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by

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Abstract

The identification and characterization of consumers' preferences for agricultural products may constitute a valuable tool for producers in identifying market niches for their current production and to plan activity choice for the future. Traditional varieties of fruits and vegetables have been subject to some scrutiny in this respect. However, but for a few studies, consumers' preferences for tomatoes have rarely been studied. Using the contingent valuation methodology applied to a panel of six different varieties of tomatoes (three national varieties, and three foreign varieties), the present paper provides evidence concerning the most relevant determinants of consumers' willingness to pay, controlling for place and mode of production of the tomatoes' varieties. In addition, the study elicits consumers' rating of these varieties with respect to appearance, taste, smell and texture. Based on our multivariate results, the estimated market price premium for national varieties of tomatoes is 35% relatively to foreign varieties.

Keywords: Valuation methods, Agro-food economics, elicitation of consumer preferences

JEL: Q20, Q50, Q10

1. Introduction

For many years, Portuguese agriculture was characterized by a remarkable diversity of fruits and vegetables. With time, however, such diversity has been considerably reduced. Increased standardization of agricultural products, vertical integration, specialized production contracts, decreased activity of local markets, and abandonment of rural areas due to the weakening of agricultural activities, are amongst the often voiced general explanations for the observed waning of traditional varieties of fruits and vegetables from the market. Notwithstanding, the dangers associated with the loss of agricultural biodiversity are becoming increasingly known (e.g., Botelho *et al.* (2012)), and it is now widely recognized that the on-farm preservation of agricultural varieties and the revitalization of local agricultural communities are of paramount importance to secure a sustainable agriculture, food production, and environmental conservation. In spite of such recognition, Portugal remains the European country with the second highest number of endangered, vulnerable and conservation dependent plant species according to the latest edition of the IUCN Red List of Threatened Species (IUCN, 2013).

The most recent data released by the Food and Agriculture Organization of the United Nations (FAOSTAT, 2012) shows that tomato is the 8th (11th) most important product in terms of monetary value (quantity) amongst all the food and agricultural commodities produced in the world, and that Portugal ranks in the 15th place (both in terms of monetary value and quantity) in the list of the 20 highest tomatoes' producing countries in the world. In fact, tomato is the most important vegetable production in Portugal. In 2012, 96 million tons of fresh tomatoes were produced just for consumption (excluding industry) in the country, with most of its production occurring in the Alentejo region (inner south of Portugal) (INE 2013).

However, as happens with many other crops, the diversity of tomato varieties present in the market is now considerable lower than in the past. The specific invoked reasons for this lack of diversity are that traditional tomatoes' varieties are less productive, have low conservation capacity, and exhibit poor resistance to handling. As a result, the maintenance of traditional varieties requires higher market prices that consumers' may not be willing to pay. Despite its apparent importance for agrobiodiversity conservation, however, no study to date has assessed whether or not there is in fact a price premium associated with traditional tomatoes' varieties. The present study fills this gap by

conducting a novel and extensive field contingent valuation study assessing Portuguese consumers' willingness to pay for national/traditional and foreign varieties of tomatoes, taking into account consumers rating of the varieties with respect to their intrinsic attributes, and controlling for the mode and place of their production.

2. Previous Literature

Brugarolas *et al.* (2009) analyze whether growing traditional varieties of tomatoes could be a profitable alternative to local farmers in Spain. They point out that traditional and local farming, in past decades, has been replaced by more intensive production systems, with the loss of diversity at different levels such as at the cropping system, the farm and the market circuits. Even so, agricultural activities are seen by many as a pillar for sustainability, particularly when it combines quality production with positive impacts on resource conservation and biodiversity. To be sustainable, however, those activities and products must be profitable for farmers. In their study, Brugarolas *et al.* (2009) find that consumers in Alicante, Spain, are willing to pay a price premium for two traditional varieties of tomatoes. Furthermore, they find that the price premium is high enough to compensate for the additional production costs. Although unable to differentiate between them, Brugarolas *et al.* (2009) propose two explanations for the observed price premium: (i) the sensory features of the traditional varieties; and (ii) the potential linkage between consumers' preferences for local products, and ethnocentrism or environmental concerns. Consumers' preference for local products is now widely documented in the literature (e.g. Carpio and Isengildina-Massa, 2009; Darby *et al.*, 2008; Darby and Ernst, 2006; Giraud *et al.*, 2005; Hébert, 2011; Loureiro and Hine, 2002). Some studies associate the preference for local products with consumers' preference for freshness (Darby *et al.*, 2008), or with a positive "feeling" of contributing to the local economy (Carpio and Isengildina-Massa, 2009). Other studies yet propose that the preference for local products is due to a perceived higher quality of these products (e.g. Carpio and Isengildina-Massa, 2009). For example, Causse *et al.* (2010) explore consumers' preferences for fresh tomatoes based on the organoleptic characteristics of several varieties, without taking into account the origin of the production or of the varieties. Still in this context, some studies investigate the influence of specific characteristics of tomatoes, like acidity, firmness and sweetness (e.g. Batu, 2004; Lê and Ledauphin, 2006), or the impact of the mode of

production (Weaver *et al.*, 1992; Huang *et al.*, 2007; Zhao *et al.*, 2007), on consumers' preferences. An earlier study by Johansson *et al.* (1999) examined consumers' preferences for fresh tomatoes focusing on sensory characteristics and information on growth conditions, concluding that consumers' rating of tomatoes was more influenced by varietal sensory differences than by information on growth conditions.

The contingent valuation method (CVM) is the most commonly used method to elicit consumers' willingness to pay in a wide range of settings. The CVM was first proposed by Ciriacy-Wantrup (1947), and consists in constructing an hypothetical market for consumers to state their WTP as if they were in a real market situation. In this paper we use the hypothetical version of the contingent valuation method, asking consumers' how much they would be willing to pay for each variety of tomatoes they have tasted. The most common criticism to the CVM is the hypothetical nature of the payment. However, in the context of eliciting consumers' valuation of private deliverable market goods, the hypothetical nature of the payment vehicle is not always a problem (see, for example, Botelho *et al.* 2013). Applications of CVM for fruits and vegetables are few, and to tomato even fewer. For example, Dinis *et al.* (2011) conducted a contingent valuation study for apple varieties; Canavari *et al.* (2005) used a CV survey for organic fruit; Boccaletti and Nardela (2000) applied the CVM to pesticide fresh fruit and vegetables; and Poole *et al.* (2007) applied CV surveys to fruit. To the best of our knowledge, however, no study but for Brugarolas *et al.* (2009), has to date focused on eliciting consumers' willingness to pay for tomatoes, and none has addressed the potential existence of a price premium associated with the origin of tomatoes' varieties while controlling for the mode and place of their production.

3. Material and Methods

3.1. Procedures for data collection

Surveys were administered in person at fruit and vegetables stores located in the Portuguese cities of Porto and Coimbra (north and center of Portugal, respectively) during the second semester of 2013. A total of 111 participants were recruited among the stores' clients. Participants were asked to taste two tomato varieties (A and B) placed on a table in front of them, and after tasting they were asked to complete a rating sheet (Hedonic

classification) for scoring the following tomatoes' attributes: appearance, texture, taste and smell (1-least preferred to 5-most preferred). They were also asked to give an overall score (1-5) for each variety.

After completing the rating task, participants were asked how much they would be willing to pay for a Kilogram (Kg) of each variety, and how certain they were of their stated valuation on a scale of 1 (less certain) to 10 (absolutely certain). Afterwards, participants were informed that both varieties were produced in Portugal using the same mode of production, but that variety A (B) was a traditional Portuguese variety, while variety B (A) was a foreign variety, and were then given the opportunity to revise their willingness to pay for each variety.

Each participant only tasted one of the 18 possible pairs of tomatoes included in this study. As shown in Table 1, each pair/combination is formed by a Portuguese traditional variety (*Arcozelo*, *Izedda*, and *Lodões*) and a foreign variety (*Bounde*, *Zinac*, and *Xuxa*). The combinations were formed so that every national variety crossed with all foreign varieties, and vice-versa. To control for the possibility of tasting order effects, tomato A was the foreign variety and tomato B was a traditional Portuguese variety in 50% of the combinations, and the order was reversed in the remaining combinations. Finally, the survey also included questions intended to characterize the sample according to socio-demographic characteristics and purchasing habits regarding tomatoes.

(Table 1 about here)

3.2. Selection of tomatoes

Our main concern in selecting the specific tomatoes' varieties was to ensure variability on their appearance, and organoleptic characteristics. Selection of Portuguese traditional varieties was particularly challenging since most of them are now absent from the market. Thus, selection of these varieties was guided, and limited, by seed availability. Even though, it was not possible to find enough material in the market circuits to carry out the study. Thus, the national/traditional tomatoes' varieties had to be grown by the project team conducting this study. The seeds were supplied by a farmers' association whose main goal is to collect and preserve traditional Portuguese varieties of cultivated plants on-farm.

4. Results

4.1. Descriptive and unconditional statistical results

Detailed descriptive information characterizing the 111 subjects that participated in the study is presented in the Appendix (Tables A and B). On average, participants are 47 years old, and earn a per capita household net monthly income of 580 euros. About 69% of the participants are employed; 17% are unemployed; and 12% are retired. With respect to schooling, the results show that most respondents have an undergraduate degree (24%) or completed high school (27%), followed by those having completed the compulsory school (17%) and by those having just the primary education (15%). Male and married respondents comprise about 17% and 68% of the total number of respondents, respectively. In 93% of the cases, the respondent is the person in charge of doing the household grocery shopping.

Regarding the habits of consumption, 53.2%, 43.2% and 2.7% of the participants reported eating tomatoes every day, two to five times a week, and just once a week, respectively. The results also show that tomatoes are the most preferred vegetable by participants, followed by cabbage and lettuce.

When asked if they knew traditional varieties of tomatoes, 73% of the participants answered affirmatively. Most of the participants reported that such knowledge was acquired through experience in a rural area (52.7%) or in-store (24.3%). Importantly, 50% of participants stated that they usually take notice of the product information provided in the store shelf or packages when buying tomatoes.

Concerning the most important factors driving the purchase of tomatoes, the participants selected first their appearance (46.4%), followed by the origin of the variety (21%), their taste (13.6%), their price (8.2%), and finally their texture and smell.

(Table 2 about here)

As noted previously, after tasting both tomatoes placed on the table in front of them, but prior to knowing their origin, participants were asked to rate each tomato with respect to appearance, texture, taste and smell. They were also asked to provide a global rating using, in each case, a 1 (lowest rating) to 5 (highest rating) point scale. The results,

provided in Table 3, show that the mean global score given by participants is higher for the national varieties than for the foreign varieties. Appearance is the highest rated attribute of the foreign varieties, while taste is the highest rated attribute of the national varieties. But for appearance, the national Portuguese varieties are rated higher than the foreign varieties in all of the other considered attributes. The highest score difference across the national/foreign varieties is observed with respect to taste, with the Portuguese varieties receiving a substantially higher score than the foreign varieties on this attribute.

(Table 3 about here)

The distribution of respondents' willingness to pay (WTP) by origin of variety and information condition (before and after receiving information on the origin of the varieties) is depicted in Figure 1. The figure shows that the distributions are very similar between information conditions for both the national and foreign varieties. However, the distributions of respondents' willingness to pay for national varieties seem to be more dispersed than the comparable distributions for foreign varieties.

(Figure 1 about here)

The results are summarized in Table 4 for both national and foreign varieties under both information conditions. As can be seen in Table 4, mean WTP is higher for national varieties under both information conditions, and the differences are statistically significant at conventional significance levels (p-values based on t-tests are reported in Table 5). Consistent with consumers' preference for local products as previously reported in the literature, the provision of information concerning the origin of the varieties increases the participants' WTP for the national tomatoes' varieties, and leaves practically unaffected their WTP for the foreign varieties. In both cases, however, these effects are not statistically significant (Table 5).

(Tables 4 and 5 about here)

4.2. Conditional statistical results

Although useful for descriptive purposes, the previous unconditional analysis may hide some important insights regarding the determinants of consumers' WTP for tomatoes. The analysis of consumers' WTP controlling for the socio-demographic composition of

the participants, their preferences for tomatoes, and treatment conditions may reveal some important features. In addition, to fully answer the main research question of the present study, it is useful to compare the relative importance, and eventually the interaction, between the origin of the varieties and their organoleptic characteristics as determinants of consumers' WTP. To this end we estimate a hedonic valuation function controlling for the panel structure of the data. The model adopted to explain consumers' stated WTP for tomatoes in the full information context (after identification of the varieties' origin) includes three sets of explanatory variables, falling under the headings of *Varieties and treatments*, *Experience and buying behavior*, and *Socio-demographic*.

The set *Varieties and treatments* includes a dummy variable for national variety (*VarNational*); a set of dummies for the global rating attributed to each tomato (*GlobalRate2*, *GlobalRate3*, *GlobalRate4*, *GlobalRate5*; each of these variables take the value 1 if consumer rated the tomato 2, 3, 4 and 5 respectively, and zero otherwise), rating of individual attributes (*Appearance*, *Texture*, *Taste*, *Smell*); and one dummy variable identifying the city of inquiry (*Porto*). But for this last variable, all others are included additively and interacted with the variable *VarNational*. We hypothesize that the effect of consumers rating of tomatoes, both globally and with respect to individual attributes, may explain the differences on WTP between national and foreign varieties.

The set *Experience and buying behavior* includes four dummy variables. One dummy variable accounts for how the consumer knew the variety (*KnowRural_exp* taking the unit value if the consumer knows the variety by experience in a rural area); another dummy variable, *BuySpecifVarieties*, takes the unit value if the consumer usually buys a specific variety of tomato; the dummy variable *TomatoFavorite* takes the unit value if tomato is the participant's favorite vegetable; and the dummy variable *TomatoDaily* takes the unit value if tomato consumption makes part of the participant's daily diet.

The set *Socio-demographic* includes covariates specific to the participants, namely their net household per capita income (*Income_pc*), their age (*Age*), and their gender (*Male*).

(Table 6 about here)

As shown in Table 6, all the coefficients of the included covariates are statistically significant. The variables included in *Attributes and Treatments* reveal that consumers' global rating of tomatoes positively impacts their WTP, and the effect is stronger for

national than for foreign varieties. With respect to individual attributes, while *Appearance* and *Texture* have positive and significant impacts (being stronger for national varieties), the characteristics *Smell* and *Taste* have detrimental effects on participants' WTP (being significantly smaller for the case of national varieties).

As expected, the variables characterizing consumers *Experience and buying behavior* are also statistically significant determinants of consumers' WTP. The knowledge of the variety by rural experience has a positive effect on participants' WTP, probably reinforcing affinity with some varieties no longer available in the market. Moreover, it is found that consumers who usually buy specific varieties of tomatoes are willing to pay significantly less for the tasted varieties than their counterparts who do not have such loyalty towards specific varieties. We also observe some local variation in consumers' WTP: consumers in Porto are willing to pay significantly lower prices than consumers in Coimbra. This observed local variation in consumers' WTP may be explained by different actual selling price levels in the two cities (eventually, selling prices in the stores provided a reference to the participants, who were recruited among their regular customers).

Concerning the socio-demographic characteristics, we found that age, male and household net income per capita are statistically significant. The results show a negative impact of the two former variables, and a positive of the latter. Thus, mean willingness to pay is lower for male and older participants (relative to counterpart segments), and it is higher as income per capita increases.

Overall, taking the joint influence of all the considered covariates, results in a predicted WTP of 0.8884 Euros for the foreign varieties, and 1.2001 Euros for the national varieties. Thus, the predicted price premium for the national varieties is 31cts per Kg, corresponding to a relative margin of 35%. This price premium is significantly higher than previously found by Brugarolas *et al.* (2009) for Spanish varieties of tomatoes.

5. Conclusions and Discussion

Our empirical findings reveal that there is in fact a price premium associated with traditional Portuguese tomatoes' varieties. Based on a first analysis of the data, the reported preliminary results indicate that consumers are willing to pay a price premium for national varieties of tomatoes in the order of 35%, which is considerably higher than

previously found in the literature both for tomatoes and for other types of vegetables and fruits.

The results provide some evidence (sensorial and behavioral) indicating that the Portuguese varieties have the potential to become consumers' favorite tomatoes' varieties, namely because (i) the majority of consumers usually buys specific varieties of tomatoes, indicating a high degree of consumers' fidelity towards each variety; (ii) consumers exhibiting fidelity are, as expected, willing to pay significantly less for the tasted varieties; and (iii) the national varieties are rated higher than the foreign varieties, and that the origin of the variety is the second most important determinant in consumers' buying decision. The latter finding, along with the estimated price premium of 35%, constitutes encouraging evidence for the introduction and competitiveness of these varieties in the market.

In the light of our findings, the market seems to support the introduction of traditional varieties even if at a significantly higher price than foreign varieties. However, the results suggest that the competitiveness of Portuguese traditional varieties cannot rest solely on the attribute *Origin* of variety, as we found no effect of such information on consumers' willingness to pay. Taken together, the results seem to indicate that it is in the combination of information provision concerning the *Origin* of the tomato's variety and organoleptic characteristics valued by consumers, that producers should base their choice of variety.

In sum, policies to promote the preservation of traditional Portuguese varieties of tomatoes through commercialization should direct their efforts to select varieties with comparative advantages in *Texture* and *Appearance* (as these are the organoleptic attributes with higher price premiums), promote tasting experiences, and effectively communicate to consumers the *Origin* of the variety. By doing so, consumers may get to know the varieties, and develop fidelity towards Portuguese traditional varieties for which they are willing to pay significantly more.

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Table 1 - Tasting Panel combinations

Combination	Panel Position	
	Left (A)	Right (B)
A	Buonde	Arcozelo*
B	Buonde	Izeda*
C	Buonde	Lodões*
D	Zinac	Arcozelo
E	Zinac	Izeda*
F	Zinac	Lodões*
G	Xuxa	Arcozelo*
H	Xuxa	Izeda*
I	Xuxa	Lodões*
J	Arcozelo*	Buonde
L	Arcozelo*	Zinac
M	Arcozelo*	Xuxa
N	Izeda*	Buonde
O	Izeda*	Zinac
P	Izeda*	Xuxa
Q	Lodões*	Buonde
R	Lodões*	Zinac
S	Lodões*	Xuxa

*National Varieties

Table 2 - Tomato attributes considered by participants (%)

Attribute	Not considered	1st	2nd	3rd	N
Appearance	24.55	46.36	15.45	13.64	110
Texture	55.45	7.27	21.82	15.45	110
Taste	54.55	13.64	20.91	10.91	110
Smell	68.18	3.64	10.91	17.27	110
Origin	51.82	20.91	13.64	13.64	110
Price	47.27	8.18	16.36	28.18	110

Table 3 - Participants' rating for national and foreign varieties after tasting (%)

Variety	Attribute\rating	1	2	3	4	5	Mean score
National	Appearance	0.90	5.41	33.33	37.84	22.52	3.76
	Texture	0.90	1.80	16.22	35.14	45.95	4.23
	Taste	0.00	3.60	18.92	18.02	59.46	4.33
	Smell	0.90	2.70	24.32	35.14	36.94	4.05
	Global	0.90	3.60	20.72	35.14	39.64	4.09
Foreign	Appearance	0.90	9.01	17.12	50.45	22.52	3.85
	Texture	0.90	8.11	29.73	43.24	18.02	3.69
	Taste	1.80	9.91	28.83	37.84	21.62	3.68
	Smell	1.80	7.21	31.53	42.34	17.12	3.66
	Global	1.80	5.41	29.73	42.34	20.72	3.75

Table 4 – Mean (SD) WTP by information condition and origin of variety

	With Info	No Info
WTP_National	1.1768 (0.5221)	1.1543 (0.5053)
WTP_Foreign	0.9563 (0.5217)	0.9586 (0.5250)

Table 5 - t-tests on effect of origin and information condition (p-values)

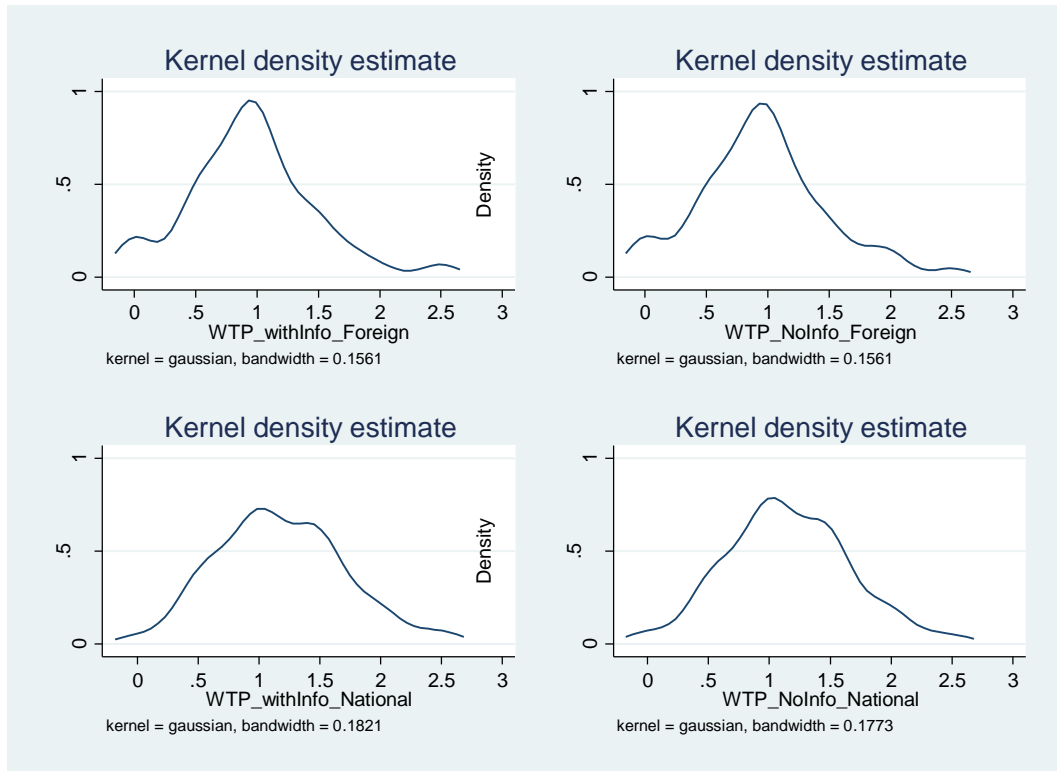
	With Info/No Info
WTP_foreign	0.8375
WTP_national	0.3281
	National/Foreign
WTP_with Info	0.0000 (WTP_national>WTP_foreign)
WTP_no Info	0.0003 (WTP_national>WTP_foreign)

Table 6 - Hedonic price function (Tobit model)

		Marginal effects	Robust Std. Err.
Attributes and treatments	VarNational	-0.4363	0.0378
	Appearance	0.0302	0.0085
	Texture	0.1294	0.0083
	Smell	-0.1863	0.0085
	Taste	-0.0497	0.0082
	VarNational*Appearance	0.0254	0.0094
	VarNational*Texture	0.0347	0.0085
	VarNational*Smell	0.0757	0.0088
	VarNational*Taste	-0.0303	0.0083
	VarnNat* GlobalRate2	3.1594	0.0653
	VarnNat* GlobalRate3	3.4284	0.0334
	VarnNat* GlobalRate4	3.7771	0.0324
	GlobalRate2	0.4113	0.0608
	GlobalRate3	0.4775	0.0269
	GlobalRate4	0.2073	0.0291
	GlobalRate5	4.1907	0.0317
Porto	-0.2633	0.0268	
Experience and buying behavior	KnowRural_exp	0.2567	0.0251
	BuySpecifVarieties	-0.2764	0.0306
	TomatoFavorite	-0.0879	0.0248
	TomatoDaily	0.2558	0.0284
Socio-demographic	Age	-0.0110	0.0007
	Male	-0.0530	0.0223
	Income_pc	0.0003	0.0001
Regression diagnosis	Number obs 134 LL=-79.030279	F(24,136)=7.15E+07 Prob>F=0.0000	
	sigma	0.4222	0.0004
PredictedWTP	Total	1.0443	
	National	1.2001	
	Foreign	0.8884	

Notes: Standard errors are clustered on individual. All coefficients are statistically significant at 1%.

Figure 1 - Distribution of consumers' willingness to pay by information condition and origin of variety



Appendix

Table A - Descriptive statistics for socio-demographic variables

Variable	N	Mean	StDev	Min	Max
Income	102	1428.191	926.9951	375.5	5000
NumHousehold	110	2.7181	1.1896	1	7
Income_pc	102	579.6715	436.2879	75.1	2875.5
Age	111	47.2883	11.8685	25	74
Male	111	0.1712	0.3784	0	1
Married	111	0.6847	0.4667	0	1
Divorced	111	0.1441	0.3528	0	1
Single	111	0.1441	0.3528	0	1
Widow	111	0.0270	0.1629	0	1
School1_4	111	0.1532	0.3618	0	1
School5_6	111	0.0721	0.2598	0	1
School7_9	111	0.1712	0.3784	0	1
School1_12	111	0.2703	0.4461	0	1
SchoolBach	111	0.0270	0.1629	0	1
SchoolUndergrad	111	0.2432	0.4310	0	1
SchoolMaster	111	0.0450	0.2084	0	1
SchoolPhD	111	0.0180	0.1336	0	1
Unemployed	111	0.1712	0.3784	0	1
Housewife	111	0.0270	0.1629	0	1
Student	111	0.0090	0.0949	0	1
Retired	111	0.1171	0.3230	0	1
Selfwork	111	0.1171	0.3230	0	1
Work	111	0.5855	0.4949	0	1

Table B - Descriptive statistics for Purchasing Habits

Variable	Obs	Mean	Std. Dev.	Min	Max
BuysGrocery	108	0.9352	0.2473	0	1
QuantVeggiesWeek	80	4.0750	2.6423	1	20
QuantTomatoesWeek	81	1.7568	1.3991	0.3	10
QuantTomatoesToday	21	1.1571	0.4884	0.5	2
ValueVeggiesWeek	66	9.4167	7.1445	1	40
ValueTomatoesWeek	54	2.5004	1.8971	0.6	10
PriceTomatoesTodayKg	18	1.1817	0.4228	0.5	2
BuyTomatoesStore	110	0.6636	0.4746	0	1
Knowprice	99	0.5859	0.4951	0	1
Buyspecifvariety	111	0.6667	0.4735	0	1
TomatoDaily	111	0.5315	0.5000	0	1
Tomato2to5Week	111	0.4324	0.4977	0	1
TomatoWeek	111	0.0270	0.1629	0	1
TomatoRarely	111	0.0090	0.0949	0	1
KnowTradVarieties	111	0.7297	0.4451	0	1
Know_store	74	0.2432	0.04320	0	1
KnowRural_exp	74	0.5270	0.5027	0	1
Know_family	74	0.2162	0.4145	0	1
Know_publicity	74	0.0270	0.1633	0	1
Know_others	74	0.054	0.2277	0	1
Know_nsr	74	0.027	0.1633	0	1
Info_characteristics	110	0.5091	0.5022	0	1