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Stated Preferences for Consumption of Sea Urchin: A Choice Experiment in Sardinia (Italy)

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Abstract

In Sardinia sea urchin (Paracentrotus lividus) roe is a basic ingredient for several dishes (e.g. pasta, pizza, croutons) and its demand is constantly increasing. However marketable value of local sea urchin appears to be potentially higher than the current value. This paper aims to estimate the value of a based sea urchin dish according to the stated preference of consumers. A Choice Experiment (CE) analysis on 475 consumers was carried out in order to estimate their willingness to pay (WTP) for consuming sea urchin. Seafood was proposed as alternative to sea urchin. CE regarded two attributes: certification of local origin and place where dishes are consumed. Findings suggest that WTP for a generic dish is significantly higher for sea urchin (11.65 Euros) than for seafood (7.94 Euros) based dish. Furthermore, we found that WTP is higher when both foods are consumed with spaghetti and as raw fresh product, whereas an opposite effect is associated to pizza. Finally, the influence of some socio-economic characteristics of responders on their preferences was estimated.

Keywords: *Choice experiment; sea urchin demand; stated preferences*

JEL codes: D12 Q13 Q22

1 Introduction

Among benthic invertebrate species, sea urchin (*Paracentrotus lividus*) is one of the most intensively harvested one in different Mediterranean areas, especially in the southern regions of the Basin (Régis 1986; Guidetti *et al.*, 2004; Ceccherelli *et al.*, 2011; Matsiori *et al.*, 2012). Sea urchin harvesting generally concerns specimens larger than 40 mm in test diameter. It is traditionally practiced due to the high commercial value and delicacy of its gonads (roe) (Régis 1986; Guidetti *et al.*, 2004; Pais et al., 2007; Ceccherelli *et al.*, 2011; Fernandez-Boan et al., 2012; Grisolia and Lopez, 2012).
In Sardinia (central-western Mediterranean, Italy) sea urchin roe is a basic ingredient for several dishes (*e.g.* pasta, pizza, croutons) and its demand is constantly increasing (Furesi *et al.*, 2013). However, today local sea urchin market size and working are limited by some normative and commercial constraints.
First, local sea urchin market is basically seasonal: regional government established that harvesting is permitted only from November to May. This is imposed in order to minimize the risk of overexploitation of this marine resource. This prevents fresh local sea urchin supply during the summer, when local food demand could be consistent due to strong presence of tourists. On the other hand, one has to bear in mind that sea urchin achieve the sexual maturity after three years. Then, the fishery regulation is aimed at preserving the renewability of the sea urchin stocks.
Second, local market is characterized by a strong presence of "black-market product" derived from illegal fishery and processing. This factor negatively affects market policies aimed at value creation along the sea urchin supply chain, with particular reference to support fishermen for achieving adequate prices for specimens harvested. In other words, marketable value of local sea urchin seems to be potentially higher than the actual one (Furesi *et al.*, 2013). The gap between actual and latent sea urchin final demand inspires some research questions, such as the estimation of the value assigned by consumers to the product. To be more precise, the research issue is to draw a map of consumers' preferences in order to estimate potential prices associated to sea urchin consumption.

In the light of these considerations, the aim of this paper is to determine the potential demand of local sea urchin in Sardinia. More in detail, our attention was focused on estimating the value of a sea urchin based dish according to the stated preference of consumers.
A Choice Experiment (CE) analysis on 475 consumers was carried out in order to estimate their willingness to pay (WTP) for consuming sea urchin rather than seafood. The reference to a specific alternative allowed us to facilitate respondents in stating their preferences. Furthermore, preferences were asked according to two specific attributes – *i.e.* the presence of local origin certification and the place where sea urchin is consumed – and to three dish typologies (spaghetti, pizza and raw fresh roe consumption).
The empirical evidences achieved here could be useful for planning effective strategies and policies aimed at supporting sea urchin value creation into the regional market.

2 Background

Over the last 2-3 decades, the demand for sea urchin has significantly increased, mainly as a result of the dramatic rise in consumption by residents and tourists (Pais *et al.*, 2007). It is estimated that about 30 million *P. lividus* specimens (1,800 t) are annually consumed in Sardinia. This is equivalent to a gross value production exceeding 10 million Euros (Carboni *et al.*, 2012). Thus, considering a population of 1.7 million inhabitants, Sardinia's annual per capita consumption is about 1.1 kg, what means four times the Japanese performance.
To meet the growing demand, the traditional harvesting system - based on the reed as collection tool - has almost disappeared and most of the catches are now made by diving, mainly by SCUBA diving and much less by free divers. Diving systems, especially SCUBA diving, allows considerably higher volumes of catches (Matsiori *et al.*, 2012).
Consumption timing and styles have changed too. Beside the consumption of fresh specimens, the demand of processed product - obtained by both freezing and vacuum preservation of the roe - has considerably grown. The processed product has made usual consumption in restaurants possible, broadened sea urchin food uses (not only as fresh roe but also as seasoning of pasta and pizza) as well as extended the consumption periods in late spring and summer when harvesting of sea urchin is not permitted.

3 Materials and methods

3.1 The methodological background

A Choice Experiment (CE) approach was used in order to estimate the expected value of a sea urchin based dish. It allowed us to evaluate the stated preferences of consumer for sea urchin on the basis of different dishes. It is well known that CE methods derive from the Lancaster's characteristics theory of value (Lancaster, 1966) and from random utility theory (Thurnstone, 1927; Manski, 1977). The basic concept is that any (market) good can be described in terms of the presence and the intensity of its inherent attributes, price included. Once attributes and their levels are identified, experimental design theory is used to generate different profiles of the good in terms of presence and intensity of its attributes. These profiles are assembled in choice sets combined in different cards to be shown to respondents. These are asked to select one of the different bundles of goods, each one described by specific presence/absence and level of the attributes considered.

3.2 The experimental design

The study was carried out considering some dishes of the Sardinian (and Mediterranean) tradition where sea urchin represent typical ingredients. These were compared to alternative dishes where sea urchin are substituted by seafood as main components. It means that each one of the CE cards submitted three options were proposed:

A. sea urchin based dish;
B. sea food based dish;
C. no choice (reference option).

The use of a well-defined alternative to sea urchin, *i.e.* seafood, allowed us to partially overcome the so called "embedding" effects (Rolfe et al., 2000; Jacobsen and Thorsen, 2010). It means that people state different WTPs for a composite good and for sub-sets of the good independently valued (Kanhemann and Knetsch, 1992). In our case, a possible substitute (seafood) of the investigated product (sea urchin) was basically involved into the alternatives of the choice sets. In this sense, sea urchin demand was handled into the wide category of seafood demand as to evaluate the role of a substitute alternative in conditioning respondents' preferences.
Furthermore, we considered three different types of sea urchin (and seafood) dishes, *i.e.* spaghetti, pizza and raw fresh dish (with a piece of bread), in order to put in evidence the role of the proposed dish in conditioning consumer's choices.
Each alternative – *i.e.*, each sea urchin/seafood based dish - was characterized by different levels or modes of three attributes:

1. certification of origin (presence/absence);
2. place of consumption (at home/at restaurant);
3. price (7, 10, 15 and 20 euros).

The *certification* attribute was introduced in order to evaluate the role played by local origin traceability in conditioning consumers' WTP. In our opinion, this is a crucial point for better addressing marketing policies aimed at enhancing sea urchin market performances. This variable could take on two levels (local certified or not certified ingredient).
The *place* attribute was considered in order to take into account the relevance of the location where dishes are eaten in affecting consumers' WTP. This variable could take on two levels (restaurant or house), too.
Finally, the *price* range was set on the basis of real standard prices for similar dishes in Sardinia, adding a bid generally higher than observed prices as to take into account possible preferences of consumers willing to pay very high price for a sea urchin based dish. Basically, prices were set at 7, 10, 15 or 20 Euros levels.
An example of card is reported in Figure 1.

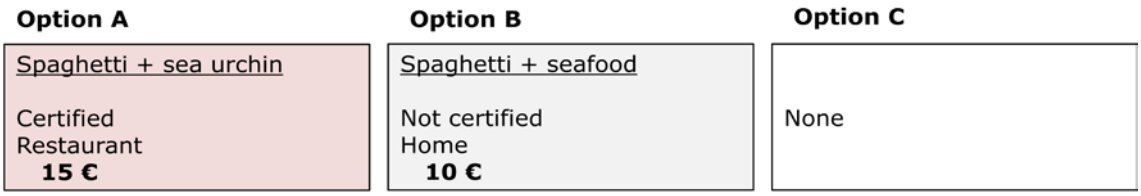

Figure 1. Example of cards of the experiment

After a round of interviews for testing the survey, we interviewed a random sample of 475 consumers throughout Sardinia. The pre-test survey was useful for reducing the price attribute and for varying the range (from 10-25 Euros to 7-20 Euros). Furthermore, people who do not know or do not consume sea urchin were excluded from the analysis. In order to elicit consumers WTP for each attribute and for each dish typology, a brief description of the problem were made as well before starting the survey. It allowed us to illustrate the issue to respondents and to describe the characteristics of products. For the same purpose, we preliminarily make sure that the respondents had understood the meaning of the question and the choice that they were called upon to perform.
Given the size of the sample, we opted to show 12 cards for each respondents. All possible alternative was equally exhibit in the sample as to be equally represented. Furthermore, each survey exhibited 4 cards for spaghetti as well as for pizza and for raw fresh. In other words, each respondent was asked to elicit preferences about every considered dish typology (spaghetti, pizza or raw fresh), with cards, choice sets and attributes that were casually submitted to their attention.
Finally, some individual characteristics were asked in order to individuate heterogeneity in the sample. Among these, we collected information on relevance attributed by each respondent on consuming local

food - leaving aside from types of food (*i.e.*, not only seafood) - and on frequency in consuming sea urchin. Descriptive statistics about heterogeneity of the sample according to these two behaviors are reported in Table 1.

Table 1.
Some consuming behavior characteristics in the sample

Relevance attributed to local food in food consumptions	**Respondents**	
	n.	***%***
Very important	304	64,0%
Important	138	29,1%
Little important or not important	15	3,1%
Indifferent	16	3,4%
No answers	2	0,4%
Total	**475**	**100,0%**

Frequency in consuming sea urchin	**Respondents**	
	n.	***n.***
Usual consumer	331	69,7%
Not usual consumer	142	29,9%
No answers	2	0,4%
Total	**475**	**100,0%**

Other information were taken about gender (63,8% males; 36,2% females), level of education (about 70% of high school or academic graduation), age (47 years old on average) and occupation of respondents. However, these data are not reported and handled here due to shortness of the paper.

3.2 The applied CE model

Results were estimated using a Conditional Logit model. It allowed us to estimate probability of selecting a specific choice set by part of interviewed, distinguishing the choice attributes from the individual characteristics. Individual characteristics are used to take into account the heterogeneity of preferences:

$$(1) \qquad V_i = a_i + \sum \beta_k x_{ik} + \sum \delta_{hi} s_{hn}$$

where V_i is the deterministic (observable) component of the utility function, a_i is the alternative specific constant (ASC), $ß_k$ is the parameter vector associated to the attributes k (k = 1….K) of alternatives i noted (x_{ik}), and δ_{hi} is the parameter vector of the h (h = 1…H) characteristics of individual n $_{(}s_{hn)}$.
The *dummy* variable ASC indicates the utility associated with moving away from the basic alternative. In other words, the value of the ASC suggests if an endowment effect or a bias associated to the basic alternative exists.
In our case, we adopted a model with two ASC as to take into account possible deviation from more basic situation (Hanley *et al.*, 1998; Grisolia *et al.*, 2012). To be more precise, the ASCs were associated to the choice of consuming a dish with sea urchin (ASC_U) or with seafood (ASC_S) (Table 2). This methodological choice allowed us to evaluate the mean WTPs for a sea urchin and seafood based dish, respectively.
Attributes (x_{ik}) are *certification*, *place* and *price*. The first variable is equal to 1 (0) in the case of presence (absence) of certification. The second dummy variable can be equal to 1 (0) when the product is consumed at restaurant (home). The third variable varies according to the four considered price levels.

Table 2.
Variables involved in the CE model

Variable		Description
ASC for sea urchin	ASC_U	Choice alternative with sea urchin
ASC for seafoods	ASC_S	Choice alternative with seafood
Certification	X_1	0 = no certification; 1 = certification
Place	X_2	0 = consumed at home; 1 = consumed at restaurant
Price	P	7, 10, 15, 20 Euros
Spaghetti	SG	0 = alternative dish; 1 = Spaghetti
Pizza	PZ	0 = alternative dish; 1 = Pizza
Fresh	FR	0 = alternative dish; 1 = Fresh
Local food	LF	0 = indifferent; 1 = little important; 2 = important; 3 = very important
Frequency	FQ	0 = not usual consumer; 1 = usual consumer

The role of the type of dish (spaghetti, pizza and raw fresh) in affecting WTP was estimated trough interaction between the dish and the ASCs. Basically, it allowed us to determine the influence of a sea urchin or seafood based dish on WTP.
Finally, we evaluated the role of the two socio-economic variables (s_{hn}) reported above in sea urchin demand – *i.e.*, relevance assigned to *local food* consumption and *frequency* in consuming sea urchin - introducing an interaction between these variables and the ASC_U. This is because they cannot enter the model on their own, since they do not change over choice occasions.
Data were processed by *N-logit* software.

4 Results and discussion

The results obtained from CE analysis are reported in Table 3.
The Hausman and McFadden (1984) test was carried out in order to estimate suitability of the Conditional Logit model to the data. It must be underlined that Conditional Logit Model is based on the *a priori* assumption of the *independence of irrelevant alternatives* (IIA) property (Hanley *et al.*, 1998a), *i.e.* the relative probabilities of two selected alternatives are unaffected by the introduction or removal of other alternatives (Ben-Akiva and Lerman, 1985).
The estimated Hausman and McFadden (1984) statistics suggest that the IIA property is not violated by the Conditional Logit Model adopted. This is because the values of the test statistics - given by the comparison between the coefficients estimated before and after removing one of the alternatives – are equal to 5.12 and 5.02 for *certification* and *local food* variables, respectively. Both values are lower than the correspondent critical value of the chi-square distribution for 3 degrees of freedom at 99.5% of confidence level. It means that the null hypothesis should not be rejected as well as the Conditional Logit model well fits the data.
All estimated coefficients are significant.
As we expected, the coefficient associated to the price is negative (inverse relationship between WTP and price). On the other hand, ASCs and the food attributes coefficients are positive. To be more precise, the WTP for local certification amounts to 8.55 Euros, whereas the contribution to WTP for eating at restaurant rather than at home is only 1.40 Euros.
These are two interesting findings for all kind of stakeholders involved in the Sardinian sea urchin market. Particular attention has to be paid on the scale of WTP for eating certified seafood or sea urchin: it is a highly significant contribution to the whole value attributed to the dishes. It is quite difficult to explain this result when one observes the low share of certified sea urchin consumed actually in restaurants as well as at home or throughout the streets in Sardinia. In our opinion, until now the demand of consumers for certification has been satisfied by their personal trust on fishermen or restaurant owners who sell sea urchin dishes.

Table 3.
Estimated findings from CE application

Variable	Coefficent	s.e.	p-value		WTP
ASC_U	2,073	0,094	0,000	***	**€ 11,65**
ASC_S	1,414	0,092	0,000	***	**€ 7,94**
Certification	1,522	0,512	0,000	***	**€ 8,55**
Place	0,249	0,053	0,041	**	**€ 1,40**
Price	-0,178	0,047	0,000	***	
ASC_U * SG	0,222	0,085	0,009	***	
ASC_U * PZ	-0,817	0,084	0,000	***	
ASC_S * SG	0,392	0,097	0,001	***	
ASC_S * PZ	-0,408	0,096	0,000	***	
ASC_U * LF	0.122	0,046	0,010	**	
ASC_U * FQ	0.356	0,046	0,000	***	
Log-likelihood value	-4.798,3				
Chi-square value	0,000				
N. of individuals	475				
N. of observations	17.100				

*significant at p = 0.10 level **significant at p = 0.10 level ***significant at p = 0.01 level

This might depend on the short length of the local supply chain and on the low size of the market. Nevertheless, the high rates of growth observed for sea urchin consumption in Sardinia in the last few years suggest that the market is becoming larger because of a wider range of consumers and of a higher frequency of consumption events for each consumer. This trend makes the level of personal knowledge and trust in the seller-buyer relationships lower: combining this change with the wider flow of products requested by the market, one can easily understand how dramatically the demand for a truly trustable certification of origin of sea urchin can rise, especially for a sample, like this, where regular consumers are predominant.

The experience of the most part of respondents explains the limited WTP for eating in the restaurant: the sea urchin/seafood consumption at home is deeply rooted in the tradition of the Sardinian families. However, the result highlights the important role fulfilled by restaurants at this stage in the promotion of sea urchin/seafood introduction in the dietary habits of the population. In fact, these are dishes characterized by high added value compared to that of basic ingredients, on which the restaurateurs count in order to build high profit margins for their whole activity. Therefore, despite a limited propensity to consume sea urchin and seafood away from home, a strong promotional campaign by restaurateurs is undergoing which somehow is deeply breaking the Sardinian consumers habits.

ASC coefficients suggest that WTP for any generic dish is significantly higher for sea urchin (11.65 Euros) than for seafood (7.94 Euros). Such a high willingness to pay gets light on the product's ability to create value to the dish characterized by its presence. This result suggests two considerations.

First, sea urchin causes strong appeal to their admirers: their specific flavor immediately draws the experience of the sea and drives the mind towards its peculiar environment.

Second, the characteristics of the fishing system and of its society connect directly the consumer with a world marked by strong identity and sense of belonging. All these things considered, sea urchin is a food product able to sell itself by its own in the Sardinian market. This is the primary result arisen from our

analysis. It implies the opportunity of an effective regulation of the whole fishery-processing-distribution system in order to control the stocks overexploitation as well as to make consumers aware on food origin and healthiness.

These goals can be achieved only by an harmonic and coherent Regional Plan for sea urchin fishery and marketing rather than by the fragmented set of measures currently adopted. It is on licensed fishermen's responsibility to find organizational solutions aimed at countervailing restaurateurs' market power and at redistributing the value created along the supply chain. An important role in this match can be played by processing firms. The results discussed here suggest that there is room enough for such strategies.

Our analysis has gone beyond the determination of WTP for sea urchin. It has also been dedicated to the influence of the types of dishes where sea urchin most frequently appear in the ordinary habits of Sardinian consumers. It can be suggested by values reported by ASC*SG and ASC*PZ. The interaction between ASCs and raw fresh roe is not involved in the model because of redundancy.

We found that WTP tends to be higher when both types of dishes (sea urchin and seafood) are combined with spaghetti (SG), whereas it tends to decline for pizza (PZ). It is a fact that Sardinians – just like Italian people – appreciate spaghetti, but we found that appreciation tends to increase in case of they are served with sea urchin. However, the combination with seafood is well appreciated, too.

On the other hand, despite the intense promotion still ongoing by restaurateurs, pizza is not experienced as a good combination for these products by the most part of respondents. It is an interesting finding of our research, especially because the Sardinian tradition of sea urchin consumption is made of raw fresh product with bread and wine and we all know that pizza derives its origin from bread. Nevertheless, pizza has become a global dish eaten all over the world, where it is served in very different ways following the specific interpretations made by local producers.

The peculiar characteristics of sea urchin described above make them difficult to be combined in a complex basket of flavors like pizza actually is. Their recent introduction in pizza dishes is experienced as a traumatic removal from their traditional and ideal placement in the local food culture. The recommendation for pizza sellers is to try to find some simple recipe for their proposals, probably removing some traditional ingredients like tomato and cheese, in order to exalt the sea urchin' flavor. This what exactly happens in the case of spaghetti: the responsibility of the flavor totally depends on the sea urchin organoleptic properties.

The most important finding of our analysis is that sea urchin presence creates value for dishes as well as their value is conditioned by the types of dishes where they are served. It means that the value of the good examined changes depending on the vehicle used for its final use: spaghetti and bread have a positive effect whereas pizza causes low value for consumers. This effects can be observed only by the specific data processing protocol used here.

Finally, WTP for sea urchin is positively related to individual frequency of consumption and to the importance assigned by respondents to local foods. Some consequences derive from these results. First of all, sea urchin is a sort of food capable to give birth to loyalty relationships with their users, where the consumption frequency is associated with higher values assigned to the good. This is particularly true for our sample which is made of regular sea urchin' consumers and suggests some kind of "addiction" on this food. The importance assigned to local food by consumers is another fundamental characteristic of sea urchin demand. It is an unequivocal signal of the real nature of the sea urchin consumer's experience: the food is conceived as a son of his territory. It is carrier of a basket of values strictly linked to the cultural as well as social and economic heritage of the region where it comes from. Seller and producers can exploit this peculiar characteristic by strategies aimed at enhancing them both against a small regional target and a wider range of consumers.

About the latter, it must be underline that regional tourism model is characterized by a strong concentration of presences in the summer. It does not support the promotion of sea urchin consumption, since the product is not available during this period because fishing is forbidden by the regional government. This makes sea urchin market size limited to regional consumers.

5 Some concluding remarks

Some indications derive from our findings. They suggest that consumers' appreciation and willingness to pay for a dish prepared with sea urchin are higher than for a similar dish with seafood. This means that sea urchin give a remarkable added value to dishes. A strategic role in affecting this sea urchin' ability is played by local origin certification.
Furthermore, we found that consumers' appreciation is not indifferent to how sea urchin are served. With specific reference to the type of dish, WTP tends to be higher when they are combined with spaghetti or, as raw fresh roe, with only bread. On the other hand, pizza with sea urchin reveals a lower appreciations by consumers.
These results suggest that some margins for selling sea urchin at more profitable prices, especially for locally certified products - as to guarantee origin, freshness and quality - and for sea urchin eaten as raw fresh roe or with spaghetti do exist. However, only effective and more rationale regulation of sea urchin market is able to ensure an equilibrate enhancing of this appreciated product. As suggested by our results, a great part of the retail value of sea urchin is assigned by consumers to the inherent properties of sea urchin rather than to other post-fishing characteristics (*e.g.*, processing, consumption at restaurant, similarity to other seafood). This means that significant rooms exist for promoting policies and strategies aimed at redistributing value from restaurateurs to fishermen and to sell sea urchin with more profitable prices.

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