Mandatory Labelling vs. Fat Tax

an Empirical Evaluation of Fat Policies in the French Yogurt and `Fromage Blanc' Market

Olivier Allais (INRA-ALISS)
Fabrice Etilé (INRA-ALISS et PSE)
Sebastien Lecocq (INRA-ALISS)

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ahepe@irdes.fr – www.irdes.fr

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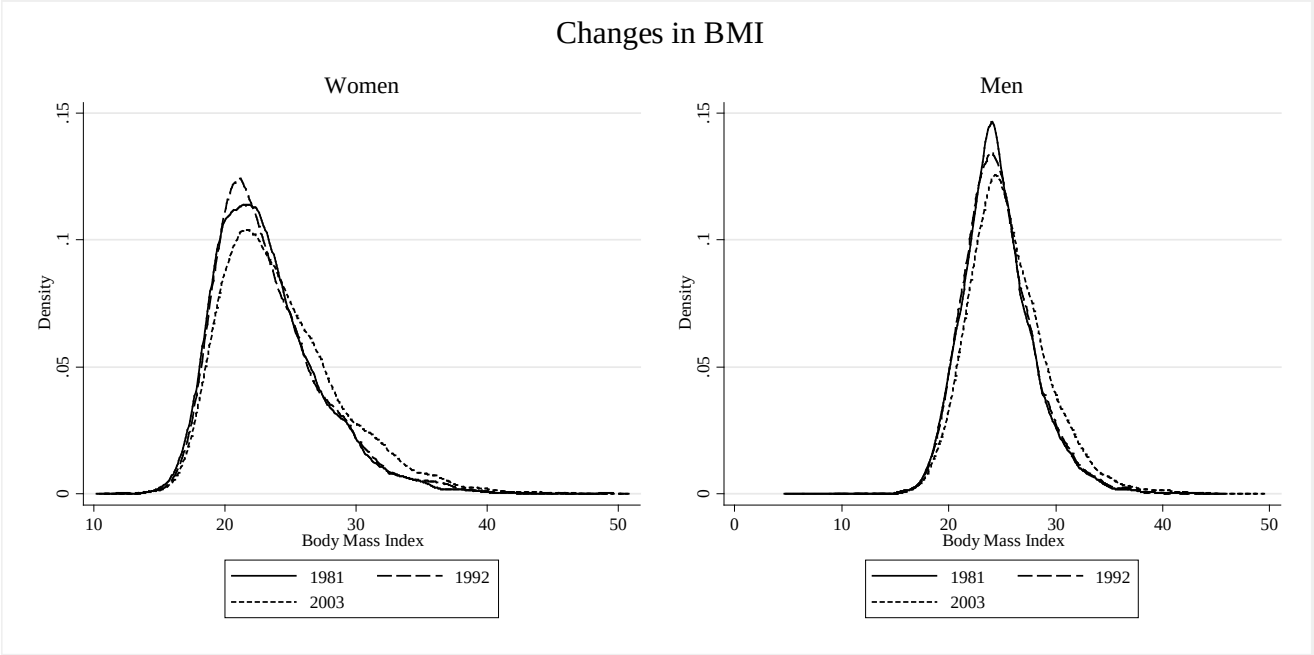
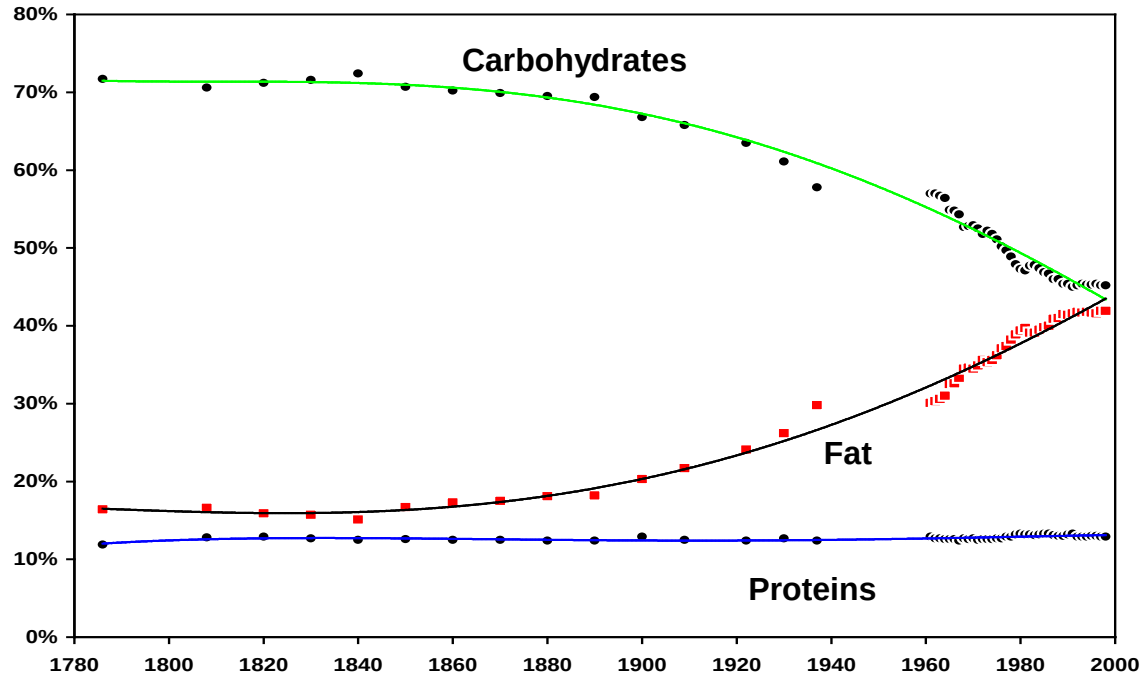
Motivation: the obesity ‘epidemic’

- **Trends in obesity**
  - BMI=weight in kg/height in meters squared and WHO recommendations : BMI ≥30: obesity; BMI ≥25: overweight.
  - France, 1991: about 6,5% adults obese; France, 2002: about 11,5%.



Motivation: the role of fat.

- **Trends in the structure of calorie intake: France, 1780-2000**



The WHO recommends that the share of fat in total calorie intake be in range 15 - 30% of total energy *vs.* 40 - 45% observed.

Fat policies

- **The `consumer sovereignty' argument : “Consumers are free to substitute standard food items for their reduced-fat counterparts” (the industry)...**
  - but the information provided by the industry is often incomplete and unreliable (Mojduszka and Caswell, 2000)
  - and consumers do not always read or understand correctly the nutrition panel facts (Grunert and Wills, 2007).

- **Mandatory labelling? Clear fat-content labels may be beneficial to consumers, in terms of risk perceptions.**
  - Labels can be effective at reducing the consumption or sales of some high-fat products (Mathios, 2000; Teisl et al., 2001; Kiesel and Villas-Boas, 2010)
  - but *do all consumers like fat content labels*?

Fat-content labels

Fat policies

- **The `consumer sovereignty' argument : “Consumers are free to substitute standard food items for their reduced-fat counterparts” (the industry)...**
  - but the information provided by the industry is often incomplete and unreliable (Mojduszka and Caswell, 2000)
  - and consumers do not always read or understand correctly the nutrition panel facts (Grunert and Wills, 2007).

- **The Fat Tax: an alternative? Taxing fatty products may also make consumers move to low-fat products**
  - The substitutions between food products may largely limit the impact of a fat tax (Caraher, 2005, Mytton, 2007, Chouinard et al.,2007 and Allais et al., 2010)
  - Taking into account *firms' strategic pricing* is a key issue: Griffith et al. (2010) and Bonnet and Requillard (2011a, 2011b).

Some questions

- **What is the consumer WTP for a fat-content label?**

- **What would be the respective impact of a mandatory labeling policy and a fat tax policy?**
  - in terms of consumer behavior (fat purchases, welfare variations)
  - in terms of firms reactions: pricing strategies

How do we do this?

- We analyze the market of dessert yogurts and fromages blancs, where products are highly differentiated and substitutes.
- To disentangle preferences for fat from the preferences for labels, we exploit a "natural" variation in legal labeling rules for this market.
- We use scanner data disaggregated at the product and household levels to estimate a Mixed Multinomial Logit model, with a control function approach to price and labels endogeneity.
- We compute firms' profit maximizing response to each policy, as in Berry et al (1995, 2004), Nevo (2001) - simple marginalization.

Agenda

1. Data (market, products, households)

2. Empirical modeling

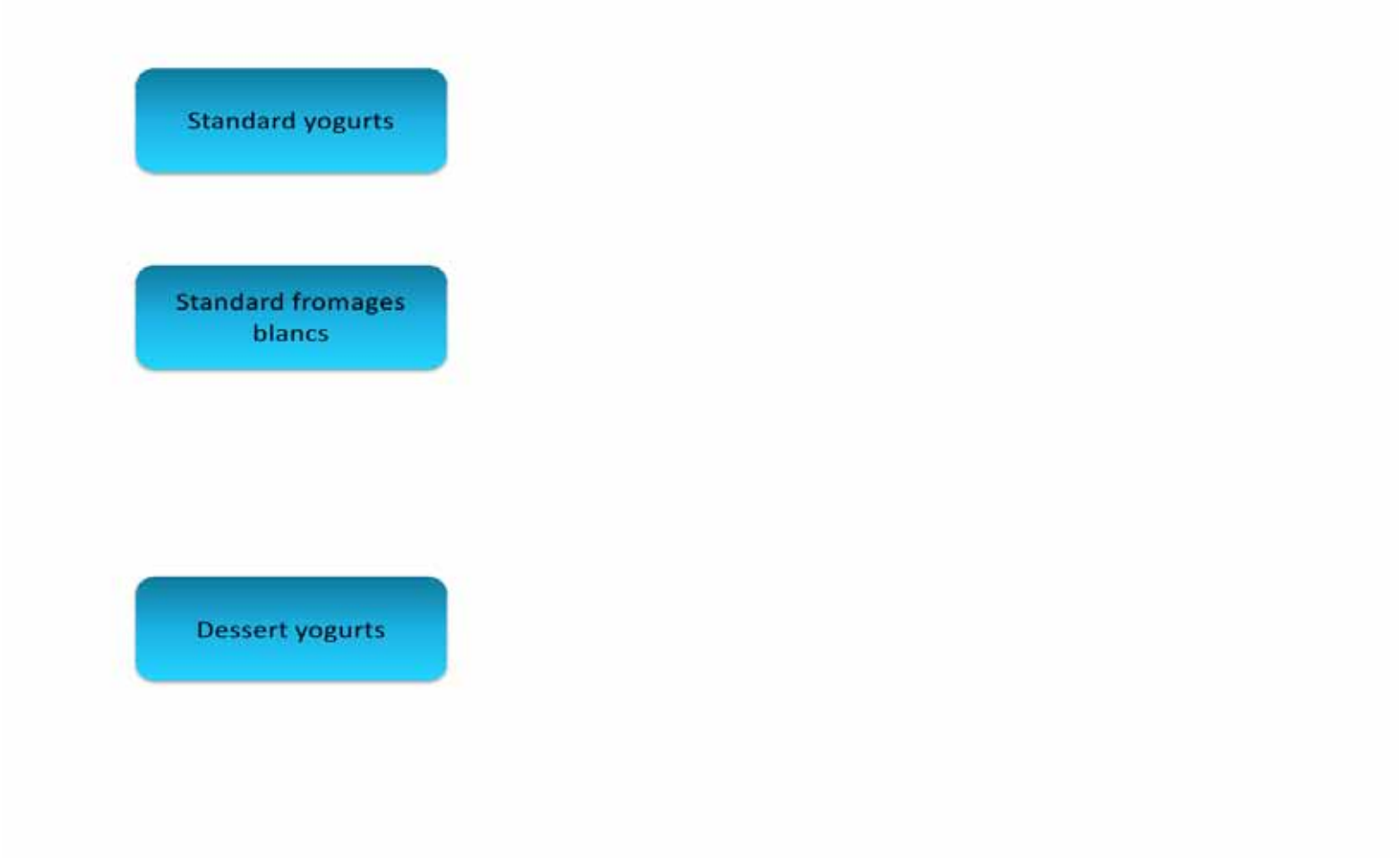
3. Estimation results & Policy simulations

Data

- **Scanner data from the TNS/Kantar WorldPanel survey collected in 2007**
  - representative of French households expenditures on food-at-home.
  - information on each purchase made in 2007: quantity, expenditure, plus a number of product characteristics.
  - 13380 households for about 5,500,000 purchases.

- **Fromage blanc : it is a style of fresh cheese, that has the consistency of a sour cream (a bit thicker than yogurts).**

Data: the market



Data: the market

Standard yogurts

Standard fromages blancs

Dessert yogurts

Data: the market

Standard yogurts

Standard fromages blancs

Dessert yogurts

Data: the market

Data: a ‘discontinuity’ in labeling legal requirements

- To identify consumer preferences for labels, we need exogenous variations in labeling between product categories, and between levels of fat.
- Mandatory labeling for fromages blancs since 1988 => producers can not choose not to label when the fat content is high, which is what they do for yogurts.
- The group of fromages blancs will act as a ‘control group’.

Data: a ‘discontinuity’ in labeling rules

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Data: the relevant market

Data: the relevant market

- Fromages blancs and dessert yogurts have similar culinary uses: they are often eaten as desserts, often accompanied with fruits, marmalade or honey.

- 6.3% of those households who consumed fromages blancs in a 4-weeks period also purchased standard yogurts, while only 5.4% purchased dessert yogurts.

- AI demand-system on the budget shares of each of the three groups in the yearly household budget for yogurts and fromages blancs.

Data: the relevant market

Table A.1

Fromages blancs and yogurts uncompensated price elasticities

	Fromages Blancs	Dessert Yogurts	Standard Yogurts
Fromages Blancs	□0.982***	0.393*	0.200
	(0.218)	(0.208)	(0.221)
Dessert Yogurts	□0.275	□1.187**	□0.381
	(0.517)	(0.492)	(0.523)
Standard Yogurts	0.094	□0.265	□1.021***
	(0.182)	(0.173)	(0.184)

Note: ***, ** and * significant at the 1, 5 and 10 percent levels.

Data: product attributes

Table 2a. **Product characteristics**

		Mean
Price		2.71 (1.22)
Products with a Label	*Label*	85%
Fromage blanc		80%
Skimmed		24%
Half-skimmed		38%
Full fat		37%
Texture	*Smooth*	75%
Products with a pack size below 200g	*Portion < 200g*	54%
Organic or bifidus products	*Organic/Bifidus*	4%
Retailer brand		64%
Hard-discount brand		15%
Low-quality retailer brands & hard-discount brands	*Low quality*	20%
Mid-quality retailer brands	*Mid quality*	39%
High-quality retailer brands & national brands	*Reference*	40%

Data: household characteristics

Table 1. **Household characteristics** (N=1785)

	Mean
Monthly household income in Euro	2696 (1435)
Household size	2.6 (1.33)
The meal planner is a male	4%
Single household	8%
Couple without children	23%
Couple with children	39%
Aged older than 65	31%
Body Mass Index (BMI)	24.77 (4.23)
Meal planner overweight: BMI $\geq$ 25	40%
Meal planner risky-overweight: BMI $\geq$ 27	26%
Meal planner obese: BMI $\geq$ 30	12%
Education = Primary	25%
Education = High school	33 %
Education = Baccalaureat	26 %
Education > Baccalaureat	16 %

Data: the market

Table 2b. **Market characteristics**

	Outside option	Fromages Blancs			Dessert yogurts	
		Skimmed	Half skimmed	Full fat	Half skimmed	Full fat
Number of products (number with a label)		50 (50)	61 (61)	58 (58)	22 (11)	20 (0)
Mean price	0	2.19 (1.25)	2.19 (0.87)	3.30 (1.32)	2.86 (1.07)	3.25 (0.67)
Market shares inc. the outside option	5.4%	16.3%	38.7%	15.8%	6.6%	17.0%
Market shares exc. the outside option		17.3%	40.9%	16.8%	7.0%	18.0%

Econometric modeling

1. **Estimate a mixed multinomial logit model of demand to identify consumer tastes *ex post***

2. **Use a structural model of Nash-Bertrand competition for the supply side: identification of the unit costs**

3. **Use the first-order condition of the firms' profit maximization program for *ex ante* policy simulations**

Econometric modeling: MMLM

$$u_{ijt} = v_{ijt} + \varepsilon_{ijt} = v_i(p_{ijt}, l_j, x_j; \alpha_i^p, \alpha_i^l, \beta_i) + \varepsilon_{ijt}, \quad (1)$$

where v_{ijt} is the deterministic part of utility, depending on the observed attributes of j, α_i^p, α_i^l and β_i are parameters representing the tastes of household i for p_{ijt}, l_j and x_j, respectively, and ε_{ijt} is the unobserved utility.

Price and label endogeneity?

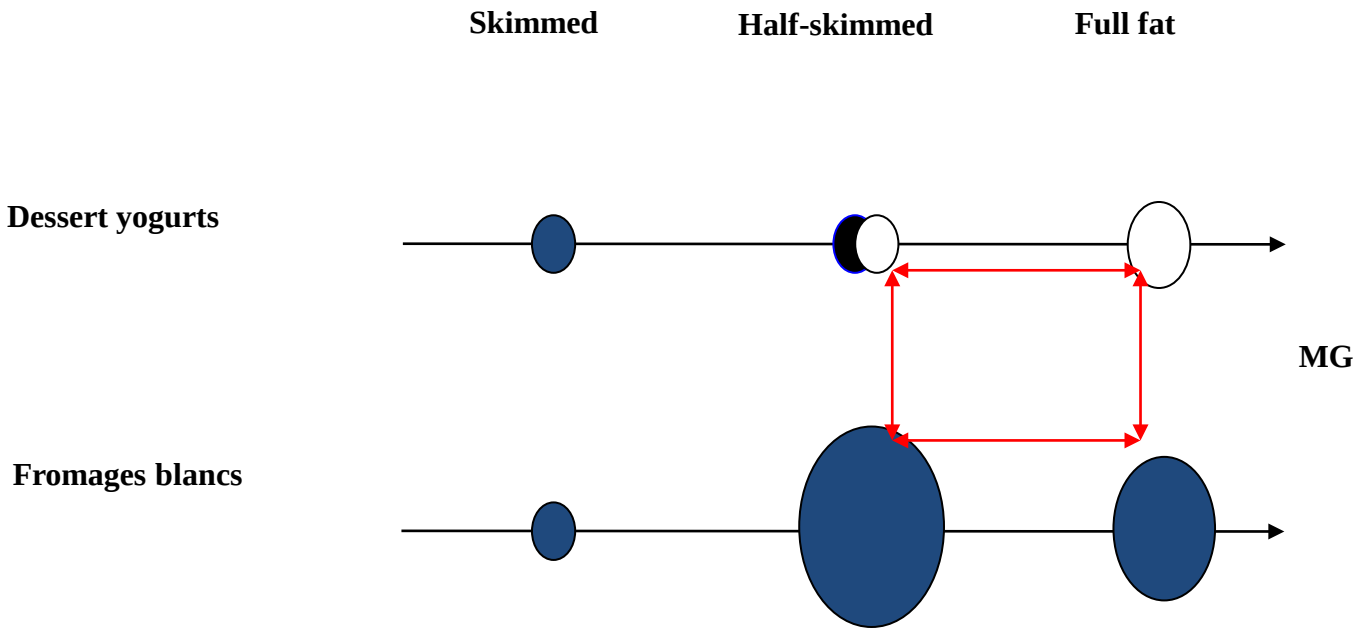
$$E(\varepsilon_{ijt} \mid p_{ijt}, l_j) \neq 0.$$

Econometric modeling: Identification issues

- **Price endogeneity : some characteristics that are positively valued by consumers might have been omitted:**
  - consumers are ready to pay for them, which may be accounted for by brands and distribution channels in setting their prices ⇒ price endogeneity
  - the price is instrumented by its past variations
  - IA: price variations are orthogonal to producers' labeling decisions when products enter the market, *cf.* Villas-Boas & Winer (1999).

- **Label endogeneity for dessert yogurts, if some unobserved characteristics that are valued by consumers are also correlated with labeling.**
  - Instrument: % Fat 1{dessert yogurts=1}.

Econometric modeling: Identification issues



Econometric modeling: MMLM + control functions

Cf. Petrin and Train (2000)

Assumption: decompose the error term as follows

$$\varepsilon_{ijt} = \widetilde{\varepsilon}^{p}_{ijt} + \widetilde{\varepsilon}^{l}_{ijt} + \widetilde{\varepsilon}_{ijt}, \tag{2}$$

where $\widetilde{\varepsilon}^{p}_{ijt}$ is the error component correlated to price, $\widetilde{\varepsilon}^{l}_{ijt}$ the error component correlated to the presence of a label, and $\widetilde{\varepsilon}_{ijt}$ an iid extreme value component. Then, assume the following orthogonal decompositions for $\widetilde{\varepsilon}^{p}_{ijt}$ and $\widetilde{\varepsilon}^{l}_{ijt}$

$$\widetilde{\varepsilon}^{p}_{ijt} = \lambda^{p}\mu^{p}_{ijt} + \sigma^{p}\eta^{p}_{ijt} \quad \text{and} \quad \widetilde{\varepsilon}^{l}_{ijt} = \lambda^{l}\mu^{l}_{j} + \sigma^{l}\eta^{l}_{ijt}, \tag{3}$$

where μ^{p}_{ijt} and μ^{l}_{j} are jointly normal, η^{p}_{ijt} and η^{l}_{ijt} are iid standard normal

Econometric modeling: MMLM + control functions

First stage regressions:

$$p_{ijt} = \delta^p z_{ijt} + \mu^p_{ijt} \quad \text{and} \quad l_j = \delta^l z_{ijt} + \mu^l_{ijt}.$$

Second stage regressions (MMLM)

$$u_{ijt} = v_{ijt} + c_{ijt} + \widetilde{\varepsilon}_{ijt},$$

where

$$v_{ijt} = \square\alpha^p_i p_{ijt} + \alpha^l_i l_j + \beta'_i x_j \quad \text{and} \quad c_{ijt} = \lambda^p \hat{\mu}^p_{ijt} + \lambda^l \hat{\mu}^l_j + \sigma^p \eta^p_{ijt} + \sigma^l \eta^l_{ijt}.$$

$$\alpha_i = \overline{\alpha} + \Sigma\nu_i + As_i \quad \text{and} \quad \beta_i = \overline{\beta} + Bs_i,$$

Econometric modeling: supply side behaviour

Profit maximisation: structural identification of the unit costs *c*

$$\pi_m = \sum_{j \in G_m} (p_j \square c_j) s_j(p;\theta),$$

$$s_j(p;\theta) + \sum_{k \in G_m} (p_k \square c_k) \frac{\partial s_k(p;\theta)}{\partial p_j} = 0,$$

Results: estimation results

Table 4: Estimated coefficients

			Income						
	Mean	Std. dev.	First Quartile	Second Quartile	Third Quartile	Man	Risky-overweight	Household size	Over 65
Price	-1.870***	1.995***	-0.232***	-0.148***	-0.013	-0.067	-0.042	0.012	0.263***
	(0.056)	(0.030)	(0.063)	(0.057)	(0.058)	(0.108)	(0.049)	(0.017)	(0.049)
Label	0.592**	3.85***	0.157	0.641**	0.180	-0.239	0.288		-0.447**
	(0.271)	(0.131)	(0.330)	(0.309)	(0.320)	(0.596)	(0.252)		(0.245)
Half-skimmed	0.283***		0.664***	0.400***	0.360***	0.766***	-0.201***		0.189***
	(0.065)		(0.085)	(0.083)	(0.089)	(0.176)	(0.070)		(0.070)
Full fat	0.250***		0.384***	0.142	0.229**	0.995***	0.010		0.226***
	(0.082)		(0.106)	(0.102)	(0.106)	(0.207)	(0.086)		(0.084)
Fromage blanc	1.447***		-0.009	-0.767***	-0.669***	0.303	-0.262*		-0.123
	(0.162)		(0.198)	(0.173)	(0.183)	(0.378)	(0.136)		(0.134)
Low-quality	-1.608***		0.367***	0.204*	0.221*			0.169***	
	(0.184)		(0.121)	(0.112)	(0.119)			(0.032)	
Mid-quality	-0.490***		0.364***	0.452*	0.447***			0.069***	
	(0.158)		(0.085)	(0.077)	(0.079)			(0.023)	
Below 200g	1.290***					-0.411***			
	(0.053)					(0.151)			
Smooth	-0.651***								
	(0.068)								
Terms to correct for endogeneity									
Residuals, price	0.585***								
	(0.056)								
Residuals, label	0.898***								
	(0.129)								
Err. compnt, price	-0.246***								
	(0.087)								
Err. compnt, label	0.004								
	(0.098)								

Note: Standard errors are in parentheses; ***, ** and * Significant at the 1%, 5% and 10% levels; The column "Std. dev." reports the standard deviation of random effects; Random effects are distributed according to the opposite of a lognormal law for price, and according to a normal law for label; Their coefficient of correlation is 2.594***; Other control variables are fixed effects for the 14 distribution channels and 15 brands or groups of brands (results available from the authors on request); Results are obtained with $D = 500$ draws; The reference individual is a female meal shopper in the top income quartile, aged under 65, whose BMI is under 27.

Results: the household WTP for the labels

Table 5: **Distribution of the willing to pay for various demographic groups (in Euros)**

	Proportion of households in percent					
Household	WTP≤-2	-2<WTP≤-1	-1<WTP≤0	0<WTP≤1	1<WTP≤2	Max WTP in Euro
All	18.47	7.73	11.85	16.31	45.64	1.81
Main shopper's body weight						
Normal weight (BMI<25)	20.06	7.25	10.72	17.42	44.55	1.81
Overweight (25≤BMI<27)	19.45	6.68	9.42	15.61	48.84	1.80
Risky-overweight (27≤BMI<30)	16.25	7.99	14.02	14.25	47.49	1.80
Obese (BMI>30)	12.40	10.48	17.93	13.98	45.21	1.78

Results: the household WTP for the labels

Table 6: **Distribution of WTP for labels according to household's product choice**

	Median of the WTP (€)		Equality of median test
	Never	At least once	p-value
Outside option	1.07	-0.40	0.000
Skimmed/fat-free fromages blancs	0.33	1.05	0.000
Half skimmed fromages blancs	-0.45	1.01	0.000
Full fat fromages blancs	0.80	0.42	0.040
Half skimmed dessert yogurts	0.88	-1.71	0.000
Full fat dessert yogurts	1.13	-4.74	0.000

Results: policy simulation

- **Fat tax: +5% on the price (offered by the supply-side) for the half-skimmed products, +10% for the full-fat products.**

- **Mandatory labeling: all products must display a fat-content label.**

Results: policy simulation

Table 9: Variations in market shares and prices following a fat tax and a mandatory fat-content label, by product category

		Fromage blanc			Dessert yogurts	
	Outside option	Skimmed/fat-free	Half-skimmed	Full-fat	Half-skimmed	Full-fat
Initial market shares in percent	6.18	15.88	38.09	15.46	6.77	17.62
Initial producer prices in Euro		1.98	1.97	2.95	2.87	3.06
Initial margins in Euro		0.46	0.44	0.41	0.57	0.67
Mandatory labelling policy						
Share variation with no firm response in pp	4.79	1.99	3.55	3.97	-1.68	-12.62
Share variation with firm response in pp	3.86	-1.84	-6.39	-0.01	0.74	3.64
Producer price variations in Euro		0.10	0.10	0.22	-1.03	-1.38
Margin variations in pp		0.01	0.02	0.02	-0.09	-0.20
Fat tax policy						
Share variation with no firm response in pp	0.81	2.66	-0.12	-2.49	0.06	-0.92
Share variation with firm response in pp	0.65	2.83	-1.08	-2.27	0.12	-0.25
Producer price variations in Euro		-0.03	0.01	-0.02	-0.10	-0.15
Margin variations in pp		-0.01	0.00	-0.01	-0.01	-0.02

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Results: policy simulation

Table 10: **Variations in market shares following a fat tax and a mandatory fat-content label, by product category and demographic group (in percentage point)**

		Δ Fromage blanc share			Δ Dessert yogurts share	
	Outside option	Skimmed fat free	Half skimmed	Full fat	Half skimmed	Full fat
			Labelling policy			
First income quartile	4.00	-1.04	-5.15	0.14	1.04	1.01
Second income quartile	3.70	-3.26	-9.64	-1.41	1.63	8.98
Third income quartile	3.92	-2.25	-7.19	-0.09	0.64	4.97
Fourth income quartile	3.84	-0.95	-3.95	1.15	-0.20	0.11
Meal shopper BMI<25	3.92	-1.47	-5.61	0.25	0.60	2.31
Meal shopper 25≤BMI<30	3.77	-2.14	-7.06	-0.16	0.75	4.84
Meal shopper BMI≥30	3.75	-2.99	-8.65	-0.98	1.49	7.38
Male	4.24	-0.58	-5.00	0.85	-0.05	0.54
Female	3.85	-1.90	-6.45	-0.05	0.78	3.77
Aged under 65	4.01	-2.10	-6.62	-0.55	1.02	4.24
Aged above 65	3.50	-1.25	-5.86	1.22	0.12	2.27
			Fat tax policy			
First income quartile	0.61	2.82	-1.12	-2.22	0.18	-0.27
Second income quartile	0.66	2.84	-1.20	-2.14	0.13	-0.29
Third income quartile	0.66	2.59	-0.94	-2.19	0.13	-0.25
Fourth income quartile	0.67	3.02	-1.04	-2.50	0.06	-0.21
Meal shopper BMI<25	0.65	2.83	-1.10	-2.25	0.12	-0.25
Meal shopper 25≤BMI<30	0.67	2.77	-1.02	-2.29	0.12	-0.25
Meal shopper BMI≥30	0.67	2.97	-1.13	-2.37	0.13	-0.27
Male	0.78	2.06	-0.05	-2.80	0.16	-0.15
Female	0.64	2.87	-1.12	-2.25	0.12	-0.26
Aged under 65	0.65	3.04	-1.22	-2.31	0.12	-0.28
Aged above 65	0.65	2.36	-0.76	-2.18	0.12	-0.19

Results: policy simulation

Table 12: **Variations in average household annual fat purchased following a fat tax and a mandatory fat-content label, by demographic group (in gram)**

	Base	Fat tax		Mandatory fat label	
	Fat	No firm response	Firm response	No firm response	Firm response
All	844	-289	-46	-325	4
Income					
First quartile	856	-287	-46	-318	-7
Second quartile	846	-299	-47	-328	21
Third quartile	849	-284	-43	-324	11
Fourth quartile	830	-287	-50	-328	-5
Meal shopper BMI					
BMI<25	836	-288	-46	-323	1
25≤BMI<30	851	-287	-46	-324	8
BMI≥30	871	-303	-50	-336	13

Results: policy simulation

Table 13: Change in household's surplus following a fat tax and a mandatory fat-content label, by demographic group (in percent)

$\frac{CS_i^{new} - CS_i^{old}}{CS_i^{old}}$	Fat tax	Mandatory fat label
All	-2.54	52.44
Income		
First quartile	-2.75	55.07
Second quartile	-2.60	52.81
Third quartile	-2.46	47.86
Fourth quartile	-2.39	53.39
Meal shopper BMI		
BMI<25	-2.52	51.68
25≤BMI<30	-2.58	53.76
BMI≥30	-2.58	53.07
Male	-3.06	52.90
Female	-2.52	52.42
Aged under 65	-2.65	56.09
Aged above 65	-2.30	44.14

Note: In the fat tax policy, the producer price of all full-fat products increases by 10%, and the producer price of all half-skimmed products increases by 5%; All results integrate firms' strategic pricing response.

Conclusion

- Fat content labels have on average a positive value, even if nutrition panel facts are already available.
- However, there is an heterogeneity in the WTP for fat-content labels: it is lower for the low-income people, the obese, and the consumers of dessert yogurts.
- A mandatory labeling policy would be less efficient than a fat tax policy, essentially because firms have the ability to cut margins on dessert yogurts.
- The simulated impact does not vary so much according the weight status of the meal planner: mandatory labeling may even have unintended consequences on obese.