Do consumers pay more for what they value more? The case of local milk-based dairy products in Senegal*

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Abstract

Senegalese consumers seem to prefer local fresh milk-based dairy products rather than the ones produced with imported powder. However, market prices of both products do not appear to be different. This paper addresses this puzzle. First, I confirm the preference for local products. Using choice-based-conjoint data, I evaluate that Senegalese consumers are willing to pay a positive and significant premium for these products. Then, I identify the determinants of prices, based on a unique dataset of milk products characteristics. Evidence suggests that consumers' misinformation regarding the product composition prevents them from allocating a higher price to local milk-based products.

Keywords: Choice-Based-Conjoint analysis, Hedonic regression, milk, Senegal, preference for local origin

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1 Introduction

Milk is an important component of Senegalese food consumption. Dairy products (including cheese and eggs) account for 6.7% of the food expanses in Dakar (ANSD, 2004). This demand is mainly satisfied by imports of milk powder, principally from the European Union. These imports of powder have received large attention among the European and African publics due to widely publicized campaigns (Oxfam (2002), CFSI (2007), etc.) claiming they put the local sector under pressure.

47% of Senegalese final milk consumption is purshased directly in this powder form (Duteurtre, 2006). But the local milk industry is also essentialy based on the use of powder. Factory-made sour milk, as opposed to home-made sour milk, accounts for 20% of the consumption (Duteurtre, 2006) and was, until recently, only produced with imported powder. Nevertheless, since the nineties, small-scale milk processing units which ensure rural milk collection have rapidly expanded (Corniaux et al., 2005, Dieye et al., 2005). These units propose sour milk made with fresh local milk.

Consumers seem to prefer these local milk-based products. Broutin et al. (2006) report that 90% of households consuming local sour milk would like to increase their consumption. Sissokho and Sall (2001) states that 79% of the consumers consider that local milk-based dairy products have a higher quality than imported ones.

Despite this preference, the price of local milk-based products do not appear to be higher than the price of imported powder-based ones. Figure 1 displays the prices of a half-liter sachet of sweetened sour milk for six different brands. Among these brands, only one (Wayembam) is made with local milk. Its price does not seem different.

[Figure 1 about here.]

This paper addresses this puzzle: higher preference for local products does not seem to be transmitted to prices. In a first step, I use data on stated preferences to confirm or infirm the assertion that local milk-based products are preferred. In particular, I evaluate Senegalese

consumers' willingness-to-pay for local raw material in the composition of the sour milk, using data from a choice-based-conjoint analysis conducted in 2002 on 400 households in the region of Dakar. This study confirms that Senegalese consumers do prefer (and value more) local fresh raw material.

In a second step, I identify the determinants of the price of sour milk and argue that the consumers' misinformation regarding the product composition prevents them from allocating a higher price to local milk-based products. This explanation is consistent with Broutin et al (2006)'s evidence of the consumers' difficulty to distinguish raw materials. I use a unique dataset collected in 2011 containing information on more than 4000 milk products in five regions of Senegal. Amongst them, 1327 concern sour milk in the region of Dakar. Based on a hedonic regression, the results indicate that prices are driven up by several misleading characteristics of the powder-based products.

Existing literature on stated preferences for local origin is large. Most of these studies have provided evidence that consumers are willing to pay a positive premium for local products over imported ones (Alfnes (2004), Ehmke, Lusk and Tyner (2008), etc.) or for the presence of a local label (Batte et al. (2010), Darby et al. (2006), Loureiro and Hine (2002), Loureiro and Umberger (2003), Mabiso et al. (2005), Nganje, Shaw Hughner and Lee (2011), Quagrainie, Unterschultz, and Veeman (1998), Tonsor, Schroeder and Lusk (2013), Umberger et al. (2003), etc.). While the definition of the local origin is not always clear, the effect seems stronger for smaller geographical areas (Meas et al. (2013)) although the difference is small (Burnett, Kuethe and Price (2011)) and the opposite is sometimes observed (Onken, Bernard and Pesek (2011)). More recent literature has compared the willingness-to-pay for local and for organic products (Bonilla (2010), James, Rickard and Rossman (2009), Lopez-Galan, Gracia and Barreiro-Hurle (2013), etc.) and explored the link between organic consumption and willingness-to-pay for local products (Wang, Sun and Parsons (2010)). The willingness-to-pay for local origin has been shown to be affected by consumers' beliefs in the presence of other attributes and by their familiarity

with the product (Dentoni et al. (2009)). It varies also significantly with education, ethnicity, marital status, etc. (George (2010)).

Regarding milk in particular, Burchardi Schröder and Thiele (2005) have found that German consumers have a higher willingness-to-pay (about 0.12 or 0.18 euros per liter depending on the method) for fresh milk from their own region compared to the same product from another region. In Grebitus et al. (2007)'s study, however, the local attribute does not seem to influence the purchase decision of conventional and organic milk. In Belgium, more than 50% of the consumers surveyed by Vandermersch and Mathijs (2004) agree to pay 0.05 or 0.1 euros more for belgian origin-certified milk. In Fearne and Bates (2003)'s study in the UK, 43% of the respondants agreed to pay 1 to 2% more for locally produced milk while 42% agreed to pay a premium of 3 to 5%. Jacob (2012) estimates that Rhode Island consumers are willing to pay a premium for local milk of $1.495 per gallon, which is higher than for organic milk. Richer and more educated consumers are willing to pay more for local milk. In Italy, Tempesta and Vecchiato (2013) found that consumers are willing to pay an even larger premium for local milk (up to 1.43 euros per liter) but this premium varies widely among different groups of consumers, making difficult to summarize it in a single value.

Despite this extensive literature on the stated willingness-to-pay for the local origin, less has be done to explore its transmission to actual prices. Nevertheless, several studies have analyzed whether local-certified products exhibit a higher price. Using a hedonic approach, Loureiro and McCluskey (2000) have found that average Spanish consumers pay a premium of about 0.19 euros for for Galician-certified veal compared to non-labeled one. Bonnet and Simioni (2001) have also used real data (supermarket scanner data) to estimate the impact of the French certification on the price of camembert. Using mixed multinomial logit models as an alternative to the hedonic one, their results indicate that the label is not significantly valued. However, in their study, the brand is the relevant information that is valued. As camembert is a well-known product for French consumers, it may be that the brand implicitly indicates its origin. In the wine sector (Panzone and Simões (2009), etc.) it is more the reputation of

the region of origin than its certification that seems to matter.

Using weekly data on prices hand-collected in 30 outlets in five US metropolitan areas, Park and Gómez (2012) calculate that the premium for local origin in the case of 2% fluid milk is 16.2%. It has to be noted that prices, preferences and purschase decisions regarding dairy products are also influenced by socio-economonic and demographic characteristics (Dharmasena and Capps (2009, 2010 and 2011), Schrock (2010), Thompson, Lopetcharat and Drake (2007)), etc.) and by the intrinsec characteristics of the product (Carlucci et al. (2013), Ueda and Frechette (2002), etc.).

This paper is structured as follows. The next section describes the two sets of data. Section 3 is devoted to the analysis of the stated willingness-to-pay for the local raw material. Section 4 discusses the consumers' inability to distinguish raw materials and how it can impede preferences to be transmitted to prices. In section 5, I analyze the characteristics of the products and determine which factors drive the price. Finally, section 6 provides policy implications and concludes.

2 Data

2.1 Choice-based-conjoint data

To estimate the consumers' willingness-to-pay (WTP), I use data from a survey realized in April 2002 in the context of the program "INCO MPE agroalimentaires" coordinated by the NGO GRET[1] (Broutin et al., 2006), on 400 households from the region of Dakar (departments of Dakar, Pikine and Rufisque).

The survey includes rating/ranking choice-based-conjoint (CBC) data about sour milk. Eight hypothetical sour milk products (products A to H in table 1) were proposed to the

[1]Groupe de recherche et d'échanges technologiques, www.gret.org.

respondents. These products differ by their characteristics (or attributes) and price, but are chosen to represent the reality, i.e products with the same characteristics and price might exist on the Senegalese market.[2]

[Table 1 about here.]

All these products are liquid sour milk, made with fresh milk or with milk powder, packed individually (sachet) or sold per weight, sweetened or unsweetened. Note that no mention of the local characteristic is made. However I use the attribute "fresh raw material" as a proxy for "local raw material". Indeed, up to now, there does not exist any milk powder produced in Senegal, thus the powder form of the raw material implicitly returns to its imported origin. Informal discussions with Senegalese consumers confirm that they consider that powder is always imported and fresh milk always local. However, I am not able, in this study, to distinguish the valuation of taste due to the freshness of the local raw material and the pure impact of the local origin.[3]

In a first step, consumers facing the eight proposed products were asked "which product(s) are you willing to buy now, taking into account its (their) characteristics and price?". The highest score (5) was given to this (these) product(s). In a second step, respondents were asked which product(s) they were not willing to buy, given its (their) characteristics and price. This (these) product(s) obtained the lowest score (1). In the last step, respondents had to rank the remaining products in three categories, corresponding to the scores 4, 3 and 2.

This scheme combines two properties that may be used for evaluate the WTP. On the one hand, people were asked to give a score (from one to five) to alternative products, this is known

[2]When constructing the survey, the GRET has identified four relevant attributes (packaging, sweetness, raw material and price) and corresponding levels using Kelly's repertory grid method (see for instance Steenkamp and Van Trijp, 1997). Combining attributes levels gave 2x2x2x3=24 possible hypothetical products, that was reduced to 8 using the SPSS Orthoplan procedure (see SPSS (2005) for more information about the procedure). This sub-set is designed to capture the main effects for each attribute level.

[3]See Darby et al. (2008) for a discussion on the independence of the willingness-to-pay for freshness and for local origin.

as rating CBC. However, the intensity of the scores may depend on unobserved individual fixed effects. Nevertheless, the particular design of the question (i.e. first giving rate 5, then rate 1, then the other rates) tends to reduce this effect. On the other hand, respondents also had to rank the alternatives from the most preferred to the least preferred one, this is known as ranking CBC. It is commonly accepted that the first two or three ranks as well as the last two or three ones reflect real preferences.[4] As the GRET survey contains five ranks, one may be confident that they reflect real preferences.

As I trust both rating and ranking are reliable, I will use both interpretations in the analysis. Note that tied rates/ranks are allowed, i.e. an individual may give the same rate/rank to several alternatives. Indeed, there are 8 alternatives for only 5 possible rates/ranks.[5] I will interpret tied rates/ranks as follows: when a consumer gives the same score for two products, he is considered to be indifferent between them. But it could also be considered that a ranking for these goods exists, but is unknown.

Table 2 gives some descriptive results from the CBC data. The hypothetical product that receives the highest average score (4.10) is the product D that costs 275 CFA and has the following characteristics: individually packed (sachet), sweetened and made with fresh milk. 56.75% of the interviewed consumers gave a score 5 (the highest score) to this product. The product that receives the lowest average score (2.59) is product A. 39.75% of the respondents gave it a score 1 (the lowest score).

[Table 2 about here.]

In addition to the CBC data, the GRET survey includes information about respondents and households' socio-economic and demographic characteristics such as department, ethnicity, education, size of the household, food expenses, etc. Descriptive statistics are given in table

[4] See for instance Wilson and Corlett (1995: 77).

[5] On average, consumers give a score 5 (most preferred) to 2.6 products and a score 1 (least preferred) to 1.7 products.

3. Households from the department of Dakar as well as medium size households are slightly overrepresented in the sample. In the sample, households are also more educated while poorer on average.

[Table 3 about here.]

It has to be noted that only households who consume sour milk were surveyed. In spite of this, one can trust there is no selection bias. Firstly, when doing inference, the population of interest is the population of sour milk consumers. Indeed, we would like to assess the additional price that those consumers are willing to pay to consume a local product rather than an imported one. We can reasonably believe that individuals who currently do not consume any kind of sour milk are not willing to consume local milk-based sour milk, and a fortiori, to pay an additional premium for it. Secondly, even if we do not know how non-consumers value the various kinds of sour milk, this only has a minor impact on the entire population behavior, as they represent a very small part of this population. Indeed, virtually all households do consume sour milk. For instance, in a survey of 82 households from Dakar, Duteurtre and Broutin (2006)[6] have observed that all of them consume sour milk during the month following Ramadan.

2.2 Products data

Data regarding the products characteristics have been collected in 2011 by a Master student at University of Liège, thanks to the support of the CNCR[7], a Senegalese farmers' organization. The database contains the price and the description of more than 4000 products collected in five regions of Senegal. Here, I restrict the analysis to the sour milk products in the region of Dakar. This gives a sample of 1327 observations.

[6] Referenced by Dia et al. (2008: 39).
[7] Conseil National de Concertation et de Coopération des Ruraux, www.cncr.org.

To collect the data, four types of stores have been identified: boutiques, superettes, gas stations and supermarkets. In the department of Dakar, the stores have been randomly selected in each of the 19 communes. In the other departments, the stores have been randomly selected at the department level. In each of these selected stores, the student has collected relevant information concerning all the milk products available.

Summary statistics are given in table 4. Among the products in the database, 85% are made with powder. This is representative of the market: products made with powder are still much more commun than the ones made with fresh milk. Products made with fresh milk tend to be more available in the gas stations but less in the supermarkets. They are more commonly sold in sachet while powder-made products can be more easily found in pots. Products made with fresh milk also tend to be named "soow", which is the Wolof word for sour milk, while products made with powder are more likely to be called "lait caillé", its translation in French. Note that 44% of the products are called "Yogurt" reflecting that products are slightly differentiated due to differences in the fermentation process.

[Table 4 about here.]

There are 11 different brands of products represented in the sample (see table 5). Two of them are made with fresh milk while the other ones are made with powder. Most of the brands propose at least five different volumes, ranging from 90cl to 5 liters. Most of the brands also propose at least two different packaging (a pot, a sachet or a bottle).

[Table 5 about here.]

3 Willingness-to-pay estimation

3.1 Model specifications and hypotheses

Respondents' choices to the CBC questionnaire are modeled according to McFadden's Random Utility Model (RUM) (see for instance Anderson, de Palma and Thisse (1992) or

Louviere, Hensher and Swait (2000)). It assumes that, given a set of alternatives, the consumer chooses the alternative that maximizes his utility. The utility U_{ij} that individual i obtains by choosing the alternative j is unobservable (latent variable) but can be defined by a deterministic component (V_{ij}) which is observable and a stochastic error term (ϵ_{ij}) which is not observable:

$$U_{ij} = V_{ij} + \epsilon_{ij} \tag{1}$$

Assume V_{ij} can be represented by the following additive linear function:

$$V_{ij} = \gamma Z_j + \theta p_j \tag{2}$$

where Z_j is a vector of attributes of the product j, p_j is the price of the product j, γ is a vector of coefficients to be estimated, θ is a coefficient to be estimated (expected to be negative). This simple utility function (2) provides the main effects of the model. It indicates how each attribute affects the level of utility, when isolated from the other attributes. Indeed γ_k (element k of vector γ) represents how the attribute z_k (element k in each vector Z_j) contributes to the individual's utility.

From this expression, one can easily define the (deterministic) willingness-to-pay for an attribute (Champ, Boyle and Brown (2003)). Indeed, by differentiating equation (2), one sees that the coefficient γ_k is nothing else that the marginal utility provided by the attribute z_k (i.e. $\partial V_{ij}/\partial z_k$). θ may be interpreted in a same way as the marginal utility of money ($\partial V_{ij}/\partial p_j$), such that the ratio $-\gamma_k/\theta = -(\partial V_{ij}/\partial z_k)/(\partial V_{ij}/\partial p_j)$ represents the marginal rate of substitution between the attribute z_k and money.[8] Facing any change in attribute z_k which would increase the utility V_{ij}, the individual is willing to pay the premium $-\gamma_k/\theta$ that keeps his utility constant. Alternatively, he has to be paid $-\gamma_k/\theta$ to accept a change in attribute z_k that would decrease his utility.

[8] $-\gamma_k/\theta$ is expected to have the sign of γ_k, as θ is expected to be negative.

In particular, I estimate the following empirical specification:

$$V_{ij} = \gamma_1 Package_j + \gamma_2 Sweetness_j + \gamma_3 RawMaterial_j + \theta p_j \tag{3}$$

in order to evaluate, among others, the WTP for fresh raw material $-\gamma_3/\theta$.

To control for heterogeneity among consumers, I include socio-economic and demographic variables in the specification:

$$V_{ij} = \gamma Z_j + \theta p_j + \delta X_i \tag{4}$$

where X_i is a vector of individual i's characteristics and δ is a vector of coefficients to be estimated. In that model, the utility is not only affected by the attributes of the product but also by the individual's own characteristics.

Consumers' characteristics may not only affect their utility but also their preferences for the attributes of the products. To treat this, I include interactions effects:

$$V_{ij} = \gamma Z_j + \theta p_j + \delta X_i + \beta(X_i Z_j) \tag{5}$$

where β is a vector of coefficients to be estimated.

The WTP for an attribute z_k can still be defined as the marginal rate of substitution between attribute z_k and money. That is:

$$-\frac{\partial V_{ij}/\partial z_k}{\partial V_{ij}/\partial p_j} = -\frac{\beta X_i + \gamma_k}{\theta} \tag{6}$$

Here, the WTP for an attribute depends on socio-economic variables and differs thus among individuals.

Precisely, one may be interested in measuring the effect of socio-economic variables such as income, education and household's size on the WTP for fresh raw material. This has two main implications. Firstly, it allows to identify niche markets of consumers who are willing to pay

relatively more than others to consume fresh milk. Secondly, as it is generally admitted[9] that richer individuals have a preference for higher quality goods, wealthier households' preferences provide interesting information about the perception of the products. If they preferred fresh milk even more than poorer households, this would be a strong indication that fresh milk has a higher *perceived* quality. It is not clear, a priori, which raw material, from the powder or the fresh milk, is perceived to have the highest quality. Indeed, fresh milk may be collected in poor sanitary conditions, but comes from local cows, and corresponds more to Senegalese rural habits, while powder production is assumed to be more controlled but consumers may think that nutritive properties or taste have been altered.

In the particular model

$$V_{ij} = \gamma_1 Package_j + \gamma_2 Sweetness_j + \gamma_3 RawMaterial_j + \theta p_j + \delta X_i + \beta(Wealth_i * RawMaterial_j) \tag{7}$$

(where $Wealth_i$=1 if the household i is in the wealthiest category), if β is positive, fresh raw material can be assimilated to high quality product, and wealthier individuals are willing to pay even more than other individuals for this attribute. If β is negative, then powder represents quality and wealthier individuals, who have a higher preference for quality, are willing to pay less than other individuals for fresh raw material.

For other major socio-economic characteristics, I expect the following results. Education should have a positive effect on the WTP for fresh raw material as more educated individuals may be more informed of the social and nutritional implications of consuming fresh milk. Being Peul, as opposed to other ethnicities, may also affect positively this WTP. Indeed, Peuls are traditionally involved in the livestock sector and should be more willing to support local producers. Finally, I expect large and small households to have a different WTP for local raw material as preference for feeding the children may be different from adults' taste.

[9] See for instance Bils and Klenow (2001) or Manig and Moneta (2009).

Ordered Logit and Probit Models (Random Utility Models) are suitable to evaluate the WTP.[10] However, Ordered Logit requires that the assumption of independence of irrelevant alternatives (IIA) holds (see LONG and FREESE, 2006). Using a Hausman test and comparing the full model with a reduced model on a subset of alternatives, it can be shown that IIA assumption does not hold. I choose to use an Ordered Probit Model as it does not rely on the IIA assumption. Nevertheless, using an Ordered Logit Model does not change much the results (not reported).

The dependent variable I focus on is the score m given by the individual i to the hypothetical product j.[11] Ordered Probit Model assumes that the alternative j receives a score m if the utility from this product crosses an unknown threshold:

$$score(j) = m \quad \text{if} \quad \alpha_{m-1} < U_{ij} \leq \alpha_m$$

As U_{ij} crosses increasing thresholds (from $\alpha_0 = -\infty$ to $\alpha_M = \infty$), the score attributed to j moves up. The probability that individual i gives a score m (=1,...,5) to the product j is given by:

$$P_{ijm} = Prob[\alpha_{m-1} < V_{ij} + \epsilon_{ij} \leq \alpha_m] = Prob[\alpha_{m-1} - V_{ij} < \epsilon_{ij} \leq \alpha_m - V_{ij}]$$

Using (5),

$$P_{ijm} = \Phi(\alpha_m - \beta(X_i Z_j) - \gamma Z_j - \theta p_j) - \Phi(\alpha_{m-1} - \beta(X_i Z_j) - \gamma Z_j - \theta p_j) \tag{8}$$

where $\Phi(.)$ is the cumulative density function for standard normal distributed errors.

[10] The rating/ranking nature of the data allows me to use both Ordered and Rank-Ordered Models. I have compared both types in the Logit case. As they provide similar results (not reported), I use the simplest one, that is, the Ordered Model.

[11] The database contains 3200 observations (400 households i* 8 alternatives j to be rated) for that dependent variable.

3.2 Results

Table 6 reports the results from the Ordered Probit Model with specification (3). All the coefficients are statistically significant at 1% level. As expected, individuals seem to prefer sour milk with the following characteristics: individually packed (sachet), sweetened and made with fresh raw material.

[Table 6 about here.]

The packaging has the most crucial importance ($|\gamma_1| = 0.63$). Preference for fresh milk is also major: keeping other attributes (package and sweetness) unchanged, the marginal WTP for fresh raw material $-\gamma_3/\theta$ is around 228 CFA. It means that, all other things being equal, the representative consumer is willing to pay 228 CFA more to buy a product made with fresh milk rather than a product made with powder. Controlling for individuals' characteristics does not change much the results (table 7). With specification (4), the marginal WTP for fresh raw material $-\gamma_3/\theta$ is around 227 CFA.

[Table 7 about here.]

The average marginal effects from the Ordered Probit Model are also illustrated in table 7. The average probability that a respondent gives a score 5 to the proposed hypothetical product increases by 13 points if the product is made with fresh raw material. Adding sugar increases the probability of a score 5 by 6.8 points and going to an individual packaging increases it by 21 points, all other things being equal.

The effects reported in table 7 are the marginal effects averaged for all individuals. They have to be distinguished from the marginal effects for an average individual (not reported in table 7). Indeed an "average" individual (that is, with the following characteristics: from Dakar, Wolof, medium size household, low education and medium food expenses) has a probability of 52.6% of giving a score 5 to the product that has the following attributes: sachet, sweetened, fresh raw material, i.e. the product with all the most preferred attributes when its price is

250 CFA. At the same price, the product with all the least preferred attributes (per weight, without sugar, made with powder) receives a score 5 with a probability of 11.9%. If the "most preferred" product was free (price was zero), the probability of receiving a score 5 would be 69.5%.

[Table 8 about here.]

Table 8 presents the results obtained from the Ordered Probit Model that includes interaction effects (specification (5)). Model *a* corresponds to the particular specification (7). The WTP for fresh raw material, for the base category household (that is with monthly food expenses between 75 000 and 150 000 CFA) is 210 CFA ($-\gamma_3/\theta$).

The interaction between food expenses and raw material is quite interesting. The WTP for fresh raw material, for a family with a low level of food expenses (less than 75 000 CFA/month) is not significantly different from the reference household's one. However, wealthier households (with food expenses higher than 150 000 CFA/month) have a WTP for this attribute of 341 CFA ($-(\gamma_3+\beta_2)/\theta$). Subject to the assumption adopted earlier, this seems to indicate that sour milk made with fresh raw material is considered to have a higher perceived quality than sour milk made with powder.[12]

Model *b* in table 8 shows that medium size households have a WTP for fresh raw material of 275 CFA ($-\gamma_3/\theta$). Smaller families (less than 5 members) are not different from them. Bigger households, however, have a quite smaller WTP for fresh raw material: 64 CFA ($-(\gamma_3+\beta_4)/\theta$). This may be partially explained by an income effect as, ceteris paribus, bigger households have a lower income per capita and the control variable *Food expenses* only represents total income. With lower income per capita, bigger households are willing to pay less for fresh raw material. Income effect is only part of the story however. Using a proxy[13] of the income per capita

[12] One may criticize the use of food expenses as a measure of wealth. Nevertheless, using another usual wealth indicator (the ownership of a color TV) does not affect the results, indicating their robustness.

[13] Food expenses/(number of children +2).

as control variable instead of *Food expenses*, β_4 is still significantly negative, indicating that bigger households are ready to pay less for fresh raw material, certainly due to differences in taste between the members of large and small families.

Model c in table 8 indicates that consumers with a high education (superior to secondary school) are willing to pay more for fresh raw material (β_5 is significantly positive) than less educated ones. They have a WTP of 285 CFA for this attribute ($-(\gamma_3 + \beta_5)/\theta$), while less educated consumers have a WTP of 191 CFA ($-\gamma_3/\theta$).

The interaction effect of being Peul on the preference for raw material is not significant (not reported) indicating that Peuls do not seem to be willing to pay more for fresh raw material. This may be an indication that the choice of the preferred raw material is dictated by taste and quality considerations more than by a wish to support local producers.

Table 9 reports average marginal effects from the Ordered Probit Model with interactions. Going from a powder raw material to a fresh one increases the probability of receiving a score 5 by 11 to 16 points of probability, depending on the specification.

[Table 9 about here.]

One may suspect that the rating/ranking CBC data overestimate the willingness-to-pay because individuals are not in a real situation of purchase (they do not have to spend money), or because of the difficulty of the ranking task. Anyway, the results show that individuals are willing to pay a premium for fresh raw material, that is significant and positive. We can use the lower bound of a 95% confidence interval as the lower limit for the WTP, interpreting that the true value of the WTP has a probability 0.975 to be above this limit.

[Table 10 about here.]

Confidence intervals for the main estimates of the WTP for fresh raw materials are reported in table 10. They are calculated using the delta method, assuming that the WTP is normally distributed. Indeed, it is reasonable to suppose that the coefficients of an Ordered Probit Model

are normally distributed when the sample is large. As the WTP is a ratio of two normally distributed variables, its distribution is approximately normal when the coefficient of variation of the denominator is small (Hole, 2006).[14] Confidence intervals are quite large, indicating that the estimation of the mean is imprecise. Nevertheless the lower bound of the confidence interval is largely positive, a comforting evidence that individuals are willing to pay a positive premium for the fresh raw material. Moreover, some types of households, in particular the wealthiest ones, are willing to pay even more than others for this raw material.

While we may easily trust that products receiving score 5 are the most preferred and that products receiving score 1 are the least preferred, it may be argued that consumers may not be able to rank intermediate products in accordance with their real preferences. To test for the robustness regarding this point I use two alternative specifications. First, I gather middle classes (scores 2, 3 and 4) and use an Ordered Probit Model with only three categories instead of five. Table 11 indicates that the main results, in terms of significance and sign, are not affected. Second, I use a Binary Probit Model where the product is considered to be chosen (choice=1) if it receives the score 5 and not chosen (choice=0) if it receives a score lower than 5 (i.e. 1, 2, 3 or 4). Table 12 indicates also that main results are not altered, neither in terms of significance nor sign, except for the interaction effect between education and raw material.

[Table 11 about here.]

[Table 12 about here.]

Interaction effects from the Ordered Probit Model must be interpreted with caution as, in non-linear models, a rigorous test for those effects must be based on the estimated cross-partial derivative, which is not the case in tables 8 and 9. To test for the robustness of the results concerning these effects, I have checked their significance using the method proposed

[14] Precisely, it should be less than 0.39 (Hayya, Armstrong and Gressis (1975)). In our case, for instance in the simple model presented in table 6, $s.e.(\theta)/\theta = 0.262 < 0.39$.

by NORTON, WANG and AI (2004). Results from the Binary Probit Model in table 13 indicate that, for models a and b, significance is not affected. Estimated interaction effects are even bigger with this method. The interaction effect between high education and raw material (model c) is no longer significant.

[Table 13 about here.]

Wealthiest households' probability of choosing a product is increased by 9.5 points if the product is made with fresh raw material instead of powder. This effect is even stronger for products whose predicted probability of being chosen is high (see figure 2). For big households, the probability of choosing a product decreases by 17 points when it is made with fresh raw material and this negative effect is even stronger for products that have higher predicted probability of being chosen (see figure 3).

[Figure 2 about here.]

[Figure 3 about here.]

4 Consumers' product knowledge and misleading information

The previous analysis seems to assess that consumers are willing to pay a positive premium for local milk-based products. However, market price of these products does not seem higher than the one of powder-based products, as illustrated earlier. A possible explanation is that consumers are not able to distinguish the two kinds of products.

Among the respondents of the GRET survey, 85.75% affirm that they are able to recognize fresh raw material from powder and vice-versa. However, when they were asked to state the raw material of the products they consume, they fail to do so. Table 14 reports summary results from the question *"according to you, what is the raw material of the following products*

(brands): powder or fresh milk?". The results are reported only for respondents who consume the brand. General ignorance about the raw material is noticed for the brands that are made with powder. For instance, 41.75% of the respondents consume Niw, but only 17% among them know it is made with powder. More than 50% think it is made with fresh raw material. However, more than 75% of the respondents who consume Wayembam correctly answer that it is made with fresh milk. This seems to indicate that people consuming a product made with fresh milk make an informed choice, while people who consume sour milk made with powder might have chosen another product if they were better informed.

[Table 14 about here.]

I check that this misperception has no impact on the WTP, that is, that consumers with better product knowledge are not significantly different from other consumers regarding the way they value the fresh raw material. I do this by including the following indicator of knowledge as control variable in the various model specifications used above:

$$K_i = \frac{\#\text{ of brands consumed and correctly known by individual } i}{\#\text{ of brands consumed by individual } i}$$

It turns out that this indicator is not significant when included in the Ordered Probit Model, neither alone neither interacted with the raw material (results are not reported here). The same applies for a dummy variable indicating that the score K_i (between 0 and 1) is higher than a threshold value, say for instance 0.5.

5 Products analysis

It is not surprising that consumers of powder-based sour milk think it is made with fresh milk. Several explanations can be advanced. First, a clear mention of the raw material is not always apparent on the packaging. Even if producers are obliged to indicate if the product is made with more than 5% of powder (decree 69-891, July 25th, 1969), they not always do so.

The ingredients list should contain "milk powder" or at least "reconstituted milk", however some producers choose to mention only "milk". Second, some producers of powder-based products indicate that it is "made in Senegal". Indeed, the raw material is imported but the processing takes place in Senegal. While the mention is not inexact, it can be misleading for the consumer. Third, some packagings present images of zebu cows, or a Senegalese character, etc. that can induce the consumer to think the product is local. Fourth, most of the brand names are in Wolof, also giving an illusion of local origin.

[Table 15 about here.]

Table 15 gives summary statistics regarding these misleading characteristics for the elements of the products database. Obviously, none of the products made with fresh milk has "milk powder" or "reconstituted milk" as one of its ingredients. But almost 50% of the products made with powder also fail to mention it. All the fresh milk-based product as well as more than 50% of the powder-based ones present a local picture and/or a Wolof brand name. Most of the local products (88%) have the mention "made in Senegal", but also 6% of the imported powder-based products.

5.1 Empirical strategy

The question is whether this misinformation about the composition of the product is important in determining its price. In particular, one need to identify whether the price is affected by the product raw material or by these misleading characteristics. To do that, I use a hedonic regression model to quantify the impact of the product attributes on its price. The model takes the following form:

$$p_j = \alpha + \beta l_j + \sum_k (\delta_k z_{kj}) + \epsilon_j \tag{9}$$

where p_j is the observed price of product j, l_j is a dummy variable taking the value 1 if the product has a characteristics related to the local origin, z_{kj} are the other attributes of product

j and ϵ_j is an error term. β and δ_k are parameters to be estimated. They represent the shadow prices of the attributes l and z_k respectively.

I consider several specifications for l_j. In a first regression, I look at the impact of the true origin of the raw material i.e. l_j is equal to 1 if the product is made with fresh milk. Then I explores the impact of the misleading characteristics defined above, in these cases l_j is respectively equal to the variables *No mention*, *Made in Sn*, *Local picture* and *Local name*.

5.2 Results

Table 16 displays the results from the OLS regression (9) where l_j is equal to one if the product j is made with fresh milk and equal to zero if it is made with powder. One may see that the raw material has no significant impact on the price.

[Table 16 about here.]

The coefficients associated with control variables have the expected signs. The appellations "soow" and "lait caillé" do not have a different effect on the price, reflecting that they are simply the translation of one another. However, the appellation "Yogurt" is more valued. Sweetened products exhibit a higher price, which is consistent with the above CBC analysis showing that consumers value more this kind of products. The same applies for light and flavored products. Regarding the packaging, a pot is more valued than a sachet, itself more valued than a bottle. New products suffer from a lower price: brands that exist for less than 6 years are significantly cheaper. Packaging with colors, as opposed to a dominance of white, are also positively valued, probably because they are implicitly associated with a higher quality. Finally, sour milk products are on average cheaper at Pikine, this department being known to be poorer.

Table 17 presents the results of the same regression, replacing the fresh raw material by one of the misleading characteristics defined above. While the raw material does not seem to have an impact on the price, it turns out that the absence of a proper mention "made with

milk powder" positively and significantly affects the price. A product that seems to be made with fresh milk, or at least a product that is not unambiguously made with powder, exhibits a higher price. It is on average 265 CFA more expensive per liter than a product with a proper mention of the powder ingredient. This is not trivial as it represents 15% of the price of a typical unsweeted pot of yaourt sold in Dakar. I find the same effect for the mention "made in Senegal". On average, the products with such a mention are 160 CFA more expensive.

[Table 17 about here.]

The evidence regarding the presence of a picture that represents a local character and the Wolof brand name is mixed. I find a strong negative impact on the price of the product. However this unexpected effect is only driven by the products named "Yogurt". Indeed, the results for "Lait caillé" and "Soow" only (table 18) show evidence for a strong positive impact of these characteristics on the price. On average, products with the local picture (resp. a Wolof brand name) are 152 CFA (resp. 111 CFA) more expensive per liter.

[Table 18 about here.]

6 Conclusions

In this paper, I estimate the Senegalese consumers' willingness-to-pay for a fresh (or local) raw material in the composition of sour milk. Using choice-based-conjoint data, I find that consumers are, on average, willing to pay a premium around 220 CFA, depending on the specification. An Ordered Probit Model that controls for consumers heterogeneity, estimates this WTP at 227 CFA with a large confidence interval (from 114 to 341 CFA at 95% level). It means that, on average, a household from the base category is ready to pay 227 CFA more to obtain sour milk made with fresh milk rather than with powder. Even if this estimation is suspected to be upward biased due to the hypothetical nature of the question, it can be reasonably trusted that the true WTP is above the lower bound of the confidence interval and

is significantly positive. This result gives us a strong indication that Senegalese consumers do prefer local products and are willing to pay more for them.

The willingness-to-pay greatly depends on the characteristics of the households and there clearly are some niche markets that could be targeted to sell the local milk-based dairy products. Wealthier households are willing to pay more than the other households, indicating that fresh raw material may be assimilated to superior *perceived* quality. Large households are ready to pay much less than the base category ones, certainly due to a difference in taste between children and adults. Highly educated respondents seem to have a higher WTP than less educated ones. Surprisingly, being Peul does not affect the WTP for fresh raw material in spite of Peuls' traditional implication in the livestock sector.

While consumers appear to be willing to pay more for local sour milk, the market price of this product is not significantly different from the one of the imported powder-based sour milk. Using data on the characteristics of a thousand of products, I provide evidence that this is due to the consumers' inability to distinguish the two ingredients. I identify several attributes of the products that may induce the consumer to think it is made with fresh local milk and show that the price is driven up by these misleading characteristics.

A clear implication of this analysis is that any policy that leads to a better information could allow local producers to sell their products on the market at a higher price, while still finding a demand. It means that there exists an opportunity for local origin certification as it has be considered by NGOs and producers' organizations (Prolait, 2009). This certification would increase the value of local milk-based products with respect to the powder-based ones, giving to local producers the possibility to compete with imports, despite their higher production costs. While a reliable certification for the local origin may be difficult to implement in a developing country context, at least producers who use local raw material could implement advertising that informs consumers about the local origin of their products. The possibility of targeting these marketing strategies to the niche markets identified above should also be considered.

From a policy perspective, better enforcement of the current regulation would be valu-

able. Producers have to mention the milk powder ingredient in case it represents more than 5 grams per 100 grams of milk (Broutin and Diedhiou, 2010). Currently, this is not always respected, and the absence of such a mention has been shown to significantly increase the price of powder-based products. Better regulation should also be encouraged regarding the packaging of powder-based sour milk. Up to now, products made with imported powder can legally be presented with a local zebu cow or a Peul woman, etc. that induce the consumer to think they are made with local milk. In the case of lait caillé and soow at least, such an ambiguous packaging has been shown to drive the price up. The same applies for brand names that sound like a Wolof word rather than French and for the mention "made in Senegal".

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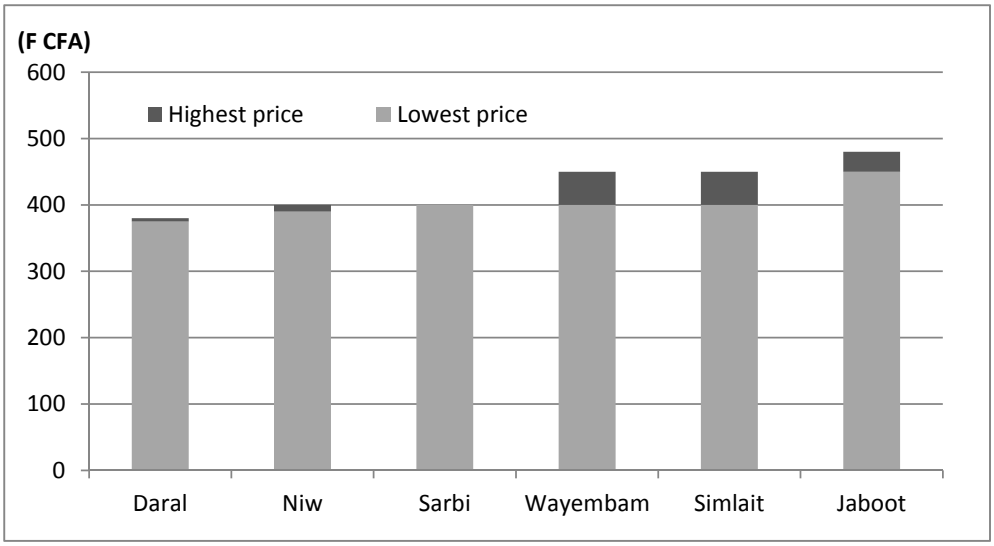
Figures

Figure 1: Prices in Dakar, 2005[a]



[a]Data source: Duteurtre (2006). Prices collected in supermarkets and superettes of Dakar in November 2005. Reported prices correspond to the following product: sour milk, sold in a plastic sachet, 1/2 liter, sweetened. Wayembam products are made with local fresh milk, other brands are made with imported powder.

Figure 2: Interaction effect High exp.*Raw material from Probit Model

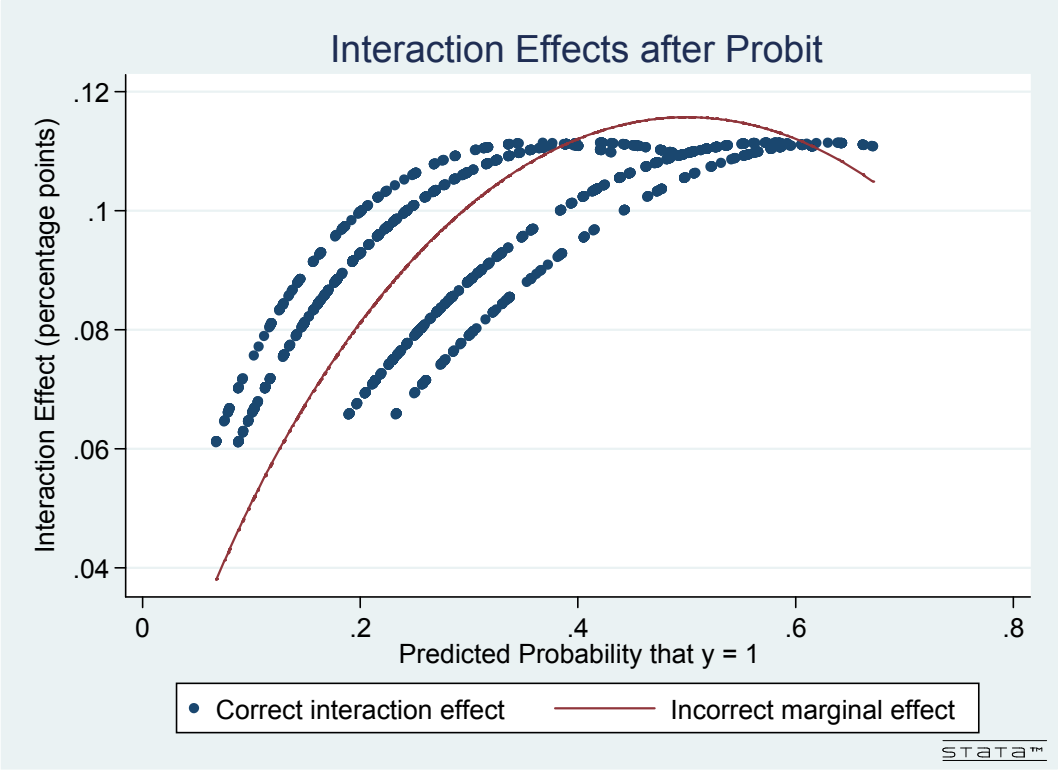
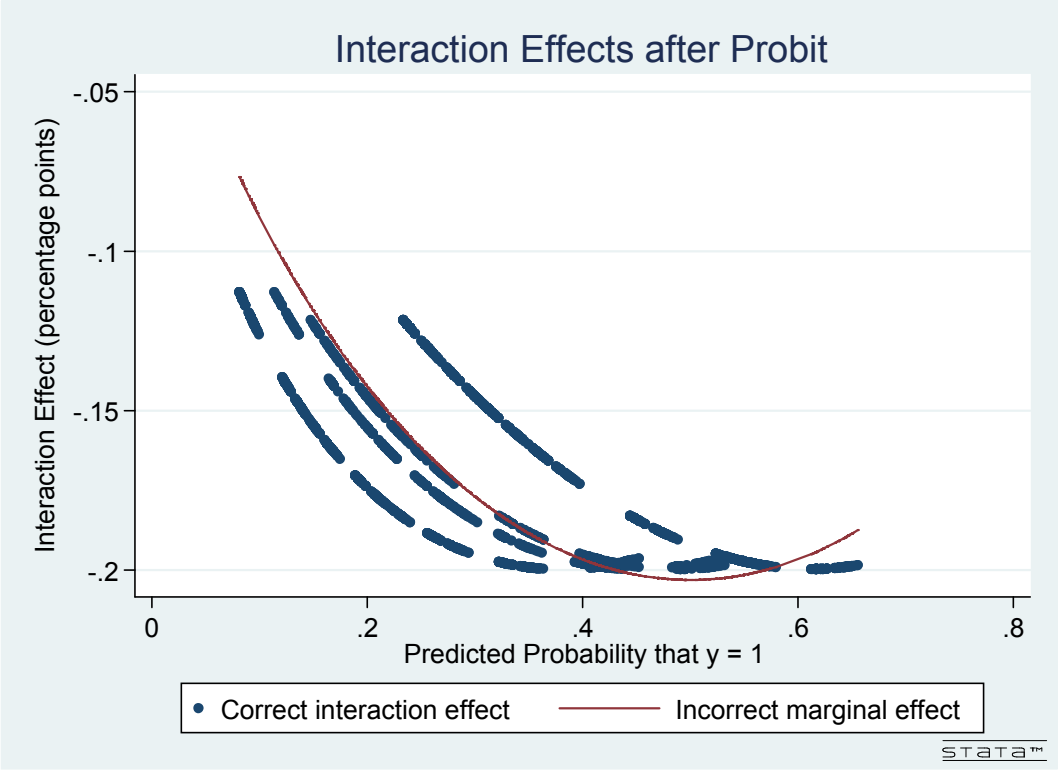


Figure 3: Interaction effect Big hh*Raw material from Probit Model



Tables

Table 1: Hypothetical products proposed to the respondents

Product	**Packaging**	**Sweetness**	**Raw material**	**Price (CFA)**
A	per weight	no sugar	powder	275
B	per weight	sugar	fresh	325
C	per weight	sugar	powder	225
D	sachet	sugar	fresh	275
E	sachet	no sugar	fresh	225
F	sachet	no sugar	powder	325
G	sachet	sugar	powder	225
H	per weight	no sugar	fresh	225

Table 2: CBC descriptive results

Product	**Mean score**	**Score=1**	**Score=2**	**Score=3**	**Score=4**	**Score=5**
		(least preferred)		**(middle classes)**		**(most preferred)**
A	2.59	39.75 %	12.25 %	12.00 %	21.50 %	14.50 %
B	3.17	25.75 %	12.25 %	11.00 %	21.00 %	30.00 %
C	2.77	31.75 %	15.75 %	13.00 %	23.25 %	16.25 %
D	4.10	8.50 %	3.75 %	9.25 %	21.75 %	56.75 %
E	3.94	9.25 %	5.75 %	11.25 %	29.25 %	44.50 %
F	3.20	19.50 %	16.50 %	12.75 %	27.50 %	23.7 %
G	3.84	10.00 %	10.25 %	9.50 %	26.50 %	43.75 %
H	3.22	23.00 %	11.75 %	1325 %	24.00 %	28.00 %

Number of observations: 400 households.

Table 3: Survey data: descriptive statistics

		Population[a] (Dakar Region)	**Sample**[b]
Department:	Dakar	42.00%[d]	48.50%
	Pikine[c]	45.40%[d]	40.25%
	Rufisque	12.60%[d]	11.25%
Ethnicity:	Wolof	42.01%[e]	52.25%
	Peul/Toucouleur	26.55%[e]	18.50%
	Others (etn. minority)	31.44%[e]	29.25%
Education:	Secondary or more	29.17%	39.50%
	Others	70.83%	60.50%
Household size:	Less than 5	23.15%	10.50%
	5 to 10	43.06%	62.50%
	More than 10	33.79%	27.00%
TV:	No	33.10%	23.75%
	Yes	66.90%	76.25%
Monthly food expenses:	Mean (CFA)	107 590	101 668
	Low ($\leq$ 75 000 CFA)	29.35%	39.50%
	High ($>$ 150 000 CFA)	18.09%	20.00%

[a]ESPS (2005), 1598 households in the Region of Dakar.

[b]GRET (2002), 400 households in the Region of Dakar.

[c]Since 2002, the department of Pikine has been divided into department of Guédiawaye and the new department of Pikine. Pikine population data for 2006 are calculated as the sum of the population of both new departments.

[d]ANSD (2006).

[e]ANSD (2008).

Table 4: Products data: descriptive statistics

Variable		**All sour milk products**	**Made with fresh milk**	**Made with powder**
Department (%):	Dakar	73.02	71.72	73.25
	Pikine	9.12	6.06	9.65
	Guédiawaye	14.24	17.68	13.64
	Rufisque	3.62	4.55	3.45
Raw material (%):	Fresh	14.92		
	Powder	85.08		
Appellation (%):	Yogurt	44.08	35.86	45.53
	Lait caillé	44.54	10.61	50.49
	Soow	11.38	53.54	3.99
Store (%):	Boutique	14.09	18.69	13.29
	Superette	22.23	18.69	22.85
	Gas station	47.40	54.04	46.24
	Supermarket	16.28	8.59	17.63
Flavored (%)		57.80	79.80	53.94
Light (%)		1.21	0.00	1.42
Sweetened (%)		29.39	11.62	32.51
Package (%):	Sachet	40.62	62.63	36.76
	Pot	56.22	37.37	59.52
	Bottle	3.17	0.00	3.72
Package color (%):	Several colors	78.90	100.00	75.20
	Mostly white	21.10	0.00	24.80
New brand (not on the market in Nov. 2005[a])(%) :		34.89	100.00	23.47
Volume (liters)		0.5281	0.6470	0.5073
Observations		1327	198	1129

[a] Brands not recorded by Duteurtre (2006).

Table 5: Products data: brands

Brand	# **of obs. (%)**	**Raw material**	# **of appellations proposed** Yogurt Lait caillé Soow	# **of volumes proposed**	# **of packages proposed** Sachet Pot Bottle
Ardo	265 (19.97%)	Powder	3	7	3
Cremor	184 (13.87%)	Powder	1	1	1
Jaboot	180 (13.56%)	Powder	1	11	3
Dolima	175 (13.19%)	Fresh	2	9	2
Niw	164 (12.63%)	Powder	1	6	2
Simlait	114 (8.59%)	Powder	2	5	2
Saprolait	97 (7.31%)	Powder	1	1	1
Daral	80 (6.03%)	Powder	3	6	2
Sarbi	29 (2.19%)	Powder	1	7	2
Galoya	23 (1.73%)	Fresh	2	6	2
Banic	16 (1.21%)	Powder	1	2	1
Total	1327 (100%)		3	17	3

Table 6: Ordered Probit Model

Variable		**Coefficient**	**(Std. Err.)**	**WTP**[a]
Package (per weight=1)	γ_1	-0.630***	(0.050)	-357.8
Sweetness (Sugar=1)	γ_2	0.205***	(0.045)	116.5
Raw material (Fresh=1)	γ_3	0.402***	(0.049)	228.3
Price	θ	-0.002***	(0.000)	
	α_1	-1.345***	(0.114)	
	α_2	-0.979***	(0.114)	
	α_3	-0.651***	(0.115)	
	α_4	0.024	(0.114)	

Log-Likelihood: -4690.959. Number of observations: 3200 (400 groups).

Standard errors are clustered.

*** indicates significance at 1% level.

[a] WTP estimates are given by $-\gamma_k/\theta$.

Table 7: Ordered Probit Model (heterogeneity among consumers)

Variable		**Coefficient**	**(Std. Err.)**	**WTP**[a]	**dy/dx**[b]	**(Std. Err.)**
Package (per weight=1)	γ_1	-0.633***	(0.051)	-355.2	-0.209***	(0.015)
Sweetness (Sugar=1)	γ_2	0.206***	(0.045)	115.6	0.068***	(0.015)
Raw material (Fresh=1)	γ_3	0.405***	(0.049)	227.5	0.134***	(0.016)
Price	θ	-0.002***	(0.000)		-0.001***	(0.000)
Pikine	δ_1	0.157***	(0.048)		0.052***	(0.016)
Rufisque	δ_2	0.231**	(0.098)		0.076**	(0.032)
Ethn. minority	δ_3	0.020	(0.048)		0.007	(0.016)
Peul	δ_4	0.065	(0.064)		0.021	(0.021)
Small household	δ_5	-0.096	(0.066)		-0.032	(0.022)
Big household	δ_6	-0.048	(0.050)		-0.016	(0.016)
High education	δ_7	-0.054	(0.045)		-0.0178	(0.015)
Low expenses	δ_8	0.024	(0.053)		0.008	(0.017)
High expenses	δ_9	0.032	(0.057)		0.011	(0.019)
	α_1	-1.277***	(0.117)			
	α_2	-0.910***	(0.117)			
	α_3	-0.580***	(0.119)			
	α_4	0.101	(0.118)			

Log-Likelihood: -4676.2297. Number of observations: 3200 (400 groups). Std. err. are clustered.

*** and ** indicate significance at 1% and 5% level.

[a] WTP estimates are given by $-\gamma_k/\theta$.

[b] Average marginal response of the probability of giving a score 5 to the product when a regressor changes and the others are unchanged. Average probability of score 5 is 0.3217.

Table 8: Ordered Probit Model (with interactions)

		Model a		Model b		Model c	
Variable		**Coeff.**	**(s.e.)**	**Coeff.**	**(s.e.)**	**Coeff.**	**(s.e.)**
Package (per weight=1)	γ_1	-0.634***	(0.051)	-0.636***	(0.051)	-0.634***	(0.051)
Sweetness (Sugar=1)	γ_2	0.206***	(0.045)	0.206***	(0.045)	0.206***	(0.045)
Raw material (Fresh=1)	γ_3	0.374***	(0.076)	0.489***	(0.062)	0.340***	(0.060)
Price	θ	-0.002***	(0.000)	-0.002***	(0.000)	-0.002***	(0.000)
Pikine	δ_1	0.157***	(0.048)	0.157***	(0.048)	0.157***	(0.048)
Rufisque	δ_2	0.231**	(0.098)	0.231**	(0.098)	0.232**	(0.098)
Ethn. minority	δ_3	0.020	(0.048)	0.021	(0.048)	0.020	(0.048)
Peul	δ_4	0.064	(0.065)	0.065	(0.065)	0.064	(0.064)
Small household	δ_5	-0.096	(0.066)	-0.191*	(0.101)	-0.096	(0.066)
Big household	δ_6	-0.049	(0.050)	0.138*	(0.072)	-0.048	(0.050)
High education	δ_7	-0.053	(0.045)	-0.054	(0.045)	-0.136**	(0.067)
Low expenses	δ_8	0.042	(0.075)	0.024	(0.053)	0.024	(0.053)
High expenses	δ_9	-0.082	(0.086)	0.032	(0.057)	0.032	(0.057)
Low exp.*Raw material	β_1	-0.037	(0.107)				
High exp.*Raw material	β_2	0.234*	(0.132)				
Small hh*Raw material	β_3			0.194	(0.159)		
Big hh*Raw material	β_4			-0.375***	(0.108)		
High educ.*Raw material	β_5					0.168*	(0.101)
	α_1	-1.295***	(0.120)	-1.240***	(0.117)	-1.310***	(0.118)
	α_2	-0.927***	(0.120)	-0.872***	(0.117)	-0.942***	(0.119)
	α_3	-0.596***	(0.122)	-0.540***	(0.119)	-0.611***	(0.120)
	α_4	0.085	(0.121)	0.144	(0.119)	0.070	(0.119)

Log-Likelihood: model a: -4672.7878, model b: -4664.3479, model c: -4673.9821.

Number of observations: 3200 (400 groups). Standard errors are clustered.

***, ** and * indicate significance at 1%, 5% and 10% level.

Table 9: Marginal effects from Ordered Probit Model (heterogeneity among consumers)

	Model a		Model b		Model c	
Variable	**dy/dx**[a]	**(s.e.)**	**dy/dx**[a]	**(s.e.)**	**dy/dx**[a]	**(s.e.)**
Package[b] (per weight=1)	-0.210***	(0.015)	-0.209***	(0.015)	-0.209***	(0.015)
Sweetness[b] (Sugar=1)	0.068***	(0.015)	0.068***	(0.015)	0.068***	(0.015)
Raw material[b] (Fresh=1)	0.124***	(0.025)	0.161***	(0.020)	0.112***	(0.020)
Price	-0.001***	(0.000)	-0.001***	(0.000)	-0.001***	(0.000)
Pikine[b]	0.052***	(0.016)	0.052***	(0.016)	0.052***	(0.016)
Rufisque[b]	0.076**	(0.032)	0.076**	(0.032)	0.076**	(0.032)
Ethn. minority[b]	0.007	(0.016)	0.007	(0.016)	0.007	(0.016)
Peul[b]	0.021	(0.021)	0.021	(0.021)	0.021	(0.021)
Small household[b]	-0.032	(0.022)	-0.062*	(0.033)	-0.032	(0.022)
Big household[b]	-0.016	(0.0164)	0.045*	(0.024)	-0.016	(0.016)
High education[b]	-0.017	(0.015)	-0.018	(0.015)	-0.045**	(0.022)
Low expenses[b]	0.014	(0.0246)	0.008	(0.017)	0.008	(0.017)
High expenses[b]	-0.027	(0.028)	0.011	(0.019)	0.011	(0.019)
Low exp.*Raw material[b]	-0.012	(0.035)				
High exp.*Raw material[b]	0.077*	(0.044)				
Small hh*Raw material[b]			0.064	(0.052)		
Big hh*Raw material[b]			-0.123***	(0.035)		
High educ.*Raw material[b]					0.055*	(0.033)

Number of observations: 3200 (400 groups). Standard errors are clustered.

***, ** and * indicate significance at 1%, 5% and 10% level.

[a] Average marginal response of the probability of giving a score 5 to the product when a regressor changes and the others are unchanged.

[b] dy/dx is for discrete change of dummy variable from 0 to 1.

Table 10: WTP for fresh raw material: estimates and confidence intervals

Model	**WTP estimate**	**Lower bound of CI[a] at 95%**	**Upper bound of CI[a] at 95%**
Ord. Probit on (3) (table 6)	228.32	113.82	342.82
Ord. Probit on (4) (heterog., table 7)	227.48	114.33	340.64
Ord. Probit on (5) (interact., table 8):			
Model a (base category household)	209.63	86.08	333.17
Model b (base category household)	274.61	140.78	408.44
Model c (base category household)	190.96	84.22	297.69

[a]Confidence intervals at 95% level calculated with delta method.

Table 11: Grouped middle classes (Ordered Probit Model)

		Model a		Model b		Model c	
Variable		**Coeff.**	**(s.e.)**	**Coeff.**	**(s.e.)**	**Coeff.**	**(s.e.)**
Pack. (per weight=1)	γ_1	-0.630***	(0.051)	-0.631***	(0.051)	-0.629***	(0.051)
Sweetness (Sugar=1)	γ_2	0.216***	(0.046)	0.217***	(0.047)	0.216***	(0.046)
Raw mat. (Fresh=1)	γ_3	0.343***	(0.077)	0.485***	(0.064)	0.327***	(0.062)
Price	θ	-0.002***	(0.000)	-0.002***	(0.000)	-0.002***	(0.000)
Pikine		0.119**	(0.047)	0.120**	(0.047)	0.119**	(0.047)
Rufisque		0.158	(0.101)	0.158	(0.102)	0.159	(0.101)
Ethn. minority		0.012	(0.047)	0.012	(0.047)	0.012	(0.047)
Peul		0.066	(0.063)	0.066	(0.063)	0.066	(0.063)
Small household		-0.096	(0.065)	-0.176*	(0.104)	-0.096	(0.065)
Big household		-0.049	(0.049)	0.141*	(0.073)	-0.049	(0.049)
High education		-0.044	(0.044)	-0.044	(0.044)	-0.132*	(0.068)
Low expenses		0.031	(0.076)	0.027	(0.053)	0.026	(0.053)
High expenses		-0.155*	(0.086)	-0.011	(0.057)	-0.011	(0.057)
Low exp.*Raw mat.	β_1	-0.010	(0.112)				
High exp.*Raw mat.	β_2	0.293**	(0.136)				
Small hh*Raw mat.	β_3			0.161	(0.169)		
Big hh*Raw mat.	β_4			-0.382***	(0.113)		
High educ.*Raw mat.	β_5					0.178*	(0.105)
	α_1	-1.291***	(0.126)	-1.223***	(0.123)	-1.297***	(0.125)
	α_2	0.083	(0.127)	0.154	(0.125)	0.076	(0.126)

Log-Likelihood: model a: 3154.2467, model b: 3147.7665, model c: 3156.2902.

Number of observations: 3200 (400 groups). Standard errors are clustered.

***, ** and * indicate significance at 1%, 5% and 10% level.

Table 12: Binary Probit Model

		Model a		Model b		Model c	
Variable		**Coeff.**	**(s.e.)**	**Coeff.**	**(s.e.)**	**Coeff.**	**(s.e.)**
Package (per weight=1)	γ_1	-0.584***	(0.056)	-0.587***	(0.056)	-0.584***	(0.055)
Sweetness (Sugar=1)	γ_2	0.273***	(0.054)	0.274***	(0.055)	0.273***	(0.054)
Raw material (Fresh=1)	γ_3	0.400***	(0.066)	0.594***	(0.071)	0.413***	(0.075)
Price	θ	-0.001***	(0.001)	-0.001***	(0.001)	-0.001***	(0.001)
Pikine		0.222***	(0.052)	0.229***	(0.055)	0.224***	(0.056)
Rufisque		0.225*	(0.132)	0.226*	(0.132)	0.226*	(0.131)
Ethn. minority		0.054	(0.059)	0.054	(0.060)	0.055	(0.060)
Peul		0.077	(0.072)	0.077	(0.073)	0.079	(0.073)
Small household		-0.059	(0.082)			-0.060	(0.082)
Big household		-0.086	(0.062)	0.189**	(0.090)	-0.087	(0.061)
High education		-0.003	(0.056)	-0.009	(0.056)	-0.065	(0.091)
Low expenses				-0.010	(0.066)	-0.007	(0.066)
High expenses		-0.140	(0.104)	0.015	(0.071)	0.015	(0.070)
High exp.*Raw material	β_2	0.290*	(0.148)				
Big hh*Raw material	β_4			-0.509***	(0.126)		
High educ.*Raw material	β_5					0.114	(0.123)
	α	-0.281*	(0.161)	-0.383**	(0.163)	-0.284*	(0.161)

Log-Likelihood: model a: -1856.9146, model b: -1848.8712, model c: -1859.1067.

Number of observations: 3200 (400 groups). Standard errors are clustered.

***, ** and * indicate significance at 1%, 5% and 10% level.

Table 13: Norton, Wang and Ai (2004)'s method for interaction effects

	Model a		Model b		Model c	
Variable	**Int. effect**	**(s.e.)**	**Int. effect**	**(s.e.)**	**Int. effect**	**(s.e.)**
High exp.*Raw material	0.095**	(0.048)				
Big hh*Raw material			-0.171***	(0.042)		
High educ.*Raw material					0.037	(0.040)

Number of observations: 3200 (400 groups).

*** and ** indicate significance at 1% and 5% level.

Table 14: Product knowledge

Brand	**% of respondents who consume**	**% of consum. who think it is made with powder**	**% of consum. who think it is made with fresh milk**	**% of consum. who don't know**
Brands made with powder				
Starlait	27.00	52.78	21.30	25.93
Sarbi	27.50	20.91	52.73	26.36
Niw	41.75	16.77	55.69	27.54
Ma Kalait	0.50	50.00	0.00	50.00
Sen Sow	16.75	14.93	49.25	35.82
Banic	5.75	26.09	43.48	30.43
Taif Sow	7.75	25.81	41.94	32.26
Jaboot	36.25	33.79	32.41	33.79
Brand made with fresh milk				
Wayembam	16.50	10.61	77.27	12.12

Number of respondents: 400.

Table 15: Misleading characteristics: descriptive statistics

Variable	**Definition**
No mention	=1 if ingredient is "lait" or "lait frais" or "lait de collecte"
	=0 if ingredient is "lait en poudre" or "lait reconstitué"
Made in Sn	=1 if mentioned "fabriqué au Sénégal"
	=0 otherwise
Local picture	=1 if presence of a zebu cow, a peul character, etc.
	=0 otherwise
Local name	=1 if brand name sounds Wolof
	=0 if brand name sounds French

Variable	**All sour milk products** (%)	**Made with fresh milk** (%)	**Made with powder** (%)
No mention	54.71	100.00	46.77
Made in Sn	18.46	88.38	6.20
Local picture	63.00	100.00	56.51
Local name	70.23	100.00	65.01
Observations	1327	198	1129

Table 16: Hedonic Regression

Variable	**Coefficient**	**(Std. Err.)**
Raw Material (Fresh=1)	15.633	(45.505)
Soow	-323.477***	(42.145)
Lait caillé	-347.494***	(30.345)
Volume (liters)	-244.468***	(14.798)
Sweetened	76.531**	(38.745)
Light	372.869***	(96.895)
Flavored	299.480***	(33.663)
Sachet	-516.504***	(29.858)
Bottle	-753.734***	(60.042)
New brand	-262.768***	(35.941)
Colored package	89.738***	(32.832)
Superette	30.767	(36.116)
Gas station	22.690	(33.079)
Supermarket	-35.747	(39.260)
Pikine	-120.570***	(35.573)
Rufisque	-38.503	(54.725)
Guédiawaye	-5.319	(29.067)
Constant	1769.372***	(51.830)

Dependent variable: price per liter. Number of observations: 1327. $R^2 = 0.6409$. *** and ** indicate significance at 1% and 5% level. Reference product: Pot of yogurt, unsweetened, non light, unflavored, sold in a boutique in the department of Dakar.

Table 17: Hedonic Regression (misleading characteristics)

Variable	**Coefficient**	**(s.e.)**	**Coefficient**	**(s.e.)**	**Coefficient**	**(s.e.)**	**Coefficient**	**(s.e.)**
No Mention	265.725***	(22.084)						
Made in Sn			159.947***	(36.094)				
Local Picture					-464.670***	(27.686)		
Local Name							-469.701***	(26.801)
Soow	-357.697***	(38.892)	-372.489***	(42.249)	-317.220***	(37.060)	-136.584***	(38.226)
Lait caillé	-312.532***	(25.780)	-299.784***	(29.252)	-275.719***	(24.865)	-243.499***	(25.031)
Volume (liters)	-221.516***	(14.139)	-241.014***	(14.675)	-212.442***	(13.529)	-206.012***	(13.468)
Sweetened	79.586**	(36.514)	80.714**	(38.199)	129.043***	(35.039)	77.648**	(34.631)
Light	417.133***	(91.465)	422.585***	(96.342)	420.858***	(87.411)	350.659***	(86.673)
Flavored	310.691***	(31.924)	302.384***	(33.387)	394.335***	(31.030)	314.481***	(30.277)
Sachet	-520.906***	(27.991)	-502.041***	(29.419)	-502.568***	(26.766)	-532.075***	(26.562)
Bottle	-571.205***	(58.133)	-703.133***	(59.883)	-529.802***	(55.259)	-521.861***	(54.819)
New brand	-186.373***	(27.731)	-320.719***	(31.993)	48.180	(31.619)	-30.860	(28.744)
Colored package	-24.485	(32.481)	127.771***	(33.527)	-143.054***	(32.779)	-126.572***	(31.942)
Superette	3.909	(34.236)	29.765	(35.733)	33.273	(32.655)	23.478	(32.400)
Gas station	-89.441**	(37.450)	11.572	(32.694)	31.655	(29.771)	28.839	(29.534)
Supermarket	-35.747	(39.260)	-48.349	(39.005)	-58.349	(35.566)	-59.399*	(35.286)
Pikine	-75.067**	(33.923)	-115.405***	(35.282)	-97.689***	(32.253)	-46.998	(32.247)
Rufisque	18.909	(51.948)	-31.093	(54.135)	-50.803	(49.443)	5.448	(49.118)
Guédiawaye	-0.867	(27.570)	1.676	(28.884)	-28.263	(26.389)	-11.750	(26.148)
Constant	1680.354***	(49.647)	1709.716***	(53.044)	2006.946***	(49.050)	2088.883***	(50.036)
R^2	0.6766		0.6461		0.7044		0.7091	

Dependent variable: price per liter. Number of observations: 1327.***, ** and * indicate significance at 1%, 5% and 10% level.

Reference product: Pot of yogurt, unsweetened, non light, unflavored, sold in a boutique in the department of Dakar.

Table 18: Hedonic Regression (misleading characteristics): Lait caillé and Soow only

Variable	**Coefficient**	**(s.e.)**	**Coefficient**	**(s.e.)**	**Coefficient**	**(s.e.)**	**Coefficient**	**(s.e.)**
No Mention	83.134***	(12.476)						
Made in Sn			180.593***	(30.316)				
Local Picture					151.978***	(20.638)		
Local Name							111.394***	(21.350)
Soow	-29.470**	(13.664)	-120.158***	(23.004)	4.341	(13.337)	-36.196**	(14.450)
Volume (liters)	-130.474***	(8.118)	-133.784***	(8.159)	-115.915***	(8.380)	-124.240***	(8.365)
Sweetened	116.066***	(19.022)	107.171***	(19.061)	65.727***	(19.558)	104.886***	(19.161)
Light	57.260	(134.768)	32.830	(135.546)	6.029	(133.990)	33.577	(136.289)
Flavored	230.268***	(18.449)	204.960***	(18.990)	152.902***	(21.044)	208.876***	(19.052)
Sachet	-372.819***	(13.198)	-372.141***	(13.394)	-306.990***	(13.449)	-312.757***	(14.062)
New brand	-19.870	(17.409)	-92.685***	(16.174)	-162.995***	(19.982)	-112.264***	(17.728)
Colored package	-4.545	(18.322)	58.282***	(16.911)	163.594***	(23.029)	124.839***	(22.665)
Superette	4.000	(15.834)	5.810	(15.914)	11.887	(15.669)	16.065	(15.952)
Gas station	12.947	(14.149)	14.929	(14.217)	22.505	(13.933)	29.060**	(14.186)
Supermarket	-34.263*	(18.487)	-31.685*	(18.574)	-27.308	(18.269)	-19.834	(18.563)
Pikine	-30.655	(19.387)	-32.663*	(19.489)	-39.374**	(19.165)	-61.412***	(19.757)
Rufisque	17.833	(24.283)	16.291	(24.432)	4.050	(23.973)	-11.306	(24.467)
Guédiawaye	-15.159	(14.544)	-10.494	(14.690)	-14.734	(14.452)	-24.922*	(14.736)
Constant	1219.444***	(24.947)	1253.535***	(25.616)	1076.847***	(31.727)	1075.512***	(37.845)
R^2	0.6904		0.6868		0.6943		0.6833	

Dependent variable: price per liter. Number of observations: 742. ***, ** and * indicate significance at 1%, 5% and 10% level.

Reference product: Bottle of lait caillé made with powder, unsweetened, non light, unflavored, sold in a boutique in the department of Dakar.