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Promoting Organic Food: Information Policy versus Production Subsidy

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Promoting Organic Food: Information Policy versus Production Subsidy

Abstract:
Governments in developed countries aim to increase the market share of organic products as a possibility to improve the environment or animal welfare or as a reaction to food crises and changing consumer preferences. Assuming that organic farming creates a positive externality, we address the question of how this environmental benefit can be internalized best. We use the concepts of heterogeneous producers with different unit production costs and heterogeneous consumers with different preferences for conventional and organic food, and compare two policy options to enhance organic supply and demand with respect to their efficiency and distributional effect: Firstly, we analyze the effect of a supply-side oriented policy like a subsidy on organic production on equilibrium prices and quantities, and producer and consumer welfare. Secondly, we compare this policy measure with a demand-side oriented information policy, which aims to enhance the acceptance and identification of an organic label. The main findings of this paper are that in either case, producers and consumers of conventional food are worse off, organic producers and consumers experience a gain in welfare, but the change in welfare is identical under the two policy options.

Keywords: organic food, labeling, production subsidy, information policy, welfare

1 Introduction

Though still small in absolute terms, organic markets are rapidly growing in developed countries. Organic food retail sales in the U.S. were estimated at $7.8 billion in 2000 with an average growth rate over the past 10 years of 23% per annum. Industry analysts forecast the sector to be worth $20 billion by 2005 (USDA, 2004). The situation is similar to the European Union (EU). These increases occur for several reasons: i) Due to increasing incomes and repeated food scares consumer preferences for food with specific characteristics increase. ii) Spurred by budgetary problems and pressure through international trade agreements some countries are trying to get rid of subsidized surplus production by giving incentives to use less intensive agricultural production techniques including organic farming. iii) Organic farming is promoted as a method to decrease the negative external costs of agricultural production and to increase animal welfare. iv) Though not scientifically verified, consumption of organic products is sometimes promoted and/or perceived as being healthier.

Especially in Europe governments at the national and the EU level are trying to promote organic farming. For examples, these days the EU is discussing and developing a European Action Plan for Organic Food and Farming. Similarly, in an answer to the BSE crisis in 2001-2002, the German Minister of Consumer Protection, Nutrition and Agriculture has declared the goal to increase the share of organic products in Germany from 5% today to 20% in 2010.

Assuming that such an increase in the market share of organic farming is beneficial to society and desired, the question remains how such a goal can be reached most efficiently. To partly answer this question is the aim of this paper. In particular, we discuss the efficiency of two alternative policies commonly used: the supply-side oriented policy of subsidizing organic production (e.g. through agri-environmental programs in the EU, jointly sponsored by the European Commission and the member states) versus a demand-side oriented policy of public expenditures to promote the consumption of organic products through information and advertising. (A good example is the German program "Organic Farming" of the German Ministry of Consumer Protection, Nutrition and Agriculture with a budget of €20 million each year between 2001 and 2007.) In this paper we build a theoretical model to compare these two alternatives concerning their efficiency and welfare distribution.

2 Basic Model

In an attempt to model the welfare effects of these two policy measures on a group of heterogeneous consumers and heterogeneous producers at the same time we combine two models, one described in Giannakas (2002) considering consumer heterogeneity and one described in Fulton and Keyowski (1999) considering producer heterogeneity. Since organic products can be characterized as credence goods, whose quality can not be evaluated by consumers even after consumption (Darby and Karni, 1973), the usual instruments to transfer

the credence good into a search good and to circumvent supply-side market failures when conventional and organic products are not segregated, is labeling and certification of organic food. While Giannakas analyses the benefits of introducing an organic label, we discuss the situation where labeling of organic products has been introduced. Therefore, consumers can easily detect the credence attributes of the products. Additionally, we assume that there is a perfect testing system in place, such that there is no scope for moral hazard or adverse selection. Furthermore, we assume that equilibrium prices producers receive equal equilibrium prices consumers pay, i.e. marketing margins are zero.[1] In addition, we consider that organic production implies a positive externality (or less of a negative externality) compared to conventional production.

2.1 Consumers' decisions

Assume a group of consumers who are heterogeneous with respect to their preferences for organic food. Using the model of vertical product differentiation of Mussa and Rosen (1978) and assuming that there are no income effects, indirect utilities associated with purchasing on unit of the organic (subscripted by o) or of the conventional (c) product are given by

(1) $U_o = U - p_o + \alpha\theta$

(2) $U_c = U - p_c + \beta\theta$

(3) $\widetilde{U} = U - \widetilde{p}$ for $\widetilde{U} > U - p_c$

U is a per unit base level of utility, which can be regarded as the willingness to pay for conventional food. We assume that consumers are uniformly distributed along their preferences θ, where $\theta \sim [0,1]$. This characteristic θ differs across consumers and captures different willingness to pay for the respective product. Parameters α and β are nonnegative

utility enhancement factors, which are constant across all consumers. Furthermore, we argue that $\alpha > \beta$, i.e. that consumers are more heterogeneous regarding the organic than regarding the conventional product. Consequently, the maximum willingness to pay for the conventional product is $U + \alpha\theta$ and $U + \beta\theta$ for the organic product. $\tilde{U}$ is a reservation utility with a reservation price of $\tilde{p}$. If the indirect utility of either the conventional or the organic product falls below this level, consumers drop out of the market and enter the market of a substitute. A further assumption is that $p_o > p_c > \tilde{p}$ to capture the fact that prices for organic foods are higher than prices for their conventional counterparts due to higher production costs in organic farming. Finally, we assume that $\tilde{U} > U - p_c$ (i.e. if $\theta = 0$), $\beta > p_c - \tilde{p}$ and $\alpha > p_o - p_c$ to allow for positive shares of organic and conventional demand. Graphically, this model is illustrated in figure 1.

Assuming utility maximization along the differentiating attribute θ, the share of consumers leaving the market and consuming a substitute is given by

$$(4) \qquad \frac{p_c - \tilde{p}}{\beta} = \theta_1 = \tilde{x}^D$$

by equating indirect utilities (3) and (2). The marginal consumer located at θ_1 is indifferent between consuming the conventional product or leaving the market for a substitute. For mathematical simplicity, let $\lambda = \alpha - \beta$. The total share of the substitute plus the conventional demand is found by equating (2) and (1), which yields

$$(5) \qquad \frac{p_o - p_c}{\lambda} = \theta_2 .$$

Likewise, the consumer located at θ_2 is indifferent between demanding the conventional product or its organic counterpart. Demand for the conventional product is derived by subtracting (5) from (4), which is

(6) $$\theta_2 - \theta_1 = \frac{\beta p_o - \alpha p_c + \lambda \tilde{p}}{\beta \lambda} = x_c^D .$$

Finally, demand for the organic product is given by

(7) $$1 - \theta_2 = \frac{\lambda - p_o + p_c}{\lambda} = x_o^D .$$

2.2 Producers' decisions

We assume heterogeneity of producers by introducing a differentiating attribute φ, by which we comprise factors which affect average production costs. Again, let producers be uniformly distributed between 0 and 1, i.e. $\varphi \sim [0,1]$, where $\varphi = 0$ denotes low average production costs and $\varphi = 1$ high average production costs. The profit functions for unit productions of the respective products are given by

(8) $$\Pi_o = p_o - (c_o + \gamma\varphi)$$

(9) $$\Pi_c = p_c - (c_c + \delta\varphi)$$

(10) $$\Pi_n = p_n - c_n \geq 0$$

c_o and c_c are the base level costs of producing the organic or the conventional product, respectively. To capture higher production costs in organic farming, which include the costs of labeling, certification and monitoring as well, let $c_o > c_c$. We further assume that γ and δ are nonnegative cost enhancement factors and that $\delta > \gamma$. By this we argue that producers of conventional food are more sensitive to factors like soil quality, climate, etc. and require factors like synthetic fertilizers, pesticides, etc., which are not permitted in organic production. For positive shares, let $\gamma > (p_o - c_o) - \Pi_n$ and $\delta > (p_c - c_c) - \Pi_n$. Π_n is the profit level of an alternative product, which is definitely not a substitute in consumption. If the profits of organic production along the differentiating attribute φ fall below the constant level

of π_n, producers drop out of this market and produce something different, yielding a profit of π_n. Graphically, producers' decisions are illustrated in figure 2.

For the subsequent equations let $\mu = \delta - \gamma$. Assuming profit maximization along the differentiating attribute φ, supply of the conventional product is found by equating (8) and (9), which yields

$$(11) \qquad \frac{(p_c - c_c) - (p_o - c_o)}{\mu} = \varphi_1 = x_c^S$$

with the marginal producer located at φ_1 being indifferent between producing conventional or organic food. The total market share of conventional and organic production is given by equating (8) and (10):

$$(12) \qquad \frac{(p_o - c_o) - \Pi_n}{\gamma} = \varphi_2$$

φ_2 is the location of the producer who is indifferent between producing organic or an alternative product. Subtracting (11) from (12) gives organic supply

$$(13) \qquad \varphi_2 - \varphi_1 = \frac{\delta(p_o - c_o) - \gamma\Pi_n - \gamma(p_c - c_c)}{\gamma\mu} = x_o^S$$

and the difference to 1 being the share of the alternative product:

$$(14) \qquad 1 - \varphi_2 = \frac{\gamma - p_o + c_o}{\gamma} = x_n^S .$$

2.3 Market Equilibrium

Assuming autarky and, hence, equal shares of supply and demand, we calculate equilibrium prices by equating (11) and (6) for the conventional market and (13) and (7) for the organic market. Matrix A shows the parameters corresponding to the price vector

$$p = \begin{bmatrix} p_o \\ p_c \end{bmatrix}$$

$$(15) \qquad A=\begin{bmatrix} \frac{1}{\lambda}+\frac{1}{\mu} & -\frac{\alpha}{\beta\lambda}-\frac{1}{\mu} \\ -\frac{1}{\lambda}-\frac{\mu+\gamma}{\gamma\mu} & \frac{1}{\lambda}+\frac{1}{\mu} \end{bmatrix}$$

C, the matrix with the parameters corresponding to the vector of the exogenous parameters $e=\begin{bmatrix} 1 \\ \widetilde{p} \\ \Pi_n \\ c_o \\ c_c \end{bmatrix}$ is given by

$$(16) \qquad C=\begin{bmatrix} 0 & -\frac{1}{\beta} & 0 & \frac{1}{\mu} & -\frac{1}{\mu} \\ -1 & 0 & -\frac{1}{\gamma} & -\frac{\mu+\gamma}{\gamma\mu} & \frac{1}{\mu} \end{bmatrix}.$$

Thus, the equation for equilibrium prices reads

$$(17) \qquad p^* = A^{-1}Ce$$

yielding an equilibrium price for the organic product of

$$(18) \qquad \begin{aligned} p_o^* = & \frac{-\beta\gamma\lambda\mu-\beta\gamma\lambda^2}{\alpha\gamma\lambda+\alpha\gamma\mu-\beta\gamma\lambda-\beta\gamma\mu+\alpha\lambda\mu+\beta\lambda^2}\left(-\frac{1}{\beta}\widetilde{p}-\frac{1}{\mu}c_c+\frac{1}{\mu}c_o\right)+ \\ & \frac{-\alpha\gamma\lambda\mu-\beta\gamma\lambda^2}{\alpha\gamma\lambda+\alpha\gamma\mu-\beta\gamma\lambda-\beta\gamma\mu+\alpha\lambda\mu+\beta\lambda^2}\left(\frac{1}{\mu}c_c-\frac{1}{\gamma}\Pi_n-\frac{\mu}{\gamma}c_o(\gamma+\mu)-1\right) \end{aligned}$$

and for the conventional product of

$$(19) \qquad \begin{aligned} p_c^* = & \frac{-\beta\gamma\lambda\mu-\beta\gamma\lambda^2-\beta\lambda^2\mu}{\alpha\gamma\lambda+\alpha\gamma\mu-\beta\gamma\lambda-\beta\gamma\mu+\alpha\lambda\mu+\beta\lambda^2}\left(-\frac{1}{\beta}\widetilde{p}-\frac{1}{\mu}c_c+\frac{1}{\mu}c_o\right)+ \\ & \frac{-\beta\gamma\lambda\mu-\beta\gamma\lambda^2}{\alpha\gamma\lambda+\alpha\gamma\mu-\beta\gamma\lambda-\beta\gamma\mu+\alpha\lambda\mu+\beta\lambda^2}\left(\frac{1}{\mu}c_c-\frac{1}{\gamma}\Pi_n-\frac{\mu}{\gamma}c_o(\gamma+\mu)-1\right). \end{aligned}$$

Comparative static analysis reveals that the organic equilibrium price is positively related to the reservation price $\widetilde{p}$, basic organic production costs c_o and the profit of the alternative product Π_n, and negatively related to basic conventional production costs c_c:

$\frac{\partial p_o^*}{\partial \widetilde{p}} > 0$, $\frac{\partial p_o^*}{\partial c_o} > 0$, $\frac{\partial p_o^*}{\partial \pi_n} > 0$, and $\frac{\partial p_o^*}{\partial c_c} < 0$.

The conventional equilibrium price is positively related to all of its arguments:

$\frac{\partial p_c^*}{\partial \widetilde{p}} > 0$, $\frac{\partial p_c^*}{\partial c_o} > 0$, $\frac{\partial p_c^*}{\partial \pi_n} > 0$, and $\frac{\partial p_c^*}{\partial c_c} > 0$.

Referring to the nonnegative enhancement factors, the organic equilibrium price is positively related to the organic utility enhancement factor α and the organic cost enhancement factor γ, and negatively related to the conventional utility enhancement factor β and the conventional cost enhancement factor δ:

$\frac{\partial p_o^*}{\partial \alpha} > 0$, $\frac{\partial p_o^*}{\delta \beta} < 0$, $\frac{\partial p_o^*}{\partial \gamma} > 0$, and $\frac{\partial p_o^*}{\partial \delta} < 0$.

Conversely, the conventional equilibrium price is positively related to all enhancement factors except for the organic utility enhancement factor α:

$\frac{\partial p_c^*}{\partial \alpha} < 0$, $\frac{\partial p_c^*}{\partial \beta} > 0$, $\frac{\partial p_c^*}{\partial \gamma} > 0$, and $\frac{\partial p_c^*}{\partial \delta} > 0$.

This implies that the greater the difference in heterogeneity of consumers subject to the product that maximizes their utility, the more organic prices increase and conventional prices decrease, causing the organic premium to rise. To put it the other way round, the less people differ in their preferences for organic food, the more the difference between organic and conventional prices converges to almost zero and the more consumers leave organic markets and enter the market for conventional food:

$\frac{\partial p_o^*}{\partial (\alpha - \beta)} > 0$ and $\frac{\partial p_c^*}{\partial (\alpha - \beta)} < 0$; $\frac{\partial \left(p_o^* - p_c^*\right)}{\partial (\alpha - \beta)} > 0$

$\frac{\partial x_o^D}{\partial (\alpha - \beta)} > 0$ and $\frac{\partial x_c^D}{\partial (\alpha - \beta)} < 0$.

Looking at the supply side, the comparative static analysis shows that an increase in the cost factor for conventional production (e.g. due to decreasing soil quality) reduces the

difference between organic and conventional prices and induces further farmers to convert to organic farming. This theoretical finding is in line with the empirical evidence that more land of a lower quality is taken into organic production:

$$\frac{\partial p_o^*}{\partial(\delta-\gamma)}<0 \text{ and } \frac{\partial p_c^*}{\partial(\delta-\gamma)}>0\,;\ \frac{\partial\left(p_o^*-p_c^*\right)}{\partial(\delta-\gamma)}<0$$

$$\frac{\partial x_o^S}{\partial(\delta-\gamma)}>0 \text{ and } \frac{\partial x_c^S}{\partial(\delta-\gamma)}<0$$

Finally, the total share of organic and conventional market taken together increases with an increase in the difference of heterogeneity of consumers and decreases with an increase in the difference of heterogeneity of producers:

$$\frac{\partial(x_o+x_c)}{\partial(\alpha-\beta)}>0 \text{ and } \frac{\partial(x_o+x_c)}{\partial(\delta-\gamma)}<0$$

This means that a greater heterogeneity of organic consumers induces some consumers to leave the market for the substitute and enter the market for the conventional product, but they cannot fully offset the exit of conventional consumers to the organic market. A greater heterogeneity of conventional producers leads to producers dropping out of the organic market and producing the alternative product, while the loss in organic producers is more than offset by conventional producers entering the organic market. Selected comparative static results are summarized in table 1.

2.4 Consumer and Producer Welfare and Externalities

Without any externality in production or consumption the resulting market equilibrium of the organic and the conventional product is the first best solution for a closed economy and no government intervention is desirable. Consumer welfare is given by area *abcd* in figure 1 covering the welfare of consumers of conventional products (CW_c) and the colored area *bcef* covering the welfare of consumers of organic products (CW_o). Producer welfare is given by

ABCD in figure 2 covering the welfare of conventional farmers (PW_c) and the colored area *CBEF* covering the welfare of organic farmers (PW_o). The respective welfare functions are given below:

$$(20) \qquad CW_o = \int_{\theta_2}^{1} (U - p_o + \alpha\theta)d\theta = (U - p_o)(1-\theta_2) + \frac{\alpha}{2}\left(1-\theta_2^{\,2}\right)$$

$$(21) \qquad CW_c = \int_{\theta_1}^{\theta_2} (U - p_c + \beta\theta)d\theta = (U - p_c)(\theta_2 - \theta_1) + \frac{\beta}{2}\left(\theta_2^2 - \theta_1^2\right)$$

$$(22) \qquad PW_o = \int_{\varphi_1}^{\varphi_2} (p_o - c_o - \gamma\varphi)d\varphi = (p_o - c_o)(\varphi_2 - \varphi_1) - \frac{\gamma}{2}\left(\varphi_2^2 - \varphi_1^2\right)$$

$$(23) \qquad PW_c = \int_{0}^{\varphi_1} (p_c - c_c - \delta\varphi)d\varphi = (p_c - c_c)\varphi_1 - \frac{\delta}{2}\varphi_1^2$$

However, there is some empirical evidence that organic production is environmental friendlier compared to conventional production (Dabbert et al. 2000). These difference in externalities between organic and conventional farming can be modeled either as conventional farming creating a negative externality that does not occur with organic production or as organic farming creating a positive externality that does not occur with conventional production. Following the later and assuming that the positive externality per unit of organic production is a constant (B), the social profit curve $\Pi_o^* = p_o - (c_o + \gamma\varphi) + B$ lies above private profits in figure 2 and social benefits of organic farming (without internalization) is area *CEGH* in figure 2. Mathematically, the environmental benefit is given by

$$(24) \qquad EB_o = B(\varphi_2 - \varphi_1)$$

Given the positive externality, $\varphi_2 - \varphi_1 = 1 - \theta_2$ is no longer the optimal market share of organic products. Social supply of organic products is

$$(25) \qquad \varphi_2^{*EB} - \varphi_1^{*EB} = \frac{\delta(p_o - c_o + B) - \gamma\Pi_n - \gamma(p_c - c_c)}{\gamma\mu} = x_o^{S*EB}$$

with the loss in producer welfare due to the positive external effect covering area JCEI in figure 2.

This gives the usual rational for government intervention in form of subsidies or promotion of organic products. In the following we compare a subsidy on organic production that fully internalizes the positive externality with an information policy aimed at increasing the utility consumers derive from consumption of organic products and thus increasing the share of organic food by exactly the same amount as in the case of the subsidy.

3 Subsidy on organic production

In this policy scenario it is assumed that the regulator knows the exact amount of the environmental benefit corresponding to each unit of the organic product produced and places a subsidy of the same (constant) amount on organic production, in the following denoted by E.

Thus, the profit function if a unit of the organic food is produced is

$$\Pi_o^S = p_o^S - (c_o + \gamma\varphi) + E, \tag{26}$$

with all other profit and indirect utility functions ((1)-(3) and (9)-(10)) left unchanged and the new equilibrium prices denoted by p_o^S and p_c^S, respectively. Now, the supply function for the conventional product is given by

$$\frac{(p_c^S - c_c) - (p_o^S - c_o) - E}{\mu} = \varphi_1^S = x_c^{S,S}, \tag{27}$$

organic supply by

$$\frac{(\mu + \gamma)(p_o^S - c_o + E) - \mu\Pi_n - \gamma(p_c^S - c_c)}{\gamma\mu} = x_o^{S,S}, \tag{28}$$

and supply of the alternative product by

$$\frac{\gamma - p_o^S + c_o + \Pi_n - E}{\gamma} = x_n^{S,S}. \tag{29}$$

Equating supply and demand, matrix A^S remains unchanged (see (15)) and the parameters corresponding to E will be implemented into matrix C^S. The resulting equilibrium prices with a subsidy for organic production and calculated as $p^{*,S} = \left(A^{-1}\right)^S C^S e^S$ are given by

$$(30)\quad \begin{aligned} p_o^{*,S} = {} & \frac{-\beta\gamma\lambda\mu - \beta\gamma\lambda^2}{\alpha\gamma\lambda + \alpha\gamma\mu - \beta\gamma\lambda - \beta\gamma\mu + \alpha\lambda\mu + \beta\lambda^2}\left(-\frac{1}{\beta}\widetilde{p} - \frac{1}{\mu}E - \frac{1}{\mu}c_c + \frac{1}{\mu}c_o\right) + \\ & \frac{-\alpha\gamma\lambda\mu - \beta\gamma\lambda^2}{\alpha\gamma\lambda + \alpha\gamma\mu - \beta\gamma\lambda - \beta\gamma\mu + \alpha\lambda\mu + \beta\lambda^2}\left(\frac{1}{\mu}c_c - \frac{1}{\gamma}\Pi_n + \frac{\mu}{\gamma}E(\gamma+\mu) - \frac{\mu}{\gamma}c_o(\gamma+\mu) - 1\right) \end{aligned}$$

and

$$(31)\quad \begin{aligned} p_c^{*,S} = {} & \frac{-\beta\gamma\lambda\mu - \beta\gamma\lambda^2 - \beta\lambda^2\mu}{\alpha\gamma\lambda + \alpha\gamma\mu - \beta\gamma\lambda - \beta\gamma\mu + \alpha\lambda\mu + \beta\lambda^2}\left(-\frac{1}{\beta}\widetilde{p} - \frac{1}{\mu}E - \frac{1}{\mu}c_c + \frac{1}{\mu}c_o\right) + \\ & \frac{-\beta\gamma\lambda\mu - \beta\gamma\lambda^2}{\alpha\gamma\lambda + \alpha\gamma\mu - \beta\gamma\lambda - \beta\gamma\mu + \alpha\lambda\mu + \beta\lambda^2}\left(\frac{1}{\mu}c_c - \frac{1}{\gamma}\Pi_n + \frac{\mu}{\gamma}E(\gamma+\mu) - \frac{\mu}{\gamma}c_o(\gamma+\mu) - 1\right). \end{aligned}$$

Partial derivatives of prices and quantities with respect to the subsidy E shows that a subsidy for organic production reduces both the organic and conventional price, increases the organic share and decreases the conventional share:

$$\frac{\partial p_o^{*,S}}{\partial E} < 0 \text{ and } \frac{\partial p_c^{*,S}}{\partial E} < 0$$

$$\frac{\partial x_o^S}{\partial E} = \frac{\mu+\gamma}{\gamma\mu} > 0 \text{ and } \frac{\partial x_c^S}{\partial E} = -\frac{1}{\mu} < 0$$

The corresponding welfare functions are

$$(32)\quad CW_o^S = \int_{\theta_2^S}^{1}\left[U - p_o^S + \alpha\theta\right]d\theta = \left(U - p_o^S\right)\left(1-\theta_2^S\right) + \frac{\alpha}{2}\left(1-\left(\theta_2^S\right)^2\right)$$

$$(33)\quad CW_c^S = \int_{\theta_1^S}^{\theta_2^S}\left[U - p_c^S + \beta\theta\right]d\theta = \left(U - p_c^S\right)\left(\theta_2^S - \theta_1^S\right) + \frac{\beta}{2}\left(\left(\theta_2^S\right)^2 - \left(\theta_1^S\right)^2\right)$$

$$(34)\quad PW_o^S = \int_{\varphi_1^S}^{\varphi_2^S}\left[p_o^S - c_o - \gamma\varphi + E\right]d\varphi = \left(p_o^S - c_o + E\right)\left(\varphi_2^S - \varphi_1^S\right) - \frac{\gamma}{2}\left(\left(\varphi_2^S\right)^2 - \left(\varphi_1^S\right)^2\right)$$

$$(35)\quad PW_c^S = \int_{0}^{\varphi_1^S}\left[p_c^S - c_c - \delta\varphi\right]d\varphi = \left(p_c^S - c_c\right)\varphi_1^S - \frac{\delta}{2}\left(\varphi_1^S\right)^2$$

Differentiating the consumer welfare functions with respect to prices and producer welfare functions with respect to the subsidy shows, that both, organic producers and consumers experience an increase in welfare, whereas welfare of conventional producers and consumers is reduced:

$$\frac{\partial CW_o}{\partial p_o^S} < 0\,,\ \frac{\partial CW_c}{\partial p_c^S} > 0\,,\ \frac{\partial PW_o}{\partial E} > 0\,,\ \text{and}\ \frac{\partial PW_c}{\partial E} < 0$$

4 Information policy

The aim of the information policy is to increase the identification and acceptance of the label, which indicates the credence attributes of the (organic) product. The economics literature distinguishes between persuasive and informative advertising. We believe that this kind of information policy belongs to the latter category by arguing that not any specific kind of agricultural product is advertised but simply the existence of a certain label promoted. We emphasize that the economic effect can be interpreted as reduced search costs for consumers demanding organic products (see for example Nelson, 1970, and Butters, 1977). This assumption implies, similar to the results of Giannakas (2002) regarding mislabeling of organic products, that labeling per se is a necessary, but still an insufficient mean in transferring a credence good into a search good.

Since any kind of economic modeling of an information policy (or advertising in general) is very critical (see, for example, the discussion in Cardon and Pope, 2003), we demonstrate two alternatives: First, we assume that consumers with a higher differentiating attribute θ are more sensitive to any information regarding organic products and, consequently, experience a higher utility enhancement. This will cause the U_o curve to rotate upwards at $\theta = 0$ by a certain amount and, thus, increases the willingness to pay for the organic product. Alternatively, it might be argued, that all consumers reached by the information policy experience a higher utility enhancement irrespective of their θ, causing

the U_o curve to shift upwards. For simplicity, let us assume that all consumers located along θ are reached by the information policy with equal probability and that the probability of getting the information equals the probability of actually deriving a utility enhancement, which leads to effective demand, provided that consumers are located at a high enough θ. For comparative static purposes we assume that the information policy aims to internalize the positive external effect inherent in organic food production by increasing the organic share by the same amount as in the previous analysis with a subsidy on organic production in place.

4.1 Rotation of U_o

As an option to model the effect of the information policy on organic food demand, let the utility enhancement be subject to the location of the consumer along the differentiating attribute and thus entering her indirect utility function in a multiplicative manner:

(36) $$U_o^I = U - p_o^I + (\alpha + \varepsilon)\theta$$

with p_o^I being the new equilibrium price for the organic products. α is simply increased by ε and causes the U_o function to rotate counter-clockwise around the point $U - p_o^I$ at $\theta = 0$. All other utility functions, as well as the profit functions on the supply side remain unchanged as in the basic model, except for prices changing to p_o^I and p_c^I. Hence, conventional and organic demand functions are given by

(37) $$\frac{\beta p_o^I - (\alpha + \varepsilon) p_c^I + (\lambda + \varepsilon)\tilde{p}}{\beta(\lambda + \varepsilon)} = x_c^{D,I}$$

(38) $$\frac{\lambda + \varepsilon - p_o^I + p_c^I}{\lambda + \varepsilon} = x_o^{D,I}.$$

The new equilibrium prices due to the resulting position of the U_o^I-curve are given by

(39) $$p_o^{*,I} =$$

$$\frac{-2\beta\gamma\varepsilon\lambda-\beta\gamma\varepsilon\mu-\beta\gamma\lambda\mu-\beta\gamma\varepsilon^2-\beta\gamma\lambda^2}{\alpha\gamma\varepsilon-\beta\gamma\varepsilon+\alpha\gamma\lambda+\alpha\gamma\mu-\beta\gamma\lambda-\beta\gamma\mu+\alpha\varepsilon\mu+2\beta\varepsilon\lambda+\gamma\varepsilon\lambda+\gamma\varepsilon\mu+\alpha\gamma\mu+\varepsilon\lambda\mu+\beta\varepsilon^2+\gamma\varepsilon^2+\beta\lambda^2+\varepsilon^2\mu}\left(-\frac{1}{\beta}\tilde{p}-\frac{1}{\mu}c_c+\frac{1}{\mu}c_o\right)+$$

$$\frac{-\alpha\gamma\varepsilon\mu-2\beta\gamma\varepsilon\lambda-\alpha\gamma\lambda\mu-\gamma\varepsilon\lambda\mu-\beta\gamma\varepsilon^2-\beta\gamma\lambda^2-\gamma\varepsilon^2\mu}{\alpha\gamma\varepsilon-\beta\gamma\varepsilon+\alpha\gamma\lambda+\alpha\gamma\mu-\beta\gamma\lambda-\beta\gamma\mu+\alpha\varepsilon\mu+2\beta\varepsilon\lambda+\gamma\varepsilon\lambda+\gamma\varepsilon\mu+\alpha\lambda\mu+\varepsilon\lambda\mu+\beta\varepsilon^2+\gamma\varepsilon^2+\beta\lambda^2+\varepsilon^2\mu}\left(\frac{1}{\mu}c_c-\frac{1}{\gamma}\Pi_n-\frac{\mu}{\gamma}c_o(\gamma+\mu)-1\right)$$

and

(40) $p_c^{*,I} =$

$$\frac{-2\beta\gamma\varepsilon\lambda-\beta\gamma\varepsilon\mu-\beta\gamma\lambda\mu-2\beta\varepsilon\lambda\mu-\beta\gamma\varepsilon^2-\beta\gamma\lambda^2-\beta\varepsilon^2\mu-\beta\lambda^2\mu}{\alpha\gamma\varepsilon-\beta\gamma\varepsilon+\alpha\gamma\lambda+\alpha\gamma\mu-\beta\gamma\lambda-\beta\gamma\mu+\alpha\varepsilon\mu+2\beta\varepsilon\lambda+\gamma\varepsilon\lambda+\gamma\varepsilon\mu+\alpha\gamma\mu+\varepsilon\lambda\mu+\beta\varepsilon^2+\gamma\varepsilon^2+\beta\lambda^2+\varepsilon^2\mu}\left(-\frac{1}{\beta}\tilde{p}-\frac{1}{\mu}c_c+\frac{1}{\mu}c_o\right)+$$

$$\frac{-2\beta\gamma\varepsilon\lambda-\beta\gamma\varepsilon\mu-\beta\gamma\lambda\mu-\beta\gamma\varepsilon^2-\beta\gamma\lambda^2}{\alpha\gamma\varepsilon-\beta\gamma\varepsilon+\alpha\gamma\lambda+\alpha\gamma\mu-\beta\gamma\lambda-\beta\gamma\mu+\alpha\varepsilon\mu+2\beta\varepsilon\lambda+\gamma\varepsilon\lambda+\gamma\varepsilon\mu+\alpha\lambda\mu+\varepsilon\lambda\mu+\beta\varepsilon^2+\gamma\varepsilon^2+\beta\lambda^2+\varepsilon^2\mu}\left(\frac{1}{\mu}c_c-\frac{1}{\gamma}\Pi_n-\frac{\mu}{\gamma}c_o(\gamma+\mu)-1\right)$$

The situation is equal to the comparative static analysis outlined in the basic model. Here we assume that the utility enhancement factor α for organic consumers increases by ε. Thus, the first derivatives of the new prices are positive for organic prices and negative for conventional prices:

$$\frac{\partial p_o^{*,I}}{\partial\alpha}>0 \text{ and } \frac{\partial p_c^{*,I}}{\partial\alpha}<0$$

For the new organic market share to equal the organic market share as if a subsidy were in place, α must increase by $\varepsilon=\frac{-\lambda x_o^{D,S}+\lambda+\mu x_c^{S,S}+c_c-c_o}{x_o^D-1}$.

Given the specification of ε, it can easily be verified that $p_c^{*,I}=p_c^{*,S}$ and that $p_o^{*,I}>p_o^*>p_o^{*,S}$ with the difference between $p_o^{*,I}$ and $p_o^{*,S}$ being equal to E, the subsidy for organic production. Therefore, organic and conventional producer welfare equals the respective welfare of the subsidy scenario. There is no difference between conventional

consumer welfare either, only consumers of organic food experience an increase in their welfare due to the counter-clockwise rotation of U_o^I.

The resulting welfare functions due to the information policy are:

$$(41) \quad CW_o^I = \int_{\theta_2^I}^{1} \left(U - p_o^I + (\alpha+\varepsilon)\theta\right) d\theta = \left(U - p_o^I\right)\left(1-\theta_2^I\right) + \frac{\alpha+\varepsilon}{2}\left(1-\left(\theta_2^I\right)^2\right)$$

$$(42) \quad CW_c^I = \int_{\theta_1^I}^{\theta_2^I} \left(U - p_c^I + \beta\theta\right) d\theta = \left(U - p_c^I\right)\left(\theta_2^I - \theta_1^I\right) + \frac{\beta}{2}\left(\left(\theta_2^I\right)^2 - \left(\theta_1^I\right)^2\right)$$

$$(43) \quad PW_o^I = \int_{\varphi_1^I}^{\varphi_2^I} \left(p_o^I - c_o - \gamma\varphi\right) d\varphi = \left(p_o^I - c_o\right)\left(\varphi_2^I - \varphi_1^I\right) - \frac{\gamma}{2}\left(\left(\varphi_2^I\right)^2 - \left(\varphi_1^I\right)^2\right)$$

$$(44) \quad PW_c^I = \int_{0}^{\varphi_1^I} \left(p_c^I - c_c - \delta\varphi\right) d\varphi = \left(p_c^I - c_c\right)\varphi_1^I - \frac{\delta}{2}\left(\varphi_1^I\right)^2$$

4.2 Shift of U_o

The second option to model the effect of the information policy on organic food demand is to assume that any utility enhancement by reduced searched costs enters the consumer's organic utility function in an additive way and causes the function to shift upwards by ρ:

$$(45) \quad U_o^{II} = U - p_o^{II} + \rho + \alpha\theta$$

Given this new utility functions, conventional and organic food demand read

$$(46) \quad \frac{\beta p_o^{II} - \alpha p_c^{II} - \delta\beta + \lambda\tilde{p}}{\beta\lambda} = x_c^{D,II}$$

$$(47) \quad \frac{\lambda - p_o^{II} + p_c^{II} + \rho}{\lambda} = x_o^{D,II}$$

with new equilibrium prices

$$p_o^{*,II} = \frac{-\beta\gamma\lambda\mu - \beta\gamma\lambda^2}{\alpha\gamma\lambda + \alpha\gamma\mu - \beta\gamma\lambda - \beta\gamma\mu + \alpha\lambda\mu + \beta\lambda^2}\left(-\frac{1}{\beta}\tilde{p} + \frac{1}{\lambda}\rho - \frac{1}{\mu}c_c + \frac{1}{\mu}c_o\right) + \tag{48}$$
$$\frac{-\alpha\gamma\lambda\mu - \beta\gamma\lambda^2}{\alpha\gamma\lambda + \alpha\gamma\mu - \beta\gamma\lambda - \beta\gamma\mu + \alpha\lambda\mu + \beta\lambda^2}\left(-\frac{1}{\lambda}\rho + \frac{1}{\mu}c_c - \frac{1}{\gamma}\Pi_n - \frac{\mu}{\gamma}c_o(\gamma+\mu) - 1\right)$$

and

$$p_c^{*,II} = \frac{-\beta\gamma\lambda\mu - \beta\gamma\lambda^2 - \beta\lambda^2\mu}{\alpha\gamma\lambda + \alpha\gamma\mu - \beta\gamma\lambda - \beta\gamma\mu + \alpha\lambda\mu + \beta\lambda^2}\left(-\frac{1}{\beta}\tilde{p} + \frac{1}{\lambda}\rho - \frac{1}{\mu}c_c + \frac{1}{\mu}c_o\right) + \tag{49}$$
$$\frac{-\beta\gamma\lambda\mu - \beta\gamma\lambda^2}{\alpha\gamma\lambda + \alpha\gamma\mu - \beta\gamma\lambda - \beta\gamma\mu + \alpha\lambda\mu + \beta\lambda^2}\left(-\frac{1}{\lambda}\rho + \frac{1}{\mu}c_c - \frac{1}{\gamma}\Pi_n - \frac{\mu}{\gamma}c_o(\gamma+\mu) - 1\right)$$

Taking the first derivatives of the prices with respect to the shift parameter ρ shows that any utility enhancement of a constant amount for all organic consumers increases organic equilibrium prices and decreases conventional prices:

$\frac{\partial p_o^{*,II}}{\partial \rho} > 0$ and $\frac{\partial p_c^{*,II}}{\partial \rho} < 0$.

Again, for the new organic market share to equal the organic market share as if a subsidy were in place, U_o^{II} must shift upwards by $\rho = \lambda x_o^{D,S} - \lambda - \mu x_c^{S,S} - c_c + c_o$. This shift parameter equals exactly E, the subsidy on organic production. Now it can be verified that $p_c^{*,II} = p_c^{*,I} = p_c^{*,S}$ and that $p_o^{*,II} = p_o^{*,I} = p_o^* + E$.

For completeness, the new organic consumer welfare function is given by

$$CW_o^{II} = \int_{\theta_2^{II}}^{1}\left(U - p_o^{II} + \rho + \alpha\theta\right)d\theta = \left(U - p_o^{II} + \rho\right)\left(1 - \theta_2^{II}\right) + \frac{\alpha}{2}\left(1 - \left(\theta_2^{II}\right)^2\right) \tag{50}$$

All other welfare functions are the same as in the previous section with indices changed. Given the new equilibrium prices as outlined above, organic and conventional producer welfare, as well as organic and conventional consumer welfare is equal to the policy scenario with a subsidy on organic production.

5 Conclusion

In many developed economies, organic markets are rapidly growing for several reasons, such as such as increasing incomes, repeated food scares, pressure through international trade agreements, environmental benefits of organic production, and the perception of organic food as being healthier. Especially in Europe governments at the national and the EU level are trying to promote organic farming, either by subsidizing organic production or by promoting organic food aimed at raising the acceptance and identification of organic food labels.

Similar to Fulton and Giannakas (2004), we combine two models, one with consumers having heterogeneous preferences and one with heterogeneous producers facing different unit production costs. Assuming that organic food production creates positive externalities, for example in regard to environment or landscape, we analyze the effect of two policy measures to fully internalize this positive externality on the welfare of producers and consumers: a subsidy as a constant amount of the environmental benefit per unit of the organic product produced and an information policy aimed at enhancing the acceptance and identification of the label on organic food and thereby raising consumers' indirect utilities.

Using a numerical example, the main findings of the theoretical model are summarized in table 2: A subsidy on organic production lowers both, conventional and organic equilibrium prices, increases the share of organic production and consumption and, thus, lowers conventional production and consumption. Welfare of organic producers and consumers is thereby enhanced, while welfare of conventional producers and consumers is lowered. Referring to the information policy, we present two different ways of the effect of promotional activities with respect to the organic label on indirect utility functions. Assuming that this kind of informative advertising reduces search costs for consumers to identify organic food, consumers with high preferences for organic food might experience a higher utility enhancement than consumers with lower preferences, and, thus, causes the organic

indirect utility curve to rotate upwards. Alternatively, one might assume that the information policy enhances utility for all consumers of an equal amount, which will cause the utility curve to shift upwards. In either case, the resulting equilibrium prices and quantities appear to be the same. In contrast to the subsidy, the information policy increases organic equilibrium prices with the difference to organic equilibrium prices of the subsidy scenario being the monetary value of the environmental benefit of organic per unit production. Conventional equilibrium prices are lowered, but at the same level as the respective price with a subsidy on production in place. Consequently, the welfare effect of a subsidy compared with that of an information policy is the same, except for a higher organic consumer welfare if their indirect utility curve rotates upwards than shifts.

The model does not specify a total welfare function due to the fact that the direct comparison of the monetary value of a subsidy with the costs of advertising expenditures per unit demanded is left to speculation and does not allow any comparative static analysis between a subsidy versus an information policy. Government expenditures in the case of a subsidy are given by the subsidy (i.e. the monetary value of the environmental benefit) times the units of the organic product produced. Since the information policy takes the form of random advertising, public expenditures are, however, subject to the probability of consumers of getting reached, subject to unit costs of transferring the information to the final consumer and subject to the intensity to affect consumers' utility in a certain manner (see, for example, the model in Butters, 1977). Seeing this, it becomes clear that total welfare will likely be different under the policy options analyzed. However, any detailed specification of the expenditure function, combined with the introduction of probabilities in organic indirect utility functions, will at least not change the quantitative nature of the model with producer and consumer welfare remaining the same as if a subsidy on the supply side were in place.

Footnote

[1] The analysis can easily be extended by introducing positive marketing margins of constant proportions to the wholesale or retail level without changing the qualitative nature of the model (see Fulton and Giannakas, 2004). However, this assumes the existence of a perfectly competitive processing industry and the absence of market power of retailers.

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Figure 1: Consumers' decisions

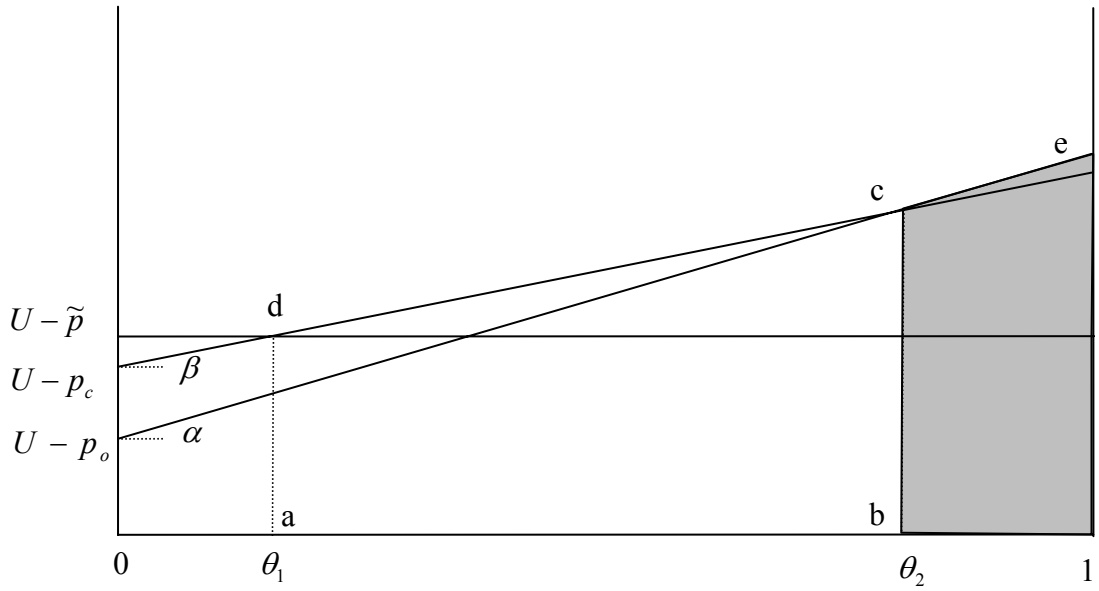

Figure 2: Producers' decisions

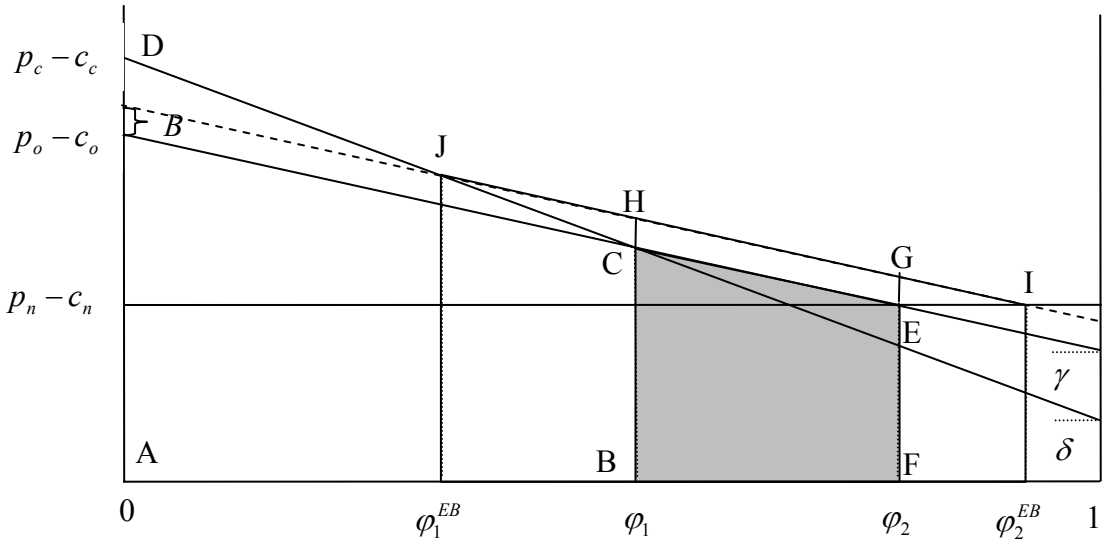

Table 1: Selected Comparative Static Results for the Basic Model

	Endogenous variable	
Exogenous parameters	p_o	p_c
α	+	-
β	-	+
γ	+	+
δ	-	+
$\alpha - \beta$	+	-
$\delta - \gamma$	-	+
c_o	+	+
c_c	-	+
Π_n	+	+
$\widetilde{p}$	+	+

Note: Table entries indicate the direction of the change that occurs in the endogenous variable for a positive change in the exogenous variable

Table 2: Effect of organic food policies on prices, quantities and welfare

Exogenous parameters			**Basic**		**Subsidy**		**Information Policy I**		**Information Policy II**	
U	20,00									
α	8,00	**organic:**	Supply/Demand	0,23	Supply/Demand	0,31	Supply/Demand	0,31	Supply/Demand	0,31
β	4,00	**conventional:**	Supply/Demand	0,64	Supply/Demand	0,58	Supply/Demand	0,58	Supply/Demand	0,58
γ	3,00	**sum:**		0,87		0,89		0,89		0,89
δ	6,00									
λ	4,00	**equilibrium prices:**	p_o	10,61	p_o^S	10,18	p_o^I	10,68	p_o^{II}	10,68
μ	3,00		p_c	7,52	p_c^S	7,43	p_c^I	7,43	p_c^{II}	7,43
c_o	8,00									
c_c	3,00	**welfare:**	CW_o	3,78	CW_o^S	5,16	CW_o^I	5,20	CW_o^{II}	5,16
Π_n	0,00		CW_c	9,13	CW_c^S	8,24	CW_c^I	8,24	CW_c^{II}	8,24
E	0,50		PW_o	0,08	PW_o^S	0,15	PW_o^I	0,15	PW_o^{II}	0,15
$\tilde{p}$	7,00		PW_c	1,67	PW_c^S	1,56	PW_c^I	1,56	PW_c^{II}	1,56
Adjusted										
ε	0,73									
ρ	0,50									