Sara Capacci

Harmonizing data from the UK Expenditure and Food Survey and the National Food Survey: an application to fruit and vegetable demand

Quaderni di Dipartimento

Serie Ricerche 2012, n. 2
ISSN 1973-9346

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Dipartimento di Scienze Statistiche “Paolo Fortunati”

1 Introduction

Unhealthy eating and food consumption have recently entered the policy agenda of most European governments. Increasing obesity rates and increasing incidence of diet-related diseases represent a serious social and economic problem for western countries, both in terms of increased health care costs (between 5% and 7% of European healthcare costs are ascribed to obesity and obesity-related diseases) and loss of productivity. Besides, the general worsening of economic conditions due to the recent economic crisis is likely to accelerate the deterioration of diet quality mostly because of the relative higher price of healthy food items. Public policies aimed at improving eating habits and discourage consumption of unhealthy food have been enforced in the US and in Europe in the last 15 years (Capacci et al., 2012). Some of those measures deeply affect the market environment (e.g. fiscal measures like the soda tax recently introduced in France) and the debate on their desirability and efficacy has also risen. All these reasons make reliable information on food consumption patterns a key need for policy makers. Eating behavior can be investigated by observing the frequency of purchase of specific food items (e.g. fruit and vegetables, food high in salt, fat or sugar, etc.), the nutritional quality of the average diet (e.g. nutritional composition of meals) and their changes over time. Appropriately detecting the dynamics of purchase of some key products over time is essential to assess the efficacy of public intervention aimed at changing consumption behavior. Ignoring pre-existing trends might lead to overestimate (or underestimate) the impact of information campaigns to promote healthy eating (see 5 a day campaigns) or discouraging consumption of specific product (see the salt campaign in the UK and Shankar et al., 2012). Moreover, economic modeling allows an estimation of the average responsiveness of consumption of specific foods to changes in price (and income), which is a key information for policy makers (and producers) who are planning or debating the introduction of a fiscal measure affecting well-defined food categories. Household Budget Surveys and Nutrition Surveys are the main source of this type of information and they are carried out in most European countries. This paper focuses on the UK, which has experienced the most dramatic increase in obesity rates in Europe in the last 15 years and whose Household Budget Survey has deeply changed its structure at the beginning of 2000s causing a break in food consumption

information. Existing studies on food consumption dynamics in the country had thus focused alternatively on the period before or after the change in the survey. In the present work the two sources of data have been harmonized and merged according to the converting factors provided by the Department for Environment, Food and Rural Affairs (DEFRA), which has not published the harmonized series. This exercise has generated a multiple cross-sections dataset which contains purchases information for more than 250 food items, recorded on about 6000 households each year, over 13 years (from 1997 to 2009)[1]. The availability of this unique dataset opens the way to a large range of potential analyses which might result very useful for policy purposes. Its helpfulness is here demonstrated through a simple preliminary analysis on fruit and vegetable consumption: the data have been employed to estimate a demand system and price elasticities along the 13 years considered. Since data before 2000 do not include information on total expenditure (although they do report household incomes), estimation of a complete system adding up to the total expenditure is not feasible. The augmentation approach by Dhar et al. (2003) is adopted here and the inclusion of an additional equation where food expenditure is related to household income allows indirect recovering of income elasticities. To our knowledge this is the first time that the two surveys have been merged in order to estimate coherent demand systems and elasticities over the period including the change in the survey structure.

The paper is structured as follows: Section 2 describes the available data and illustrates the harmonization process for the two surveys; Section 3 includes a descriptive analysis performed with the harmonized dataset and focusing on fruit and vegetables, foods high in sugar, fats and salt and sodas. In Section 4 the fruit and vegetables demand system specification and estimation procedure are described and results are reported in Section 5. Conclusions and issues to be considered in future research are drawn in Section 6.

[1] Harmonized data before 1997 are also available.

2 From the National Food Survey to the Living Costs and Food Survey

The Family Food Module of the actual Living Costs and Food Survey (LCS), known as the Expenditure and Food Survey (EFS) from 2001 to 2007, has been combined with the National Food Survey (NFS) which existed before 2000, in order to get a multiple cross-sections of 13 years, from 1997 to 2009.

Estimates from the EFS were broadly comparable with another existing national budget survey known as the Family Expenditure Survey (FES), and the design of the new EFS was based on the previous FES. However, the latter did not collect information on purchased quantities which are essential to recover price information (approximated by unit values) for estimating cross-sectional demand models. For this reason in this work we employ the NFS after harmonization with the LCS (and EFS) data structure.

The EFS and the NFS differ in some structural characteristics. In the NFS one main diary keeper (the household's head) recorded all household expenditures and consumption, while in the EFS (and LCS) all household components older than 7 record purchases in personal diaries. Moreover in the NFS the record period is only one week, differently from the two-weeks period of the subsequent EFS (and LCS). These different filling procedures might explain some systematical differences in the estimates of expenditure between the two surveys. For some kind of food products, particularly snack foods and alcoholic drinks, the National Food Survey estimates of expenditure result considerably lower than EFS estimates. In order to reduce the under-reporting problem in the NFS and make its estimates comparable with expenditure estimates from subsequent surveys, DEFRA produced a set of adjusting factors. The essence of the DEFRA procedure was to compare food expenditure estimates using quantity and unit value data from the National Food survey in 2000 with expenditure estimates on the same year from the Family Expenditure Survey, whose structure is broadly comparable with the EFS' (and LCS) one. Adjustment factors have been derived from the differences in the expenditure estimates of 65 types of food once demographic and socio-economic discrepancies in the two samples have been accounted for. Assuming that the underreporting has not changed between 1974 and

2000 DEFRA suggests employing the same factors to correct estimates back to 1974.
Harmonization factors have thus been applied to expenditure and quantity NFS data. Because of the unavailability of adjustment factors for eating out observations, eating out purchases have been excluded from our dataset. Additionally, the harmonization process required to convert measurement units of purchased quantities from the Imperial System (in NFS) into the Metric System (EFS). In order to check for the correctness of the harmonization process of food data, we have exactly reproduced aggregated DEFRA expenditures and purchased quantities estimates over the 13 years[2]. Some further minor adjustments were applied to demographic variables such as household composition, geographic location and household income.
Until 2005-06 the EFS has been carried out on a fiscal year basis (April to March), thus information in calendar years between 2002 and 2006 is combined from two different waves of data (for example 2005 data come from EFS 2004-05 and EFS 2005-06, with no effect on representativeness which is guaranteed within years and quarters[3]).
The resulting multiple cross-sections dataset contains expenditures and purchased quantities for more than 250 food items, recorded over about 6000 households each year, over 13 years (from 1997 to 2009).

3 An introductory descriptive analysis employing the harmonized dataset

DEFRA provides harmonized estimates for average expenditures and purchased quantities for all the food groups from 1974 to date, however disaggregate harmonized estimates for specific subgroups of the population have not been published. The multiple cross-sections dataset resulting from the harmonization procedure allows a number of interesting preliminary analyses on food consumption patterns with the valuable opportunity of disaggregating the series across relevant population groups. Purchases of fruit and vegetable (FV), soft drinks and an aggregate category of food items high in salt, sugar and fats are

[2] DEFRA aggregate estimates are reported at http://www.defra.gov.uk/statistics/foodfarm/food/familyfood/datasets/ .
[3] The drawback is a break in the series from January to March 2001.

considered in order to conduct a simple descriptive analysis of purchase patterns. Average expenditures and purchased quantities are computed for the whole population and among households of the first and the fourth income quartiles.

Given the relevance of the 5-a-day social marketing campaign[4] implemented in the UK starting on March 2003, FV consumption is regularly monitored by DEFRA who reserves a section of its yearly Family Food Report based on LCS data to FV purchases patterns in the country. Besides, much attention has recently been devoted to some categories of food whose consumption is mainly responsible for unhealthy diets. For example, the UK communication regulator has recently enforced an advertising regulation aimed at reducing consumption of the so-called HFSS foods (high in fats, sugar and salt) among children. A heated debate has risen in Europe on the introduction of taxes on specific food items considered unhealthy per se (see for example "twinkie taxes" in the US or the "soda tax" enforced in France in 2012). Definition of an unhealthy food aggregate may be a very controversial exercise. Single food items can hardly be blamed to be unhealthy per se, as healthiness should rather refer to the diet as a whole. Hence, nutritional composition of foods should be accompanied at least by information on the frequency of consumption before being employed as discriminating criteria for detecting its healthiness. For our preliminary analysis and given the relevance of the issue, we refer to an existing definition, which relates to the "big 6" criterion by the Food Standard Agency. According to this definition, individual food brands are categorized as high in fats, sugar and salt (HFSS) or non-HFSS for the purposes of enforcing the OFCOM advertising regulation. Confectionery, soft drinks, crisps/savoury snacks, fast food, pre-sugared breakfast cereals and pre-prepared convenience foods are included in the "Big 6" category. Given the recent debate on the introduction of a soda tax the soft drinks category has also been highlighted.

In Table 1 average per capita purchased portions of FV are computed for the whole population and for the poorest and the richest quartiles of households. An average of about 4 purchased portions emerges across the

[4] The UK "5 a day" is an information campaign aimed at increasing fruit and vegetable consumption among the population in order to reach the World Health Organization recommendation of 5 portions per day.

13 years, which probably overestimates the true consumption level because of waste and storage biases. An increase is registered in 2005-2007 and disappears in the subsequent years. This rise might be reasonably ascribed to the 5-a-day campaign which might have induced an increase in the average purchased portions at least immediately after its enforcement. In the subsequent years purchased levels seem to turn to the pre-policy levels, which is quite common for public information campaign whose impact on consumption can be preeminent in the first period, and decrease during the exposure period while people get used to the messages (Mazzocchi et al., 2009).

Besides their relevance in a preliminary analysis, simple purchase patterns are far from being exhaustive as a policy efficacy assessment, since they can be deeply influenced by a number of confounding factors besides the policy itself, like market forces as price trends (see Capacci and Mazzocchi, 2011).

Differences among income quartiles are also preeminent: the poorest quartile of the population is far from the World Health Organization Recommendation of 5 portions per day, while the richest one is already above (again this is a purchase level, not a consumption one). With reference to the expenditure shares, on average the portion of food expenditure devoted to FV remains smaller than the quote devoted to the Big 6 foods across all the 13 years (excepted for 2006). It is the opposite for the richest quartile of the population, whose FV quote of expenditure (18% in 2009) is well above the Big 6 quote (14% in 2009). Note that the choice for quality might affect expenditure shares, in particular with reference to the FV category: richest households are likely to buy high quality and more expensive products than poorest ones. Despite this potential quality effect the figures reported in Table 1 show important qualitative differences in eating behavior (or at least purchasing behavior) among different income groups. FV expenditure share for the richest quartile is about 5% higher than the poorest quartile share, while the picture is the opposite when considering the expenditure share for foods in the Big 6 category (which is 5% higher for the fourth quartile than for the first). Exactly the same pattern characterizes the quote of food expenditure devoted to soft drinks.

Table 1. Fruit & Vegetables, soft drinks and "Big 6" average expenditure shares by per-capita income quartiles.

		FV portions [a] (daily per capita)	FV exp. share (%)	Soft drinks exp. share (%)	Big 6 exp. share (%)
	Tot. pop.	*4.09*	*14.96*	*1.87*	*17.67*
1997	1st quartile	2.90	12.70	2.43	19.88
	4th quartile	5.31	16.96	1.39	15.69
	Tot. pop.	*4.14*	*15.26*	*1.86*	*17.61*
1998	1st quartile	3.03	12.86	2.43	19.75
	4th quartile	5.66	17.69	1.41	14.82
	Tot. pop.	*4.10*	*15.40*	*2.00*	*18.14*
1999	1st quartile	2.97	13.26	2.48	20.17
	4th quartile	5.42	18.06	1.49	15.82
	Tot. pop.	*4.17*	*15.09*	*2.17*	*17.44*
2000	1st quartile	3.13	12.64	2.73	19.58
	4th quartile	5.62	17.73	1.72	14.90
	Tot. pop.	4.07	14.88	2.43	17.63
2001	1st quartile	3.15	13.36	3.04	19.53
	4th quartile	5.21	17.07	1.99	15.06
	Tot. pop.	*4.10*	*15.13*	*2.40*	*17.57*
2002	1st quartile	3.05	13.07	3.20	20.22
	4th quartile	5.41	17.92	1.83	14.78
	Tot. pop.	*4.02*	*15.07*	*2.64*	*17.60*
2003	1st quartile	2.97	13.19	3.28	19.88
	4th quartile	5.19	17.18	2.13	15.18
	Tot. pop.	*4.04*	*15.22*	*2.62*	*17.51*
2004	1st quartile	3.18	13.83	3.16	19.44
	4th quartile	5.13	17.60	2.17	15.60
	Tot. pop.	*4.33*	*16.07*	*2.45*	*17.14*
2005	1st quartile	3.45	14.18	3.20	19.51
	4th quartile	5.43	18.83	1.89	14.66
	Tot. pop.	*4.40*	*16.53*	*2.38*	*16.49*
2006	1st quartile	3.34	14.54	3.14	18.23
	4th quartile	5.79	19.27	1.87	14.17
	Tot. pop.	*4.32*	*16.66*	*2.25*	*16.43*
2007	1st quartile	3.42	14.79	2.85	19.06
	4th quartile	5.71	19.70	1.70	13.86
	Tot. pop.	*4.16*	*15.98*	*2.30*	*16.71*
2008	1st quartile	3.17	13.72	3.07	18.92
	4th quartile	5.30	18.78	1.85	14.11
	Tot. pop.	*4.02*	*15.67*	*2.28*	*16.55*
2009	1st quartile	3.09	13.75	3.13	18.39
	4th quartile	5.18	17.87	1.57	14.11

[a] FV category does not include potatoes. 1 portion is about 80 grams.

4 Specification and estimation of a demand system

Since the NFS dataset does not include any information on household total expenditure (food and non-food purchases) the unique viable option is estimating a demand system conditional on food. The classic Almost Ideal Demand System (AIDS) specification by Deaton and Muellbauer (1980) is adopted in its linearized form:

$$w_{ih} = \alpha_i + \sum_j \gamma_{ij} \ln p_{hj} + \beta_i \ln\{\frac{\tilde{x}_h}{P_h}\} + \epsilon_{ih} \qquad i = 1, \dots, n \qquad (1)$$

where the budget share for good *i* of the *h*-th household (w_{ih}) is a function of prices p_j[5], an adjusted measure of household food expenditure $\tilde{x}_h$, the corrected Stone index P_h and a stochastic error term ϵ_{ih}[6]. Following Deaton and Muellbauer (1980) $\tilde{x}_h$ is a "needs corrected" per capita food expenditure obtained by deflating the total food expenditure of the *h*-th household by an adjusted measure of its size weighted by its composition.[7] Consistency with economic theory requires the following testable restrictions to hold in order to ensure the demand functions add up to total (food) expenditure, are homogenous of degree zero in prices and total expenditure and satisfy Slutsky symmetry[8]:

$$\sum_{i=1}^{n} \alpha_i = 1 \quad \sum_{i=1}^{n} \gamma_{ij} = 0 \quad \sum_{i=1}^{n} \beta_i = 0 \quad \sum_{j=1}^{n} \gamma_{ij} = 0 \quad \gamma_{ij} = \gamma_{ji} \qquad (2)$$

The system is then augmented with an additional equation for the total food expenditure, according to the augmentation approach by Dhar et al. (2003):

$$\ln X_h = \delta_0 + \delta_1 \ln y_h + u_h \qquad (3)$$

where y_h is the household income and u_h is an error term. The inclusion of this equation is helpful in addressing the potential endogeneity of the food expenditure variable (a change in budget shares allocation is likely to affect the overall food budget) and it allows indirect estimation of income elasticities.

The two equations in (1) along with the augmenting expenditure equation in (3) are estimated simultaneously by full information maximum

---

[5] Unit values (obtained as the ratio between expenditure and purchased quantity) are employed in place of prices, as a common practice in the literature.

[6] Prices in *P* have been scaled by their sample means to correct for the units of measurement error induced by the Stone price Index (see Moschini, 1995).

[7] The adjusted household size is obtained by weighting adults by 1 and children by 0.6.

[8] Negative own-price elasticities replace the fourth theoretical condition on the negative semi-definitiveness of the Slutsky matrix.

likelihood (FIML). Estimation has been performed year by year for the whole population and for households in each income quartile. Following Green and Alston (1990) uncompensated own price elasticities of the *i*-th good are recovered for each income quartile by taking the derivative of (1) with respect to $\ln p_i$:

$$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i w_j}{w_i} \qquad \delta_{ij} = \begin{matrix} 0, & if\ i \neq j \\ 1 & if\ i = j \end{matrix} \qquad (4)$$

The augmenting expenditure equation allows estimating income elasticities for fruit and vegetables, despite the system is conditional on food. Estimates of the income elasticity for the *i*-th product ($\partial \ln q_i / \partial \ln y_h$) is obtained as the product of the income elasticity of total food expenditure ($\partial \ln x_i / \partial \ln y_h$) estimated through the additional total food expenditure equation and the food expenditure elasticity for the *i*-th good ($\partial \ln q_i / \partial \ln x_h$) estimated by the demand system:

$$\eta_i = \frac{\partial \ln q_i}{\partial \ln y_h} = \frac{\partial \ln q_i}{\partial \ln x_h} * \frac{\partial \ln x_h}{\partial \ln y_h} \qquad (5)$$

Direct price elasticities for fruit and vegetables estimated through the LA/AIDS are reported in Table 2 while income elasticities are shown in Table 3.

5 Results.

Consumers responsiveness to food price changes is a key information for fiscal policy purposes. DEFRA has published estimates of price elasticities based on data from the NFS and the LCS for some of the main food groups in the 2000 National Food Survey Report and in the recent 2012 Price Elasticities Report. Both the reports based their elasticity estimates on the estimation of AIDS models covering the periods 1988-2000 and 2001-2009, respectively[9]. Our analysis, despite preliminary, is consistent with the approach followed in the above reports and is meant to provide harmonized estimates of price elasticities over the period 1997-2009, by exploiting adjusted NFS data. Own price elasticities are reported in Table 2. Their order of magnitude is on average comparable with the DEFRA estimates both for fruit and for vegetables.

[9] Until 1989 estimates were provided in the annual report. Yet, a constant elasticity model of demand was used and cross-price effects where not accounted for.

Table 2 Own price elasticities for fruit and vegetables, by income quartile (year 1997-2009)

	Fruit			Vegetables		
	Tot.Pop.	1st quartile	4th quartile	Tot.Pop.	1st quartile	4th quartile
1997	-0.716	-0.780	-0.613	-0.527	-0.542	-0.475
	0.025	*0.025*	*0.025*	*0.016*	*0.016*	*0.016*
1998	-0.716	-0.723	-0.724	-0.595	-0.574	-0.615
	0.020	*0.020*	*0.020*	*0.017*	*0.017*	*0.017*
1999	-0.725	-0.571	-0.563	-0.614	-0.556	-0.546
	0.023	*0.023*	*0.023*	*0.015*	*0.015*	*0.015*
2000	-0.704	-0.642	-0.639	-0.515	-0.549	-0.495
	0.024	*0.024*	*0.024*	*0.018*	*0.018*	*0.018*
2001	-0.760	-0.820	-0.740	-0.625	-0.606	-0.612
	0.020	*0.020*	*0.020*	*0.016*	*0.016*	*0.016*
2002	-0.714	-0.817	-0.640	-0.629	-0.708	-0.617
	0.020	*0.020*	*0.020*	*0.013*	*0.013*	*0.013*
2003	-0.730	-0.793	-0.634	-0.645	-0.644	-0.590
	0.019	*0.019*	*0.019*	*0.015*	*0.015*	*0.015*
2004	-0.707	-0.710	-0.593	-0.631	-0.629	-0.615
	0.019	*0.019*	*0.019*	*0.014*	*0.014*	*0.014*
2005	-0.664	-0.749	-0.553	-0.657	-0.702	-0.666
	0.018	*0.018*	*0.018*	*0.015*	*0.015*	*0.015*
2006	-0.641	-0.679	-0.526	-0.650	-0.625	-0.625
	0.015	*0.015*	*0.015*	*0.013*	*0.013*	*0.013*
2007	-0.647	-0.725	-0.660	-0.662	-0.582	-0.716
	0.018	*0.018*	*0.018*	*0.015*	*0.015*	*0.015*
2008	-0.620	-0.663	-0.561	-0.677	-0.705	-0.675
	0.020	*0.020*	*0.020*	*0.017*	*0.017*	*0.017*
2009	-0.638	-0.663	-0.663	-0.735	-0.873	-0.671
	0.020	*0.020*	*0.020*	*0.017*	*0.017*	*0.017*

Note: Standard error in italic.

Elasticities remain relatively stable over the 13 years, with an average slight decrease for the total population, and the demand for fruit results more elastic than the demand for vegetables consistently across the time periods. Indicatively, a 1% increase in the fruit price induces an increase in demand for fruit by about 0.7%, whereas the same increase in vegetables price leads to a decrease vegetables demand by about 0.6%. As one might expect, direct price elasticities both for fruit and for vegetables are higher for households in the lower income quartile who are reasonably more responsive to price changes with respect to better-off households.

Income elasticities have been computed exploiting the augmented total expenditure equation, according to the specification in (5) and they are reported in Table 3. On average income elasticity is higher for fruit than for vegetables and indicatively a 1% increase in income induce a 0.5% increase in demand for fruit and a 0.4% increase in demand for vegetables.

Table 3 Income elasticities for fruit and for vegetables, by income quartile (1997-2009)

	Fruit			Vegetables		
	Tot.Pop.	1st quartile	4thquartile	Tot.Pop.	1st quartile	4thquartile
1997	0.622	0.721	0.689	0.490	0.548	0.485
	0.017	*0.073*	*0.073*	*0.014*	*0.037*	*0.031*
1998	0.495	0.621	0.572	0.437	0.445	0.578
	0.012	*0.071*	*0.071*	*0.010*	*0.025*	*0.028*
1999	0.515	0.541	0.519	0.417	0.559	0.417
	0.012	*0.063*	*0.063*	*0.010*	*0.033*	*0.027*
2000	0.440	0.509	0.513	0.382	0.461	0.441
	0.011	*0.066*	*0.066*	*0.010*	*0.030*	*0.026*
2001	0.419	0.349	0.595	0.369	0.308	0.499
	0.006	*0.026*	*0.026*	*0.005*	*0.013*	*0.020*
2002	0.473	0.468	0.606	0.397	0.389	0.489
	0.007	*0.033*	*0.033*	*0.006*	*0.016*	*0.018*
2003	0.469	0.362	0.619	0.409	0.320	0.541
	0.005	*0.025*	*0.025*	*0.005*	*0.012*	*0.016*

Note: Standard error in italic.

Table 4 (continued)

	Fruit			Vegetables		
	Tot.Pop.	1st quartile	4thquartile	Tot.Pop.	1st quartile	4thquartile
2004	0.429	0.357	0.565	0.390	0.345	0.539
	0.007	*0.029*	*0.029*	*0.007*	*0.014*	*0.021*
2005	0.439	0.452	0.579	0.399	0.403	0.508
	0.007	*0.032*	*0.032*	*0.006*	*0.015*	*0.015*
2006	0.421	0.374	0.529	0.396	0.382	0.478
	0.006	*0.029*	*0.029*	*0.006*	*0.014*	*0.017*
2007	0.397	0.354	0.664	0.404	0.384	0.672
	0.008	*0.035*	*0.035*	*0.008*	*0.017*	*0.029*
2008	0.436	0.381	0.646	0.420	0.404	0.631
	0.007	*0.039*	*0.039*	*0.007*	*0.018*	*0.028*
2009	0.421	0.387	0.640	0.420	0.452	0.538
	0.007	*0.035*	*0.035*	*0.007*	*0.020*	*0.024*

Note: Standard error in italic.

6 Conclusion.

Reliable data on food consumption are needed in order to adequately design and evaluate nutrition policies. The demanding process of harmonizing and merging two sources of data on food consumption in UK has been described in the present work. As a result, a multiple cross-section dataset for the period 1997-2009 has been produced. As a preliminary analysis, the dataset has been employed to estimate a demand model for fruit and vegetables and price and income elasticities. The analysis is meant to provide a basic example of data utilization and suffer from some weakness which can be easily addressed given the available data. First, unit values have been used in place of prices as it often happens in the food demand literature. However, employing unit values instead of prices has some precise implications and risks. Albeit unit values depend on market prices, they also embed a quality choice component which can be substantial for prices of quality-heterogeneous goods like foods. Ignoring these problems leads to incorrect evaluations of price responses and price elasticity based on unit values might overestimate actual price elasticity because of the reallocation of quality choices within the same consumption aggregate. A correction of the quality choice component will be performed in future analysis. Second,

the employed demand model can be improved by exploring alternative specification (adding of demographic variables, introduction of a quadratic total expenditure term and a non-linear price index). However the basic LA/AIDS performed satisfactorily for our preliminary analysis and provided a reliable picture of food demand patterns, as illustrated by elasticities estimates. As historical data potentially go back to 1974 a time series approach could also be adopted. Data can be aggregated and structured according to a pseudopanel scheme, and trends and dynamics in food consumption can be explored. Finally, the present work has focused on fruit and vegetable consumption, but it can be extended to other food items and food aggregates (for example aggregation according to nutritional characteristics of food items). Besides all these feasible extensions of the analysis, the present work is meant to provide an example of a number of potential uses of the harmonized dataset, which provides continuous information about UK households' food consumption over more than 30 years and with a deep level of food disaggregation.

References

S. Capacci, M. Mazzocchi (2011), *Five-a-day, a price to pay: An evaluation of the UK program impact accounting for market forces,* Journal of Health Economics, n.30, pp. 87-98.

S. Capacci et al. (2012), *Policies to promote healthy eating in Europe: a structured review of policies and their effectiveness,* Nutrition Reviews, n.70, pp. 188-200.

A. Deaton, J. Muellbauer (1980), *An almost ideal demand system,* The American Economic Review, n.70, pp. 312-326.

T. Dhar, J. P. Chavas, B. W. Gould (2003), *An empirical assessment of endogeneity issues in demand analysis for differentiated products,* American Journal of Agricultural Economics, n.85, pp. 605-617.

R. Green, J. M. Alston (1990), *Elasticities in Aids Models,* American Journal of Agricultural Economics, n.72, pp. 442-445.

M. Mazzocchi, W. B. Traill, J. F. Shogren (2009), *Fat Economics. Nutrition, Health, and Economic Policy*. Oxford University Press, New York.

G. Moschini (1995), *Units of Measurement and the Stone Index in Demand System Estimation,* American Journal of Agricultural Economics, n.77, pp. 63-68.

B. Shankar et al. (2012), *An evaluation of the UK Food Standards Agency's salt campaign*, Health Economics, first published online: 6 January 2012.