than the ATT, and evidence that these are anticipation effects: because the date at which the requirements will become really binding is uncertain, farmers start complying with the requirements early on. Indeed, these anticipation effects vanish when we look at recipients who enter an AES at a later stage. We nevertheless provide a lower bound on the treatment effect by providing estimates from triple-difference (DDD) matching. Finally, because farmers can enter multiple AESs and we want to perform a separate cost-benefit analysis for each AES, we test and find strong support for the absence of sizeable crossover effects for most AESs under study.

We find that the average recipient farm has planted 10 additional hectares of cover crops, at the expense of almost 7 ha of windfall effect. Because the per-hectare payment for this AES is quite high, and because the social value of cover crops is limited, this AES does not appear to be cost effective. On the contrary, we find that the AES subsidizing grass buffer strips could very well be cost effective, despite very large windfall effects, because grass buffer strips are very efficient at curbing the runoff of pollutants. We finally estimate that the AES subsidizing conversion to organic farming has very low windfall effects and very high additionality. According to our estimates, this AES is responsible for 90% of the increase in areas converted to organic farming between 2000 and 2005. We estimate that it costs 151 € to convert one additional hectare to organic farming, compared to an average estimated social benefit from organic farming of 540 €/ha. We cannot apply a complete cost-benefit analysis to the AESs aiming at increasing crop diversity because payments were not directly tied to a practice that we can observe. We nevertheless estimate that these measures triggered the planting of 0.65–0.85 new species on treated farms, but on a very limited proportion of the total farmland, resulting in a small decrease in the