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Abstract

After fossil fuels, agricultural production and fisheries are industries with the largest impact on the environment in terms of greenhouse gas (GHG) emissions, especially in the production of ruminant meats such as beef, veal or lamb. In order to reduce this environmental impact, consumers can change their food consumption habits to utilize less polluting products such as white meats or vegetable food products. We analyze whether or not a CO_2 equivalent (CO_2-eq) tax policy can change consumer habits with respect to meat and marine purchases, and using different indicators, we examine the effect of such a tax policy on the environment. We also infer the implications of such a tax on nutritional indicators as well as on consumer welfare. First, to evaluate the impact of a variation in the price of meat and marine products on consumption, we estimate a random coefficients logit demand model using purchase data from the French household panel Kantar Worldpanel. We define 28 meat and marine products, and divide them into eight meat and marine product categories. This model allows us to estimate flexible own- and cross-price elasticities of meat and marine products' demand. Results on the consumer purchase behavior model suggest that the demands for these products are fairly inelastic, and substitutions occur both within and between categories for all products. Moreover, using two levels of a CO_2-eq tax (€56 and €200 per tonne of CO_2-eq per kilogram of product) applied to either all meat and marine products, only ruminant meats, or only beef, we show that a tax of €56 leads to a very small change in GHG emissions, even if all meat and marine products are taxed. The most efficient scenario would be to tax only the beef category at a high level since it would allow a 70% reduction in the total variation of GHG emissions, and would be responsible for only 20% of the consumer welfare damages generated when all products are taxed.

Key words: meat, demand analysis, environment, greenhouse gas, CO_2-eq tax, consumer diet

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1 Introduction

After fossil fuels, agricultural production and fisheries are the two main industries that impact the environment the most. They are significant contributors in terms of climate change but also in terms of eutrophication, land use, water use and toxicity. Among agricultural activities, meat and dairy are two of the major impacting sectors, as a large proportion of crops are indirectly used for the production of meat and marine products, resulting in a high land use (UNEP, 2010). The environmental impact of food is in large part determined by household diet and consumption habits. For instance, Reynolds et al. (2015) evaluate that meat and bakery products/flour/cereals are the food categories with the largest footprint contribution for all household income classes in Australia, and that the higher the household income, the larger the environmental burden.

Population and economic growth should lead to an even higher environmental impact on the future if patterns of production and consumption are not changed. Moreover, as the aggregate world meat consumption, as well as per capita consumption, has increased over time (by 60% and 25% respectively between 1990 and 2009 from Henchion et al. (2014)), this trend is predicted to continue in the future. For instance, the study of Fiala (2008) shows that if current consumption patterns continue, total meat consumption will increase by 72% between the years 2000 and 2030, mostly lead by a large increase in chicken and pork consumption. Such a trend is also observed in Europe. For instance, the share of meat in the Spanish diet increased between 1970 and 2005 with an average annual meat consumption per capita that rose from 11.7 kg to 65 kg (Rios-Nunez et al., 2013). This trend in the consumption per capita in the European Union (EU) is expected to be positive for all meats (except sheep meat) between 2013 and 2022 with a decrease in the share of red meat in the total meat consumption in favor of white meat (Henchion et al., 2014). In France, the total consumption of meat has decreased since 1998. However, France still represents one of the three countries with the highest consumption of animal proteins in the European Union (source FAOSTAT).[1] In 2014, the quantity consumed in France accounts respectively for more than 20% of the total EU consumption (in tonnes equivalent carcass) for beef, veal and marine products, 14% for poultry and 11% for pork (FranceAgriMer, 2015).

At the consumption end, some studies have analyzed how changes in consumption habits and diet may mitigate the environmental impact of food consumption. However, as shown in Hedenus et al. (2014), the literature on the mitigation potential through dietary changes under the constraints of consumer preferences is relatively poor. Hedenus et al. (2014) considered different assumptions on food consumption patterns using FAO projection and two assumptions with respect to consumer preferences: "75% of ruminant meat and dairy products are replaced by other meat (on kcal basis)", and "75% of animal food is replaced by pulses and cereals (on kcal basis)". They conclude that environmental impacts can be mitigated only with dietary changes in which the consumption of animal products is reduced. In the same vein, Tukker et al. (2011) estimate the impact of three simulated diet patterns (a pattern according to universal dietary recommendations, the same pattern with reduced meat consumption, and a

[1] http://faostat3.fao.org/

'Mediterranean' pattern with reduced meat consumption) with respect to a status quo scenario. They found a reduction of up to 8% in the environmental impact in reduced meat scenarios but that higher exports will compensate for losses on the domestic meat market. In addition, as emphasized by McMichael et al. (2007) and Horrigan et al. (2002), the growth in meat consumption, and in animal fat in particular, can also increase the risk of chronic diseases, and thus does not only exacerbate environmental problems but also health risks. Along these lines, using simulations of scenarios representing different variants of meat consumption in Sweden, Hallstrom et al. (2014) show the existence of beneficial synergies of a reduction in meat consumption in Sweden in terms of health, greenhouse gas emissions and land use.

Changing consumption habits towards a more sustainable direction and achieving a reduction in meat consumption may be a difficult task even if it is part of the sustainability public policy objectives (Austgulen, 2014). In this paper, we propose to analyse the impact of environmental price policies that target meat and marine products based on the analysis of French consumers' purchasing behaviors. This analysis requires a precise knowledge of consumer demand for meat and marine products. In the literature focusing on animal products demand estimation, most studies use data aggregated at the country or regional level, while only a few studies are conducted at the individual consumer level. Moreover, most of the literature deals with the demand for meat in North America (Gallet, 2010). In this paper, we develop a demand model of French meat and marine products consumption. We develop a random coefficients logit model using individual data from a French household panel that gives detailed information on food purchases. This discrete choice model allows for the analysis of consumer preferences for all purchase alternatives available in the market. This model also allows for the estimation of consumption patterns between the different meat and marine products but also for substitution with an alternative food product aggregate composed only of vegetable food products. As far as we know, the proposed demand model is one of the most disaggregated ones with 28 possible meat and marine product alternatives proposed to consumers. This disaggregated model allows us to catch the substitution pattern at a very precise product level. Given the demand patterns for the different animal product categories, we analyze whether or not public policy tools can be used to encourage more sustainable food consumption habits. We focus on environment-based taxes. Such taxes are used, for instance, in Sweden to reduce emissions (a carbon tax but also a sulfur tax). We focus on a GHG tax based on CO_2 equivalent and examine if such a tool can efficiently guide consumers' choice of food consumption (cf. Vinnari and Tapio (2012), Wirsenius et al. (2011) and Edjabou and Smed (2013)). We investigate the impact of different carbon tax policies.[2] In 2007, the European Union committed to target a limitation of global warming to 2°C (as per pre-industrial times) in order to halve the global emissions by 2050. In order to achieve these objectives, GHG emissions should be reduced by 20% by 2020 at the 1990 levels and by 60% by 2050, and the recommended carbon price should be set at €56 per ton of CO_2-eq in 2020 and €200 per ton of CO_2-eq in 2050 (Quinet, 2009). We use these levels of carbon prices to simulate the impact of an CO_2-eq tax policy on meat and marine products. We compare the effects of taxing all meat and marine products given their contribution to climate change, only ruminant products, or only beef products, all of which have the highest environmental impact. We compare the

[2]The term "carbon" in this paper will refer to GHG emissions or CO_2-eq emissions.

results according to their environmental impacts as well as their effect on consumer welfare. Finally, we infer the nutritional impacts of such policies in order to evaluate corroborating results or not.

Our results on consumer purchase behavior suggest that the demands for those products are fairly inelastic. Own-price elasticities for categories of meat and marine products range from -0.82% to -1.07%. Substitutions occur both within and between categories for all products. Moreover, using two levels of carbon tax (€56 and €200 per tonne of CO_2-eq per kilogram of product) applied to either all the meat and marine products, only ruminant meats, or only beef, we show that a tax of €56 leads to a very small change in GHG emissions, even if all meat and marine products are taxed (-1.54%). Even a high level of €200 per tonne of CO_2-eq is not a sufficient level to meet the 20% objective threshold of GHG emissions reduction for 2020, since it would only lead to a 5% decrease. Despite the weak effect of such a tax, the most efficient scenario would be to tax the beef category only at a high level, since it would allow a 70% reduction in the total variation of GHG emissions but would only generate 20% of consumer welfare damage generated when all products are taxed.

The following section motivates the use of taxes based on GHG emissions to mitigate environmental emissions. Section 3 discusses the market for meat and fisheries in France. In Section 3, we also present our estimation methodology to estimate the demand for the different categories of meat and marine products, as well as the demand estimation results that drive the demand substitution patterns for these products in France. Section 4 presents the different CO_2-eq tax policy simulations and analyzes their impact on different environmental and nutritional indicators. The last section concludes.

2 Motivation for an environmental tax policy and related literature

Market failures that lead consumers to make suboptimal decisions are one of the main reasons to justify public intervention. Suboptimal food choices result from consumers' lack of information about the environmental impact of the food products on the one hand, but also by the externalities of such choices on wildlife, global pollution and on human health, on the other hand.

In order to change consumption patterns, different policy tools can be used including tax policies, information intervention programs or subsidies. Informational measures have been analyzed in the literature mainly under the form of dietary recommendations, promotions via social marketing campaigns, labeling regulation, and/or educational measures. While such tools clearly modify attitudes and behaviors towards healthy diets, they do not seem to have a significant impact on consumers' consumption, at least in the short/medium term (for a survey, see the report of Traill et al. (2013)). Environmental subsidies could be an option if they provide incentives to invest in environmental innovations. However, they are costly, as all taxpayers will have to pay for the subsidies whatever their consumption of meat and marine products. Moreover, these subsidies are not able to drastically change consumers' purchasing behavior as consumers will not have to pay a higher price for high impacting meat and marine products. Thus, among the available instruments, taxes are the most efficient tools, as they directly address the negative externalities linked with environmental damage. The resulting prices can integrate environmental cost impacts such that both consumers and firms will adapt their behaviors to reduce their environmental footprint. Thus, this policy instrument is that which is recommended by most economists (Quinet, 2009).

A tax can be implemented either directly on emissions, on the product input at the origin of the environmental impact or on the final product purchased by consumers. From economic theory we know that it is more efficient to use a tax that directly targets the source of the market failure. However, as highlighted by Edjabou and Smed (2013) and Wirsenius et al. (2011), in the case of agricultural products, the monitoring costs are high, the technical potential for emission reduction is low and the possible output substitution exists such that emission or input taxes are less effective than output based taxes. Thus, we propose in this paper to estimate whether or not consumption taxes differentiated by the level of GHG emissions of meat and marine products can mitigate environmental indicators. This idea of taxing animal products is not new, as acknowledged by Vinnari and Tapio (2012). High enough taxes can be efficient tools to guide consumer decision-making. However the effectiveness of such taxes has not yet been fully investigated.

Few studies have explored the impact of an environmental tax on food consumption, most of which consider taxes based on CO_2 emissions even if a multi-GHG tax can be more efficient than a CO_2 tax (Feng et al. (2010)). Edjabou and Smed (2013) analyze the impact of a tax in Denmark based on CO_2 emissions on more than 20 food products differentiated with respect to average GHG emissions. This analysis is based on elasticity estimates from Smed et al. (2007). Their most efficient scenario leads to a decrease in GHG emissions for an average household by 2.3%–8.8% (at a cost of 0.15–1.73 DKK per kg CO_2 equivalent), and their most effective scenario in reducing the environmental footprint leads to a larger decrease in the GHG emissions by 10.4%–19.4% but at a higher cost (3.53–6.90 DKK per kg CO_2 equivalent). Wirsenius et al. (2011) focus on GHG weighted consumption taxes on animal food products in the EU, based on a model of food consumption in the EU. They show that agricultural emissions in the EU27 can be reduced by approximately 32 million tons of CO_2-eq with a tax of €60 per ton CO_2-eq, and that most of the effect of a GHG based tax on animal food can be captured by taxing the consumption of ruminant meat alone. The studies of Edjabou and Smed (2013) and Wirsenius et al. (2011) rely on demand elasticity values at a meat category aggregate (pork, beef, etc.). We contribute to this literature by providing an exhaustive analysis of the demand for meat and marine products at a very detailed product level using a unique dataset. This allows for the estimation of elasticities that can be comparable at a very disaggregated level, and for substitution estimates according to product by product substitution, not only at a meat category level.

Two different tax strategies could be used to reduce the environmental impact of meat and marine product consumption: first, reduce the global consumption of those products; and second, favor the substitution within the meat and marine category toward less impacting animal products. Analyzing the benefits of public policies that target this second option requires having precise knowledge of consumer demand for such animal products. In this paper, we thus propose to analyze the impact of environmental price policies that target either all meat and marine products or some meat products based on the analysis of consumer purchasing behaviors towards meat and marine products.

3 Consumption substitution patterns in the French meat and marine market

We use a structural model of demand to estimate consumer preferences for meat and marine products and derive the substitution between these products.

3.1 Data on the French meat and marine market

To conduct the analysis on the consumption of meat and marine products, we use consumer panel data collected by Kantar WorldPanel, a French representative survey of over 25,766 households conducted in 2010. This database records information about all purchases of food products for each household in the panel (for example quantity, price, brand, characteristics of goods, and the retailer from which the products are purchased). The data cover household purchases for home consumption. Out-of-home consumption, which represents around 25% of the total food consumption, is not taken into account.

We aggregate the meat and marine purchases at a monthly level. A period is defined as four consecutive weeks of purchases, with the study carried out over 13 periods. We consider eight categories of meat and marine products (pork, beef, chicken, other poultry, other meats, marine food, eggs and ready-made meals), with each category disaggregated into several products (cf. Table 1). In particular, we choose to separate fresh meat from processed meat and to disaggregate these further according to the use of pieces. This is why the pork category contains more products than beef or chicken, for example. When products from the same category have low frequencies, they are grouped into an "other" aggregate.

We define an outside good, which represents a substitute for the 28 meat and marine products. It is composed of vegetable food products, such as vegetables, starches, pulses and vegetable ready-made meals. The share of this vegetable food product is roughly 45% of the defined market. Defining such an outside option allows us to consider substitutions between meat and marine food, and vegetable food. From our data, we compute that the average consumption of meat and marine food is about 84g and 24g a day per person respectively; values consistent with the INCA2 report (Afssa, 2009).[3] Pork meat and marine food products dominate the meat and marine products market since they represent on average 34% and 16% of meat and marine product purchases respectively (19% and 9% of the entire market). It is important to

[3]INCA2 ("Etude Individuelle Nationale des Consommations Alimentaires 2006") is a survey on individual food consumption over a seven-day time period for a sample of 2,624 French adults and 1,455 children.

Table 1: Descriptive statistics

Product	Market share (%)	Price (€/Kg)
Fresh pork	1.34 (0.09)	6.38 (0.41)
Cooked ham and roasts	5.60 (0.21)	10.57 (0.08)
Fresh sausages	1.17 (0.30)	7.58 (0.26)
Other sausages (Frankfurt, Strasbourg)	1.22 (0.10)	5.19 (0.15)
Bacon	2.23 (0.23)	6.95 (0.12)
Blood pudding	0.64 (0.16)	9.10 (0.28)
Other pork (dry sausage, pate, processed pork)	6.77 (0.36)	11.15 (0.36)
Pork category	**18.96 (0.66)**	**8.80 (0.21)**
Minced beef	2.04 (0.16)	7.43 (0.13)
Beef for grilling	1.37 (0.07)	14.93 (0.38)
Other beef (for braising or boiling, marinated)	0.86 (0.14)	8.39 (0.85)
Beef category	**4.27 (0.27)**	**10.37 (0.55)**
Ready to cook chicken	0.35 (0.04)	4.98 (0.17)
Chicken parts	0.99 (0.09)	6.57 (0.16)
Other chicken (ham, breaded chicken)	1.79 (0.18)	8.50 (0.20)
Chicken category	**3.12 (0.29)**	**6.52 (0.17)**
Turkey	1.71 (0.10)	7.92 (0.22)
Duck	0.81 (0.32)	17.26 (3.32)
Other poultry (goose, ostrich, rooster)	0.66 (0.10)	7.89 (0.83)
Other poultry category	**3.19 (0.35)**	**9.66 (1.27)**
Veal	0.85 (0.09)	14.41 (0.57)
Lamb, sheep	0.43 (0.06)	11.87 (0.62)
Mixed meats	0.32 (0.03)	7.41 (0.55)
Rabbit	0.19 (0.02)	8.67 (0.27)
Other meats (horsemeat, game)	0.30 (0.11)	13.15 (1.47)
Other meat category	**2.09 (0.12)**	**11.91 (0.39)**
Fresh fish	2.13 (0.16)	12.43 (0.42)
Fresh shellfish	0.80 (0.20)	7.98 (1.04)
Processed fish and shellfish	6.09 (0.60)	10.71 (1.18)
Fish category	**9.02 (0.54)**	**10.62 (0.58)**
Eggs	**3.51 (0.14)**	**4.96 (0.08)**
Pizzas, quiches	0.99 (0.05)	6.57 (0.08)
Snacking	1.58 (0.06)	6.28 (0.40)
Other ready-made meals	8.44 (0.80)	6.84 (0.36)
Ready-made meal category	**11.01 (0.80)**	**6.73 (0.32)**
Outside Good	**44.83 (1.26)**	**-**

(.) : standard deviation

Numbers on grey rows are weighted means

note that ready-made meals make a large part of consumer consumption, representing 11% of the purchases. According to the INCA2 report, there was no change in the number of ready-made meals between 1989 and 2006. Among meat and marine products, beef (mainly for grilling), marine food products, and some specific poultry products such as duck (€17 per kilogram), and other meats such as veal, are the most expensive products, with a weighted average price around €10 per kilogram or more. Households face lower prices for eggs, chicken, ready-made meals and pork (except for some products such as cooked ham and roasts), which would explain the bigger market shares for these categories. Prices per category tend to be stable within the considered period as the standard deviations of prices (indicating the variability of prices over periods) are small for the meat categories. However, the variability is larger at the product level within meat categories, especially for duck, other meats and processed marine food products.

3.2 Demand model

We use a random utility approach, in particular, a random coefficients logit model, to estimate the demand model and the related price elasticities. This structural model based on consumers' utility generates flexible substitution patterns of consumers (Revelt and Train, 1998). We assume that the indirect utility function V_{ijt} for consumer i buying product j at period t is given by:

$$V_{ijt} = \beta_j + \alpha_{ij} p_{jt} + \epsilon_{ijt}, \tag{1}$$

where β_j is a product fixed effect that captures the (time invariant) unobserved products characteristics and then represents the average preference of consumers for product j, p_{jt} is the price of product j at period t, α_{ij} is the marginal disutility of the price for consumer i, and ϵ_{ijt} is an unobserved individual error term. We assume that α_{ij} varies across consumers because their disutility with respect to prices could be heterogeneous. We assume that the parameter has the following specification:

$$\alpha_{ij} = \sum_{c=1}^{C} \alpha_{c_j} + \sigma \nu_i,$$

where α_{c_j} is the mean price sensitivity for consumers buying a product in a category c, C is the total number of categories, ν_i captures unobserved consumer characteristics, and σ measures the dispersion of the unobserved heterogeneity from the mean price sensitivity. We assume a parametric distribution for ν_i denoted by $P_\nu(.)$ and P_ν is independently and identically distributed as a standard normal distribution.

We can then break down the indirect utility into a mean utility:

$$\delta_{jt} = \beta_j + \sum_{c=1}^{C} \alpha_{c_j} p_{jt},$$

and a deviation from this mean utility $\mu_{ijt} = p_{jt} \sigma \nu_i$. The indirect utility is then given by:

$$V_{ijt} = \delta_{jt} + \mu_{ijt} + \epsilon_{ijt}.$$

The consumer can decide not to choose one of the considered products. Thus, we introduce an outside option that allows for substitution between the considered meat and marine products, and a substitute with vegetable food. The utility of the outside good is normalised to zero. The indirect utility of choosing the outside good is $V_{i0t} = \epsilon_{i0t}$.

Assuming that ϵ_{ijt} is independently and identically distributed like an extreme value type I distribution, we are able to write the individual probability for consumer i to buy product j at time t in the following way:

$$s_{ijt} = \frac{\exp\left(\delta_{jt} + \mu_{ijt}\right)}{1 + \sum_{k=1}^{J} \exp\left(\delta_{kt} + \mu_{ikt}\right)}.$$

The aggregated market share of product j at period t is then given by (Nevo, 2001):

$$s_{jt} = \int_{A_{jt}} \left(\frac{\exp\left(\delta_{jt} + \mu_{ijt}\right)}{1 + \sum_{k=1}^{J} \exp\left(\delta_{kt} + \mu_{ikt}\right)} \right) dP_{\nu}(\nu),$$

where A_{jt} is the set of consumers who have the highest utility for product j at period t, a consumer being defined by the vector $(\nu_i,\epsilon_{i0t},...,\epsilon_{iJt})$.

The random coefficients logit model generates a flexible pattern of substitution between products, driven by the different consumer price disutilities α_{ij}. Thus, the own- and cross-price elasticities of the market share s_{jt} can be written as:

$$\frac{\partial s_{jt}}{\partial p_{kt}} \frac{p_{kt}}{s_{jt}} = \begin{cases} -\frac{p_{jt}}{s_{jt}} \int \alpha_{ij} s_{ijt}(1 - s_{ijt}) \phi(\nu_i) d\nu_i & \text{if } j = k \\ \frac{p_{kt}}{s_{jt}} \int \alpha_{ik} s_{ijt} s_{ikt} \phi(\nu_i) d\nu_i & \text{otherwise.}^4 \end{cases}$$

Own-price (cross-price respectively) elasticity of market share s_{jt} represents the variation of market share s_{jt} when the price of product j (k different from j respectively) at time t increases by 1%.

3.3 Price elasticities

We estimate the demand model (1) using individual data.[5] From the demand estimation results and market share estimates, own- and cross-price elasticities of demand among meat and marine products can be computed. From these individual product elasticities, we also compute aggregated own- and cross-price elasticities by meat and marine product categories.

Table 2 reports the own-price elasticities at the product level in the second column, the cross-price elasticities within the same meat or marine product category in the third column and the cross-price elasticities between products of different product

[4] Where ϕ is the probability density function of the normal distribution.

[5] We use a subsample of 500,000 over 7,260,307 observations to estimate the demand parameters. This subsample is representative of the whole sample in terms of purchase shares over products and time periods. The results are available upon request.

categories in the fourth column. The own-price elasticities vary from −0.87 to −1.11, meaning that the demands at the product level are rather inelastic. Consumers are more responsive to changes in the own-price of fresh pork and sausages, fresh shellfish, pizzas, and snack food, and less responsive to changes in the own-price of duck, veal and other meats. The last three products are the more expensive products, meaning that those high-quality level product demands are the most inelastic. Table 2 also shows that substitutions occur both within and between categories for all products. For most of the products, these substitutions are higher towards other products from the same product category. However, this is not the case for minced beef and other beef, two of the three chicken products, turkey, lamb/sheep and mixed meats for which the cross-price elasticities are higher towards other products from other meat categories, and for other pork sausages where the substitution with vegetable food product is the highest.

At the aggregated category level, own-price elasticities of the eight categories are between −0.82 and −1.07 (Table 3). These estimates are consistent with other studies on meat consumption performed at the category level. From the meta-analysis conducted in Gallet (2010), predicted price elasticities range from −0.78 (poultry) to −1.62 (lamb) when considering studies from different countries around the world. This elasticity is evaluated at −0.85 at the world meat level and −0.88 for Southern Europe, while the demand for meat is more elastic in Northern Europe with an elasticity evaluated at −1.016. A recent study conducted by Dong et al. (2015) on US household purchases confirms the inelasticity of meat demand in the US. Based on a censored AIDS demand system model, they found estimates varying from −0.48 (seafood products) and −0.75 (ground beef).

Table 2: Intra and inter category cross-price elasticities for each meat product

	Own-price elasticities	**Cross-price elasticities**		**OG**
		Same Category Other Products	**Other Categories Other Products**	
Fresh pork	-1.1023	0.0161	0.0145	0.0149
Cooked ham and roasts	-0.9940	0.0873	0.0771	0.0351
Fresh sausages	-1.1003	0.0154	0.0138	0.0108
Other sausages (Strasbourg)	-1.0937	0.0125	0.0113	0.0156
Bacon	-1.0873	0.0280	0.0255	0.0229
Blood pudding	-1.0889	0.0094	0.0084	0.0049
Other pork	-0.9703	0.1069	0.0932	0.0388
Minced beef	-1.0529	0.0208	0.0292	0.0137
Beef for grilling	-0.9408	0.0223	0.0210	0.0032
Other beef	-1.0507	0.0103	0.0118	0.0047
Ready to cook chicken	-1.0062	0.0037	0.0052	0.0013
Chicken parts	-0.9509	0.0130	0.0148	0.0024
Other chicken	-0.9049	0.0298	0.0268	0.0031
Turkey	-1.0062	0.0182	0.0258	0.0075
Duck	-0.8674	0.0223	0.0129	0.0008
Other poultry	-0.9078	0.0146	0.0128	0.0013
Veal	-0.8836	0.0093	0.0063	0.0004
Lamb, sheep	-1.0231	0.0073	0.0092	0.0027
Mixed meats	-0.9114	0.0042	0.0047	0.0004
Rabbit	-0.9011	0.0041	0.0038	0.0003
Other meats	-0.8829	0.0078	0.0049	0.0003
Fresh fish	-1.0520	0.0339	0.0291	0.0141
Fresh shellfish	-1.1101	0.0096	0.0084	0.0084
Processed fish and shellfish	-1.0112	0.0896	0.0790	0.0501
Eggs	-1.0668	.	0.0407	0.0352
Pizzas, quiches	-1.0914	0.0145	0.0124	0.0079
Snacking	-1.0872	0.0230	0.0198	0.0137
Other ready-made meals	-0.9739	0.1325	0.1104	0.0665

Table 3: Own- and cross-price elasticities

	Pork	**Beef**	**Chicken**	**Other poultry**	**Other meat**	**Fish, shellfish**	**Eggs**	**Ready-made meals**	**OG**
Pork	**-0.8153**	0.2185	0.1311	0.1800	0.0578	0.2829	0.3152	0.2836	0.1431
Beef	0.0649	**-0.9825**	0.0417	0.0509	0.0224	0.0665	0.0696	0.0669	0.0216
Chicken	0.0475	0.0488	**-0.9059**	0.0481	0.0311	0.0474	0.0443	0.0477	0.0067
Other poultry	0.0494	0.0465	0.0381	**-0.9589**	0.0233	0.0501	0.0500	0.0504	0.0115
Other meats	0.0313	0.0379	0.0470	0.0419	**-0.8482**	0.0301	0.0255	0.0302	0.0022
Fish, shellfish	0.1286	0.1007	0.0575	0.0815	0.0241	**-0.9659**	0.1518	0.1347	0.0727
Eggs	0.0452	0.0333	0.0166	0.0256	0.0063	0.0475	**-1.0668**	0.0475	0.0352
Ready-made meals	0.1586	0.1244	0.0703	0.1003	0.0292	0.1658	0.1875	**-0.9370**	0.0881

Table 4: Own- and cross-price elasticities (values)

	Pork	**Beef**	**Chicken**	**Other poultry**	**Other meat**	**Fish, shellfish**	**Eggs**	**Ready-made meals**	**OG**
Pork	**-0.1523**	0.0091	0.0039	0.0056	0.0012	0.0252	0.0109	0.0309	0.0654
Beef	0.0121	**-0.0409**	0.0012	0.0016	0.0005	0.0059	0.0024	0.0073	0.0099
Chicken	0.0089	0.0020	**-0.0271**	0.0015	0.0007	0.0042	0.0015	0.0052	0.0031
Other poultry	0.0092	0.0019	0.0011	**-0.0297**	0.0005	0.0045	0.0017	0.0055	0.0053
Other meats	0.0058	0.0016	0.0014	0.0013	**-0.0180**	0.0027	0.0009	0.0033	0.0010
Fish, shellfish	0.0240	0.0042	0.0017	0.0025	0.0005	**-0.0861**	0.0052	0.0147	0.0332
Eggs	0.0084	0.0014	0.0005	0.0008	0.0001	0.0042	**-0.0368**	0.0052	0.0161
Ready-made meals	0.0296	0.0052	0.0021	0.0031	0.0006	0.0148	0.0065	**-0.1021**	0.0402

The resulting elasticities at the category level are shown in Table 3. Because prices and market shares are different from one category to another, these elasticities do not reflect the magnitude of substitution effects among categories. We thus also provide in Table 4 elasticities in terms of market share changes (evaluated at the observed market share).

Cross-price elasticity values presented in Table 4 show that an increase in the price of one category of products will increase the market shares of all other categories, especially ready-made meals and vegetable food products. For the other meat categories (including beef, chicken, other poultry and other meats), the pork category benefits the most from an increase in the price of the considered meat category.

The second most important market share report for the meat categories is for ready-made meals and then on vegetable food products, except for beef for which the report on vegetable food products is higher. An increase in the price of the marine food products or in the price of eggs induces higher market share reports towards the vegetable food category, the pork category and then towards the ready-made meals category.

Finally, regarding a change in the price of the ready-made meals, reports are mainly in favor of the vegetable food aggregate and pork.

From the own-price elasticity results, we can thus conclude that a change in the price of a given meat and marine product will not generate a large decrease in the purchase of this product. These results may be explained by the existence of pre-committed demand (Tonsor and Marsh, 2007). Some purchases may be influenced by non-price factors such as generic advertising, food safety concerns or health concerns. Other habits such as cultural or family habits could also explain this inelastic demand for meat and marine products. Moreover, among meat categories, pork that which benefits most from a price increase in any other meat category. Finally, the substitutions with ready-made meals and vegetable food are important and may even be higher in value for the vegetable food category. This is the case when the price of pork, marine food products or eggs increases.

4 Impact of a taxation policy on food diet

Using data on the environmental impact of our 28 differentiated meat and marine products, we analyse some pricing policy instruments such as taxes to infer how food consumption behavior could be changed towards more sustainability.

4.1 Environmental data

We use environmental data collected by Greenext, a French company specializing in calculating and analyzing the environmental impact of consumer goods. This database contains three environmental indicators (acidification, eutrophication and climate change) for 311 different food products. The environmental data are based on the life-cycle analysis (LCA) of the differentiated products. LCA is a multi-step method which allows us to take into account all the phases of the life-cycle of a product from the production of raw materials, processing, distribution and use, until the end of its life.

We use this data source because it is the only source of environmental indicators available at such a detailed level in France that provides comparable values for the different products. The methodology used to compute those values is consistent among all products considered in the database, and the indicators used are the most reliable among the environmental data actually measured. Thus, other environmental indicators such as energy use, land use or biodiversity are not taken into account in this study because data for these are not available in a comparable and reliable format.

Some products considered in this analysis could not be directly matched with Greenext products. For these products, we allocate the average environmental values of the closest Greenext products. For example, we allocate the same environmental values to the three products in the beef meat category since only the values for minced beef are available, and because the three products are similar in terms of environmental impact, and they all correspond to fresh meat. In the same way, fresh chicken pieces have the same environmental values as ready-to-cook chicken. Additionally, there is no environmental data for rabbit, thus we allocate the mean values of poultry as its composition is quite similar. Finally, for mixed meats, we affect the mean environmental values of all other meats since we could not recover the part of each meat for this product. Regarding the vegetable food aggregate, 76% of the observations have been matched with their corresponding environmental values. Next, we compute the mean environmental values for the three indicators, weighted by the market share of products that are part of the outside good.

As shown in Table 5, beef is the meat product that has the largest environmental impact in terms of CO_2-eq, followed by veal and lamb and sheep which are all defined as ruminant meats. The carbon impact of pork is the lowest among meat products, with GHG emissions representing roughly a third of the beef emissions. The marine food category has the equivalent GHG emissions as pork, while eggs are even less impacting. Compared with meat categories, ready-made meals are less impacting as they contain less meat per kilogram of product. Finally, as expected, vegetable food products are the least impacting, with their GHG emissions representing 10% of the beef emissions. The ranking of products regarding their impact on CO_2-eq is similar for acidification, whereas chicken and poultry are more impacting in terms of eutrophication.

Except for the beef category (for which we were not able to collect more precise information about the environmental impact of the three beef products), we can see that this impact is heterogeneous within the eight categories. For instance, in the pork category, the environmental indicators between blood pudding and other pork products double.

Table 5: Environmental indicators

Product	Environmental values (g/100g)		
	Acidification	Eutrophication	CO_2-eq
Fresh pork	10.83	4.53	479.82
Cooked ham and roasts	9.93	4.15	490.47
Fresh sausages	8.87	3.70	466.53
Other sausages (Strasbourg)	10.30	4.29	496.21
Bacon	11.39	4.78	581.24
Blood pudding	5.73	2.42	352.51
Other pork	12.56	5.14	610.11
Pork category	**10.73**	**4.46**	**521.20**
Minced beef	33.72	4.62	1589.23
Beef for grilling	33.72	4.62	1589.23
Other beef	33.72	4.62	1589.23
Beef category	**33.72**	**4.62**	**1589.23**
Ready to cook chicken	13.89	8.24	796.74
Chicken parts	13.89	8.24	796.74
Other chicken	10.61	5.42	581.18
Chicken category	**13.06**	**7.53**	**742.47**
Turkey	10.56	6.00	599.87
Duck	12.40	7.56	766.05
Other poultry	10.23	4.61	520.25
Other poultry category	**10.80**	**5.86**	**606.14**
Veal	20.67	2.88	1148.39
Lamb, sheep	28.67	3.01	1182.79
Mixed meats	14.77	4.85	734.92
Rabbit	10.23	4.61	520.25
Other meats	14.77	4.85	734.92
Other meat category	**20.10**	**3.58**	**981.05**
Fresh fish	2.01	1.84	448.77
Fresh shellfish	4.82	0.59	603.30
Processed fish and shellfish	2.74	1.74	510.18
Fish category	**2.97**	**1.52**	**510.60**
Eggs	**6.72**	**3.19**	**332**
Pizzas, quiches	3.13	1.40	268.20
Snacking	5.69	1.75	414.59
Ready-made meals	5.25	1.90	387.02
Ready-made meals category	**5.17**	**1.84**	**382.89**
All Inside Goods	**11.92**	**3.77**	**668.37**
Outside Good	**0.76**	**0.77**	**148.13**

Numbers on grey rows are weighted means

4.2 Simulations

Given the substitution patterns estimated in the previous section and the differences in the environmental indicators for the various meat and marine products and a vegetable food aggregate, an environmental tax will have differing environmental implications, depending on its design.

We consider taxes based on the CO_2 equivalent emissions. Two different levels of taxes are chosen: €56 and €200 per tonne CO_2-eq. They are computed as a differentiated tax per kilogram of final product depending on the level of GHG emission per product. These levels of taxes correspond respectively to a reduction in GHG emissions by 20% and 60%, that are the medium- and long-term European Union's targeted values by 2020 and 2050. Note that these values are higher than the top price observed on the carbon market (€30 per tonne in 2008) and much higher than the carbon price recently observed (€4 per tonne) (Committee on Climate Change, 2014).[6]

Because GHG emissions are heterogeneous from one product to another (even for products from the same category), the impact of such a tax on prices will also differ. This heterogeneity within product categories fosters the substitutions between products from the same category. Since beef products are the most impacting in terms of GHG emissions, their prices increase the most. A tax of €56 per tonne CO_2-eq is relatively low and corresponds to an increase in the price of the product between roughly 2% (fish products) and 12% (beef products). A tax of €200 per tonne CO_2-eq has a more significant impact on the prices and corresponds to a rise in prices from 7.2% for marine products to 42.8% for beef (Table 6).[7]

We consider three possible cases. First, we consider a tax on all meat and marine products. Because beef products are more impacting, we also consider the case where only beef products are taxed. Finally, we consider an intermediate case where veal, lamb and sheep products (the most impacting after beef) are taxed in addition to beef. Given the two possible levels of taxes, this leads to six possible scenarios. Table 7 summarizes the impacts of the tax policy on market shares for each scenario. We assume that the market is closed, meaning that we only study the reports between categories, and that there is no variation in the total meat and marine food, and vegetable food

[6]In their evaluation of environmental costs, Irz et al. (2015) use values close to the price of carbon in 2008, relying on the median carbon price (€32 per tonne) estimated in a meta-analysis of the social cost of carbon developed by Tol (2012). Our higher value is in the range of the value found for the 95-percentile of the fitted distribution (€185 per tonne). Note that our assumptions on the level of the taxes are higher compared to the values considered in Edjabou and Smed (2013), and our low value assumption is consistent with that used in Wirsenius et al. (2011).

[7]Note that ready-meal products include both meat, marine and vegetable components. So, when taxing ready-made meal products, we consider a tax on both ingredients. As we are not able to recover the proportion of meat and marine components in the final product, we simulate a scenario with a lower tax on ready-made meals to check the robustness of our results. The level of the taxes are computed given the share of meat and marine components in the product, that is 45% for pizzas, quiches and tarts, 64% for snack food and 62% for prepared meals. We found a similar reduction in environmental impacts. Results are available upon request.

Table 6: Impact of the public policy scenarios on prices

		Tax (€/ T CO_2-eq / KG meat)	
		56	**200**
Category	**Price (€/Kg)**	**Price variation interval (%)**	
Pork	8.80 (0.21)	[2.17–5.35]	[7.76–19.12]
Beef	10.37 (0.55)	[5.96–11.98]	[21.30–42.80]
Chicken	6.52 (0.17)	[3.83–8.96]	[13.68–32.00]
Poultry	9.66 (1.27)	[2.55–4.25]	[9.12–15.17]
Other meats	11.91 (0.39)	[3.16–5.59]	[11.28–19.98]
Fish, shellfish	10.62 (0.58)	[2.02–4.30]	[7.23–15.36]
Eggs	4.96 (0.08)	3.75	13.40
Ready-made meals	6.73 (0.32)	[2.29–3.71]	[8.16–13.24]

(.) : standard deviation

The interval corresponds to the range of the tax across products within the category.

consumption. However, as we allow for an outside option composed of vegetable food products, the total consumption of meat and marine products could vary and be substituted with vegetable food products. When all meat and marine products are taxed, the purchase of almost all meat products decreases in favor of marine food products and vegetable food products to a larger extent. However, when the tax is low, the decrease in market shares is small, due to the fact that demand is quite inelastic. The reduction is less than 1% for all categories of product except for other meats, poultry, chicken and beef. Beef is more impacted with a decrease in its market share by 7%. When the tax is much higher, the reduction in the purchases is much higher for beef (losing more than 20% of market share), but also for other meats and chicken that lose around 10% of their market share. The loss in the market share of meat products is substituted for by an increase of 4.7% of the market share for vegetable food products and a small increase of 0.4% of the market share of marine food products.

When only beef is taxed, the market share of beef decreases by much more than in the previous case, with a decrease of 25% with a high level of tax. Because beef can be substituted with various meats and vegetable food products, the market shares of all other categories increase. Finally, in the intermediate case where only ruminant meats are taxed, the market shares of all other products increase only slightly compared to a taxation on beef only.

Given the impact of different tax policies on market shares, a tax of €56 per tonne CO_2-eq would lead to a very small change in GHG emissions (-1.54%) even if all meat

Table 7: Impact of the public policy scenarios on market shares

		Tax scenarios (€/ T CO_2-eq / KG meat)					
		All		Beef		Beef, veal, lamb	
		56	**200**	**56**	**200**	**56**	**200**
Category	**Market share (%)**	**Market share variation(%)**					
Pork	18.96	−0.57	−2.16	0.58	1.71	0.67	1.99
	(0.66)	(0.04)	(0.11)	(0.03)	(0.09)	(0.04)	(0.11)
Beef	4.27	−7.01	−20.38	−8.82	−25.05	−8.72	−24.75
	(0.27)	(0.27)	(0.65)	(0.30)	(0.69)	(0.29)	(0.69)
Chicken	3.12	−3.17	−10.20	0.36	1.16	0.50	1.61
	(0.29)	(0.06)	(0.17)	(0.01)	(0.03)	(0.02)	(0.05)
Poultry	3.19	−1.47	−5.08	0.45	1.39	0.57	1.78
	(0.35)	(0.06)	(0.20)	(0.02)	(0.06)	(0.03)	(0.08)
Other meats	2.09	−2.96	−9.72	0.19	0.63	−2.12	−6.83
	(0.12)	(0.11)	(0.32)	(0.01)	(0.02)	(0.10)	(0.31)
Fish, shellfish	9.02	0.21	0.4	0.60	1.75	0.68	2.01
	(0.54)	(0.14)	(0.48)	(0.03)	(0.08)	(0.03)	(0.10)
Eggs	3.51	−0.75	−2.86	0.63	1.80	0.70	2.02
	(0.14)	(0.08)	(0.27)	(0.04)	(0.11)	(0.05)	(0.12)
Ready-made meals	11.01	−0.32	−1.40	0.60	1.76	0.68	2.03
	(0.80)	(0.07)	(0.25)	(0.04)	(0.10)	(0.04)	(0.11)
Outside Good	44.83	1.41	4.68	0.20	0.49	0.20	0.51
	(1.26)	(0.04)	(0.13)	(0.02)	(0.05)	(0.02)	(0.05)

(.) : standard deviation

and marine products were taxed (Table 8). Similarly, the impact on other environmental indicators is limited given this small amount of tax; the highest impact being for the acidification indicator. The environmental impact is multiplied by four with a tax of €200 per tonne CO_2-eq when all products are taxed for the GHG emissions. The carbon tax can lead to a decrease of up to 4.8% of GHG emissions per year, 3.7% for eutrophication and 7.3% for acidification. Thus, we can see that even with a carbon tax of €200 per tonne CO_2-eq on all meat and marine products, we are far from the desired carbon emission reduction of 20%.

Table 8: Environmental, nutritional and welfare indicators variations according to the public policy scenarios

Taxed Products	**All**		**Beef**		**Beef,veal,lamb**	
Tax (€/T CO_2-eq / KG meat)	**56**	**200**	**56**	**200**	**56**	**200**
△ CO_2-eq per year (%)	−1.54	−4.77	−1.11	−3.12	−1.19	−3.36
△ Acidification (SO_2) per year (%)	−2.35	−7.26	−1.72	−4.83	−1.83	−5.21
△ Eutrophication (N) per year (%)	−1.15	−3.71	−0.30	−0.80	−0.28	−0.75
△ Meat (per day) (Tonnes)	−109.26	−362.99	−15.37	−38.09	−15.79	−39.44
△ Meat (per day and person) (g)	−1.75	−5.80	−0.25	−0.61	−0.25	−0.63
△ Calories (per year and person) (%)	−0.29	−0.98	−0.00	+0.01	−0.00	+0.02
△ Lipids (per year and person) (%)	−0.79	−2.63	−0.01	+0.02	−0.00	+0.05
△ Proteins (per year and person) (%)	−0.92	−3.00	−0.25	−0.69	−0.28	−0.78
△ SFA (per year and person) (%)	−0.98	−3.22	−0.12	−0.27	−0.13	−0.30
△ Cholesterol (per year and person) (%)	−1.16	−3.91	−0.01	+0.02	−0.08	−0.19
△ Welfare (%)	−0.21	−0.73	−0.04	−0.12	−0.06	−0.21
Tax revenue (billion €)	1.10	3.74	0.21	0.61	0.26	0.78

Results of simulations also show that a tax on all meat and marine products leads to a decrease in all nutritional indicators especially saturated fat acids and cholesterol.[8] When only beef or ruminant meats are taxed, the impact on nutrition is almost annihilated because the reduction in the market share of beef (or beef, veal and lamb) generates a substitution, not only in the vegetable food category, but also with other meat products that have higher nutritional indicators, such as pork. In fact, pork is the most caloric among all categories, as it contains more saturated fat acids, more lipids and less proteins (after fish and eggs), while eggs, chicken and poultry contain more cholesterol.

[8] Table A in the Appendix presents the value of all nutritional indicators for each of the 28 products and an average value for the vegetable food aggregate.

We can thus conclude that a tax policy targeting all meat and marine products with the highest level of tax will be the most efficient scenario to reduce the environmental impact. However, Table 8 shows that if we consider consumer surplus, this scenario is not the most efficient. For the same level of tax, taxing only beef would reach around 70% of the total environment reduction when all meat and marine products are taxed, whereas it would deteriorate the consumer welfare five times less. Because beef is the most impacting meat, such a policy has the advantage of limiting the decrease in the consumption of meat and marine products but still to substantially lower environmental damages. This is in line with the conclusion of Wirsenius et al. (2011), that most of the effect of a GHG tax on animal food can be captured by taxing the consumption of ruminant meat alone. This scenario would be the best policy as it is an acceptable trade off between reducing the environmental impact and not affecting consumer welfare too much.

5 Conclusion and discussion

Sustainable diet recommendations encourage a reduction in meat consumption. While the results in the literature show that a reduction in meat consumption would effectively have positive benefits both in terms of environment and health (Irz et al. (2015) and Soret et al. (2014)), there is also a consensus to say that consumers' dietary habits are difficult to change (Pérez-Cueto et al., 2013) through public information interventions. This paper analyzes a public policy which targets a change in the environment of consumers: a tax policy on meat and marine products. We address this question dealing with two different intervention strategies: first, to change the global consumption habits toward all meat and marine products by reducing the consumption of the whole meat and marine products category; or second, to favor changes within this category and then promote substitutions towards meat and marine products which have a lower environmental impact.

Our analysis of French meat and marine consumption has contributed to the policy debate regarding the ability of environmental taxes to mitigate environmental damages linked to animal product consumption. Our results, based on a flexible demand model for meat and marine products disaggregated at a very detailed category level, initially confirm that it is indeed difficult to significantly decrease the market shares of meat and marine products even with a high level of taxes. The reason is that the demand for meat and marine products is quite inelastic. A change in the price of meat and marine products generates quite low and partial substitutions with vegetable food products. This is because part of the substitutions occur within the meat and marine product categories; pork being the meat product that benefits most from a rise in the price of other products. However, if a relatively low level of tax fails to significantly reduce the different environmental damage indicators, our results suggest that a high level of tax (corresponding to the long-term European Union's commitments on carbon prices) will have a significant impact on the environmental footprint: almost 5% for GHG emissions and up to 7% for acidification. This suggests the implementation of a high level of tax in order to mitigate the environmental impact. Moreover, in a context where the prevalence of obesity is a major public health concern in most developed countries, it is essential to confirm that environmental and nutritional policies head in the same direction. We show that such taxes will not damage the nutritional quality of food consumption.

Finally, an interesting outcome from our simulations of tax policies suggests that even if we only tax the main environmentally-impacting meat and marine products (beef meat), we may recover a large part of the environmental benefits without significantly hurting consumers. Such an instrument will only partially reduce the consumption of meat, as part of the substitution will occur within the meat and marine product categories. Thus, it is better from a welfare point of view to design a policy that targets only beef and not all meat and marine categories.

Our analysis is a first attempt to better include the impact of consumers' purchasing behaviors on the design of an environmental tax policy. To go further, there is also a need to better anticipate the change in the behaviors of the meat supply chain when facing a tax policy, and such an analysis is important to better evaluate the environmental impacts. Indeed, Bonnet and Réquillart (2013) show that, in the case of public health policy, ignoring firms' strategic pricing decisions leads to a biaised effect in estimating the impact of a sugar tax on the soft drink industry. However, the analysis of the supply chain reaction would require more precise information about the supply chain structure and decision variables at each stage of the supply chain. It is thus beyond the scope of this paper, even though economists should be encouraged to put this issue on their agenda for future work.

Appendices

Table A: Nutritional indicators

Product	**Nutritional values** Calories (kcal/100g)	Lipids (g/100g)	Proteins (g/100g)	SFA (g/100g)	Cholesterol (mg/100g)
Fresh pork	166.71	9.70	19.82	3.76	54.36
Cooked ham and roasts	116.75	3.86	19.73	0.90	42.43
Fresh sausages	296.60	25.00	16.91	9.83	70.33
Other sausages (Strasbourg)	304.44	27.80	12.50	9.94	66.20
Bacon	260.81	21.07	17.28	7.88	57.58
Blood pudding	253.70	20.37	15.71	10.22	137.05
Other pork	335.60	27.33	21.24	10.08	89.70
Pork category	**236.55**	**17.44**	**19.11**	**6.53**	**67.77**
Minced beef	189.91	12.48	19.22	5.30	65.55
Beef for grilling	151.53	5.00	26.63	1.89	57.07
Other beef	173.77	8.60	22.60	3.28	92.79
Beef category	**225.06**	**11.46**	**29.87**	**4.63**	**91.34**
Ready to cook chicken	231.00	14.20	25.90	4.20	122.00
Chicken parts	167.22	7.84	23.92	2.28	88.78
Other chicken	183.75	9.86	22.66	3.05	92.65
Chicken category	**192.64**	**10.47**	**24.26**	**3.11**	**100.83**
Turkey	170.21	5.88	25.70	1.91	74.47
Duck	174.57	7.87	24.84	3.06	171.76
Other poultry	324.97	27.52	17.53	10.44	343.15
Other poultry category	**217.39**	**12.73**	**23.09**	**4.67**	**172.65**
Veal	222.38	14.37	23.00	6.84	113.20
Lamb, sheep	231.73	15.80	20.74	5.63	134.85
Mixed meats	250.55	18.80	19.57	7.02	85.58
Rabbit	192.98	12.14	20.22	5.08	86.88
Other meats	229.83	15.38	22.23	4.89	88.97
Other meat category	**225.23**	**15.12**	**21.49**	**6.13**	**109.67**
Fresh fish	134.52	5.37	19.10	1.00	53.54
Fresh shellfish	101.14	2.29	16.99	0.40	83.40
Transformed fish and shellfish	160.62	8.13	19.03	1.80	62.94
Fish category	**138.55**	**5.90**	**18.60**	**1.22**	**64.40**
Eggs	**142.16**	**9.88**	**12.60**	**2.64**	**378.00**
Pizzas, quiches	227.77	9.63	9.99	3.73	25.49
Snacking	215.83	10.31	9.58	4.04	29.21
Ready-made meals	156.46	7.70	9.00	2.79	39.69
Ready-made meals category	**210.31**	**11.01**	**12.72**	**3.79**	**144.13**
All Inside Goods	**190.45**	**11.42**	**18.11**	**4.05**	**91.15**
Outside Good	**126.43**	**2.99**	**4.09**	**0.79**	**3.90**

The study uses “NutriXConso” database (Kantar home scan data linked with Nutritional Data), cf (De Mouzon and Orozco, 2011)

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