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The distortive effect of organic payments: An example of policy failure in the case of hazelnut plantation

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ABSTRACT

Organic farming is supported in the European Union (EU), among others, via area-based organic payments, targeting better environmental standards, as well as consumers' demand for organic products. Despite the wide interest growing on hazelnut production in non-traditional production areas in Italy, supply of organic hazelnuts remains negligible. At the same time, evidences show that Italian farmers can receive organic payments, while plantation is not yielding and then either switch to conventional production or continue organic production with no harvest. We employ the annual annuity approach in order to check whether organic payment initiates investments that otherwise would have been unprofitable; and whether it can be exploited by a farmer who has never had intention to produce organic hazelnuts. Results suggest that organic support indeed might be distortive and does not stimulate stable conversion to organic production of hazelnuts. In this regard, we recommend that the current policy should be substantially changed by imposing additional restrictions on conventional or no production or by implying additional requirements for receiving organic payments, for instance at least two subsequent organic contracts.

1. Introduction

The European Union (EU) has recently set the ambitious target of reaching 25% of agricultural land under organic farming by 2030[1] (European Commission, 2020) with area-based organic payments provided by the EU Rural Development Policies as one of the most important tools to promote organic agriculture. Yet, empirical analysis of organic payments and their effects on land use, distribution of on-farm resources, and farm output is very limited. We closed the gap and found out that existing area-based organic payments might lead to a policy failure and market distortion, hence causing resources' misallocation in terms of land use and financial endowment at farm level. Different avenues to resolve the policy failure are discussed.

The EU supports organic farming because the market for organic food contributes to food safety. The demand for some organic products is expected to grow faster than supply implying deficits to be compensated with imports (European Commission, 2019). Furthermore, organic farming is considered as beneficial for the environment (European Commission, 2020), as it has to comply with strict standards of chemicals use, i.e., no synthetic fertilisers and pesticides, as well as stricter rules on animal medication. Despite no consensus on exact contribution of organic farming to the environment and ongoing debates on the matter, previous research reported a positive impact on biodiversity and soil organic matter (Tuomisto et al., 2012), as well as on emissions of nitrates ammonia and energy comparing with conventional farming (Mondelaers et al., 2009).

Currently, organic farming in the EU is supported via annual payments granted per hectare of crop, on the basis of commitment lasting usually for at least five years. In theory, organic payment should be set up at a level in order to compensate for additional costs and income loss due to switching from conventional to organic production, such that beneficiaries are indifferent between conventional and organic production. In the reality, the level of such payments is set at regional level by competent authorities and are characterized by two main features: (i)

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[1] Despite an increase of 46% between 2012 and 2019, only 9% of the total farmland in the EU is currently devoted to organic agriculture (Eurostat, 2022). The distribution across the EU Member States is however very heterogeneous with Austria, Sweden and Estonia being the leading countries with > 20% of Utilised Agricultural Land managed under organic schemes (Eurostat, 2022).

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their level does not depend on the level of production; and (ii) they are differentiated by groups of crops with the maximum level of payment per hectare defined in the EU regulation as 600 Euro/ha per year for annual crops, 900 Euro/ha for specialised perennial crops such as hazelnut, and 450 Euro/ha for other land uses. The peculiarity (i) hints that organic payments being independent on actual costs and income might be suboptimal and could explain why organic land is often characterised by low yields or does not produce organic labelled products at all (Pietola and Oude Lansink, 2001; Cisilino et al., 2019). The literature presented in the next section hints that such payments can affect production choices, meaning that crop choice and associated land use are driven by organic policy support only, without considering if and to what extent organic products are requested by the market (Argyropoulos et al., 2013). Although organic policy support does lead to larger areas under organic farming in this case, it also causes inefficient use of resources resulting in less supply of food products. The hint towards such a policy failure is particularly relevant in the case of perennial crops. On the one hand side, perennial crops are usually characterised with no yields within several years after establishment; on the other hand, organic perennials are often granted with a much higher organic payment than annual crops.

Nevertheless, empirical investigations of how EU organic payments affect land use, resource allocation, and output level at farm are still very limited. We close the gap by modelling optimal land use behaviour and production choice of a farmer aiming to maximise annuities with and without organic payments. We consider farmers with different perceptions that are expressed via different levels of private discount rate and different expected market prices. We use an empirical example featuring hazelnut cultivation in the Lazio region, Italy. This is an interesting case study not only because hazelnuts is a perennial crop, but also because there has been observed a substantial growth of area under organic hazelnuts in the region with no increase in organic production.

The paper is structured as follows. The next section provides a literature review on organic agriculture and on the distortionary nature of policies with particular emphasis on the role of agri-environmental and organic payments. It also describes the case study, our calculations, and used data. Section 3 presents the results. The last two sections discuss our findings and conclude.

2. Methodology and data

2.1. Literature background

The literature on organic agriculture emerged soon after the adoption of subsidies for organic agriculture (Weber, 2000). However, the majority of research have been focused on the following four topics so far: production efficiency, environmental implications, market and consumers' behaviour, and financial sustainability of organic production at farm level.

Investigations devoted to production efficiency compared technical efficiency between organic and conventional production in several countries (Cisilino et al., 2019; Kumbhakar et al., 2009; Lakner, 2009; Latruffe and Nauges, 2014; Madau, 2007; Nastis et al., 2012; Oude Lansink et al., 2002; Park and Lohr, 2010; Serra and Goodwin, 2009; Larsen and Foster, 2005). However, based on Data Envelopment Analysis and Stochastic Frontier Analysis applied to production efficiency, these studies do not explicitly model behaviour aiming at maximising public subsidies, e.g., via harvesting and selling organic yields as conventional, abandoning organic harvest, or not achieving any agricultural output at all. Instead, they do not consider that the Rural Development Policy support to organic farming is currently provided through area-based payments without making it conditional to the amount of production obtained. Another strand of literature focuses on environmental effects of organic agriculture and confirm a positive impact on biodiversity, which may justify policy support of organic agriculture (Aldanondo-Ochoa and Almansa-Sáez, 2009; Bengtsson et al., 2005; Casey and Holden, 2006; De Boe, 2020; Fuller et al., 2005; Gomiero et al., 2008; Hansen et al., 2001; Hole et al., 2005; Mondelaers et al., 2009; Morri and Santolini, 2022; Shepherd et al., 2003; Stolze et al., 2000; Tuck et al., 2014). However, organic payments are not unique policy measure aiming at fostering farmers' practices towards higher sustainability and better environmental performance. In fact, organic payments are one of the most criticised ones because its implementation is unable to distinguish between farmers who are mainly interested in delivering ecosystem services, and those who aim at production of organic goods to be sold on the market. Despite the growing importance of agri-environmental payments in the EU and ongoing criticism of organic payments, the analyses focused on how these policies affect farmers' production choices are scant (Baylis et al., 2008; Spiegel et al., 2018; Uthes and Matzdorf, 2012). The link between demand and supply for organic products has been investigated by research focused on marketing aspects and consumers preferences towards organic food products (Aslihan Nasir and Karakaya, 2014; Castellini et al., 2014; Chinnici et al., 2002; Michelsen et al., 1999; Padel and Midmore, 2005; Paul and Rana, 2012; Rana and Paul, 2017). However, these papers do not focus on political support of organic agriculture. This gap is partly closed by investigations whether organic agriculture could be financially worthwhile at farm level comparing to conventional farming. They found out that in some EU countries public subsidies are an important entry in organic farms balance sheets, and consistently contribute to financial sustainability of organic practices (Offermann and Nieberg, 2000; Nieberg and Offermann, 2008; Oude Lansink et al., 2002; Oude Lansink and Jensma, 2003).

On the contrary, little attention has been devoted so far to analysis of organic support, currently implied in the EU in the form of area-based agri-environmental schemes. Going beyond organic agriculture, Moro and Sckokai (2006) and O'Toole and Hennessy (2015) assessed the impact of area-based payments on the allocation of quasi-fixed inputs and in particular land, entry and exit from specific sectors and, when these release financial constraints, investment decisions. Guyomard et al. (2004) compared four support programmes (i.e., output subsidy, land subsidy, decoupled payment with and without mandatory production) in terms of achieving different policy goals. It has been revealed that policy measures, including those decoupled from production, can influence farmer's choices, resources' allocation, and market equilibrium (e.g., Guyomard et al., 1996, Hennessy, 1998; Moro and Sckokai, 2013). Furthermore, direct payments (even if decoupled) can affect investment behaviour on farm (Viaggi et al., 2011), because they reduce the requirement to seek external finance (Latruffe et al., 2010), affect investment financial constraints (O'Toole and Hennessy, 2015), and can reduce the risk of bankruptcy (Vercammen, 2007). Risk-averse farmers additionally value direct payments as a relatively "risk-free" source of income, which hence could stimulate (eventually more aggressive) investment behaviour (O'Toole and Hennessy, 2015). As for organic agriculture specifically, Michelsen (2002) highlighted that organic support being too high might kill any incentive for farmers to sell their organic products at premium prices. Furthermore, different level of organic subsidies in different countries may show distortive effects on environment, farm-level efficiency, and international trade competition (e.g., Bach, 2006; Nastis et al., 2012; Wynen, 2003). Daugbjerg et al. (2011) argued that conversion to organic production may be policy-driven, e.g., as in case studies in the UK and Denmark, directly affecting number of organic farmers, area of organic land, and stocks of organic products. More recent empirical investigations in Greece (Argyropoulos, 2013) and Poland (Łuczka, 2021) revealed a rapid increase in the area under organic farming without a significant increase of organic products supplied. These results hint towards land use change driven by organic policy, which might not have taken place in absence of any organic support, assuming a profit-maximising farmer. To this end, despite suspicions that organic support in the EU may have a distortive effect on land use and distribution of other resources at farm level, empirical investigations in this direction are limited. We close the gap.

In particular, we explicitly model how existing organic payments affect land use and production choice at farm.

2.2. Case study

We use a case study featuring hazelnuts cultivation in the Lazio region, Italy, which is a relevant case study for four main reasons. First, being a perennial crop, hazelnuts are eligible for particularly high organic payments, although it binds land for decades and reduces flexibility in response to risks in the future. Second, there is a strong increase of the area under hazelnut in Italy —— approximately 15% just in the period 2018–2020, according to ISTAT (2021), and new investments are likely to occur in coming years. This is specifically the case of the Lazio region being the second most important area of hazelnut production in Italy. In fact, hazelnut accounts for more than 70% of perennial crops at the regional level, and durum wheat is one of the most important alternative crops in Lazio, occupying 18.2% of the overall Utilised Agricultural Area in the region (CREA, 2020). Third, switching from annual crop to a perennial one often implies intensification of land use that bears possible negative consequences on the environment. In the Lazio region, the shift to hazelnut has raised some environmental concerns due to excessive simplification of agricultural ecosystems (a single species cultivated on the majority of available agricultural land) and higher use of chemicals and irrigation comparing with traditional arable crops, such as durum wheat. Fourth, despite the growing areas under organic hazelnuts, organic hazelnut production still accounts for less than 5% of total hazelnut production at the national level, according to estimates of organic producers' associations. This is mainly because of the difficulties in controlling some pests (noticeably insects) without use of traditional chemicals unless farms are located in the best production areas. These risks have negative effects on the quality of the products that substantially reduces the market price and the opportunities to sell the product on the market.

Hazelnuts, like many perennial crops, do not yield in the first six/seven years after establishment. However, they are still eligible for organic payment immediately after establishment, since organic payments are not coupled with production. When opting for organic certification, farmers must enrol for organic support for a minimum of five years, and they can either switch to conventional production or continue organic cultivation with or without harvesting after this period. This former shift is often observed and motivated by the low profitability of organic hazelnut production. This phenomenon provokes a number of issues. First, it seems that organic payments may indeed have a distortive effect on land use choices. It is not clear whether farmers would opt for hazelnuts at all if no organic payments were available. Second, the presence of wide organic area without (or with limited) organic production, like observed in the case study region, only delivers ecosystem services but does not provide additional supply on the market. We test these hypotheses and check whether organic payments initiate investments into hazelnut plantations that otherwise would not have been established and whether organic payments support sustainable organic production under assumption of annuity maximisation. In order to check for a distortive effect of organic payments, the following options over the time horizon of 35 years are considered:

1. Conventional durum wheat;
2. Conventional hazelnuts with no organic contract;
3. One 5-years organic contract and conversion of hazelnut plantation to conventional production afterwards (Fig. 1);
4. Two subsequent 5-year organic contracts, no harvest in years 7–10 (with low production level), and conversion of hazelnut plantation to conventional production afterwards (Fig. 1);
5. Organic hazelnuts with no production.

Due to absence of reliable data for price and yields of organic hazelnuts, we cannot consider organic hazelnuts with organic production as an additional option. The lack of data is explained by the fact that there is hardly any supply of organic hazelnuts in the reality. In this regard, we proceed the other way around, namely derive the minimum gross margin of organic hazelnuts that would be sufficient to maintain organic production. Please also note that we rely on an assumption that the whole farm is devoted to one of the crops. This is done in order to replicate the reality, indicating that hazelnut farms in Lazio region are highly specialised, and hazelnut production is rarely combined with other arable crops. This is probably motivated by the fact that these farms are quite small (30 ha in our case), so that partial conversion to hazelnuts would not justify high investments into machinery and irrigation facilities. In case conventional durum wheat production (Option 1) is preferred over conventional hazelnut production with no organic contract (Option 2), yet any option with organic contracts (Option 3 or 4) is preferred over conventional durum wheat, organic payments overcompensate income loss due to switching from conventional to organic hazelnut production. In this case, we say that organic payments have a distortive effect and initiate investments into hazelnuts that were otherwise not preferred. We conduct two simulations referring to possible policy changes that may reduce the distortive nature of the subsidy. First, we impose that farmers have to sign two consecutive 5-year organic contracts. Second, we consider reducing the level of the subsidy and derive the maximum level of organic payment that would cut annuities of Option 3 or 4 down to the level of conventional durum wheat (Option 1).

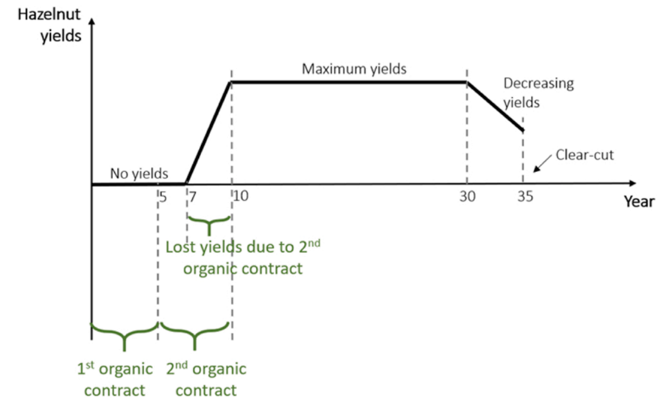

Fig. 1. Development of hazelnut yields and timing of organic contracts as considered in the analysis.

3. Calculations

The calculations were performed in four steps. First, we derived annuities for each of the five alternative options. We used the following formula for annuities:

$$A_{c,i,p} = NPV_{c,i,p} * \frac{i}{1-(1+i)^{-\overline{T}}} \tag{1}$$

where $A_{c,i,p}$ stay for annuities (euros, €) of alternative option c, at annual private discount rate i and hazelnut market price multiplicator p; NPV stays for net present value (€); and $\overline{T}$ stays for the total time horizon (years). The net present values of durum wheat and hazelnuts production were derived according to the formulas:

$$NPV_{c=DW,i,p} = \sum_{t=0}^{\overline{T}} \frac{\overline{L} * Y_{c=DW} * QI_{c=DW} * P_{c=DW} - \overline{L} * VC_{c=DW}}{(1+i)^t} = (\overline{L} * Y_{c=DW} * QI_{c=DW} * P_{c=DW} - \overline{L} * VC_{c=DW}) * \frac{1-(1+i)^{-\overline{T}}}{i} \tag{2}$$

$$NPV_{c=H-OP,i,p} = \sum_{t=0}^{\overline{T}}[-\overline{L}*IP_{c=H} - \sum_{m}\frac{IM_m}{(1+i)^t} - \frac{\overline{L}*IR_{c=H}}{(1+i)^{\overline{T}}} + \frac{\overline{L}*Y_{c=H}*QI_{c=H}*P_{c=H}*p}{(1+i)^t} - \frac{\overline{L}*PC_{c=H}+\overline{L}*Y_{c=H}*VC_{c=H}+(\overline{L}*lab_{c=H}-\overline{Lab})*w}{(1+i)^t}] \quad (3)$$

$$NPV_{c=H+OP,i,p} = \sum_{t=0}^{\overline{T}}[-\overline{L}*IP_{c=H} - \sum_{m}\frac{IM_m}{(1+i)^t} - \frac{\overline{L}*IR_{c=H}}{(1+i)^{\overline{T}}} + \frac{\overline{L}*Y_{c=H}*QI_{c=H}*P_{c=H}*p}{(1+i)^t} + \frac{\overline{L}*OP}{(1+i)^t} - \frac{\overline{L}*PC_{c=H}+\overline{L}*Y_{c=H}*VC_{c=H}+(\overline{L}*lab_{c=H}-\overline{Lab})*w}{(1+i)^t}] \quad (4)$$

where $NPV_{c=DW,i,p}$ stays for net present value of durum wheat cultivation; $\overline{L}$ stays for land endowment (hectares, ha); Y_c stays for yields (tonnes per hectare, t ha^{-1}); QI_c stays for so-called quality index, i.e., the difference between the market price and the farm-gate price, reflecting not only the quality of the product, but also farmer's negotiation skills; P_c stays for market price (euros per tonne, € t^{-1}); $VC_{c=DW}$ stays for variable costs of durum wheat cultivation (euros per hectare, € ha^{-1}); $NPV_{c=H-OP,i,p}$ and $NPV_{c=H+OP,i,p}$ stay for net present value of hazelnuts without and with organic contracts respectively (€); $IP_{c=H}$ and $IR_{c=H}$ stay for planting and reconversion costs of hazelnut plantation respectively (€ ha^{-1}); IM_m stays for investments into required machinery m (€); p stays for multiplicator of market price of hazelnuts, reflecting different expectations; OP stays for organic payments (€ ha^{-1}); $PC_{c=H}$ stays for variable production costs of hazelnuts (€ ha^{-1}); $VC_{c=H}$ stays for variable harvesting costs of hazelnuts (€ t^{-1}); $lab_{c=H}$ stays for labour input for hazelnuts (hours per hectare, h ha^{-1}); $\overline{Lab}$ stays for labour endowment (hours, h); and w stays for wage rate (€ per hour, € h^{-1}). Note that since we assume constant prices, yields, and associated costs for durum wheat, the formula for summing up a finite geometric series can be applied to the NPV of durum wheat, as shown in Eq. (2). It means that annuities from conventional durum wheat depends neither on the expected market price of hazelnut, nor on the private discount rate. Please also note that we consider neither fixed costs nor labour costs in the case of durum wheat. In fact, we explicitly assume resources endowments at farm that allowed durum wheat cultivation prior to hazelnut adoption. Yet, the initial level of resources endowments does not matter for comparison of annuities of durum wheat and hazelnuts; what actually matters is the difference in resources requirements between the two crops. So, we set up a fixed initial level of resources endowments required for durum wheat cultivation and explicitly consider how much additional resources would be needed if hazelnuts are adopted. Detailed consideration of resources requirements for both crops would require additional data and might unnecessary complicate calculations, while not affecting the outcome at all.

At the second step, we compared the options in terms of their annuities and defined the optimal decision. At this step, we also identified combinations of discount rate and expected hazelnut price when the organic payments have a distortive effect, i.e., when the following holds:

$$A_{c=H-OP,i,p} < A_{c=DW,i,p} < A_{c=H+OP,i,p} \quad (5)$$

Whenever a distortive effect of organic payments is observed, we derived the maximum level of organic payments per hectare that would eliminate this distortive effect, i.e., the level of OP, such that $A_{c=DW,i,p} \geq A_{c=H+OP,i,p}$. The maximum level of organic payments having no distortive effect, however, would not facilitate organic production. Hence, in the final step, we derive the minimum benefits required to initiate and maintain production of organic hazelnuts. Due to absence of reliable data, we cannot consider yields and market price for organic hazelnuts separately. In this regard, we derive so-called gross margin that reflects revenues from organic yields, revenues from organic payments, as well as variable harvesting costs of organic hazelnut. We assume that all other costs are the same as for conventional hazelnuts, including production and labour costs, as well as required investments into irrigation facilities and machinery. The calculations can be found in the supplementary Excel file, including detailed calculations for the baseline scenario with additional comments explaining the approach step-by-step.

4. Data

Our analysis draws on multiple data sources (Table 1), including the Italian Farm Accountancy Data Network (CREA, 2021), Eurostat (2022), World Bank (2022), Census data (ISTAT, 2021), agricultural output prices (ISTAT, 2021) and the Italian Central Bank, as well as available literature (Frascarelli, 2017; Liso, 2017; Ribaudo, 2011) and expert judgement. The CREA (2021) data are only available for the period 2008–2016; the data from ISTAT, Eurostat, and the World Bank were selected for the period 2000–2016. All monetary values were deflated using the GDP deflator for Italy provided by the World Bank (2015 =100) to ensure comparability over time. Since no reliable source was found for the private discount rate and expected market prices of hazelnuts, we consider several levels of both, i.e., conduct a sensitivity analysis. The reader should note here that both private discount rate and expected market price of hazelnut reflect farmer's perception in our model, since she decides based on her beliefs and expectations. So, different combinations of private discount rate and expected market price of hazelnut can be interpreted as farmers with different perception.

5. Results

Our results are twofold. First of all, the results are highly sensitive to the discount rate and the expected hazelnut prices (Fig. 2). A slight change in the private discount rate or expected market price of hazelnut can quickly lead to a different optimal decision. The difference in annuities from hazelnut production with and without organic contracts increases with the increase of the discount rate. This is observed due to the fact that organic payments are assumed to be paid in the beginning of the hazelnut production cycle, while a higher discount rate favours earlier payments.

Second, there are multiple combinations of the discount rate and expected hazelnut price that lead to distortive effect of organic payments (Fig. 3). In the light-green area, there is no distortive effect, because hazelnuts would have been preferred over durum wheat even without organic payments, although one organic contract with subsequent conversion to conventional hazelnut production (Option 3) would be exercised under the current level of organic payments. In this case, organic payments might be used solely as a compensation for ecosystem services, while supplying no organic production. In the light-yellow area, there is no distortive effect, because hazelnuts cannot compete with durum wheat despite of organic payments. However, distortive effect (the dark-green area) can be observed for annual private discount rate between 2% and 7% throughout the whole range of considered market price expectations. Since both price expectations and a private discount rate are very difficult to empirically confirm and since both can change over time, one can never be sure that organic payments are not distortive, at least for some farmers.

In order to reduce the distortive effect of organic payments, we suggest different policy avenues. A reduction of the level of organic payments for the first contract is intuitive, yet not promising for two reasons. On the one hand side, the maximum level of organic payments in the first contract is highly significant to the combination of private discount rate and expected market price of hazelnut. Hence, it is not easy to identify the appropriate level of the subsidy in practice. As Fig. 4

Table 1
Assumed parameters and references.

Parameter	Value	Units	Source
Hazelnuts			
Annual organic payments per hectare in the first contract (5 years)	800,00	€ ha^{-1}	Regione Lazio (2014)
Annual organic payments per hectare in the second contract (5 years)	670,00	€ ha^{-1}	Regione Lazio (2014)
Hazelnut yields at the age of 7	0,58	t ha^{-1}	CREA (2021)
Hazelnut yields at the age of 8	1,16	t ha^{-1}	CREA (2021)
Hazelnut yields at the age of 9	1,74	t ha^{-1}	CREA (2021)
Hazelnut yields at the age of 10	2,32	t ha^{-1}	CREA (2021)
Hazelnut yields at the age of 11–30	2,90	t ha^{-1}	CREA (2021)
Hazelnut yields at the age of 31	2,61	t ha^{-1}	CREA (2021)
Hazelnut yields at the age of 32	2,32	t ha^{-1}	CREA (2021)
Hazelnut yields at the age of 33	2,03	t ha^{-1}	CREA (2021)
Hazelnut yields at the age of 34	1,74	t ha^{-1}	CREA (2021)
Hazelnut yields at the age of 35	1,45	t ha^{-1}	CREA (2021)
Quality index	0,92		ISTAT (2021)
Expected market price*	2160,73	€ t^{-1}	ISTAT (2021), World Bank (2022)
Variable costs of harvesting hazelnuts	50,00	€ t^{-1}	Ribaudo (2011)
Operational costs, incl. fertilisation, chemicals application, irrigation, and variable machinery costs (occur annually independent on hazelnut harvesting)	1700,00	€ ha^{-1}	Expert-based information
Planting costs	8000,00	€ ha^{-1}	Liso et al. (2017), Ribaudo (2011), Frascarelli (2017)
Investments stand-alone harvesting machinery	40000,00	€	Liso et al. (2017), Ribaudo (2011), Frascarelli (2017)
Lifetime of stand-alone harvesting machinery	600,00	ha	Liso et al. (2017), Ribaudo (2011), Frascarelli (2017)
Investments into tractor	20000,00	€	Expert-based information
Investments into other machinery	10000,00	€	Expert-based information
Investments into a well	12000,00	€	Liso et al. (2017), Ribaudo (2011), Frascarelli (2017)
Labour input T1-T6 if not harvesting	49,50	h ha^{-1}	Liso et al. (2017), Ribaudo (2011), Frascarelli (2017), expert-based information
Labour input T7-T35 if not harvesting	89,50	h ha^{-1}	Liso et al. (2017), Ribaudo (2011), Frascarelli (2017), expert-based information
Labour input T1-T6	49,50	h ha^{-1}	Liso et al. (2017), Ribaudo (2011), Frascarelli (2017), expert-based information
Labour input T7-T35 if stand-alone harvesting machinery	104,50	h ha^{-1}	Liso et al. (2017), Ribaudo (2011), Frascarelli (2017), expert-based information
Reconversion costs	2000,00	€ ha^{-1}	Expert-based information
Durum wheat			
Yields	3,91	t ha^{-1}	CREA (2021)
Quality index	0,98		CREA (2021), ISTAT (2021)
Market price	237,22	€ t^{-1}	Eurostat (2022), World Bank (2022)
Variable costs	371,75	€ ha^{-1}	CREA (2021)
Other parameters			
Labour endowment at farm	350,00	h year^{-1}	Own elaborations based on the assumption that there is no hired labour before adoption of hazelnuts
Expected wage rate	10,00	€ h^{-1}	Local collective contracts for hired labour
Land endowment	30,00	ha	CREA (2021)
Discount rate*	0,02		Expert-based information
Time horizon	35	years	

* For annual discount rate and expected farm-gate hazelnut price, the baseline levels are indicated in the table. We additionally conduct a sensitivity analysis with respect to both parameters.

demonstrates, while for some combinations, no change in the level of organic payments is needed, others require a 20 times reduction down to 40 euros per hectare or lower. On the other hand, both conventional and organic hazelnut production imply substantial investment costs in the first years of production cycle, and a relatively high level of organic payments could serve as a financial support of long-term investments.

Another policy avenue is to impose at least two subsequent organic contracts. As Fig. 2 demonstrates, whenever two organic contracts with later conversion to conventional hazelnuts (Option 4) is preferred over conventional durum wheat (Option 1), it is less attractive than conventional hazelnuts with no organic contract (Option 2), i.e., there is no distortive effect.

Suggested policy avenues would eliminate the distortive effect, yet they would not lead to more organic production. In this regard, we derived the minimum level of gross margins of organic hazelnuts that would ensure sustainable organic production (Fig. 5). As explained above, the gross margins reflect revenues from organic hazelnut yields, revenues from organic payments, as well as variable harvesting costs of organic hazelnut. Hence, the resulting level of minimum gross margin can be achieved either by implying a higher organic payment and coupling it to organic production, or by imposing a guaranteed price for organic hazelnuts, or by subsidising variable harvesting costs for organic hazelnuts.

Our results suggest that the higher the discount rate, the less the required gross margins depend on the expected market price of conventional hazelnuts. A similar result can be seen in Fig. 2, which shows that farmers with a discount rate above 8% would never prefer hazelnuts over durum wheat for the considered range of conventional hazelnut price. Indeed, high discount rates lower the value of postponed revenues from later harvesting, while at the same time increase the burden of initial investments required for hazelnuts in the beginning of its production cycle. In this regard, the minimum gross margin of organic hazelnut in the case of high discount rates reflect competition with durum wheat only. In contrast, as Fig. 2 shows, farmers with a discount rate of 1% would always prefer hazelnuts over durum wheat for the considered range of hazelnut prices. So, gross margins ensuring sustainable organic production should outperform revenues from conventional hazelnuts, which directly depend on their market price. To this end, the required level of gross margin depends on the combination of discount rate and expected market price of conventional hazelnuts. This result suggests that identifying the required level of gross margin would be challenging in practice. Hence, coupling any support for organic hazelnuts production to the market price of conventional hazelnut seems more promising than identifying a fixed level, unless a relatively high discount rate is empirically proven.

6. Discussion

Results confirm that organic support schemes show three main types of failure under a plausible range of expected price and discount rate. Firstly, from the investment point of view organic support might alter ordinary investment decisions in favour of the adoption of new hazelnuts plantations that otherwise would not be profitable. The possibility to benefit from organic subsidies in the first five years after plantation

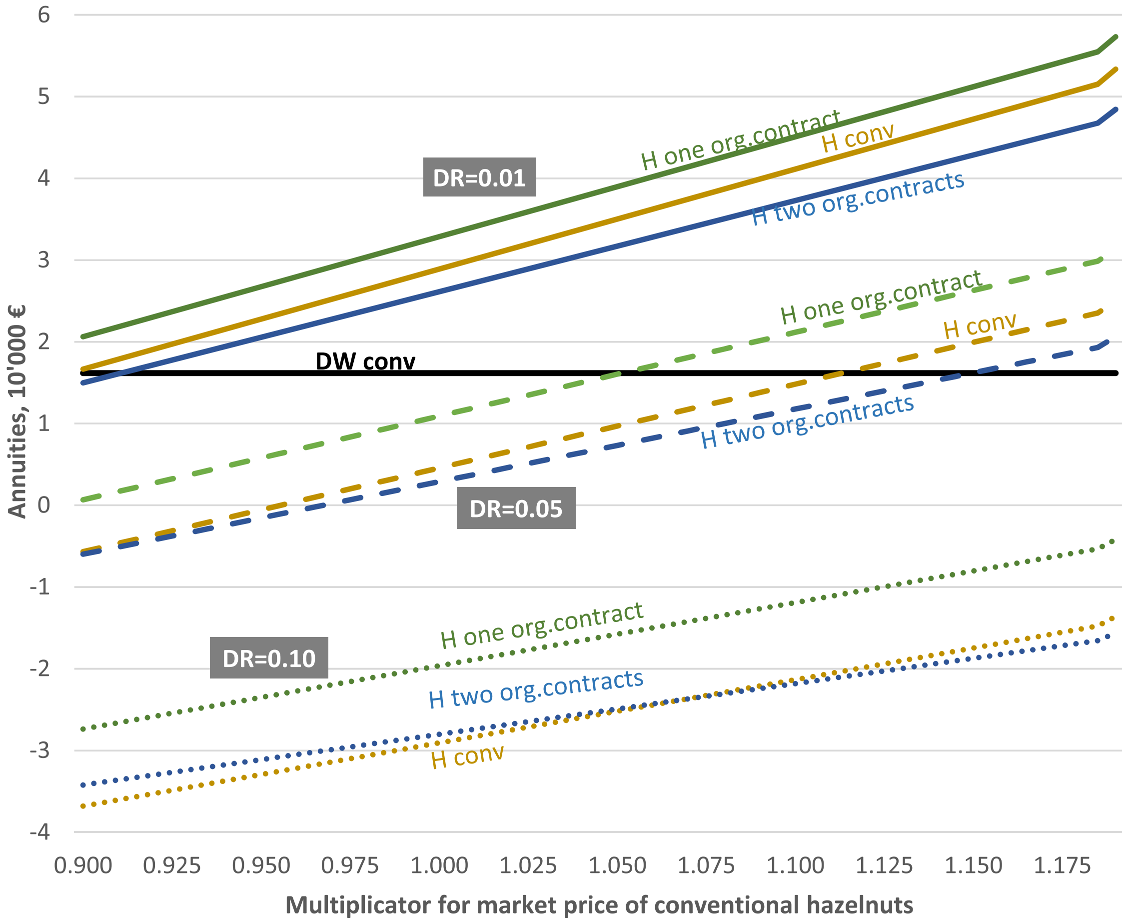

Fig. 2. Results of the sensitivity analysis with respect to discount rate (DR) and hazelnut (H) price multiplicator.
Note: DW conv stays for conventional durum wheat (Option 1); H conv stays for conventional hazelnut production with no organic contract (Option 2); H one org. contract and H two org.contracts stay for hazelnut production with one or two organic contracts respectively and later conversion to conventional production (Options 3 and 4 respectively).

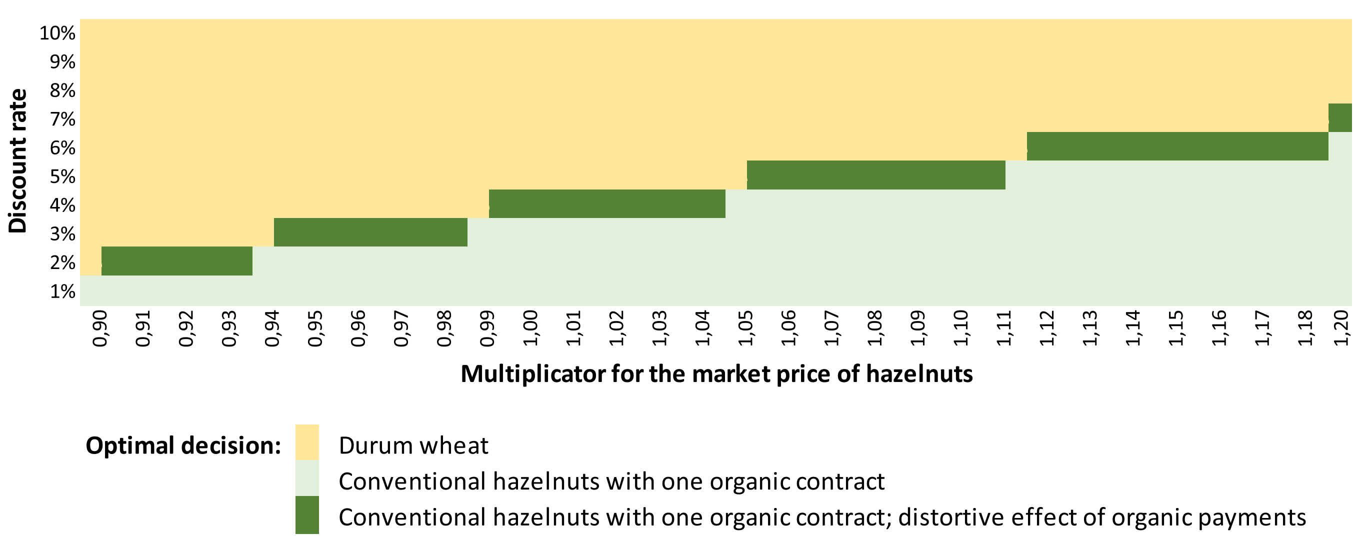

Fig. 3. Optimal decisions for all considered combinations of private discount rate and hazelnuts price multiplicator.

substantially increases the attractiveness of investment into hazelnuts. Although this decision would bind land for many years, the farmer still has the flexibility to refuse from a subsequent organic contract and proceed with conventional hazelnut production. This is also confirmed by empirical evidence of a widespread adoption of organic schemes in the first years after introducing a hazelnut plantation combined with very limited organic production observed afterwards. Secondly, organic subsidies do not sustain a more environmentally friendly production process. In presence of specific parameters values that should suggest to maintain an extensive and low input crop (durum wheat, if compared

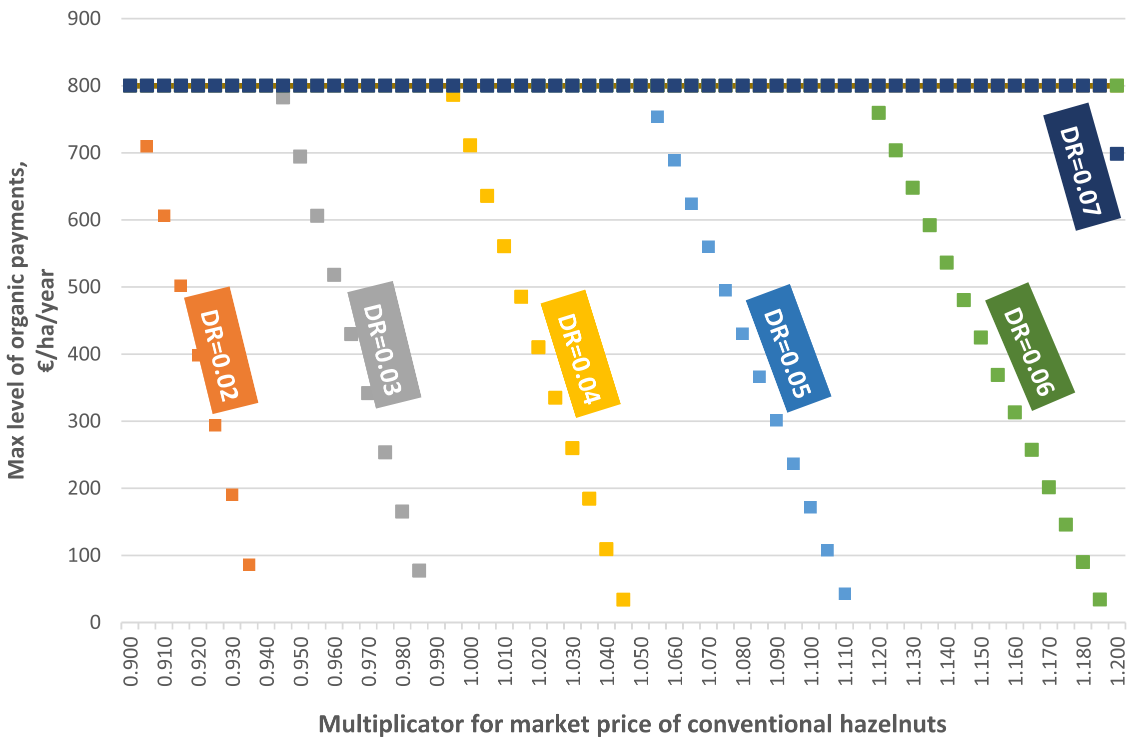

Fig. 4. Maximum level of organic payments in the first organic contract that has no distortive effect under different levels of discount rate (DR) and hazelnut price.

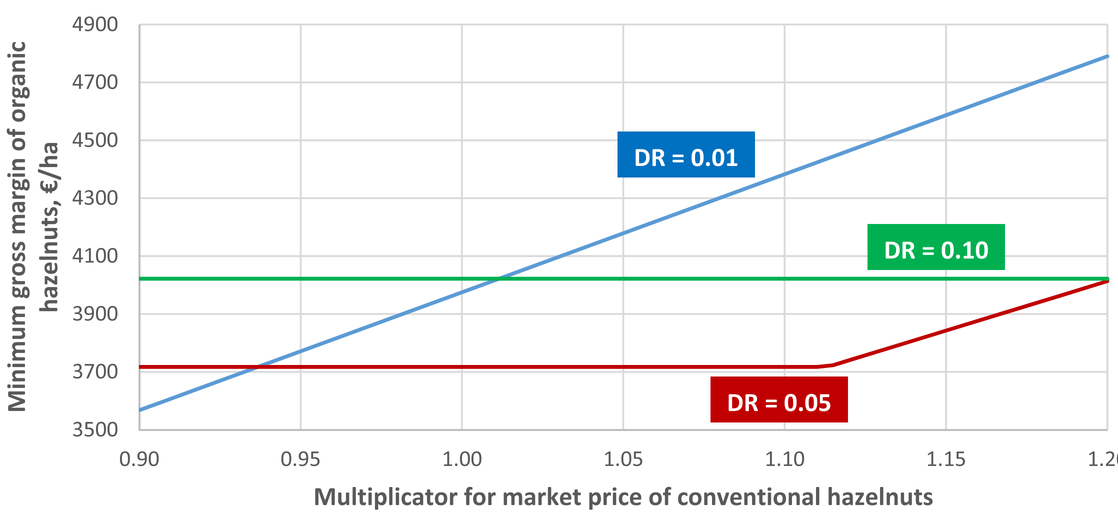

Fig. 5. Minimum level of gross margin of organic hazelnuts that would lead to sustainable conversion to organic production under different assumptions on the discount rate (DR).

with hazelnut), the possibility to adopt organic schemes push farmers to invest in a more intense cultivation: organic hazelnut. The eco-service provision of organic choice stops very soon and leads to a more intensive cropping pattern with an increase of the use of chemicals, since farmers quit organic practices in favour of conventional production after the first five years when approaching first years of production (i.e., does not stimulate the stable conversion to organic practices). This seems clearly in contrast with the aim of the support to organic farming related to its environmental sustainability (even without production). Thirdly, organic payments fail to cause an increase in organic production. This market failure is neither resolved by alternative policy avenues suggested above. Indeed, low incentives to deliver organic hazelnut to the market are also explained by the fact that major consumers of hazelnuts – manufacturers of chocolate and confectionery products – rank high quality of the product first, which is at substantially higher risk for organic hazelnuts compared with conventional ones. These, so far overlooked, unexpected effects of organic payments seem to provide a clear case of policy failure that should be mitigated to increase the efficiency of the policy measures devoted to the support of organic production. In this regard, our results recommend that the current policy should be substantially changed.

From a theoretical point of view many options could be adopted: a reduction in the level of payments, additional restrictions to avoid the shift to conventional production, organic payments for perennial crops being granted only once the plantation starts yielding, commitment to harvest organic production when it becomes available, support of organic price. All these options could be evaluated in future analyses considering their likely impact and the easiness of application in the considered cases since not all the options seem to be enforceable easily. However, some of them show difficulties with regards of their enforcement. The extension of shortest allowed period of organic engagement seems quite simple to impose (e.g. from 5 to 7 years or more), but it is often in contrast with budget allocation of agri-environmental schemes based on five-years budgetary planning. At the same time, the harvest constraint is somehow difficult to impose in all cases, since several adverse phenomena can take place, and often they make harvest non-profitable (mainly during first years of production when physiological low productions occur). Another option is the possibility to adopt organic schemes only after a minimal period starting from the cadastral information update, which however would require an access to different subsidies and be subject to yearly control from the agricultural payment agency – AGEA. Finally, price support for organic products could be interesting as a theoretical option but, at the moment, it cannot be implemented due to the World Trade Organisation (WTO) rules, and accordingly not feasible.

7. Conclusions

Organic farming is supported in the EU, among others via area-based organic payments, targeting better environmental standards, as well as consumers' demand for organic products. Organic payments are, however, often criticised for altering optimal market equilibrium and resources' allocation. Moreover, the literature suggests serious difficulties in distinguishing between farmers targeting ecosystem services and those aiming to supply organic products. Very limited economic analysis are conducted so far and none of them focus on perennial crops. We close the gap by testing whether existing area-based organic payments might cause resources' misallocation in terms of land use and financial endowment. We use an empirical example featuring hazelnut plantations in the Lazio region, Italy.

More specifically, we derive annuities of hazelnut production with and without organic payments, as well as annuities of alternative crop cultivation, and assume that a farmer opts for an option with the highest annuities. Due to negligible share of organic hazelnut production observed and resulting lack of data for organic hazelnut production, we assume no production during an organic contract. Yet, later conversion to conventional production and initiating of harvesting is possible. In case introduction of organic payments lead to a different crop choice, we say that organic payments have a distortive effect. We additionally run sensitivity analyses with respect to private discount rate and expected conventional hazelnut price.

Although our results are sensitive to private discount rate and expected conventional hazelnut price, we found a number of combinations of both where a distortive effect is observed. Whenever hazelnuts are established, organic contract is maintained during the first five years with no yields, and then the plantation is converted to conventional one with harvest. For some farmer's expectations, this shift from annual crop to hazelnuts would not have taken place in absence of organic payments. Our results are in line with the limited available empirical evidences (Argyropoulos, 2013, Łuczka, 2021), who argued that in many cases a rapid increase in the area involved under organic farming occurs without a sensible increase of organic products supplied. They indirectly confirm the hypothesis of land misallocation suggested by Daugbjerg et al. (2011). Decreasing the level of organic subsidy is challenging, since the optimal level equally depends on private discount rate and expected conventional hazelnut price. Instead, we suggest adding an additional (output-based) requirement for organic payments or imposing at least two subsequent organic contracts as alternative policy avenues. The recommended policies would eliminate the distortive effect, yet they would not cause an increase in organic production and might lead to a decrease in organic areas. In this regard, follow-up research can focus on designing alternative policy measures supporting organic production, while creating no distortive effect. We provided some preliminary calculations on the minimum required level of gross margin of organic hazelnut production. A more sophisticated research in this direction would require detailed reliable data of organic hazelnut production. Furthermore, follow-up research can check other policy instruments targeting higher sustainability standards. Indeed, several other policy measures often overlap in their support of public goods' and/or environmental externalities' provision, as public goods (or services) are influenced by several farms' activities. The level of their provision is, accordingly, the result of different producers' behaviours influenced by specific policy measures. As an example, reduction of fertilisers' and of pesticides' use, crops' rotations, biodiversity increase, organic payments, increase in soil organic matter, biodiversity protection, minimum tillage, precision farming, cultivations devoted to wild species' feeding, can be cited among current Rural Development Policy measures (II pillar). However, the same result is undoubtedly delivered by other additional measures included in current Common Agricultural Policy under the pillar I based on cross-compliance and greening requirements. Policies' overlap is not easy to separate nor evaluate, as clearly shown by the debate on effective and efficient policy measures to deliver public goods (see among others the Court of Auditors' concerns related to greening measures included in the special report n. 21 (European Court of Auditors, 2017) and cross compliance in special report n. 26 (European Court of Auditors, 2016).

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.landusepol.2022.106202.

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