Characteristics of production and consumption of organic trout in Italy

MARTA DISEGNA*, CHRISTINE MAURACHER*,
ISABELLA PROCIDANO*, GIOVANNA TREVISAN*

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Abstract

The evolution of life-styles has made the modern consumers increasingly attentive to issue of environmental, health and safety. In addition consumers require a blend of characteristics inspired by concepts of quality and distinctiveness. These requirements have led to the formation of a whole series of new laws and the consequent establishment of new categories of certified products (organic food, controlled production chains, typical and/or regional specialities, etc.) both in Europe and throughout the world. The Italian agri-food system must now interpret these trends, also in view of the profound changes involving market organization of markets and growing competition. The present paper aims at analysing the principal characteristics of organic trout breeding and its potential in Italy from the aspects both of supply and demand. Particular attention was paid to investigate on consumers' willingness to pay (WTP) for trout from organic breeding farms through the application of a two-equation generalization of the Tobit model.

Keywords: organic trout, contingent valuation method, WTP, Tobit model.

Résumé

L'évolution des styles de vie a rendue les consommateurs modernes de plus en plus concernés par les problèmes environnementaux, de santé et de sureté. Les consommateurs demandent un ensemble de caractéristiques inspirées par les concepts de qualité et de distinction. Plusieurs lois ont été promulguées et de nouvelles catégories de produits certifiés élaborées (produits biologiques, filière de production contrôlée, spécialités typiques et/ou régionales, etc.) en Europe et dans le monde. Le système agro-alimentaire italien doit interpréter ces tendances même en vue des changements des marchés et de la compétition croissante. Cet article analyse les traits principaux de l'élevage de la truite biologique, son potentiel en Italie en termes de demande et d'offre et la disponibilité à payer des consommateurs à travers l'application du modèle Tobit.

***Mots clé**: truite biologique, méthode d'évaluation contingente, disponibilité à payer, modèle Tobit.*

1. Introduction

Evolving life-styles, due to socio-economic changes in the more highly developed countries, as well as people's awareness that foodstuffs have new functions, are issues that have also led to innovations in consumption dynamics. Modern consumers are increasingly conscious of environmental, health and safety concerns, in addition to the cultural, ethical and service aspects that products possess, i.e. consumers require a blend of characteristics inspired by concepts of quality and distinctiveness. Over the past few years, consumers have been gradually changing their habits and consumption patterns, a process that is also due to the various food scandals that have undermined their trust in the international production system. Fear of contamination of every kind, in relation to both food and the environment, has resulted in a whole series of new laws and the consequent establishment of new categories of certified products (organic food, controlled production chains, etc.) both in Europe and throughout the world. Moreover, growing attention towards everything that can affect human health has accelerated this phenomenon, which was already expanding at a considerable rate. Nowadays, the certified products sector is more or less consolidated, especially in Italy, which holds the record in Europe for certified agri-foodstuffs and has a high production volume of organic products for which there is a fairly good domestic demand (Nardulli, 2004; Cicia, 2007). The Italian agri-food system must now interpret these trends, also in view of the profound changes involving market organization of markets and growing competition.

Considering the maturity of the market, steady demand, increasing competition in foreign markets as well as the problem of environmental pollution caused by the breeding systems and the fact that the consumers are frequently prejudiced against the farmed product, the use of organic breeding techniques would seem to be the way to face this situation in the fish farming sector, especially for trout breeding. Whereas organic farming has achieved a certain importance, especially in our country, as to areas involved, production output and consumption (ISMEA (Institute of Services for the Agri-Food Market), 2004), fish farming is still in an initial phase (FAO, 2002, European Commission, 2005). In Italy, UNIPROM (2001) (Consortium for the Promotion of Fish Products) conducted, at the beginning of the third millennium, the first experiments on the technical and economic feasibility of farming sea fish (sea bream and sea bass) using organic techniques, as well as research into the potential demand for organic fish products (Defrancesco, 2004).

The Italian Association of Fish Breeders (API, 2007) subsequently embarked upon similar research but focused on

* Dipartimento di Statistica e Sezione di economia e Politica Agraria, Università Ca' Foscari di Venezia.

one species of freshwater fish, i.e. trout. This type of product possesses peculiar characteristics that justify an ad hoc investigation. Trout do not enjoy a very high standing within the wide range of fish products available. There is a high production volume of trout in Italy, but a medium-low level of consumption, especially in certain areas. Rainbow and salmon trout account for a considerable percentage of the freshwater fish consumed. According to ISMEA data (2005), trout account for about half the total amount of freshwater fish consumed. When it comes to the importance of trout consumption (rainbow and salmon trout considered together) in relation to the total fresh and frozen fish category, it is worth noting that, in 2006, this product was in fifth place as to volumes consumed and value, although these data varied considerably from region to region.

The purpose of this research is to analyse the principal characteristics of organic trout breeding and its potential in Italy from the aspects both of supply and demand. Since the sector's experimental phase recently came to an end, this study contains the first considerations about production and its relative costs, while attention will mainly be focused on demand. In this case, the aim is to evaluate the consumers' willingness to pay (WTP) for trout from organic breeding farms[1]. Thus an investigation was conducted in order to: i) analyse the socio-economic factors that influence WTP; ii) identify the determinants of WTP a premium price for this new product.

2. Trout breeding in Italy: main characteristics and peculiarities

Rainbow trout (*Oncorhynchus mykiss*) breeding has, for many years, been Italy's most important type of fish breeding in lakes. With a domestic production of 40,200 tonnes in 2006, trout breeding continues to hold Italy's fish breeding production record (in our country, only shellfish breeding boasts a larger production). The sector has continued to grow for decades and has worked to achieve quantity rather than quality, by using intensive farming techniques. Trout farming had already developed to a remarkable extent by 1984, when 20,000 tonnes were produced, and production continued to increase by about 10% per year until 1997. After that, the production rate remained more or less stable, or even decreased, with small annual fluctuations, but was still one of the most important fish production sectors in Italy and Europe. In more recent years, the number of trout breeding farms has diminished considerably, also owing to the effect of new dietary habits. So much so, that the 600 or so farms present in 1987 have dropped to the current 359, thus with a 40% decrease. However, the production rate has remained at very high levels thanks to the increased productivity of those farms still in business (ICRAM, API, 2007). Trout breeding is mainly localized in the north of Italy, where 75% of the production is concentrated, even though there is an important production area in the central regions, with about 18%; while the southern regions and the islands account for only 7% of the total. If one analyses the way the farms are distributed by macro areas, in relation to their production capacity (Table 1), one notes that the enterprises are mainly medium-small in size, i.e. they produce less than 200 tonnes per year.

Table 1 – *Number of plants per productions ranges and Regions (year 2006).*

Regions	Range of production (tonnes)					
	< 50	50-200	200-500	500-1000	> 1000	Total P. U. (n°)
Aosta Valley	2	0	0	0	0	2
Piedmont	12	11	1	0	0	24
Liguria	0	0	0	0	0	0
Lombardy	30	20	3	2	0	55
Trentino Alto Adige	35	18	3	0	0	56
Veneto	38	30	9	1	0	78
Friuli Venezia Giulia	24	23	16	2	1	66
Emilia Romagna	5	0	0	0	0	5
Tuscany	25	4	0	0	0	29
Umbria	2	6	0	1	0	9
Marche	6	1	1	2	0	10
Lazio	3	1	1	0	0	5
Abruzzo	3	2	1	0	1	7
Molise	1	0	0	0	0	1
Campania	5	0	0	0	0	5
Basilicata	1	0	0	0	0	1
Apulia	0	0	0	0	0	0
Calabria	3	0	0	0	0	3
Sicily	1	0	0	0	0	1
Sardinia	2	0	0	0	0	2
Total	**198**	**116**	**35**	**8**	**2**	**359**

Source: ICRAM, API

The region with the highest number of trout breeding farms is the Veneto, with as many as 78 farms plus 13 trout processing plants. The production output amounts to 10,300 tonnes of which half is processed. The Veneto is followed by Friuli Venezia Giulia (66 farms), Trentino Alto Adige (56), Lombardy (55), Tuscany (29) and Piedmont (24). Friuli holds the record as to quantity produced, with an output of almost 12,000 tonnes followed by the Veneto, Lombardy (4,000 tonnes) and Piedmont, Abruzzo and the Marches (around 2,500-2,000 tonnes each). In the EU 25, Italy occupies one of the highest positions in the classification of principal producers and despite the evident downswing (the 51,000 tonnes of 1997 have progressively dropped to the current 40,000 tonnes), its trout production corresponds to about 20% of that of the EU as a whole.

Weak domestic and foreign demand, growing international competition (trout are bred throughout the European Union) and, more recently, competition from other farmed products, are the main factors that have contributed towards this downswing. Organic farming could make a difference and compensate for the current shortcomings in the Italian production system because it would act on the more problematic aspects - safety of the species raised, environmen-

[1] Numerous studies (one of the more recent being Gil *et al*., 2000, Bocaletti *et al*., 2000, Corsi *et al*., 2003, Smed, 2005, Stefani *et al*., 2005, Arnoult *et al*., 2007, Charatsari *et al*., 2007, Rodriguez *et al*., 2007, Tsakiridou *et al*., 2007) have analyzed consumers' willingness to pay (WTP) for quality and safety attributes in agri-food products using the Contingent Valuation (CV) method. Many of these studies focus on WTP for organic products.

tal impact and wholesomeness of the product - that prevent a rise in consumption of this product.

3. Conversion to organic trout farming

In 2003, the world's organic fish farming production[2] amounted to an estimated 25,000 tonnes, of which 14,000 were produced in Europe. This quantity represents about 0.06% of the total fish farming production (FAO, 2002).

Trout is one of the species most frequently reared using organic techniques[3]. An overall 1,500 tonnes were produced in Europe in 2003 (ISMEA, 2007). Italy and Great Britain are among the main producer countries, with 320 and 318 tonnes, respectively. They are followed by France with 250 tonnes, then Ireland (120 tonnes). Germany produces about 60 tonnes of organic trout per year. There are different farms, but they are associated with each other and market the product under the same brand name: "*Teichgut"*. Spain's production amounted to about 50 tonnes in 2003, while Austria only produces about 10 tonnes of organic trout per year. In 2003, Switzerland produced around 220 tonnes, with 11 certified farms. One of the reasons for such slow development is the absence of a specific regulatory framework. Organic fish farming was neither envisaged nor considered in Reg. EEC 2092/91 concerning agricultural crops or in Reg. EC 1804/99, which governs the organic animal husbandry sector.

The lack of a specific regulatory framework has led to the adoption of numerous regulations proposed by private certification bodies on the basis of guidelines established by IFOAM Reg. EC 834/07, which concerns "organic production and labelling of organic products", and which replaced Reg. EEC 2092/91 on January 1 2009, has only recently also considered fish farming and defined the relative "production rules for aquaculture animals" (art.15). In this particular field, the goals set for organic production are to maintain the biodiversity of the natural aquatic ecosystems in fish farming practices and the health of the aquatic environment over time, as well as the quality of the surrounding aquatic and terrestrial ecosystems; to feed the aquatic organisms on feedstuffs obtained from sustainable fishery management or organic feedstuffs made with ingredients from organic agriculture and natural substances of non-agricultural origin.

Besides the general regulations governing agricultural production, specific rules are applied to the production of aquaculture animals. These rules concern the origin of the aquaculture animals themselves, the zootechnical practices employed, reproduction, the feeds given to the fish and crustaceans, the prevention of diseases and veterinary care[4]. Organic trout production is only at an experimental stage in Italy and is based on production protocols already in force in certain EU member countries. In 2003, API conducted experiments in 13 breeding farms in the Veneto Region and 10 in the Region of Tuscany, in order to assess the technical feasibility of organic trout breeding. The decision to implement an experimental project in the Veneto was due to the fact that a consistent part of the regional trout breeding activity takes part in the foothills and mountain districts. The production of these enterprises, which are generally small in size, features environments free from forms of pollution, good quality water and limited use of technical means. The production rates per unit, which are lower than those of other areas, are characterized by the excellent organoleptic quality of the product.

These are all conditions that make conversion to organic breeding feasible.

More specifically, the project covers:

- environmental analysis. This task concerned: i) a description of the environmental site in which the farm is located so as to assess the risks from possible sources of pollution; ii) a description of the production site; iii) identification and assessment of the environmental aspects and impacts stemming from the productive activity
- assessment of the availability of organic feedstuffs that could be used in the feed formulas
- comparison between "organic" and conventional feeds with an assessment of the different effects on breeding performance, food safety and quality.

3.1. Production cost estimate

Having ascertained the technical feasibility of trout breeding according to organic techniques, the research went on to assess its economic feasibility. Conversion to organic production naturally involves additional costs concerning the conversion process itself, the production of this new type of product and the lower output due to the different stocking density. The stocking density for trout was established as 25 kg/m^3 (Schiavo, 2008).

In the cost-benefit assessment of conversion to organic fish breeding practices, the most suitable cost concept is full cost, through which all costs are ascribed to the product regardless of whether they can be classified as specific or common, fixed or variable. A possible method would be to quantify the costs of the different tasks (preparation and entry of the fattening schedules, feeding, monitoring, fish catching and processing, other supporting tasks). The costs of each task can

[2] The term *organic fish* is not a synonym for *wild fish* or *natural product*. Organic fish production requires total control of the production process, from the origin of the egg through to the adult fish, from the composition of the feeds to the quality of the water. Thus, it is wrong to use the term "organic" for wild fish as the entire life cycle of the latter cannot be controlled (the fish may have lived in polluted areas and eaten contaminated food). This means that certification cannot be produced for this type of product (ISMEA, 2007).

[3] The other main species reared organically for which significant production volumes have been reached, are salmon and shrimp.

[4] In particular, the zootechnical practices, including the administration of feeds, the way the farms are designed, the stock density and the quality of the water, must ensure that the physiological, behavioural and development needs of the animals are satisfied. The vegetable part of the fish food must come from organic productions, while the part obtained from aquatic fauna must come from sustainable fishery practices. Use of growth stimulants and synthetic amino acids is not allowed.

be found with the *direct costing* technique, by considering the effective use of resources and manpower at standard prices. The costs of back-up tasks to assist those of fattening and fish processing can be allocated on the basis of cost determinants. The main cost items to consider in the case of organic fish production are outlined in table 2.

Table 2 – *Main cost items for estimating the normal full cost.*

Direct breeding costs
- *seeding and preparation of modules*
- *feeding*
- *monitoring and controls*
Direct costs for catching & processing
Direct depreciation
Indirect costs
Certification

A study conducted by UNIPROM[5] (2001) showed how, during the full production phase, the normal full cost of organic sea bream was 7.4 €/kg in the conventional lake and around 7.5 €/kg in the more intensive system. The full cost for sea bass is 7.8 €/kg. There is a 20-30% cost increase compared to conventional production and the differentials are mainly due to the lower final stocking density plus the higher costs for feeds and monitoring (Defrancesco, 2004).

With reference to zootechnical practices, particularly to organic poultry breeding, which is widespread in our country and, in some aspects, more pertinent to the characteristics of the sector covered by this study, the differential between production cost for the conventional product and the organic one ranges from 100 to 130%, i.e. the cost of producing 1 kg of organic meat is, on average, 2-2.5 times higher than that of the conventional product[6] (Pignattelli, 2002). Experiments and research conducted in this sector show that the cost of feeding on the organic farm is only slightly higher than that on a conventional breeding farm. On the other hand, the cost of manpower, health costs and depreciation are much higher. Considering that the stocking density of the organic product is generally lower than that of conventional farms[7], the cost items to consider should also include opportunity cost, i.e. the loss of income due to stock limitation. According to UNIPROM's research, the loss of margin due to the lower production rate is about 2.6 €/kg.

At the present time, only general considerations can be made as to the exact entity of the added costs for organic trout farming. The evaluations can also be based on investigations conducted in other European countries since the enterprises are still undergoing conversion. Considering the type of farms in the Veneto area, which, as mentioned, feature an environment free from forms of pollution, with good quality water and limited use of technical means, the main cost differentials can be presumably ascribed to feedstuffs. However, one must remember that the zootechnical performance obtained with the organic feed used is not unlike that currently achieved with conventional feeds. According to Naturland (2004), the price differential between conventional and organic feed is about 30-50%, while the monitoring and certification costs are around € 1,000-3,000 per year. A study conducted on a French farm assessed the production costs by considering a 35 kg/m^3 stock density in a 600 hectare lake. By calculating the implications of a production cycle lasting two months longer than that of a conventional farm, the enterprise found that the cost differences were around +30% (Schiavo, 2008).

4. Investigation into willingness to pay

4.1. Survey methodology

A questionnaire was administered to a sample of 321 individuals in certain Provinces (Venice, Padua and Treviso)[8] of the Veneto Region. The sample was first stratified as to the population size of the various provinces considered and then as to the age of the local inhabitants (the starting point being the data provided by the National Statistical Bureau). The survey was carried out in November-December 2007 and face-to-face interviews were conducted near large-scale retail supermarkets, fish shops and markets. The questionnaire is divided into four sections with questions on: 1) purchasing habits and consumption of fish; 2) knowledge and consumption habits of organic foods, with particular reference to the willingness of the respondents to buy organic fish; 3) WTP for the consumption of organic trout and the reasons for not purchasing; 4) socio-demographic characteristics of the respondents.

4.2. Interviewee's Profile

69.78% of the interviewees were women, since grocery shopping is mostly a female activity. On average, the respondents were 48 years of age with a median age of 46.5 years.

As for their level of education, 38.63% of the respondents had successfully completed high school and 18.07% held a

[5] The goals of the UNIPROM project were: to create an organic aquaculture protocol, test this protocol in certain farms, assess its strong and weak points, launch a sales campaign with the organic aquaculture product so as to assess consumers interest in that product. The analysis was conducted in 4 breeding farms using different technologies (cages, lakes, cement tanks and PVC tanks) and concerned sea bass and sea bream.

[6] According to CRPA data, the average production cost of the conventional breeding farm is around 0.8 €/kg. However, in a study conducted by Asdrubali (2001) the average cost in the organic breeding farm is about 1.9 €/kg, while according to Pignatelli (2002), it is around 1.6 €/kg.

[7] In UNIPROM's research, the stocking density of the organic product was 3.6 kg/m^3 for lakes, 15 kg/m^3 for cement tanks and 13.5 kg/m^3 for PVC tanks as against 4.1 kg/m^3, 29 kg/m^3 and 22 kg/m^3 respectively, for the conventional product.

[8] We decided to conduct the analysis in this region as more trout farms are concentrated there than in any other area of the country. Another explanation for this choice was the fact that Northern Italy also has the highest consumption rate of trout in the country.

university or postgraduate degree. More than half of the respondents (55.76%) were employed, 20.87% were housewives and 18.69% were pensioners. On average, the households were composed of 3.6 persons, with a median and modal family size of 4 members. 51.71% of households had no children aged under 14 and 23.29% of them had more than 1 family member under 14. The modal income class was the € 20,000-30,000 range (see table 3 for more details about the socio-demographic characteristics).

Table 3 – *Socio-economic characteristics of the sample.*

Age groups		**Gender**	*Percent*
< 39	26.79	Male	30.22
39-47	25.55	Female	69.78
48-59	22.74	**Household size**	*Percent*
> 60	24.30	1-2 people	16.51
Missing	0.62	3 people	24.92
Province of		4 people	44.55
Venice	29.91	more than 4	14.02
Treviso	33.02	**Households with people aged 14 and under**	
Padua	36.14	None	51.71
Missing	0.93	1 person	23.36
Educational level		2 people	19.63
University	18.07	more than 2	4.36
Secondary school	38.63	Missing	0.93
Primary school	42.68	**Income level**	
Missing	0.62	0 |- 20,000	19.63
Occupation		20,000 |- 30,000	30.53
Employed	55.76	30,000 |- 40,000	18.38
Housewife	20.87	> 40.000	14.95
Pensioner	18.69	Missing	16.51
Other	4.06		
Missing	0.62		

4.3. Purchasing habits

78.82% of the sample buy fish once a week while 4.98% never buy fish. The respondents mainly consume fresh fish (89.18%) rather than packed (25.90%) or unpacked (19.02%) frozen/deep-frozen fish, while only 1.64% of the interviewees eat pre-cooked and convenience products. The consumers mainly buy the fish in hyper/supermarkets (51.49%), but there are also a significant number of consumers who obtain their supplies from fish shops (43.56%) and markets (42.24%). Only 3.96% of fish consumers are supplied directly by the fishermen. The large majority of fish purchasers regularly consume the product at home (90.81%) rather than in restaurants. Amongst the species habitually eaten by consumers, it is interesting to note that 30.49% of them consume conventional trout.

93.77% of the sample are aware of the existence of organic products but only 56.81% actually purchase them. The buyers of organic products can be divided into three categories based on their frequency of purchase (table 4): 1) habitual consumers, who purchase organic foods at least once a week; 2) occasional consumers, who purchase these products 1-2 times per month; 3) infrequent consumers, who purchase them only once every 2-3 months.

Table 4 – *Distribution of respondents amongst the three consumption classes.*

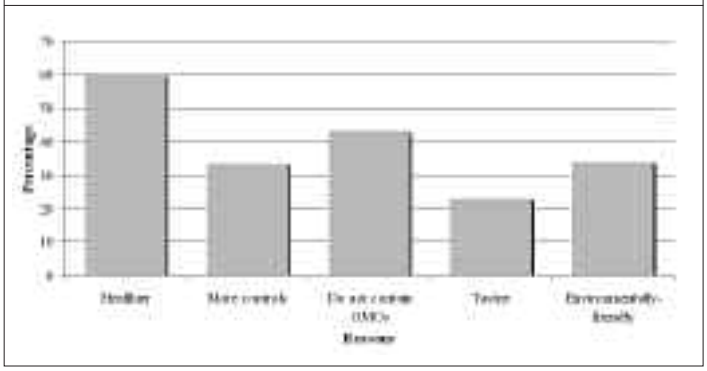
Frequency of purchase	**Habitual**	Occasional	Infrequent
%	47.37	42.69	9.94

Regarding the reasons for purchasing organic foods, the majority of consumers (59.65%) believe that they are healthier than conventional ones, while 43.27% think that these products do not contain GMOs (see figure 1).

Figure 1. Reasons for eating organic foods.

Regarding the reasons for not purchasing organic foods, 48.46% of the non-buyers do not perceive any important differences from conventional products and 34.62% of them consider the price of organic food too expensive (see figure 2).

Figure 1 – *Reasions for eating organic foods.*



4.4. The potential buyer of organic trout and the average premium price

The Potential Buyers of organic trout (called PB for the sake of brevity) amount to 43.3% of the whole sample and they are willing to pay an average *premium price*[9] of € 2.55 for the product, corresponding to an average WTP of € 8.05[10]. The PB live mainly in the province of Treviso (see table 5). They are men (44.32% of PB are men as against 42.86% women) with a mean age of 49 and a median age of 48 years.

Table 5 – *Frequency of PB with reference to the province of residence.*

Provinces	Venice	**Treviso**	Padua
PB (%)	37.50	**46.23**	43.97

The average *premium price* is lower for those who live in Venice (2.34 €/kg against 2.64 €/kg in the other provinces), probably because consumers can choose from a large variety of fish; while men are willing to pay more than women (2.64 €/kg against 2.51 €/kg). As far as the age of the consumer is concerned, we noted that the more age increases,

[9] The *premium price* is the difference between the amount of the respondents' WTP and the average conventional trout price, i.e. 5.5 €/kg according to the information released by the Italian National Association of Aqua-farmers.
[10] In calculating the average WTP were not considered respondents willing to purchase organic trout but at the same price as the conventional product (1.25%).

Figure 2 – *Reasons for not eating organic foods.*

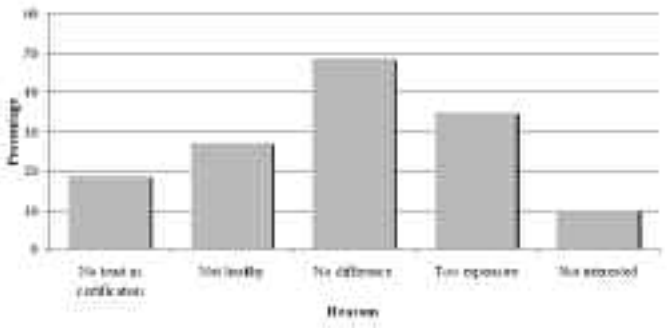


Table 6 – *Average* premium price *for different classes.*

Age	< 39	39 |- 48	48 |- 60	≥ 60
Premium Price (€/kg)	2.73	2.69	2.40	2.42

the more the *premium price* they are willing to pay decreases (table 6).

Regarding employment, we noted that 45% of the pensioners and 44.78% of the housewives were PB; whereas for the level of education, we noted that the majority of people with a university degree (53.45%) were PB (see table 7). As can be seen (see table 7), the *premium price* is higher among employees, with large differences in relation to different professional situations. Moreover, it increases as the educational level becomes higher.

Table 7 – *Frequency of PB and average* premium price *with reference to the occupation and level of education.*

		PB (%)	*Premium Price* (€/kg)
Occupation	Employed	43.58	**2.79**
	Retired	**45.00**	2.37
	Housewives	44.78	2.14
	Other categories	30.77	1.83
Educational level	**University**	**53.45**	**2.87**
	High school	42.74	2.58
	Low level	39.42	2.33

Primarily, the PB has a large family, with more than three members (45.15% of this kind of family are PB) and more than two children under 14 (57.14% of this family typology are PB). The *premium price* is higher for households with more than four family members (2.98 €/kg against 2.36 €/kg recorded for single people and couples) and for households with more than two children under 14 (3.44 €/kg against 2.43 €/kg recorded for households with no members under the age of 14). 50.94% of the interviewees who did not state their income are PB. Among those who did declare their income, we found that the great majority of PB were from families with a large income (more than € 40,000). Even though it may sound quite obvious, consumers with higher incomes are much more willing to pay extra for purchasing organic trout. Households with incomes exceeding € 30,000 are especially willing to pay 2.74 €/kg extra, as compared to the 2.31 €/kg declared by families with lower incomes, while the *premium price* for those who did not state their income was 2.65 €/kg. 72.04% of the respondents who usually buy conventional trout are PB, but this particular consumer category stated a lower *premium price* than those who do not normally purchase this kind of fish (2.48 €/kg against 2.60 €/kg), probably because consumers of conventional trout are already satisfied with the product. 67.67% of the buyers of organic products and 68.13% of the potential buyers of organic fish are PB. As regards the average *premium price*, we noted that these two particular consumer categories are willing to pay more than the others in order to purchase organic trout (see table 8).

Table 8 – *Average* premium price.

	Consumer of organic products		Willing to purchase organic fish	
	Yes	No	Yes	No
Premium Price (€/kg)	2.63	2.14	2.60	2.27

It is interesting to point out that 79.13% of PB prefer to buy the already processed product, at a slightly higher *premium price* than that stated by the PB who prefer the unprocessed product (2.57 €/kg against 2.51 €/kg), and that they would mainly buy the fillet (85.45%) or the smoked fillet (29.09%) of the organic product. As to the frequency with which the PB would purchase organic trout (see table 9), we noted that most (53.33%) of them would buy the product occasionally (1-2 times per month) with an average *premium price* of 2.54 €/kg.

Table 9 – *Frequency and average* premium price *of PB of organic trout.*

Frequency of potential consumption	Composition (%)	*Premium price* (€/kg)
Habitual	20.74	2.53
Occasional	**53.33**	**2.54**
Infrequent	25.93	2.59

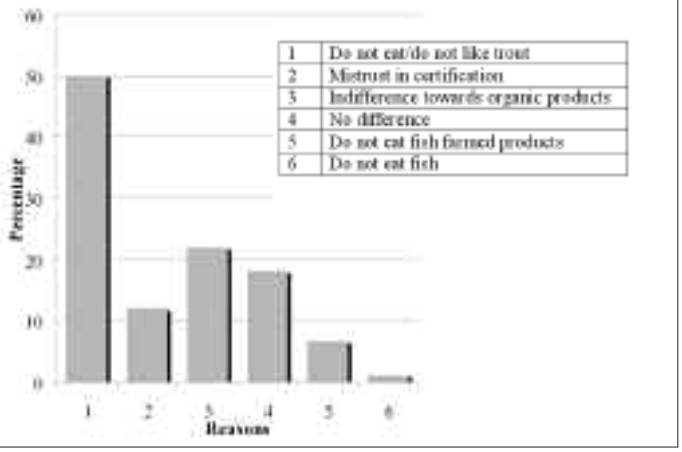
Finally, many PB are interested in the use of organic trout in school canteens (68.35%) and they would be willing to pay 2.65€/kg on average. The main reason for people being against this initiative is that they have no school-age children.

4.5. Non-potential buyer of organic trout: reasons for not purchasing

By examining the results obtained in the previous section, one notes that non-potential buyers of organic trout (called NPB for the sake of brevity) amount to 46.7% of the sample. The NPB lives mainly in the province of Venice, is a woman with a mean age of 48 and a median age of 45 years, is a student or unemployed and has a low educational level and income (generally less than € 20,000). As to family size, we noted that the NPB is primarily single or lives with another person, but that he/she

has no children under 14. NPB are not interested in buying organic trout, mainly (50%) because they do not eat or do not like conventional trout. If the respondent usually consumes conventional trout (14.3%), the lack of interest in purchasing organic trout stems primarily from the fact that the organic product is not considered any better than the conventional one, followed by a general diffidence towards certification and the real goodness of organic food (see figure 3). Finally, NPB are either not interested or do not know how to respond to the question regarding the use of organic trout in school canteens (35%), or they are not in favour (26%).

Figure 3 – Reasons for not purchasing organic trout.



5. The model

To evaluate the WTP for organically farmed trout we must use a two-equation generalization of the Tobit model (Tobin, 1958) estimated by means of the Heien and Wessells two-step estimator (1990). The two-stage approach allowed us to take into account the fact that the monetary value obtained from the individual after the elicitation question is the result of two possible processes: the individual assigns a value to the commodity according to some choice model, and decides whether or not to pay this value (i.e., his or her reservation price) according to another choice model (Strazzera *et al*., 2003).

On the other hand, use of the estimator proposed by Heien and Wessells can correct the problem of sample selection, due to the fact that estimating a model by means of the sub-sample and non-zero responses only, which correspond to the PB in our work, may lead to biased estimations.

The model used therefore comprises the formulation of two estimated regression models in two different stages but linked to each other. A Probit regression is formulated in the first stage, so as to model the decision to pay or not to pay (selection stage), while in the second stage, an Ordinary Least Square (OLS) regression is estimated in order to model the sum of money consumers are willing to pay, after having decided to pay (outcome stage).

As regards the first stage, let us assume that $\boldsymbol{PP}_1^*$ is a latent variable[11] expressed as a vector Nx1, which contains the propensity or willingness of the respondents to pay a *premium price* for a particular commodity; N is the sample size; $\boldsymbol{x}_1$ is a matrix Nx(k+1) in which the first column consists of a column of 1[12] and the remaining k columns contain the values of the independent variables; $\boldsymbol{a}_1$ is a vector of coefficients (k+1)x1, which remains constant throughout the whole sample; $\boldsymbol{u}_1$ is a vector Nx1 representing the values of the error term, which we assume as being distributed like a Gaussian variable with zero mean and unknown constant variance (σ_1^2). The following linear relation is assumed between $\boldsymbol{PP}_1^*$ and $\boldsymbol{x}_1$:

$$\boldsymbol{PP}_1^* = \boldsymbol{x}_1\boldsymbol{a}_1 + \boldsymbol{u}_1 \qquad (1)$$

Since, in practice, the elements of $\boldsymbol{PP}_1^*$ (PP_{1i}^*, where i=1,…, N) cannot be observed but we know if the respondent is willing to pay a *premium price* or not, we defined an observable dummy variable $\boldsymbol{PP}_1$ in which each element (PP_{1i}) is compared to the latent variable elements by means of the following relation:

$$PP_{1i} = \begin{cases} 1 & \text{if} \quad PP_{1i}^* > 0 \\ 0 & \text{if} \quad PP_{1i}^* \le 0 \end{cases} \qquad (2)$$

In view of equation (1), relation (2) and the assumptions made about the error term, we found that the model that described the selection stage was the Probit model (Maddala, 1983; Breen, 1996).

Using the estimations obtained in the first stage, we calculated a new variable, the inverse Mill Ratio (MR)[13], which we included as an instrument variable in the second-stage regression. The MR variable allows the two stages to be linked and the sample selection problem to be corrected.

As regards the second stage, let us assume that $\boldsymbol{PP}_2^*$ is a latent variable expressed as a vector Nx1, which comprises the *premium prices* that respondents are willing to pay; $\boldsymbol{x}_2$ is a matrix Nx(k+1) in which the first column consists of a column of 1 and the remaining k columns contain the values of the independent variables, which may differ from the independent variables used in the first stage; $\boldsymbol{a}_2$ is a vector of coefficients (k+1)x1 which remains constant throughout the whole sample; $\boldsymbol{u}_2$ is a vector Nx1 representing the values of the error term, which we assumed as being distributed like a Gaussian variable with zero mean and unknown constant variance (σ_2^2).

[11] Latent variables are the ones that cannot be observed directly. However, their existence and availability can be inferred thanks to the properties of an observed variable, which has been directly measured beforehand.
[12] This column contains an artificial variable or dummy, associated with the intercept of the model.
[13] The *MR* variable was calculated for each respondent on the basis of the rule proposed by Heien and Wessels (1990).

$\boldsymbol{PP_2}^*$ is a latent variable, the elements (PP_{1i}^*) of which are not observable. But it is possible to observe the $\boldsymbol{PP_2}$ variable, in which each element (PP_{2i}) is linked to the elements of the latent variable by means of the following decision rule:

$$PP_{2i} = \begin{cases} PP_{2i}^* & \text{if} \quad PP_{1i}^* > 0 \\ 0 & \text{if} \quad PP_{1i}^* \leq 0 \end{cases} \qquad (3)$$

The model that explains the relation between $\boldsymbol{PP_2}$ and the independent variables ($\boldsymbol{x_2}$, **MR**) is the following:

$$\boldsymbol{PP_2} = \boldsymbol{x_2 a_2} + b\mathbf{MR} + \boldsymbol{u_2} \qquad (4)$$

where b is the covariance between the error terms of the selection and outcome stages (Heckman, 1976). It is important to note that if b=0, the decision to pay and the decision of how much to pay are independent.

6. Results of the regression models

Both regressions were estimated using a stepwise robust method (the cut-off value $\alpha = 0.05$) in order to correct the possible heteroskedasticity of the error terms[14].

We included the income among the independent variables, following the method proposed by Alberini *et al*. (2005), which allows two variables to be specified: 1) the variable denoted by *income* is equal to the mean of income category to which the respondent declares that he/she belongs. It is equal to 0 when this information is missing; 2) the variable denoted by *missing income* is a dummy variable equal to 1 when the interviewee does not state his/her annual income (i.e. 17% of the sample), and is equal to 0 in all other cases. The regressions of the two stages are first estimated considering all the variables of interest (the complete list of independent variables is given in appendix A). STATA software was used and the stepwise results are given in table 10.

Table 10 – Premium price *determinants.*

Independent variables	First stage*	Second stage**
buying organic food	0.631 (0.227)*	0.839 (0.265)
buying organic fish	1.388 (0.243)	1.249 (0.341)
PD		0.416 (0.165)
TV		0.364 (0.161)
Job_Employed		0.859 (0.261)
Job_Housewife		0.555 (0.265)
Job_Pensioner		0.792 (0.263)
young3		1.064 (0.380)
MR		-0.727 (0.341)
constant	-1.471 (0.150)	-0.760 (0.287)

* Robust Std. Err. in brackets
* Number of obs = 307, Wald (hi2[2]=113.98, Prob > chi2=0, McKelvey and Zavoina's R2 = 0.443
** Number of obs = 307, F(9, 297)=26.52, Prob > F=0, Adjusted R2 = 0.360

In order to test multiple restrictions in the Probit model we used the Wald test. As known, the Wald statistic has an asymptotic chi-square distribution, with a degree of freedom equal to the number of restrictions being tested. Various goodness-of-fit measures have been proposed in the literature for the binary choice model given that, in this type of model, the coefficient of determination, R^2, calculated for the linear regression model estimated with the OLS method, is not an appropriate statistic for evaluating the explicative capacity of the model. Veall and Zimmermann (1992) found that for the Probit regression, the measure which was most closely related to the R^2 was the McKelvey and Zavoina pseudo-R^2 (1975). We noted that a pseudo-R^2 measure is a measure that has the same kind of interpretation as the R^2 of the OLS regression, and is thus within the [0, 1] interval at least (Windmeijer F., 1995). Amongst all the explicative variables estimated in the model in the first stage (Probit regression), only those variables indicating the real purchase of organic food and the willingness to buy organic fish were significant, with a positive sign. This means that the probability of being willing to pay for organic trout increases if the interviewee is a real consumer of organic food and would like to buy organic fish. The variables that were significant in the second stage (OLS regression) reveal that the *premium price* is influenced by the part of the country in which the family lives, the presence of youngsters under 14, the occupational status of the interviewee and by the dummies pertaining to the habit of eating organic food and the willingness to purchase organic fish. In particular, we noted that the presence of more than two children under 14 increases the *premium price* by about 1.1 €/kg, the values of the other variables being equal. As for the part of the country in which the families live, we noted that interviewees residing in Padua or Treviso were willing to pay more than Venetians for organic trout, while in relation to the occupational status, we observed that employed persons and pensioners were the ones with the highest *premium price* (0.86 €/kg and 0.79 €/kg, respectively, without any change in the values of the other variables). Lastly, if the interviewee is interested in purchasing organic fish, the *premium price* increases by 1.25 €/kg while if he/she is a real consumer of organic food, it increases by 0.84 €/kg, all the other variables being equal. By way of example, we noted that the *premium price* estimated for the modal family, i.e. for the family living in Padua without children under 14 years of age, in which the interviewee is employed and a real purchaser of organic foods as well as being a potential purchaser of organic fish, was 3.363 €/kg. Finally is important to note that the *MR* coefficient is statistically significant, indicating that the two stages are dependent and that the estimate of a two-stage model is necessary.

7. Conclusion

The first experiments with organic breeding have also begun in our country, encouraged by the consumers' con-

[14] The robust regressions were estimated by using White's robust variance-covariance matrix to generate robust standard errors for our statistics (White, 1980).

tinual demands for safe, good quality products and to face the recent scandals that have hit the agri-food industry. It could be a strategy for certain enterprises to diversify their products by offering organic ones, and thus to acquire a margin that would allow them to recover their profit-earning capacity. As is well-known, the Italian fish farming sector has currently had to face a crisis situation due to its reduced profit-earning capacity. The domestic demand for aquaculture products has stabilized and as to prices, there is evident competition from imported products. Our research could be a valid starting point for a more extensive project (ICRAM, API, 2007) directed towards defining techniques that can be used to obtain an organic product. A project whose goal is to:

- provide the means for introducing organic breeding techniques in areas with a particular natural value, reducing the environmental impact, providing a quality product and, at a second stage, promoting the widespread use and development of such methods;
- increase the income of those enterprises which, in view of their size and geographical locations, are unable to maximize their scale economies but could gain advantage from products obtained with organic methods;
- make the breeders aware of environmentally-sound forms of management with a low breeding intensity.

Firstly, this study attempts to provide a theoretic reference framework for estimating the production costs involved should the breeding farms be fully converted. Apart from estimating the cost differential between conventional and organic breeding farms which, at the present time, cannot be calculated owing to lack of data and information, one can certainly affirm (also considering the experience with this sort of farming practice abroad and that of other sectors) that the full production cost of the organic product is considerably higher than that of the conventional one. Firstly, this is due to the low stocking density, which involves higher unit costs than in conventional production; then there is the greater incidence of the fixed costs as well as an increase in production costs, especially for the feeds, monitoring and the actual certification itself.

This cost increase can only be justified if adequate price differentials can be obtained on the market.

However, it also seems that the consumer would be willing to pay a premium price for organic trout. It is important to underscore that, according to the analysis we conducted, the decision to purchase this product significantly divides into two phases: first of all, the individual decides whether to purchase the product or not and then evaluates the price in a second phase. Purchasers of organic products, who were more than half of our sample, were much more interested in buying organic trout and were willing to pay a higher *premium price* than those who do not already purchase this type of product. The interviewees who would like to purchase organic fish (about 57% of our sample) are also potentially more in favour of buying organic trout and would be willing to pay a higher *premium price* than those who said they were not interested in organic fish farming. Of the interviewee's socio-demographic characteristics that influence price surplus evaluation, place of residence and the presence of family members aged less than 14 years seem to be most important.

Thus an advertising campaign to encourage consumers to purchase these products should underline their organic characteristics and be directed towards the targets identified in this study.

Appendix A – *List of independent variables.*

Independent variables	Definitions
a1_never	1 = never buying fish; 0 = otherwise (reference category)
a1_once a week	1 = buying fish only once a week; 0 = otherwise
a1_many times per week	1 = buying fish more than one time per week; 0 = otherwise
buy organic food	1 = buying organic food; 0 = otherwise
buy organic fish	1 = would buy organic fish; 0 = otherwise
Socio-demographic	
Sex	1 = being male; 0 = otherwise
Age_1	1 = ≤ 38 years old; 0 = otherwise
Age_2	1 = 39-47 years old; 0 = otherwise
Age_3	1 = 48-59 years old; 0 = otherwise
Age_4	1 = ≥ 60 years old and over; 0 = otherwise (reference category)
PD	1 = living in Padua; 0 = otherwise
TV	1 = living in Treviso; 0 = otherwise
VE	1 = living in Venice; 0 = otherwise (reference category)
study_Primary	1 = having attended primary schools; 0 = otherwise (reference
study_Secondary	1 = having attended secondary schools; 0 = otherwise
study_University	1 = having a university degree; 0 = otherwise
job_Employed	1= being Employed; 0 = otherwise
job_Housewife	1= being Housewife; 0 = otherwise
job_Pensioner	1= being Retired; 0 = otherwise
job_Other	1= being Unemployed/Student/other; 0 = otherwise (reference
comp12	1 = family with 1-2 persons; 0 = otherwise
comp3	1 = family with 3 persons; 0 = otherwise
comp4	1 = family with 4 persons; 0 = otherwise
comp>4	1 = family with more than 4 persons; 0 = otherwise (reference
young0	1 = family without children under 14; 0 = otherwise (reference
young1	1 = family with one children under 14; 0 = otherwise
young2	1 = family with two children under 14; 0 = otherwise
young3	1 = family with more than two children under 14; 0 = otherwise
Missing income	1 = respondents do not state their income category; 0 = otherwise
Income	The mid-point of each income category is considered; 0 if
MR	Inverse Mill's Ratio

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