Impact of sucrose contents and cooking time on cowpea prices in Senegal[1]

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Abstract

An alternative approach to traditional consumer behaviour and demand theory is characteristics theory, which assumes that a consumer's utility function is generated by the characteristics, or attributes, that goods and services possess. Instead of a utility being a function of a product, it becomes a function of the attributes provided by these products. In this paper a hedonic pricing model is used to investigate the influence of sucrose level and cooking time on cowpea prices in Senegal. Cooking time has a significant impact on price only at Tilene market in Dakar, while the sucrose contents tend to provide a premium throughout. Further investigation shows that the local varieties, *AW*, *Matam* and *Ndiassiw* have higher sucrose contents than the other cowpea varieties.

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1 Introduction

An alternative approach to traditional consumer behaviour and demand theory is characteristics theory, which assumes that a consumer's utility function is generated by the characteristics, or attributes, that goods and services possess. Instead of a utility being a function of a product, it becomes a function of the attributes provided by these products. Their combinations of attributes distinguish goods and the demand for goods is derived from the demand for attributes (Eastwood, Brooker & Terry, 1986). In other words, products possess certain characteristics that are attractive to consumers. In examining demand for a product it is useful to think of consumers not as purchasing the product, but as purchasing its characteristics that provide utility. Consequently, it is important to measure the specific characteristics that consumers perceive as providing them with utility. This can be done by using a hedonic pricing model. According to Lancaster (1971), a hedonic price function is a regression of observed prices of a commodity against its quality attributes.

Research by the Senegalese Agricultural Research Institute (ISRA) revealed a gap in terms of information on how buyers value the different characteristics (colour, grain size, taste, sucrose, cooking time, etc.) of cowpea varieties. Moreover, very little is known about the willingness of consumers in Senegal to pay for certain characteristics of cowpeas. Not only will such information assist producers to more appropriately align what they produce with consumer needs and preferences, it will also assist intermediaries to lower transaction costs through more efficient marketing.

In this paper, the influence of sugar contents and cooking time on cowpea prices in Senegal is discussed. The paper is organised as follows: Section 2 focuses on applicable literature, while Section 3 describes the data used. In Section 4 the specific model used in this paper is specified. Sections 5 and 6 contain the results and conclusions respectively.

2 Literature review

Since their introduction, many economists have employed hedonic pricing models as a tool for estimating the price-quality relationships of commodities over time or through cross-sectional data analysis. One of the earliest examples of this methodology dates back to 1974, when Rosen first used a model of product differentiation based on the hedonic hypothesis that goods are valued for their utility-bearing attributes. He used observed product prices and a specific number of attributes associated with each good to define a set of implicit or hedonic prices.

Brorsen, Grant and Rister (1984) contributed further to the acceptance of this analytical tool by studying market acceptance of rough rice. They evaluated the ability of Federal Grain inspectors to explain the factors that led to the grade classification and estimated the discount associated with each factor using a hedonic price model.

Espinosa and Goodwin (1991), with the same motivation as those authors cited earlier, used a hedonic pricing model to assess the impact of wheat characteristics on market prices. Their results showed the importance of grain size and processing abilities on wheat prices.

In 1999, a Jefferson Institute study using a hedonic pricing model concluded that cowpea prices are responsive to discoloured seeds as well as foreign material. As a result, prices differed in concordance with variations in these variables and the product may even be rejected if there are too many discoloured, broken or cracked seeds (Jefferson Institute, 1999).

Faye, Ndiaye and Lowenberg-DeBoer (2000) used the same tool to analyse the impact of the main physical characteristics of cowpeas on market prices in Senegal. Using a simple OLS model, their results showed that buyers are willing to pay a premium for larger cowpeas with a white skin colour, while prices were discounted for any other skin colour and for a certain number of holes.

Balyamujura (2001) also used a hedonic pricing model to assess the impact of different characteristics of tea on tea prices in Uganda.

3 Data used

To examine the influence of sugar contents and cooking time on cowpea market prices, data were collected from January 2002 until December 2003 at six Senegalese markets. Markets were chosen according to their location and volume of cowpea sales. The six Senegalese markets included were:

- MPal and Sagatta in the main cowpea production area;
- Bambey and Nioro in the peanut basin where cowpeas are a secondary crop; and
- Tilene and Castors in Dakar, which is a major urban consumption area where cowpeas are not grown.

Data were collected each month on the first market day of the third week. At each market five samples were bought from five different vendors. The choice of vendors at a given market was random. The sample started from a randomly chosen seller and every 5th seller was then selected, from whom a sample was purchased.

For each sample the following variables were recorded: market price, weight of 100 grains, skin texture, testa colour, eye colour, number of bruchid holes per 100 grains, sucrose contents and cooking time. Within the context of this paper, descriptive statistics are only provided for the latter two variables (see Faye, Jooste, Fulton & Lowenberg-DeBoer, 2004 for a discussion on the other variables).

The sucrose tests used the method developed in 2003 by Murdock's group at Purdue University, while the cooking time test was done

using a Matteson cooker. The minimum number of grains needed for the cooking time test is 25. The cooking time tests were conducted under the most popular household conditions of cooking cowpeas using tap water.

Table 1 shows descriptive statistics for different markets for cowpea sucrose levels and cooking time. The average sucrose level ranges from 3.5 per cent (Bambey) to 4.1 per cent (Nioro). It is evident from the result that the sweetest cowpeas are found at Tilene and MPal. The lowest sugar content is observed at Castors. The average cooking time is almost homogeneous throughout and is between 30 and 34 minutes for all samples. The longest cooking time was found at Castors market, followed by Bambey and Tilene.

Table 1
Descriptive statistics sucrose contents and cooking time in selected Senegalese markets

Item	N=72	Bambey	Castors	Nioro	MPal	Sagatta	Tilene
Sucrose contents (%)	Mean	3.5	3.5	4.1	4.0	3.9	3.9
	St. Dev	0.7	0.9	1.0	1.1	1.0	1.2
	Min	2.0	0.6	2.1	2.0	2.0	1.3
	Max	5.2	6.4	6.1	6.7	6.6	6.8
Cooking time (mns)	Mean	32	32	34	31	30	33
	St. Dev	9	9	9	6	6	10
	Min	11	16	16	20	18	16
	Max	68	69	59	47	54	68

4 Model specification

The hedonic price model can be expressed as:

$$P_i = \alpha + \Sigma_{j=1} \beta_{ij} Z_{ij}$$

Where P_i = price of good i
α is an intercept
β_{ij} = marginal value of characteristic j for good i

Faye, Jooste, Fulton and Lowenberg-DeBoer (2004) discuss derivation of the above model, statistical properties of the data and statistical tests performed on the data.

In order to measure the explanatory power associated with all the variables listed, a linear hedonic demand system of five equations using seemingly unrelated regressions (SUR) was estimated, using the Shazam econometrical software package.

A linear model is used for easy interpretation of its coefficients, which are seen as discounts or premiums on price due to a given characteristic. The estimated discounts or premiums were rounded up because the Senegalese currency does not have decimals.

The SUR is denoted by the following equations:
BPRICE = f (Bw100, Bnh100, Brsc, Bbsp, Bsmo, Bbey, Bsuc, Bct)
CPRICE = f (Cw100, Cnh100, Crsc, Cbsp, Csmo, Cbey, Csuc, Cct)
NPRICE = f (Nw100, Nnh100, Nrsc, Nbsp, Nsmo, Nbey, Nsuc, Nct)
PPRICE = f (Pw100, Pnh100, Prsc, Pbsp, Psmo, Pbey, Psuc, Pct)
TPRICE = f (Tw100, Tnh100, Trsc, Tbsp, Tsmo, Tbey, Tsuc, Tct)

Where:

- The first letter of the independent and dependent variables indicates the name of the markets, i.e. B stands for Bambey, C for Castors, N for Nioro, P for MPal and T for Tilene,
- The dependent variable is price (PRICE) in FCFA per kg,

- nh100 = Number of bruchid holes per 100 grains,
- w100 = Grain weight or grain size (average weight of 100 grains),
- Skin colour (rsc for red skin; bsp for black speckled skin and wsc for white skin),
- Skin texture (smo stands for smooth skin and rou for rough skin),
- Eye colour (bey for black eye and mey for maroon eye),
- Sucrose contents (suc) and
- Cooking time (ct)

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Results of the specified model

Results from the defined model show an overall R^2 of 81.9 per cent (Table 2). This result suggests that the independent variables included in the model jointly explain 81.9 per cent of the variation observed in cowpea prices.

Table 2
Output from SUR model

Variables	Bambey	Castors	Nioro	MPal	Tilene
W100	24** (2.4)	10* (1.7)	14** (2.8)	11*** (3.1)	10** (2.1)
NH100	–0.4 (–0.3)	–0.3 (–0.2)	–1.1 (–1.1)	–0.3 (–0.4)	–1.3 (–1.2)
RSC	–24 (–1)	43 (1.1)	–5.8 (–0.1)	58* (1.8)	16* ‘(1.7)
BSP	25* (1.7)	49 (1.5)	48 (1.1)	–54* (–1.9)	7* ‘(1.8)
SMO	–36 (–0.3)	–77 (–1.2)	–65** (–2.2)	–46 (–1.4)	–76 (–1.1)
BEY	–13 (–1)	45 (1.55)	–39 (–1.3)	–0.4 (–0.1)	–8* (–2.2)
SUC	59* (1.8)	38* (3.2)	21** (2.1)	13* (1.8)	18** (2.2)
CT	–1.9 (–0.7)	–0.3 (–0.3)	–0.5 (–0.4)	–0.3 (–0.2)	–3.3** (–2.7)
SYSTEM R^2 = 0.819					

The t-statistics are in parentheses

*** Significant at 1%; ** Significant at 5%; * Significant at 10%.

In terms of grain size (w100), consumers in all markets are willing to pay a premium. For example, in Bambey market consumers are willing to pay up to 24 FCFA (US$ 0.05)[2] for each additional unit of grain weight. This can be explained by (i) consumers prefer large seeds for their sauce or rice and (ii) processors are willing to pay a premium for large seeds since they yield a larger amount of flour.

The impact of bruchid holes (nh100) on cowpea prices is not significant at any of the surveyed markets. This can be attributed to the low level of insect infestation due to the high rate of using metallic drums to store cowpeas. Faye and Lowenberg-DeBoer (1999) found that over 80 per cent of cowpeas in Senegal are stored in metallic drums that reduce insect infestation by limiting air contact.

The impact of skin colour on price is significant in the Bambey, MPal and Tilene markets. At MPal market consumers are willing to pay a premium of 58 FCFA (US$ 0.12) for red skin colour (rsc), but discount price with 54 FCFA (US$ 0.11) for black skin (bsp) compared to the white skin colour, which is the preferred variety. In Bambey consumers are willing to pay a premium for black speckled skin. At Tilene market consumers are willing to pay a premium for both red and black speckled skin.

With regard to skin texture (smo), consumers discount prices for smooth skinned cowpeas in Nioro for 65 FCFA (US$ 0.13). The reason for this discount can be related to the fact that cowpea varieties with a smooth skin are not easy to cook. Consumers in other markets appear to

be indifferent to the skin texture of the cowpea. Price is discounted for black eye at Tilene market.

Cooking time has a significant impact on price only at Tilene market, while the sucrose contents tend to provide a premium throughout. This premium is as high as 59 FCFA at Bambey (US$ 0.12) and 38 FCFA (US$ 0.08) at Castors in Dakar.

Table 4 shows the average sucrose contents of cowpea varieties available in the markets investigated. From a production and marketing point of view, varieties that should be promoted to take advantage of the premiums consumers are willing to pay are *AW*, *Matam, Ndiassiw and 5857*. In addition, the results provide important information for plant breeding research.

Table 4
Average sucrose contents by variety

VAR	AW	Matam	NDIAS	5857	MF	BNG	Melakh	Mouride
SUC (%)	4.18	3.88	3.61	3.59	3.53	3.48	2.97	2.69

6 Summary and conclusion

Very little is known about the willingness of consumers in Senegal to pay for certain characteristics of cowpeas. Based on the economic principle that product demand stems from the utility provided as a function of its quality characteristics (Berndt, 1991), a hedonic pricing model was used to investigate the impact of different cowpea characteristics on its price.

The results show that consumers are willing to pay a premium for grain size in all markets. Bruchid holes are not significant, while skin colour showed mixed results. Skin texture and eye colour were only significant in selected markets.

Cooking time was only significant in one market, while sucrose content proved to be important for consumers in all the markets. This is an important finding, since it provides guidance on what cultivars should be used for production in order to increase the amount of cowpeas with higher sucrose content for different markets in Senegal. It also provides important information for future research on cultivating cowpeas with a higher sucrose content.

Endnotes

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2 US$1 = 500FCFA

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