Working Paper Series

No. 54

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Anabela Botelho

Isabel Dinis

Lina S. Lourenço-Gomes

Jorge Moreira

Lígia M. Costa Pinto

Núcleo de Investigação em Microeconomia Aplicada

Universidade do Minho

Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

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Anabela Botelho
NIMA
Escola Economia e Gestão
Universidade do Minho, Gualtar
4710-057 Braga, Portugal

Isabel Dinis
CERNAS
Instituto Politécnico de Coimbra
Escola Superior Agrária de Coimbra
Bencanta
3040-316 Coimbra, Portugal

Lina Sofia Lourenço-Gomes
(corresponding author)
Department of Economics, Sociology and Management (DESG)
Centre for Transdisciplinary Development Studies (CETRAD)
University of Trás-os-Montes and Alto Douro (UTAD)
Quinta de Prados (Complexo pedagógico)
5000-801 Vila Real, Portugal

Jorge Moreira
CERNAS
Instituto Politécnico de Coimbra
Escola Superior Agrária de Coimbra
Bencanta
3040-316 Coimbra, Portugal

Lígia M. Costa Pinto
NIMA
Escola Economia e Gestão
Universidade do Minho, Gualtar
4710-057 Braga, Portugal

PRELIMINARY DRAFT

Support from the project "Aplicação de metodologias de economia experimental na avaliação da disposição a pagar dos consumidores por variedades tradicionais de frutas e legumes" (PTDC/EGE-ECO/114091/2009) is greatly appreciated.

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by
Anabela Botelho, Isabel Dinis, Lina Lourenço-Gomes, Jorge Moreira, Lígia Costa Pinto

Abstract

The increased depletion of biological diversity in agriculture can be attributed to the massification and standardization of production. Another argument is the often mentioned lower productivity of these varieties and the lack of a market price premium that compensates for these higher production cost. Policies to address this issue can either rest on market instruments or on command and control initiatives. The paper aims to determine the role that the origin of the apple variety plays in consumers' choice, controlling for the place of production. Most literature analyzing the role of origin of production finds that national or local productions have a positive effect on consumers' choices, receiving a positive price premium. However, appellation of origin has, to our knowledge, never been analyzed in the fruit market. Determining, in a controlled design, whether the Portuguese traditional variety has a positive price premium and characterizing the socio-economic characteristics of consumers valuing this attribute the most can provide valuable insights for apple producers and policy makers. It can help designing more effective strategies to increase market shares or identifying market niches for producers and to promote agro-biodiversity more effective by policy makers. Our results indicate that consumers are willing to pay a statistically significant price premium for the national varieties. In addition, consumers that value the national variety, on average, buy larger quantities and buy more frequently, buy specific varieties, are more aware of products characteristics and are on average older. These results are encouraging for policy makers as they demonstrate the potential for policies based on market instruments as consumers are responsive to price. In addition, the analysis of consumers' heterogeneity typifies the segments that are more willing to buy national varieties. Finally, the results also indicate, to apple producers and marketers, possible ways to increase their market shares by identifying the socio-demographic characteristics of consumers more willing to buy national varieties at higher prices that may compensate for the increased costs of production.

1. Introduction

Concerns about agrobiodiversity have steadily increased in the last decades, leading to the adoption of the International Treaty on Plant Genetic Resources for Food and Agriculture by the Food and Agriculture Organization of the United Nations (FAO) in 2001. The Treaty has now been adopted by over 100 countries, having entered into force in 2004. The treaty aims at recognizing the role farmers play in the conservation of genetic diversity, and ensuring that recipients of benefits from these resources share them with their country of origin. Benefit generation depends crucially on the revenues farmers can collect through product sales which, in turn, may condition farmers willingness to adopt these varieties.

Supply side studies have examined farmers' decision to adopt traditional varieties. For example, Botelho et al. (2012) analyze the determinants of farmers' adoption of traditional varieties of fruit trees, concluding that younger and better informed farmers are more likely to adopt the traditional variety; having good access to reliable information also significantly contributes to quicker adoptions; and, the size of the farm and specialization in apple production significantly contribute to sooner adoption rather than later.

While demand side studies focusing on the origin of fruit trees (controlling for the place of production) are, to our knowledge, non-existent, the literature on the determinants of consumers' choice of fruits has focused on organoleptic characteristics, organic mode of production, place of production, and price. Some studies have argued that appellation of origin, local and organic production have some degree of association with consumers' choices, in part explained by the argument that local varieties are better adapted to local environmental conditions and, consequently, are more resistant to pests and diseases thus requiring less pesticides (Simões et al., 2006). Thiene et al. (2013) analyze the importance of appellation of origin and mode of production in consumers' choice of Italian sparkling wine, finding that there is considerable variation in consumers' preference within region of origin, which, according to the authors, goes in line with the considerable diversity of producers and product lines in the same region of origin. Winfree and McCluskey (2005), and Loureiro and McCluskey (2000) found that, for the case of apples and veal, certification of origin had a positive price premium. However, Winfree and MsCluskey (2005) found these certificates to constitute a public good subject to the over-extraction problem, and thus some quality criteria should be

added to the certification of origin. In the same vein, Perrouty et al. (2006), for the case of wine, find that the price premium of certification of origin is mediated by products' characteristics. A related issue concerns the definition (or perceived definition) of some attributes (such as local or organic) of the products. Adalja et al. (2013) analyze the value of the attribute "local produce" for ground beef. The choice of ground beef was made based on the fact that the attribute "local" would not be taken as freshness. They found a positive price premium related to this attribute. In addition, they investigate the possible existence of substitution or complementary effects between "local produce" and, for example, more environmentally friendly production practices, finding that there is some substitution and that stores would benefit from a more structured definition of "local". Preferences for local products for environmental reasons (food miles) or other reasons, termed ethnocentrism, is analyzed by Brugarolas et al. (2009) in the contexts of traditional varieties of tomatoes. Using hypothetical contingent valuation surveys and experimental methods, these authors show that consumers value these products very highly and are willing to pay significant price premiums, in the order of 80% above the average market prices for tomatoes.

Another issue also analyzed in studies eliciting consumer preferences is the value of "pesticide free" or "organic" fruits and vegetables. Using a contingent valuation study, Boccaletti and Nardella (2000) found that consumers' willingness to pay for organic fruit and vegetables was positively related to income and risk concerns, and negatively related to education. In line with previous research, they also found that some consumers use heuristics to make their choices, associating organic products to the "good old ones", as termed by the authors. Moreover, they found that some consumers are relatively ill informed about the meaning of "organic" products and the advantages of pesticide free production, and that the information given at the buying occasion is not well integrated into consumers' choices. Aertsens et al. (2009)'s results corroborate this last outcome, finding that reduction of uncertainty during the buying process increases consumers' willingness to buy organic products. In addition, subjective factors and perceptions, together with attitudes, also positively influence consumption of organic foods. In the same vein, Canavari et al. (2005), in a study of consumers' willingness to pay to buy organic fruit (apples and peaches), and their willingness to pay to have a pesticide ban (public good), found that a significant percentage of consumers do not trust the quality of organic products. Additionally, they found that consumers were more reluctant to pay for the public good than for the private good, and that there was a

significant anchoring effect in the dichotomous choice responses leading to higher predicted willingness to pay than in the open-ended willingness to pay question. Grunert (2005) reviews the literature on consumer preferences for safety and quality and concludes that although there are considerable variation in results, quality and safety have a positive price premium in the majority of the studies. Moreover, it is found that price after purchase, for most costumers, is not known with certainty as most consumers don't recall the exact price after the buying decision.

van der Pol and Ryan (1996) use choice experiments to elicit consumers' preferences for fruit and vegetables, and segmenting the sample by income through the creation of interaction terms, find that cost has a higher marginal valuation for the high income group when compared to the low income group.

Using the choice discrete choice technique, the present article intends to enhance knowledge about consumers' preferences regarding the most valuable apples' attributes, with a special emphasis on the origin of the variety. To this end, following the introduction, we describe the methods used (section 2) to address the questions posed. The results are presented in section 3, and section 4 presents the main conclusions of the paper.

2. Methods

The primary focus of this study is to assess the influence of the origin of the apple variety (traditional Portuguese versus foreign variety, both produced in Portugal) on consumers' choices. Specifically, we intend to estimate how much consumers are willing to pay to buy apples of a Portuguese variety relatively to a foreign variety. In order to answer this research question, we designed a discrete choice experiment (DCE).

The literature identifies several determinants of consumers' choice of fruit in general and of apples in particular, where flavor, texture, juiciness, firmness, acid/sweet, and price, are the most common. Dinis et al. (2011), comparing nine different varieties of apples in a sensory experiment in Portugal, found that taste, appearance, smell and national variety had a significant and positive influence on consumers buying decisions; on the other hand, texture, mode of production, and being in danger of extinction, were not significant. Botelho et al. (2013) found, on a blind tasting experiment that appearance, taste, texture, and smell were highly rated by participants. From these results, we selected five attributes defined at two, three or four levels, namely: texture

(Crispy, juicy or floury), taste (sour or sweet), color of the skin (yellow, green or red), size (small, medium, big), origin of the apple variety (Portuguese or foreign), and price/kg (0.6€/Kg, 0.9€/Kg, 1.2€/Kg, 1.5€/Kg). Using a D-efficient design (NGene® version 1.1.1, ChoiceMetrics, 2012) for a generic DCE (choice sets formed by two alternatives: $Apple_1$ and $Apple_2$), the attributes and levels were combined and paired producing 12 choice sets. An example of a choice set is presented in Table 1.

In addition to the 12 choice sets, the questionnaire was composed of an introductory section covering questions to ascertain the knowledge about traditional Portuguese apple varieties, fruit/apple consumer habits, and preferences for apples in general. Section 2, the valuation section, contained 12 sequential choice sets from which the respondents were asked to choose a preferred alternative, representing an apple for each choice set presented. Following each choice set, respondents were asked if they would be willing to buy one kilogram of the chosen apple at the specified price; and, how certain they were of the choice made (using a scale ranging from 0 to 10). The first question intended to capture those consumers that would have signaled "none" if the design did not force a choice. Concluding this section, consumers were asked how certain they were of the overall answers to the posed choice questions, and the degree of difficulty in the choice. In addition, we asked respondents if they considered all the attributes, and if not, which ones they did consider. Finalizing the questionnaire, section 3 presented some socio-demographic questions such as respondents' age, gender, income, household size (including the number of children), professional status, level of education, city of residence, rural origin, along with some questions on risk preferences (an English translation of the survey is available from the authors).

The questionnaire was made available through "google docs" and announced through institutional mailing lists at the University of Minho (UM), University of Trás-os-Montes e Alto Douro (UTAD), and at Escola Superior Agrária de Coimbra (ESAC). These mailing lists include students, professors and other staff. The questionnaire was administered on line from October to December 2013, and 649 respondents answered it completely, corresponding to 15.576 useful choice responses.

3. Results

The definition of the variables used in the analysis and descriptive statistics are reported in Table 2. Concerning the respondents' socio-economic characteristics, the figures in Table 2 show that 72% of the respondents are women, and that the average respondent is 35 years old. The average monthly household income is 1827.46 €, ranging from 125€ to 5000€ and, on average, the household includes 1.4 children under 12 years old. About 82% of the respondents completed at least the post-secondary education and 18.6% live in a rural area.

Concerning their consumption habits, experience and preferences for apples, Table 2 shows that, on average, respondents buy 5.7kg/week of fruit, in general, and 2.6kg/week of apples. The related expenditure is 6.4€/week on fruit in general, and 2.5€/week on apples. About 75% of the responds usually buy a specific apple variety, and apple consumption is part of the daily diet for 35.6% of the respondents, and nearly daily (2 to 5 times/week) for 44.4% of the respondents. The majority of the respondents (about 59%) is aware of the products' characteristics as indicated in the package or in the store stand.

The choice between two unlabeled apples *j* by respondent *n* in the choice set *t* is analyzed through the specification of a random parameter logit (RPL) model (e.g. Hensher and Greene, 2003). Assuming a linear additive utility function, the utility that respondent *n* derives from the choice of apple *j* in choice set *t* is written as:

$$U_{njt} = \beta_0 + \beta_n^{'} X_{njt} + \gamma' Z_n X_{njt} + \varepsilon_{njt}, \qquad j = 1,2$$

where:

X_{njt} = apple attributes (texture, skin color, taste, size, variety origin, and price/kg);

$\beta_n^{'} = (b' + s'\eta_n)$

b' = population mean;

$s'\eta_n$ =independent random deviates representing the respondent' taste relative to the average tastes in the population;

$Z_n X_{njt}$ = interactions terms between alternatives' attributes (X_{njt}) and respondent' characteristics Z_n. Due to the special interest in the influence of the attribute "variety's origin", the model includes interaction terms between this attribute and person specific variables.

η =randomness in the coefficients, assumed to be random and normally distributed, implying that $\beta \sim N(b, s^2)$.

Table 3 presents the results of the estimation of the RPL model (NLOGIT® Econometric Software, Inc., version 5.0) using Halton draws with 500 replications. In summary, the results in Table 3 reveal that national varieties receive a price premium relative to foreign varieties. The results also uncover some attributes with a negative and statistically significant influence on the choice of apples: higher prices (as expected, the estimated derived utility is inversely related with price/kg), foreign variety's origin (compared with the base level as represented by the national variety), floury texture and sour taste. Additionally, big apples are preferred to small apples, and the yellow skin is statistically preferred to the green skin.

Considering the random parameters, all the estimated attributes' standard deviations are statistically significant and large compared with the respective means, suggesting the presence of unobserved heterogeneity among respondents regarding the apple' attributes (namely texture, taste, skin-color and size). The presence of statistically significant interaction terms capture some heterogeneity, indicating that the respondents who derive greater utility from the national origin of the variety (compared to foreign) buy larger quantities of apples/week (OKGA), usually buy a specific apple variety (OAESP), are frequent consumers of apples (OFREQ), are aware of the product characteristics provided in the package or in the store stand (OCarac), and are, on average, older (OAGE). Moreover, male respondents (OGE), wealthier respondents (OINCOME), and those from rural areas (ORURAL) are found to value the foreign variety higher than their counterparts. Additionally, respondents who attach a higher certainty degree to their stated buying intention value the foreign variety above the national.

Quantitatively, and accounting for all the other attributes, consumers are, on average, willing to pay 31 more cents for a Kg of a national apple variety than for a foreign variety (as both coeficients are non-random, the willingness to pay measure is computed as the ratio between the attribute "origin" coefficient and the price coefficient).

4. Conclusion

The results from the implemented discrete choice experiment clearly show that Portuguese traditional varieties are significantly valued by the market. However, other attributes are also significant determinants of consumers' choices of apples: crispiness, sweetness and size are relevant attributes. Among the attributes included in the design, the attribute "color" (red, yellow and green) is the closest related to variety. The most favored color is yellow followed by the green, suggesting that, with respect to this characteristic, varieties like golden delicious (foreign) or bravo (national) are preferred to apples of a different color.

These results have clear policy implications. First, consumers who are better informed of products characteristics through the package or through in-store information are those who most value the national variety. Thus, policy makers can use information as a vehicle to increase the share of national varieties. In addition, as consumers are willing to pay a significant price premium, we can infer that there is the possibility that the lower productivity of national varieties may be compensated by the price premium. Together these two results indicate that there are significant opportunities for increasing the market share of national apple varieties. Moreover, producers and policy makers should be aware of the specific attributes that consumers value, such as crispiness, sweetness and size, at the time of selecting which variety to place on the market.

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Table 1- Example of a choice set

	Apple 1	**Apple 2**
Texture (pulp)	Crispy	Floury
Taste	Sour	Sweet
Colour of Skin	Yellow	Green
Size	Medium	Medium
Origin	Traditional variety (produced in Portugal)	Foreign variety (produced in Portugal)
Price €/kg	1.2	0.9
Your Choice	☐	☐

Table 2- Definition of Variables and Descriptive Statistics

Variable	Acronym	Codification	Mean	Standard Deviation
Respondent	id	1-649	325.00	187.36
Choice	choice	1-chosen alternative; 0-non chosen		
Texture	Text	0=Crispy; 1= Floury	0.50	
Taste	Taste	0=Sweet; 1= Sour	0.50	
Color	Skin	CoYel=1 if Skin=Yellow CoYel=0 if Skin=Red CoYel=0 if Skin=Green CoRED=1 if Skin=Red CoRED=0 if Skin= Yellow CoRED=0 if Skin= Green		
Size	Size	SIZEB=1 if Size=Big SIZEB=0 if Size= Medium SIZEB=0 if Size= Small SIZEM=1 if Size= Medium SIZEM=0 if Size=Big SIZEM=0 if Size= Small		
Origin	Orig	0=Portuguese;1=Foreign	0.50	
Price	P	0.6; 0.9; 1.2; 1.5 (€)	1.05	0.34
Respondent' characteristics				
Gender	GE	1-Male; 0-Female	0.28	
Age	AGE	17-70	34.48	12.07
Average household income (Monthly)	INCOME	< 250€ = 125; [251€-500€]=375,5; [501-750€]=625,5 ;[751-1000€]=875,5 [1001-1250€]=1125,5 ;[1251-1500€]=1375,5 [1501-1750€]=1625,5;[1751-2000€]= 1875,5 [2001-2250€]=2125,5 ;[2251-2500€]=2375,5 [2501-2750€]=2625,5 ;[2751-3000€]=2875,5 [3001-3250€]=3125,5;[3251-3500€]=3375,5 [3501-3750€]=3625,5;[3751-4000€]=3875,5 [4001-4250€]= 4125,5;[4251-4500€]=4375,5 [4501-4750€]=4625,5;[4751- 5000€]=4875,5 > 5000 =5000€	1827.46	1160.98
N^{er} of children (<12)	CHILD	0-8	1.37	1.53
N^{er} of young (13-18yearsold)	YOUNG	0-10	0.40	0.78
Education	EDU	0=4 years;1=6years; 2=9years; 3=12years; 4=pos-secondary;5=higher		
Residence	RURAL	0-Rural; 1-other	0.19	
Fruit Purchase (kg)/week	KGFRU	0-11	5.70	3.20
Expenditure on Fruit(€)/week	EUFRU	0-11	6.40	3.25
Apple Purchase (kg)/week	KGA	0-11	2.60	2.17
Expenditure on Apple(€)/week	EUA	0-11	2.50	2.02
Purchase specific Apple variety	AESP	1- Yes; 0-No	0.75	
Apple Consumption' pattern	FREQ	0=Daily; 1=2 to5 times/week; 2 = one time/week;3=rarely;4=Never	0.92	0.89
Be aware of apple features described in the package	CARAC	1- Yes; 0-No	0.59	
Scale of response certainty	CERT	0-no certainty to 10-total certainty	7.63	1.74

Table 3- Estimation Results of the Random Parameter Logit Model

		Coefficient	*Standard error*
Random parameters			
Texture	Mean	-2.968***	0.045
	Sd	3.571***	0.073
Taste	Mean	-0.588***	0.034
	Sd	2.568***	0.051
Coloryellow	Mean	0.186***	0.042
	Sd	1.279***	0.048
Colored	Mean	0.065	0.108
	Sd	0.187***	0.048
SizeB	Mean	0.182***	0.043
	Sd	1.210***	0.046
SizeM	Mean	0.061	0.115
	Sd	0.122**	0.057
Nonrandom parameters			
Origin	Mean	-0.262**	0.115
P	Mean	-0.853***	0.043
INTERACTIONS			
Orig			
× KGA		-0.045***	0.012
× EUA		-0.002	0.012
× AESP		-0.071*	0.043
× FREQ		-0.040*	0.022
× CARAC		-0.109***	0.037
× GE		0.093**	0.040
× AGE		-0.021***	0.002
×RURAL		0.208***	0.047
×INCOME		0.0003**	0.0002
×CHILD		-0.016	0.012
× CERT		0.049***	0.009
Constant		2.568***	0.095
Restricted log-likelihood		-10796.5	
Unrestricted log-Likelihood		-6612.9	
N(n)		15576(649)	
Pseudo-R^2		0.187	

***, **, * Significant at the 0.01, 0.05, 0.1 level; Simulation based on 500 Halton draws