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Abstract

This paper aims to evaluate Senegalese consumers' willingness-to-pay (WTP) for local fresh milk-based products, in opposition to the ones produced with imported powder. Using data from a choice-based-conjoint analysis conducted on 400 households in the region of Dakar, we evaluate the premium that consumers are willing to pay for fresh raw material (rather than powder) in the composition of sour milk. Based on an Ordered Probit Model, the results show evidence for a positive WTP for fresh raw material, which may be seen as a strong indication of preference for local products.

This WTP greatly depends on the characteristics of the households. Wealthier households are willing to pay more than the medium households, while big households are ready to pay much less than the base category ones. Obviously, some niche markets exist, that producers may target to sell the local milk-based dairy products. However, more information has to be provided about the composition of dairy products, as consumers are not currently able to distinguish both types of raw material, even if they are willing to pay more for one of them.

In spite of some restrictions about the presence of a potential "hypothetical bias" due to the nature of the data, this study gives a first insight of consumers' preferences for local milk-based dairy products.

Keywords: Choice-Based-Conjoint analysis, Ordered Probit Model, milk, Senegal
JEL classification: C25, D12, Q13

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1 Introduction

Although milk consumption is still low compared to the rest of the world, dairy products make now part of the consumption habits of most African households. In Senegal, as in much other West African countries, milk products availability, whatever their origin is, is one of the government priorities[1]

Currently, Senegalese demand is mainly satisfied by imports, mostly from Europe. Indeed, local production only covers 32% of the demand (MINEFI, 2006). However, it is argued that consumers prefer local milk. A recent study (Broutin et al., 2006: 11) shows that 90% of households consuming local sour milk would like to increase their consumption but cannot do it because of the lack of availability (mentioned by more than 50% among them). Another study, from Sissokho and Sall (2001), states that 79% of the consumers consider that local milk-based dairy products have a higher quality than imported ones.

Until recently, Senegalese dairy industry used mainly imported milk powder. However, since 1990, small-scale milk processing units, which ensure rural milk collection, seem to rapidly expand (Corniaux et al., 2005; Dieye et al., 2005). It is often claimed that this development is hampered by a lack of competitiveness due to high transport costs as well as to cheap imports of milk powder coming from European Union subzided exports.

Our study aims to evaluate consumers' willingness-to-pay for local fresh milk-based products, in opposition to the ones produced with imported powder. As they seem to prefer local milk, it is intuitive that they are willing to pay more for this kind of product. Precisely, we want to quantify the "premium" consumers are willing to pay to consume local milk-based products.

This estimation has important implications. If consumers do not value local/fresh raw material, the so-called import surge of milk powder from Europe does not hurt them, as it makes cheaper products available and that they are indifferent between the two kinds of goods. However, if Senegalese consumers do value local milk-based products more than imported ones, the premium they are willing to pay for this good has to be high enough to compensate the higher production costs, mainly high transport costs due to the perishable nature of fresh milk and to the poor quality of road infrastructures. In this case only, local milk-based products may be sold on the Senegalese market at such a price that they find a demand. If this condition is satisfied, increasing local milk production may be profitable to consumers as well as to produc-

[1] See for instance the Senegalese President's New Year speech (December 2008) which announced prices decrease for imported milk powder as well as a program of insemination of 50 000 cows in order to increase local milk production (`http://www.gouv.sn/discours_pres/detail.cfm?numero=309`).

ers. In a country where, in rural areas, nine out of ten households own cattle, this expansion would increase and smooth income of a large share of the population.

This paper is structured as follows. Next section presents an overview of studies about willingness-to-pay for local products, using various methods based on individuals' stated or revealed preferences. In section 3, we present the methodologies we use and describes the data. Section 4 is devoted to model specifications and hypotheses while section 5 exposes and discusses the results. Finally, section 6 concludes.

2 Evaluation of willingness-to-pay for local products

Consumers value local food products because of taste preferences, because they think the local good is healthier, or because they want to support local agriculture. They express their preference for domestic products by accepting to pay a premium for it. Several methods have been used to evaluate this willingness-to-pay (WTP), such as choice-base-conjoint analysis, contingent valuation, experimental auctions or hedonic prices.

Contingent valuation consists in directly questioning individuals about their WTP. Conducting this type of survey on consumers from Colorado, Loureiro and Hine (2002) have found that locally grown potatoes carry a potential premium of about 10% over the initial price. Loureiro and Umberger (2003) have evaluated that respondents are willing to pay 38% more for "US Certified Steak" and 58% more for "US Certified Hamburger".

In Vandermersch and Mathijs (2004)'s study in Belgium, more than 50% of the respondents agree to pay 0.05 or 0.1 euros more for Belgian milk. Buchardi et al. (2005) have determined that German consumers have a higher WTP (about 0.18 euros per liter) for fresh milk from their own region compared to the same product from another region. However, the comparison with an auction experiment, in which the WTP for local is only 0.12 euros higher, indicates the presence of bias due to the hypothetical nature of the contingent valuation questions.

Indeed, a major limitation of contingent valuation methods is the so-called "hypothetical bias", the tendency for stated WTP to overestimate actual WTP (Cummings et al., 1995). It is due to the hypothetical nature of question: the transaction does not effectively occur. Reminding budget constraint to the individual before asking the questions does not seem to reduce the bias (Loomis et al., 1994). However, the bias seem to be eliminated by "cheap talk" script, i.e. explaining hypothetical bias to individuals prior to asking questions (Cummings and Taylor, 1999; Lusk, 2003).

In choice-based-conjoint (CBC) analysis, individuals are asked to choose between alternative products defined by various attributes including price. Comparing the choices allows to estimate the WTP for the different characteristics. For instance, according to Alfnes (2004), using a ranking CBC analysis, Norwegian consumers are willing to pay 34 NOK (about 4 euros) less for Swedish hormone-free beef compared to domestic one and 110 NOK (about 13 euros) less if it comes from Botswana. In a paired comparison CBC study, Quagrainie et al. (1998) have shown that consumers from western Canada are willing to pay 15% less for Canadian beef without any region specification than for Alberta-labeled beef. In the same kind of study, Darby et al. (2006) have found that Ohio grocery store consumers are willing to pay 0.64 dollars more for a carton of strawberries that are labeled "Grown in Ohio" while this premium is 1.17 dollars for direct market (such as farm) consumers.

Choice-based-conjoint surveys have a serious advantage over methods such as contingent valuation. Indeed, as they mimic individuals' typical purchase choices, they permit to avoid the hypothetical bias[2]. Carlsson and Martinsson (2001) have shown, in the case of public goods (environmental projects) that the (hypothetical) preferences expressed in a CBC survey are not significatively different from the (actual) ones expressed when the money transfer takes place. In the case of private goods (beef steaks) however, Lusk and Schroeder (2004) have found that hypothetical responses are statistically different from actual ones. As our analysis is focused on a pure private good, we must treat result with caution. CBC generally overestimate the WTP.

In experimental auctions, individuals receive an amount of money and have to bid on several competing products, knowing that they will have to pay for one of the goods. Mabiso et al. (2005) have used a Vickrey fifth-priced experimental auction to evaluate the WTP of US consumers for apples and tomatoes that are labeled "Grown in the US". They have shown that average respondents are willing to pay 0.49 and 0.48 dollar more for labeled apples and tomatoes. With a random nth-price experimental auction, Umberger et al. (2003) have observed that respondents are willing to pay a 11% premium for beef labeled "U.S.A. Guaranteed: Born and Raised in the U.S"

Loureiro and McCluskey (2000) have calculated the WTP for Galician-certified veal

[2]See Lusk and Hudson (2004: 156) for a review of other advantages. CBC analysis presents also some drawbacks: as only discrete choices are observed, estimation of the WTP is relatively more complex; the respondent's task is more difficult; responses may be inconsistent across questions; answer may be influenced by the complexity of the task or by the context of the experiment, etc., see Lusk and Hudson, (2004: 157) or Carlsson and Martinsson (2001: 180) for a more complete review of drawbacks.

with a hedonic approach. While the previous approaches are "stated preferences" methods, hedonic prices method is a "revealed preferences" one i.e. it is based on actual market behavior and not on an hypothetical scenario. They have detected that average Spanish consumers are willing to pay a premium of 32 pesetas (about 0.19 euros) for this kind of meat compared to non-labeled one. However, when studying interactions between the label and other quality indicators, results suggest that the label leads to a premium only for certain levels of quality. The label is not significant for either the poorest and the highest quality, indicating that the label is an effective signal of quality only when it is associated with other quality indicators and that it may have decreasing marginal returns with respect to quality.

Bonnet and Simioni (2001) have also used real data (supermarket scanner data) to estimate the WTP for French-labeled camembert. Using mixed multinomial logit models as an alternative to hedonic one, their results indicate that consumers do not significantly value the label. At the same price, a large part of them prefer to buy a product without label. However, in their study, the brand is the relevant information that consumers value. From our point of view, as camembert is a well-known product for French consumers, the brand implicitly indicates its origin.

3 Data and methods

We use data from a survey realized in April 2002 in the context of the program "INCO MPE agroalimentaires" coordinated by the NGO GRET[3] (Broutin et al., 2006), on 400 households from the region of Dakar (departments of Dakar, Pikine and Rufisque).

The survey includes rating/raking choice-based-conjoint (CBC) data about sour milk. Eight hypothetical sour milks (products A to H in table 1) were proposed to the respondent. 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[4].

All these products are liquid sour milk, made with fresh milk or with milk powder; packed individually (sachet) or sold per weight; with or without additional sugar. Note that no men-

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

[4]When constructing the survey, GRET has identified four relevant attributes (packaging, taste, 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.

tion of local characteristic is made. However we use the attribute "fresh raw material" as a proxy for "local raw material". Indeed, up to now, it does not exist any milk powder produced in Senegal, thus the powder form of raw material implicitly returns to its imported source. Our own informal discussions with Senegalese consumers confirm that they consider that powder is always imported and fresh milk always local. However, we are 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.

Table 1: Hypothetical products proposed to the respondents

Product	Packaging	Taste	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

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 note (5) was given to this (these) product(s). In a second step, respondents were asked which product(s) they are not willing to buy, given its (their) characteristics and price. This (these) product(s) obtained the lowest note (1). In the last step, respondents had to rank remaining products in three categories, corresponding to the notes 4, 3 and 2.

This scheme combines two properties that may be used for evaluate the WTP. On one hand, people were asked to give a note (from one to five) to alternative products, this is a known as rating CBC. However, the intensity of the notes may depends 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. It is commonly accepted that the first two or three ranks as well as the last two or three reflect real preferences[5]. As GRET survey contain five ranks, we are confident that they reflect real preferences.

As we trust both rating and ranking are reliable in our setting, we will use both interpretations in the rest of the analysis. Note that tied rates/ranks are allowed, i.e. an individual may

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

give the same rate/rank to several alternatives. This is obvious as there are 8 alternatives for only 5 possible rate/rank. Table 16 in Appendix illustrates the importance of tied ranks. For instance, each consumer give a note 5 (most preferred) to 2.6 products on average and a note 1 (least preferred) to 1.7 products on average. We will interpret equal note for two products as indifference between them, but it could also be considered that a ranking for these goods exists, but is unknown.

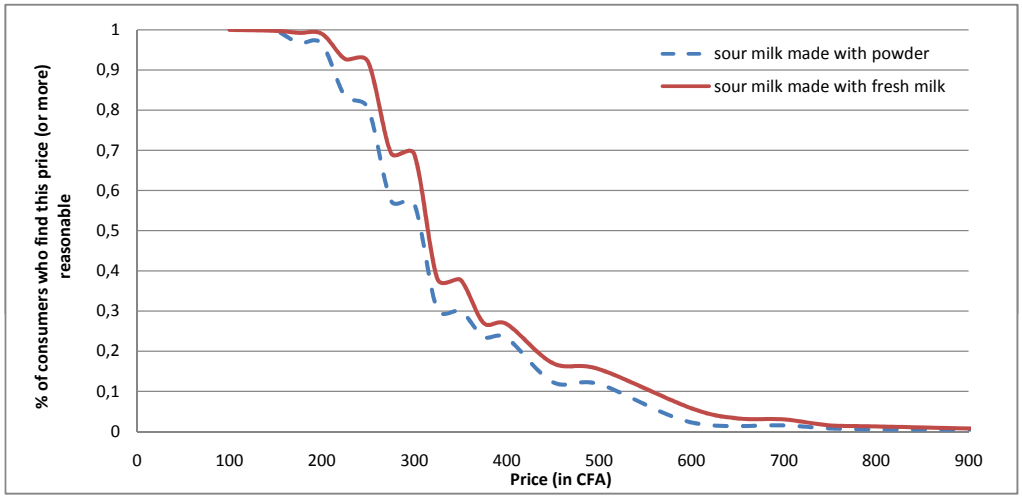
Table 2: CBC descriptive results

Product	Mean note	Note=1 (least preferred)	Note=2	Note=3 (middle classes)	Note=4	Note=5 (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 2 gives some descriptive results from the CBC data. The hypothetical product that receives the highest average note (4.10) is product D that cost 275 CFA and has the following characteristics: individually packed (sachet), with sugar and made with fresh milk. 56.75% of the interviewed consumers gave a note 5 (the highest note) to this product. The product that receive the lowest mean note (2.59) is product A. 39.75% of the respondents gave it a note 1 (the lowest note).

Figure 1: Contingent valuation of reasonable price



In addition to the CBC data, GRET survey contains information about contingent valuation. Indeed, consumers were asked to answer to various questions about the price they find reasonable for sour milk made with powder and made with fresh raw material (see table 3 for descriptive results). Figure 1 is based on the cumulative density for the question "what is a reasonable price for a sachet of 1/2 litre of sour milk made with...?".The curve for fresh raw material is above the one for powder, indicating that, for any given price p, a higher proportion of consumers find p reasonable for sour milk made with fresh milk than for sour milk made with powder. For any proportion of the consumers, the price that is found reasonable for fresh raw material is higher that the reasonable price for powder.

Table 3: Contingent Valuation descriptive results

Question:	Mean	Std. Dev.	Min	Max
"What is a **reasonable** price for a sachet of 1/2 litre of sour milk made with powder?"	312.7193	120.6122	125	1500
"At what price do you think a sachet of 1/2 litre of sour milk made with powder is **expensive** but you still buy it?"	406.4536	154.1866	200	2000
"At what price do you think a sachet of 1/2 litre of sour milk made with powder is **so expensive** that you do not buy it?"	563.4085	262.3556	250	3000
"At what price do you think a sachet of 1/2 litre of sour milk made with powder is **cheap** but you still buy it?"	240.1184	90.65752	125	1000
"At what price do you think a sachet of 1/2 litre of sour milk made with powder is **so cheap** that you doubt about its quality and you do not buy it?"	178.3843	48.40673	125	500
Number of observations: 399 households.				

Question:	Mean	Std. Dev.	Min	Max
"What is a **reasonable** price for a sachet of 1/2 litre of sour milk made with fresh milk?"	339.5625	121.0159	100	1000
"At what price do you think a sachet of 1/2 litre of sour milk made with fresh milk is **expensive** but you still buy it?"	438.5625	166.7979	150	1500
"At what price do you think a sachet of 1/2 litre of sour milk made with fresh milk is **so expensive** that you do not buy it?"	602	234.6391	200	1800
"At what price do you think a sachet of 1/2 litre of sour milk made with fresh milk is **cheap** but you still buy it?"	247.9375	101.8799	75	800
"At what price do you think a sachet of 1/2 litre of sour milk made with fresh milk is **so cheap** that you doubt about its quality and you do not buy it?"	150.5	62.97551	25	500
Number of observations: 400 households.				

As we explained, CBC analysis is generally preferred to contingent valuation because of the hypothetical bias. As individuals are not in a real situation of purchase, they tend to report higher stated WTP than the actual one. As CBC mimics consumers behavior, it is assumed to reduce the bias, while not eliminating it, especially in the evaluation of WTP for private goods.

However, contingent valuation measures in the GRET survey provides reliable WTP estimates that we can assume to be unbiased. Indeed, individual were asked, separately, what is a reasonable price for sour milk made with powder and then made with fresh raw material. It can reasonably be assumed that the hypothetical bias acts the same way on both answers. Using the difference between them as a measure of the WTP for fresh raw material mathematically eliminates the bias, assuming it is additive. We used various measures, based on that difference, that are summarized in table 4.

Table 4: Definition of contingent valuation measures

Variable	Definition
$Premium_R$	Reasonable price for sour milk with fresh raw material - Reasonable price for sour milk with powder
$Premium_E$	Expensive price for sour milk with fresh raw material - Expensive price for sour milk with powder
$Premium_{\%}$	(Reasonable price for sour milk with fresh raw material - Reasonable price for sour milk with powder) /Reasonable price for sour milk with powder

The survey also includes data about respondents and households' socio-economic and demographic characteristics such as department, ethnicity, education, size of the household, food expenses, etc. Definitions of the variables we use are presented in table 5.

Table 5: Definition of socio-economic and demographic variables

Variable	Definition	
Department	Department	Dakar=0 Pikine=1 Rufisque=2
Ethnicity	Respondent's ethnicity	Wolof=0 Peul/Toucouleur=1 Other(ethn. minority)=2
Size	Number of members in the household	Small: less than 5 members Big: more than 10 members
High education	Respondent's education	Secondary or more=1 Others=0
Food expenses	Household's food expenses per month	Low: $\leq$75000 CFA High: >150000 CFA
Housing	Housing type	Regular (with or without floor)=0 High standing=1 Social or provisional=2
TV	Color TV ownership	No=0 Yes=1

It has to be noted that only households that consume sour milk were surveyed. Some descriptive statistics are given in table 6. Households from Dakar department as well as medium size households are slightly overrepresented in the sample.

Table 6: Descriptive statistics

		Population[a] (Dakar Region)	Sample[b]
Department	Dakar	42%[d]	48.5%
	Pikine[c]	45.4%[d]	40.25%
	Rufisque	12.6%[d]	11.25%
Age (chief of household)	15 to 24	0.94%	0.75%
	25 to 34	10.45%	5.75%
	35 to 44	22.28%	19.5%
	45 to 54	28.09%	28.25%
	55 to 64	19.9%	21.75%
	65 and more	16.78%	15%
	Don't know/answer	1.56%	9%
Household size	Less than 5	23.15%	10.5%
	5 to 10	43.06%	62.5%
	More than 10	33.79%	27%
Housing ownership	Owner	62.39%	65.75%
	Tenant	33.85%	30%
	Free housing	3.32%	4.25%
	Others	0.44%	
Mean annual food expenses	(CFA)	1 291 085	1 220 022

[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).

In spite of this, we trust there is no selection bias. Firstly, when doing inference, the population we are interested in, 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 local product rather than imported one. We can reasonably believe that individuals who currently do no 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 every 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.

4 Model specifications and hypotheses

4.1 Choice-based-conjoint analysis

Respondents' choices to the CBC questionnaire are modeled according to McFadden's Random Utility Model (RUM) (see for instance ANDERSON et al., 1992 or LOUVIERE et al., 2000). We assume that, given a set of alternatives, consumers choose the alternative that maximizes their utility. The utility U_{ij} that individual i gets by choosing 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:

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

We 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 product j, p_j is the price of product j, γ is a vector of coefficients to be estimated, θ is a coefficient to be estimated (expected to be negative)[7]. 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 other attributes. Indeed γ_k (element k of vector γ) represents how attribute z_k (element k in each vector Z_j) contributes to individual's utility.

From this expression, one can easily define the (deterministic) willingness-to-pay for an attribute (CHAMP et al., 2003: 189). Indeed, by differentiating equation (2), we see that the coefficient γ_k is nothing else that the marginal utility provided by 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

[6] Referenced by DIA et al. (2008: 39).

[7] Note that a product-specific intercept (to be estimated) would have been included. Such an intercept α_j would represent the effect of non included (maybe non observable, such as quality) attributes of product j. As in the data, products are precisely defined by their four attributes, we assume $\alpha_j = 0$. Intercept to be estimated may be useful when alternatives are, for example, various brands of products, which implicitly represents their attributes.

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 utility constant. Alternatively, he has to be paid $-\gamma_k/\theta$ to accept a change in attribute z_k that would decrease his utility. A simple way to make the WTP for various attributes readily comparable is to normalized $\theta = -1$ i.e. divided all the expression by $-\theta$ such that coefficient associates with z_k is $-\gamma_k/\theta$.

In particular, we estimate the following empirical specification:

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

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

To control for heterogeneity among consumers, we 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, utility is not only affected by the attributes of the product but also by individual's own characteristics.

Consumers' characteristics may affect not only their utility but also their preferences for product's attributes. To treat this, we 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, we are interested in measuring the effect of socio-economic variables such as income, education and household's size on the WTP for fresh raw material rather than powder.

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

This has two main implications.

Firstly, it will allow to identify niche markets of consumers that are willing to pay relatively more than others to consume fresh milk. Local producers should specially target these consumers to sell their differentiated product at a higher price.

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 local milk even more than poorer households, this would be a strong indication that local 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 are altered.

In the particular model

$$V_{ij} = \gamma_1 Package_j + \gamma_2 Taste_j + \gamma_3 RawMaterial_j + \theta p_j + \delta X_i + \beta_1 (Wealth_i * RawMaterial_j) \quad (7)$$

(where Wealth=1 if the household is in the wealthier category), we expect γ_3 to be positive (i.e. consumers are willing to pay more for fresh raw material). If γ_3 was not significantly different from zero, consumers would just be indifferent between powder or fresh raw material. However, we have no particular expectation on the effect of wealth β_1. If β_1 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_1 is negative, then powder represents quality and wealthier individuals, that have a higher preference for quality, are willing to pay less than other individuals for fresh raw material.

For other major socio-economic characteristics, we 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, as Peuls, traditionally involved in livestock sector, should be more concerned by local producers' difficulties. Finally, we expect small and big 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 assumption of independence of irrelevant alternatives (IIA) to hold. The relative probability of choosing alternative j versus alternative l has to be independent on which other alternatives are available as well as on which alternatives have been already chosen (LONG and FREESE, 2006: 341). Using a Hausman test and comparing the full model with a reduced model on a subset of alternatives, we can show that IIA assumption does not hold. For example comparing the full model with a model excluding profile G, Hausman test (not reported) reject the null hypothesis of IIA ($\chi^2_4 = 13.65,\ p < 0.01$). We choose to use an Ordered Probit Model as it does not rely on the IIA assumption. Nevertheless, using an Ordered Logit Model doesn't change much the results (not reported).

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

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

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

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

That is,

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

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

4.2 Contingent valuation

Using various contingent valuation measures from the survey, we estimate the stated WTP for fresh raw material depending on socio-economic and demographic characteristics, using the following linear regression:

$$Premium_i = a + bX_i + e_i \tag{9}$$

[10] The rating/ranking nature of the data allows us to use both Ordered and Rank-Ordered Models. We have compared both types in the Logit case. As they provide similar results (not reported), we 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.

where $Premium_i$ is the measure of the additional amount that individual i is willing to pay to consume sour milk made with fresh raw material rather than with powder, X_i is a vector of socio-economic and demographic variables, b is a vector of coefficients to be estimated, a is a constant to be estimated and e_i is the error term.

5 Results

5.1 Choice-based-conjoint analysis

Table 7 reports results from the Ordered Probit Model with specification (3). All coefficients are statistically significant at 1% level. As expected, individuals seem to prefer a sour milk with the following characteristics: individually packed (sachet), with sugar and made with fresh raw material.

Packaging has the most crucial importance ($|\gamma_1| = 0.63$). Preference for fresh milk is also major: keeping other attributes (package and taste) 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 household is willing to pay 228 CFA more to consume a product made with fresh milk rather than a product made with powder.

Table 7: Ordered Probit Model

Variable		Coefficient	(Std. Err.)
Package (per weight=1)	γ_1	-0.630***	(0.050)
Taste (Sugar=1)	γ_2	0.205***	(0.045)
Raw material (Fresh=1)	γ_3	0.402***	(0.049)
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.

Controlling for individuals' characteristics does not change much the results (table 8). With specification (4), the marginal WTP for fresh raw material $-\gamma_3/\theta$ is around 227 CFA.

Average marginal effects from the Ordered Probit Model are also illustrated in table 8. The average probability that a respondent gives a note 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 note 5 by 6.8 points and going to an individual packaging increases it by 21 points, all other things equal.

Only average marginal effects are reported in table 8. Those are the marginal effect averaged for all individuals. They have to be distinguished from the marginal effects for an average individual (not represented here). 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 note 5 to te product that has the following attributes: sachet, sugar, fresh raw material, i.e. the product with all the most preferred attributes when its price is 250 CFA (a common market price). At the same price, the product with all the least preferred attributes (per weight, without sugar, made with powder) receives a note 5 with a probability of 11.9%. If the "most proffered" product was free (price was zero), the probability of receiving a rate 5 would be 69.5%.

Table 8: Ordered Probit Model (heterogeneity among consumers)

Variable		Coefficient	(Std. Err.)	dy/dx[a]	(Std. Err.)
Package (per weight=1)	γ_1	-0.633***	(0.051)	-0.209***	(0.015)
Taste (Sugar=1)	γ_2	0.206***	(0.045)	0.068***	(0.015)
Raw material (Fresh=1)	γ_3	0.405***	(0.049)	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] Average marginal response of the probability of giving a note 5 to the product when a regressor changes and the others are unchanged. Average probability of note 5 is 0.3217.

Table 9 presents results obtained from the Ordered Probit Model that includes interaction effects (specification (5)). Model *a* corresponds to the particular specification (7). WTP for fresh raw material, for the base category household (that is with monthly food expenses included between 75 000 and 150 000 CFA) is 210 CFA ($-\gamma_3/\theta$).

The interaction between food expenses and raw material is quite interesting. 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 we adopted, this seems to indicate that sour milk made with fresh raw material is considered to have a higher perceived quality that sour milk made with powder.

Table 9: 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)
Taste (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.

One may criticize using food expenses as a measure of wealth. Nevertheless, using another usual wealth indicator (the ownership of a color TV) does not affect the results[12] (see table 18

[12]Note nevertheless that this is not true when using the housing type as a proxy for wealth.

in Appendix), indicating their robustness.

Model *b* in table 9 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. This intuitive interpretation is similar to the previous one about poorer versus wealthier households. Income effect is only part of the story however. Using a proxy[13] of the income per capita 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 big and small families.

Model *c* in table 9 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 marginal WTP of 285 CFA for this attribute ($-(\gamma_3+\beta_5)/\theta$), while less educated consumers have a WTP of 191 CFA ($-\gamma_3/\theta$).

We see that the WTP for fresh raw material greatly depends on the characteristics of the households. It clearly exists some niche markets (i.e. wealthier and educated consumers), that milk producers may target to sell the local milk-based dairy products.

The interaction effect of being Peul on the preference for raw material is not significant (β_6 in table 17 in Appendix) 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 preferred raw material is dictated by taste and quality considerations more than by wish to support local producers.

We 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. Indeed, saying that individuals are willing to pay 228 CFA more for a product that already costs 250 CFA, that is, saying that they are ready to pay almost the double of the current price, seems unrealistic. However, the results show that individuals are willing to pay a significantly positive premium for fresh raw material. 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.

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

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%
Ordered Probit on (3) (table 7)	228.32	113.82	342.82
Ordered Probit on (4) (heterog., table 8)	227.48	114.33	340.64
Ordered Probit on (5) (interact., table 9):			
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.

Confidence intervals for the main estimates of the WTP for fresh raw materials are reported in table 10. They are calculated using delta method, assuming that WTP is normally distributed. Indeed, it is reasonable to suppose that the coefficients of an Ordered Probit Models 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[14](Hole, 2006). Confidence intervals are quite large, indicating that the estimation of mean WTP is imprecise.

While we may easily trust that products receiving note 5 are the most preferred and that products receiving note 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 we use two alternative specifications.

First, we gather middle classes (notes 2, 3 and 4) and use an Ordered Probit Model with only three categories instead of five. Table 19 in Appendix indicates that main results, in terms of significance and sign, are not affected.

Second, we use a Binary Probit Model where the product is considered to be chosen (choice=1) if it receives the note 5 and not chosen (choice=0) if it receives the note lower than 5 (i.e. 1, 2, 3 or 4). Table 20 in Appendix indicates also that main results are not altered, neither in terms of significance or sign, except for the interaction effect between education and raw material.

Table 11 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 note 5 by 11 to

[14]Precisely, it has to be less than 0.39 (Hayya et al., 1975). In our case, for instance in the simple model presented in table 7, $s.e.(\theta)/\theta = 0.262 < 0.39$.

16 points of probability, depending on the specification.

Table 11: Marginal effects from the 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)
Taste[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 note 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.

Interaction effects 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 table 11 . To test for the robustness of the results concerning these effects, we have checked their significance using the method proposed by NORTON et al. (2004). Results from the Binary Probit Model in table 21 in Appendix 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.

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 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 prob-

ability of being chosen (see figure 3).

5.2 Contingent valuation

Results from the linear regression (9), using various measures of *Premium* (see table 4), are presented in table 12. Some results are consistent with the CBC analysis, particularly, wealthier households have a higher willingness-to-pay for fresh raw material ($b_9 > 0$ in all the three models). However, consumers from Pikine are ready to pay much less for this attribute than consumers from Dakar (b_1 negative and highly significant), which did not appear in the CBC analysis.

Table 12: Contingent valuation : linear regressions

		(a) $Premium_R$		(b) $Premium_E$		(c) $Premium_{\%}$	
Variable		Coeff.	(s.e.)	Coeff.	(s.e.)	Coeff.	(s.e.)
Pikine	b_1	-50.491***	(14.072)	-63.180***	(17.240)	-0.161***	(0.040)
Rufisque	b_2	-4.095	(21.392)	-2.362	(26.209)	-0.002	(0.060)
Ethn. minority	b_3	-12.257	(14.834)	0.103	(18.174)	0.020	(0.042)
Peul	b_4	8.736	(17.110)	4.841	(20.964)	0.014	(0.048)
Small household	b_5	6.592	(21.241)	18.261	(26.025)	0.035	(0.060)
Big household	b_6	-7.669	(14.514)	-6.931	(17.783)	-0.043	(0.041)
High education	b_7	10.119	(13.578)	11.177	(16.635)	0.034	(0.038)
Low expenses	b_8	28.081*	(14.814)	33.221*	(18.150)	0.035	(0.042)
High expenses	b_9	30.024*	(17.395)	49.217**	(21.313)	0.102**	(0.049)
Constant	a	30.043**	(14.888)	29.397	(18.240)	0.164***	(0.042)

Number of observations: 400 households.

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

Based on model (a), consumers from the base category are, on average, willing to pay a premium of 30 CFA for fresh raw material. For wealthier households, this premium is around 60 CFA. Results from the other models are similar. Based on model (c), reference households are willing to pay a premium of 16.4% above the original price. For instance, if sour milk made with powder costs 250 CFA, they are willing to pay 291 CFA for a product made with fresh milk, that is 41 CFA more. For wealthier individuals, this premium is 26.6%, or 66.5 CFA if the original price is 250 CFA.

Those results confirm our previous observations. Firstly, CBC results are upward biased, due to the hypothetical nature of the question. But, secondly, we may be confident that consumers are willing to pay a positive premium for fresh raw material, even if we can not unequivocally quantify this premium. Thirdly, wealthier individuals are willing to pay even more than other consumers to get a product made with fresh milk rather than powder.

5.3 Allocation of the willingness-to-pay

The previous analysis seems to assess that consumers are willing to pay more for fresh raw material, allowing local producers to set a higher price for their products than the one of the same product made with powder. However, we do not observe in reality any evidence that the price of products made with fresh milk is higher. For instance, table 13 shows the results of a linear regression of the observed prices of various sour milks on some of their characteristics, including raw material.

This analysis uses data on the prices of 41 products (7 different brands) collected in the supermarkets of Dakar in November 2005 (DUTEURTRE, 2006). Due to the small size of the sample, the results have to be interpreted with caution. Nevertheless, they do no show any significant difference between prices of sour milks made with powder of fresh milk, i.e. the coefficient related to the raw material is not significant.

Table 13: Determinants of observed prices (linear regression)

Variable	Coeff.	(s.e.)
Packaging (Sceau=1, sachet=0)	265.86***	(42.65)
Taste (Sugar=1, no sugar=0)	32.67	(42.81)
Raw Material (Fresh=1, powder=0)	0.997	(60.45)
Volume (in liters)	-79.48***	(27.09)
Constant	856.36***	(47.98)

Number of observations: 41 products. R^2=0.5318.

Dependant variable: price per liter. *** indicates significance at 1% level.

We suspect this is due to consumers' inability to recognize raw material. Indeed, a higher willingness-to-pay for fresh raw material may be lead to higher price only if consumers are able to recognize fresh raw material from powder when buying a dairy product. However, evidence shows it is not necessarily true.

Table 14 reports summary results from the GRET survey 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 that 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 Niiw, 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 that consume Wayembam correctly answer that it is made with fresh milk. This seems to indicate that people consuming product made with fresh milk do an informed choice, while people that consume sour milk made with powder may have chose another product if they were better informed.

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
Niiw	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

It is even more a concern as 85.75% of the respondents affirm that they are able to recognize fresh raw material from powder and vice-versa.

We check if the product knowledge has an impact on the WTP for fresh raw material by including the following indicator of knowledge as explicative variable in the various model specifications we used:

$$K_i = \frac{\#\text{ of (powder-based) brands consumed and correctly known by individual } i}{\#\text{ of (powder-based) brands consumed by individual } i}$$

It turns out that this indicator is not significant neither when included in the Ordered Probit Model, with and without interaction (CBC analysis), neither when included in the linear regression of the contingent valuation analysis. 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.

It is not surprising that consumers of powder-based sour milk think it is made with fresh milk, as the advertising about these products is often ambiguous, for instance most of the brands include wolof words (such as "sow", which means "milk"). Even when the composition is clearly indicated, most of the consumers does not read it, or are not able to read it, and are more influenced by a picture of Senegalese characters or local zebu cows on the packaging.

Table 15 shows how those marketing characteristics affect prices. Method and data used are the same as in table 13 but the explicative variable "fresh raw material" is now replaced by the characteristics that tend to persuade the consumers that the raw material is fresh milk. Subject to the same caution as before, results from table 15 indicate that the presence of a

local image on the packaging significantly increases the price of the sour milk. On average, products that have such a picture cost 118 CFA more per liter (or 28 CFA per 1/4 liter to compare with previous results).

Table 15: Impact of marketing on price (linear regression)

Variable	Coeff.	(s.e.)
Packaging (Sceau=1, sachet=0)	263.45***	(40.96)
Taste (Sugar=1, no sugar=0)	19.28	(45.61)
Picture (Local=1, other=0)	118.19***	(43.21)
Name language (wolof=1, other=0)	-5.70	(51.70)
Volume (in liters)	-71.53***	(24.81)
Constant	806.61***	(61.06)

Number of observations: 38 products. R^2=0.6427.

Dependant variable: price per liter. *** indicates significance at 1% level.

A policy implication of this analysis is that a better marketing of local product, and most of all a better regulation for products made with powder, could allow local producers to sell their products on the market at a higher price, while still finding a demand. Indeed, consumers are willing to pay a positive premium for these products but are not currently able to distinguish them from powder-based ones. They currently agree to pay a premium for products that they *think* are local, but which actually are not. As a better knowledge does not seem to influence the WTP, improving this knowledge would permit that consumers agree to pay more for products that are *actually* made with fresh milk.

6 Conclusions

In this paper, we estimated the Senegalese consumers' willingness-to-pay for a fresh (or local) raw material in the composition of sour milk. Using choice-based-conjoint data, we found that consumers are, on average, willing to pay a premium aroud 220 CFA, depending on the specification. An Ordered Probit Model that control for consumers heterogeneity, estimates this WTP at 227 CFA with a large confidence interval (from 104 to 351 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.

The willingness-to-pay greatly depends on the characteristics of the households and it clearly exists some niche markets that milk producers may target 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. This higher willingness-to-pay from the wealthier households is confirmed by an analysis based on contingent valuation measures. Big households are ready to pay much less than the base category ones, certainly due to difference in taste between children and adults. Highly educated respondents 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 livestock sector.

The existence of a positive WTP for local products may have an important impact on local production, but only if this premium is sufficient to compensate the higher production cost (mainly transport cost) of local milk-based dairy products. This comparison has not been treated in this paper but has some implications. If consumers are not ready to compensate the increased cost of local production, then cheaper subsidized imports bring them a higher utility and they are better-off under this policy. If in the contrary, they are willing to pay a sufficient premium to compensate the cost, local milk-based dairy products are profitable and the market for these products should extend. As such extension does not appear, it may exist some market failures than can be solved by better organization, reduction of transaction costs, etc. which are beyond the scope of this study.

It has been shown that consumers are not currently able to distinguish powder-based products from the one made with fresh milk. A better regulation for dairy products made with powder, coupled with a good marketing of local products, targeted to the niche markets we defined, might increase sales of local products.

We are aware of the weaknesses of the present analysis, that may be improved in future researches, mainly by constructing new databases that better fit our objectives. First, GRET database only contains information about fresh raw material which is a proxy for local raw material. But we are not able to distinguish the valuation of taste due to freshness from the pure effect of locality.

Second, we 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. The present analysis gives us an indication that consumers are willing to pay a positive premium for local product. The existence of this significantly positive premium is confirmed by contingent valuation measures that are assumed to be unbiased. However, we should not trust the CBC evaluation of the magnitude of the premium. Reliable estimation of the WTP should be obtained by observing individuals in a real environment, such as in an experimental framework or by observing real purchase behavior on the market.

In spite of these restrictions, this paper gives a first insight of consumers' preferences for local milk-based dairy products and encouraging results for future researches.

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Appendices

Table 16: Tied ranks

	note 1	note 2	note 3	note 4	note 5
% who gave the note to 0 product	16.50	41.50	37.25	9.00	1.50
% who gave the note to 1 product	33.75	36.25	37.75	32.75	19.75
% who gave the note to >1 product	49.75	22.25	25.00	58.25	78.75
Average number of products	1.675	0.8825	0.920	1.9475	2.575

Number of observations: 400 households.

Table 17: Ordered Probit Model (with interactions)

Variable		Coeff.	(s.e.)
Package (per weight=1)	γ_1	-0.633***	(0.051)
Taste (Sugar=1)	γ_2	0.206***	(0.045)
Raw material (Fresh=1)	γ_3	0.404***	(0.055)
Price	θ	-0.002***	(0.000)
Pikine	δ_1	0.157***	(0.048)
Rufisque	δ_2	0.231**	(0.098)
Ethn. minority	δ_3	0.020	(0.048)
Peul	δ_4	0.061	(0.085)
Small household	δ_5	-0.096	(0.066)
Big household	δ_6	-0.048	(0.050)
High education	δ_7	-0.054	(0.045)
Low expenses	δ_8	0.024	(0.053)
High expenses	δ_9	0.032	(0.057)
Peul*Raw material	β_6	0.007	(0.120)
	α_1	-1.278***	(0.118)
	α_2	-0.911***	(0.118)
	α_3	-0.580***	(0.119)
	α_4	0.100	(0.119)

Log-Likelihood: -4676.2272. Nb of observations: 3200 (400 groups).
Standard errors are clustered.
*** and ** indicate significance at 1% and 5% level.

Table 18: Robustness: other income related variables (ordered probit)

		Model a		Model b	
Variable		Coeff.	(s.e.)	Coeff.	(s.e.)
Package (per weight=1)	γ_1	-0.634***	(0.051)	-0.634***	(0.051)
Taste (Sugar=1)	γ_2	0.206***	(0.045)	0.206***	(0.045)
Raw material (Fresh=1)	γ_3	0.370***	(0.062)	0.219**	(0.092)
Price	θ	-0.002***	(0.000)	-0.002***	(0.000)
Pikine	δ_1	0.171***	(0.045)	0.175***	(0.047)
Rufisque	δ_2	0.242**	(0.098)	0.231**	(0.098)
Ethn. minority	δ_3	0.021	(0.048)	0.025	(0.048)
Peul	δ_4	0.068	(0.064)	0.073	(0.064)
Small household	δ_5	-0.094	(0.065)	-0.093	(0.067)
Big household	δ_6	-0.046	(0.050)	-0.049	(0.050)
High education	δ_7	-0.055	(0.046)	-0.067	(0.046)
Low type housing		0.030	(0.069)		
High type housing		-0.200	(0.124)		
TV				-0.059	(0.066)
Low type housing*Raw mat.		0.039	(0.102)		
High type housing*Raw mat.		0.418	(0.262)		
TV*Raw material				0.246**	(0.107)
	α_1	-1.285***	(0.117)	-1.335***	(0.129)
	α_2	-0.918***	(0.117)	-0.967***	(0.129)
	α_3	-0.587***	(0.118)	-0.636***	(0.130)
	α_4	0.094	(0.118)	0.046	(0.131)

Log-Likelihood: model a: -4673.1; model b: -4671.9676.

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

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

Table 19: Robustness: grouped middle classes (ordered probit)

		Model a		Model b		Model c		Model d		Model e	
Variable		Coeff.	(s.e.)	Coeff.	(s.e.)	Coeff.	(s.e.)	Coeff.	(s.e.)	Coeff.	(s.e.)
Package (per weight=1)	γ_1	-0.626***	(0.051)	-0.628***	(0.051)	-0.630***	(0.051)	-0.631***	(0.051)	-0.629***	(0.051)
Taste (Sugar=1)	γ_2	0.216***	(0.046)	0.216***	(0.046)	0.216***	(0.046)	0.217***	(0.047)	0.216***	(0.046)
Raw material (Fresh=1)	γ_3	0.394***	(0.051)	0.396***	(0.051)	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)	-0.002***	(0.000)	-0.002***	(0.000)
Pikine				0.119**	(0.047)	0.119**	(0.047)	0.120**	(0.047)	0.119**	(0.047)
Rufisque				0.158	(0.101)	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)	0.012	(0.047)
Peul				0.066	(0.063)	0.066	(0.063)	0.066	(0.063)	0.066	(0.063)
Small household				-0.096	(0.065)	-0.096	(0.065)	-0.176*	(0.104)	-0.096	(0.065)
Big household				-0.049	(0.049)	-0.049	(0.049)	0.141*	(0.073)	-0.049	(0.049)
High education				-0.044	(0.044)	-0.044	(0.044)	-0.044	(0.044)	-0.132*	(0.068)
Low expenses				0.026	(0.053)	0.031	(0.076)	0.027	(0.053)	0.026	(0.053)
High expenses				-0.011	(0.057)	-0.155*	(0.086)	-0.011	(0.057)	-0.011	(0.057)
Low exp.*Raw material	β_1					-0.010	(0.112)				
High exp.*Raw material	β_2					0.293**	(0.136)				
Small hh*Raw material	β_3							0.161	(0.169)		
Big hh*Raw material	β_4							-0.382***	(0.113)		
High educ.*Raw material	β_5									0.178*	(0.105)
	α_1	-1.305***	(0.121)	-1.262***	(0.123)	-1.291***	(0.126)	-1.223***	(0.123)	-1.297***	(0.125)
	α_2	0.062	(0.122)	0.110	(0.125)	0.083	(0.127)	0.154	(0.125)	0.076	(0.126)

Log-Likelihood: model a: -3167.9884; model b: -3158.6391; model c: 3154.2467; model d: 3147.7665; model e: 3156.2902.

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

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

Table 20: 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)
Taste (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 21: Norton et al. (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.

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

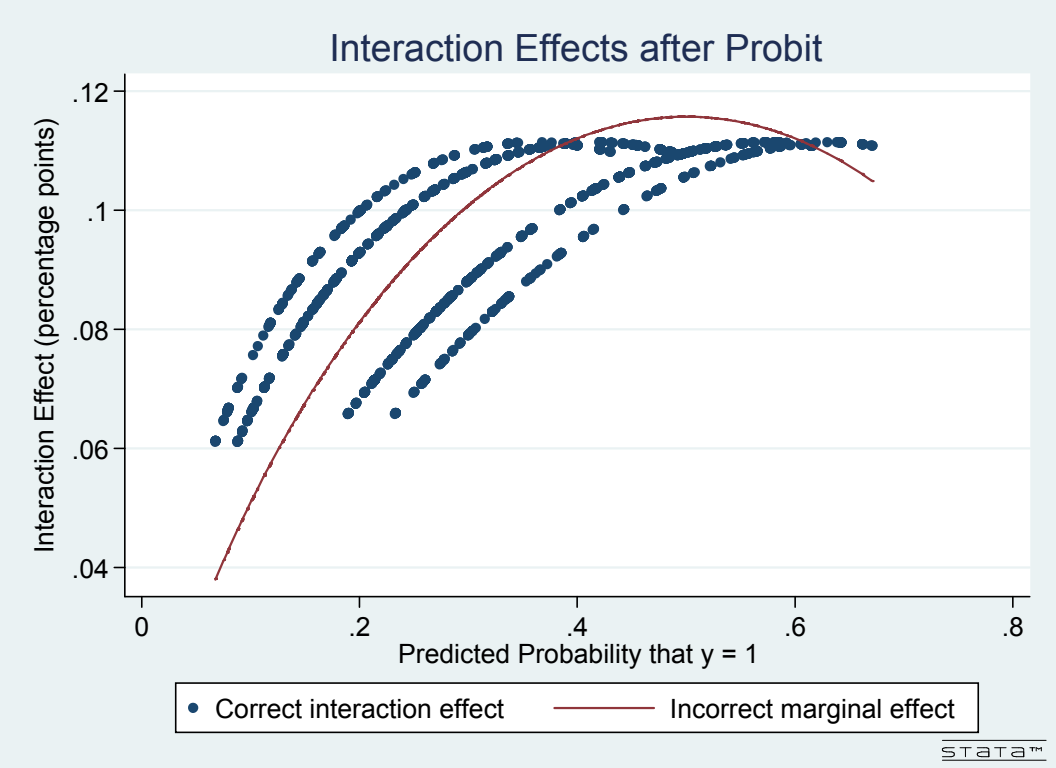

Figure 3: Interaction effect Big hh*Raw material from Probit Model