Industry Levy Versus Banning Promotion on Soft Drinks in the Scotland: A Distributional Analysis

by W. Dogbe and C. Revoredo-Giha

Industry levy versus banning promotion on soft drinks in the Scotland: A distributional analysis

W. Dogbe[1], C. Revoredo-Giha[2]

[1]The Rowett Institute of Nutrition and Health, University of Aberdeen, Aberdeen AB25 2ZD, UK;

[2]Rural Economy, Environment and Society Department, Scotland's Rural College (SRUC), King's Buildings, West Mains Road, Edinburgh EH9 3JG, United Kingdom.

Correspondence: wisdom.dogbe@abdn.ac.uk

Abstract

The increasing prevalence of overweight and obesity in the UK led Public Health England and the UK House of Parliament Health Committee to introduce a soft drinks industry levy to reduce the consumption of sugar-sweetened beverages (SSBs). In addition, in January 2019, the UK Government opened a consultation to consider regulating the use of price promotions on foods high in fat, sugar and salt content. Empirical studies suggest a decline in sugar consumption after the implementation of the soft drinks industry levy. For instance, a reformulation by Sprite and Lipton Iced Tea led to reduction in sugar concentration by 30 per cent in 2015. However, there is no study comparing the effectiveness of both policies on caloric and sugar consumption. As such, the goal of the present study is to compare the distributional impact of the soft drinks levy to banning promotions on soft drinks in the UK. To achieve this, we applied an EASI demand model to home scan data collected by Kantar Worldpanel between 2013 and 2017. Simulations were based on derived own and cross price elasticities. The results from the present study show that restricting promotions on soft drinks is more effective in reducing caloric purchases than taxing soft drinks. Tax policies and promotional policies are also less effective on higher income households, older family households, remote small towns, and household living in most deprived areas in Scotland. This clearly advocate for targeted policies instead of the usual one-for-all government policy.

Keywords: Soft drink industry levy, banning promotions, EASI demand model, UK, nutrition

I. Introduction

Consumption of sugar sweetened beverages (SSBs) predisposes consumers to weight gain and risk of dental caries, adiposity, and type 2 diabetes (Hu, 2013; Mishra and Mishra, 2011). For instance, soft drinks intake is strongly associated with increased energy intake and body weight (Vartanian, Schwartz, and Brownell, 2007).

As a result, the UK Scientific Advisory Committee recommends minimal or reduced intakes of SSBs (Briggs et al., 2017). Following their recommendation, in March 2016, Public health England and UK House of Parliament Health Committee advised a tax on SSBs known as the soft drinks industry levy. The levy is imposed on industries manufacturing or importing sugar-sweetened beverages in three tiers: soft drinks with sugar content of less than 5 g/100 ml – no tax; drinks with sugar content 5-8 g/100 ml – basic level tax; more than 8 g/100 ml – higher level tax) and came into effect in April 2018 (Pell et al., 2019). All kinds of alcoholic drinks, milk-based drinks and fruit juices are exempted from the tax irrespective of their sugar composition. In addition, small producers are excluded from the levy[1]

Even though the UK government does not want the tax to be passed on to buyers through increase in the retail price of SSBs, this cannot be guaranteed. Industries are to respond to the tax through reformulation to minimize the sugar content of SSBs (Bandy et al., 2020). In addition, to minimize sugar intake, industries can encourage buyers to buy reformulated drinks (lower in sugar content) through advertisement (Briggs et al., 2017).

Ludbrook (2019) highlighted that taxes, subsidies and price-based interventions are economic instruments which can help promote healthier food and drink choices. Similarly, a policy study by Hagenaars, Jeurissen, and Klazinga (2017)concluded that taxation is effective on reducing the consumption of energy-dense products. For instance to deal with the rising prevalence of obesity, Hungary raised taxes on Sugar Sweetened beverages (SSB), energy drinks, confectionaries, chocolate and salty snacks in 2011(Escobar et al., 2013); Finland, in 2011, raised taxes on SSB, ice-creams, chocolates and confectionary; and France, in 2012, raised taxes on SSB and energy drinks (Berardi et al., 2016). Denmark introduced taxes on saturated fat (nutrient tax) in October 2011 but was abolished in 2012 (Jensen et al., 2016; Smed, 2012).

The impact of the UK Soft Drinks Industry Levy will vary depending on the measures adopted by the soft drink industries. For instance, a reformulation by Sprite and Lipton Iced Tea led to

[1] Briggs et al., 2017 showed that small producers contribute a negligible amount of 0.6% to the total UK SSB sales. As a result, we did not adjust the data to account for these producers.

reduction in sugar concentration by 30% in 2015 (Mason, 2015). Similarly, in 2015 the soft drinks association projected to reduce sugar and caloric concentration by 20% in 2020 (British Soft Drinks Association (BSDA), 2016).

Even though price-based interventions on unhealthy foods has been beneficial in western European and North America (see Escobar et al., 2013; Hagenaars et al., 2017; Jensen et al., 2016), some policy makers are agitating for mandatory restriction on price promotions of unhealthy foods and beverages (Huse et al., 2020). Price promotions are temporary price reductions and bundle deals used by retailers and/or manufacturers to increase sales (Chandon, 1995). According to Backholer, Sacks, and Cameron (2019) buyers are more responsive to price promotions on unhealthy foods and beverages and vice versa. Price promotions, therefore, presents an untapped policy to influence diet and reduce obesity among the population (Zorbas et al., 2019).

Following the increasing prevalence of obesity in the UK, the UK and Scottish governments have proposed policy reforms through the restrictions on price promotions on unhealthy foods and beverages (APS Group Scotland, 2018; Obesity Action Scotland, 2019; Pomeranz, 2014). According to Huse et al. restricting promotions on SSBs present a cost-effective option for reducing daily energy intake by 12.52 kJ and mean body weight by 0.11 kg. However, the extent of cost-effectiveness depends strongly on how buyers and the SSB industry respond (Huse et al., 2020).

To the best of our knowledge no study has compared the potential effectiveness of mandatory promotion restriction verses taxing soft drinks. Recent studies have towed the line of either estimating the effectiveness of SSB taxes (Berardi et al., 2016; A. M. Colchero et al., 2016; Jensen et al., 2016; Smed, 2012) or evaluating the effectiveness of promotion restriction (Huse et al., 2020) in different countries. The later study assessed the potential effectiveness of mandatory restrictions on promotions for SSBs in Australia using consumption data from Australia and SSB sales data from the UK. They applied a multi-state, multiple-cohort Markov model to estimate the impact on obesity and cost impact. They concluded that mandatory restriction of price promotions on SSBs is likely to be more cost effective. Mexico implemented a 1 peso per litre excise tax on SSBs on January 2014. Colchero et al. (2016) estimated the changes in beverage purchases for 2014 and 2015. They concluded that purchases of SSBs reduced by 5.5 percent in 2014 and 9.7 per cent in 2015. Even though these two studies suggest that SSB taxes and mandatory promotion restrictions are effective in reducing the consumption of SSBs, they are incomparable.

The aim of the present study is to estimate and compare the potential effectiveness of taxing soft drinks verses eliminating all forms promotions on soft drinks. The former suggests that increasing the price of soft drinks will reduce quantities purchases. Similarly, restricting promotion of soft drinks will result in less of it being purchased. We estimate changes in caloric and nutrient intake due to reductions in purchases.

II. Data and empirical model

The econometric dataset used for the analysis was constructed from the Kantar Worldpanel database that contained detail information of all purchases made from 2013 to 2017. Kantar Worldpanel collects population representative data across the Scotland. The dataset contains food purchases intended for home consumption from a range of retail shops including traditional grocery stores, super- and hyper- markets, and convenience shops. All food products were identified by their universal product code (UPC). Households were made to scan the UPC of each product purchased, type of promotion[2] and promotional prices, date of purchase, retail store, location and the quantity of each product purchased. Retail promotions usually last a week and run from Thursday of one week to Wednesday of the following week. We identified all households who made use for temporary price discounts during their shopping trip in the week. At the end of each week, participating households transmit their purchase data electronically to Kantar Worldpanel. The data used for the analysis covered the years 2013 to 2017, purchases in 2018 were excluded from the estimation to eliminate the potential effect of the introduced soft drinks industry levy.

A panel of 2,581 unique consumers who had remained in the data for more than 40 weeks (static panel) were used for the analysis. Consumer specific information that were included in the dataset are age, gender, social class, location, Scottish index of multiple deprivation (SIMD), number of kids, number of adults, and life stage.

Based on UK eat well guidelines, we aggregated beverages into mineral water, soft drinks, juices, other drinks, and drinks with healthy claims. All other food product purchased were

[2] Includes temporary price reductions, multi-buy offers and buy-one-get-one free offers.

aggregated into numeraire category[3]. This allow as to model the complete basket of foods purchased by each consumer in the panel.

In computing the product group prices and promotional indices we followed the approach of used by Dreze et al. (2004). The approach required computing group price using a weighted average of the prices of the individual products in each group. For instance, the soft drinks group comprised of fruit carbonates, canned colas, ginger ale, soda water etc. The advantage of using this method to compute the category price is that category price during a giving trip by a given household would reflect the price of all products the household might buy. However, using weighted average to construct price indices comes with its own challenges (see Dreze et al. 2004). We have also followed the approach proposed by Manchanda, Ansari, and Gupta (1999) and Krishnamurthi and Raj (1988) to deal these challenges. We estimated the overall price for a category during a specific shopping trip as the weighted average of product prices in effect that week where the weights[4] are the long run share of each product bought by the household.

The mathematical formula for computing the group expenditure, weighted prices and promotion variables are expressed as:

Group expenditure of each household Y_{jt}^{i}, was estimated as:

$$Y_{jt}^{i} = \sum_{s=1}^{S} p_{st} \,.\, q_{st}^{i} \qquad (1)$$

Group price of each household P_{jt}^{i}, was estimated as:

$$P_{jt}^{i} = \sum_{s=1}^{S} p_{st} \,.\, w_{s}^{i} \qquad (2)$$

Finally, the group promotional index for each household, Pr_{jt}^{i} was also estimated using

$$Pr_{jt}^{i} = \sum_{s=1}^{S} pr_{st} \,.\, w_{s}^{i} \qquad (3)$$

Where:

[3] The numeraire category included food products such as grains and grain-based products; vegetables and vegetable products; starchy roots, tubers, legumes, nuts and oilseeds; fruit, fruit products and fruit and vegetable juices; animal source of protein; milk, dairy products and cheese; sugar and confectionary and prepared desserts; animal and plant based fats; tea, coffee, cocoa, and drinking water; alcoholic beverages; as well as prepared meals Composite dishes

[4] Weight given to each item is the share of expenditure of that item over the whole span of the study for the given individual.

Pr_{jt}^{i} is *1* if product s was on promotion at time *t*; *0* otherwise.

p_{st} is the price of product s during time *t*.

q_{st}^{i} is the quantity of product s bought by household *i* at time *t*.

s = number of individual products in category j.

t = time period from 1...T

The weights associated with product *s* in household *i*, w_{s}^{i} was be calculated as follow:

$$\frac{\sum_{t=1}^{T} p_{st} \cdot q_{st}^{i}}{\sum_{t=1}^{T} \sum_{k=1}^{S} p_{kt} \cdot q_{kt}^{i}}$$

Since not all households purchased all five beverages, missing prices were replaced with the mean prices from adjacent regions.

Summary of the data is presented in Table 1. Drinks with healthy claims are the most consumed beverage followed by soft drinks. All other types of drinks that were not in any of the four categories were summed into other drinks representing 0.26 per cent of food bought between 2013 and 2017. Non-consuming households were 16.00 per cent, 3.30 per cent, 23.20 per cent, 24.10 per cent and 2.5 per cent for mineral water, soft drinks, juices, other drinks and drinks with healthy claims, respectively. In terms of promotions, drinks with healthy claims had the highest promotional index followed by soft drinks. Among the beverages, mineral water had the lowest average price per litre whilst all other drinks had the highest average price.

Paste Table 1 here

Table 2 present the sociodemographic characteristics of the respondents in our data. Sociodemographic data that was considered in the analysis include Life stage of respondents, Scottish Index of Multiple Deprivation (SIMD), Income levels, gender, age, number of children and number of adults in the household. Gender, age, number of children and number of Adults were including in the model as explanatory variables. The data was subset by Life Stage, Scottish Deprivation Index and Location and Income groups for a more tailored analysis and comparisons.

The majority of the respondents representing 67.5 per cent live in urban areas whilst the remaining 32.5 per cent live in remote small towns, accessible small towns, and accessible rural areas. The Scottish 2017 census data show that 71 per cent of households live in urban areas (The Scottish Government, 2018). The SIMD is the Scottish Government's standard approach to identify areas of multiple deprivation in Scotland. This considers the extent to which residents in an area are deprived of income, employment, education, health, access to services, crime, and housing. Table 2 shows that 16.5 percent of respondents are in the first quintile, 21.5 percent are in the second quintile, 20.5 per cent are in the third quintile, 21.04 percent are in the fourth quintile and 18.40 per cent are in the fifth quintile. The distribution is quite similar to that found in Scotland in 2017 (see The Scottish Government, 2018). About 2 per cent of the respondents did not belong to any of the five quintiles. By life stage[5], consumers were identified as belonging to one of the following: pre-family (13.6 per cent), young family (11.7 per cent), middle and older family (16.9 per cent), and family without children (11.7 per cent). According to income groups, the majority of the respondents representing 58.4 per cent earn less than £ 29,999. However, only about 12.07 per cent of the respondents earn more than £ 50,000. This figure is slightly lower compared to the 2017 Scottish census data, which shows that 63 per cent of households earn below £30,000 (The Scottish Government, 2018).

Paste Table 2 here

The Kantar Worldpanel data contain nutritional information on all products purchased by UPC. Nutritional information contained in the dataset include Carbohydrates, Proteins, total Fats, Saturated Fats, Sugar, Fibre and Sodium. The impact of eliminating all forms of promotion verses Soft drinks Industry levy were assessed from the nutritional context.

Table 3 present the mean quantities of nutrient contained in the five beverages. Soft drinks contain the lowest amount of protein and fat per 100 ml. However, it has the highest amount of carbohydrate. Other drinks have the highest amount of sugar followed by soft drinks. Soft drinks are of public interest as they contain relatively high number of calories and sugar but the lowest amount of protein. This explains the large number of policies directed at soft drinks worldwide. Despite the low nutritional composition of soft drinks, Table 1 shows that it is the second most consumed beverage by consumers.

Paste Table 3 here

We acknowledge that the data used for the analysis does not fully represent the consumption behaviour of consumers. First, the dataset excludes purchases from restaurants and vending machines suggesting that changes in consumption maybe lower than expected. Second, since the analyses is based on purchased data, we do not consider actual consumption which excludes

[5] Life stage was categorised by GB Kantar FMCG as pre-family (main shopper under 45 years, no children), young family (youngest child 0–4 years), middle family (youngest child 5–9 years), older family (youngest child 10+ years), and older dependents (main shopper 45+ years, no children, 3+ adults).

spoilage and food waste. Though these limitations are presently insurmountable, we believe their impacts are negligible and the results are plausible.

III. Empirical Methodology: EASI demand model

A. Theoretical Framework

Temporary price reductions are widely used by retailers to induce shoppers to visit the promoting store and purchase promoted and nonpromoted products. Inman and Winer (1999) suggest that about 60 per cent of household supermarket purchases are due to in-store decisions. Temporary price reductions therefore have positive effect on total household shopping expenditure during a shopping trip. Richards and Padilla (2009) studied the effect of price promotions on the demand for fast foods. They used a Canadian panel data for their analysis They find that price promotions increase the demand for fast foods and has similar effect on restaurant market shares.

Most research work has been done on the impact of promotions on retail sales, specifically on intra-category and inter-category demand (Gupta, 1988; Leeflang and Parreño-Selva, 2012; Nijs et al., 2001; Sun, Neslin, and Srinivasan, 2003). We deviate from these previous studies by adopting a consumer demand approach where the consumer allocates expenditures between the numéraire good and the five beverage groups. The demand model adopted here is an extension of the EASI demand model that allows for intra-category substitution as well as substitution with the numeraire good within the shopping basket.

To be able to incorporate the effect of eliminating promotions on soft drinks on net energy and nutrient intake, we modified the Exact Affine Stone Index (EASI) demand systems to incorporate promotional indices. We expect that promotion for soft drinks at any given shopping occasion would have a positive impact of the share of soft drinks but a negative impact on the share of the remaining beverages. As such eliminating promotions on soft drinks should decline the expenditure on soft drinks. However, the impact on the remaining drinks would depend on the level of substitution between soft drinks and the other drinks. The promotional indices are incorporated in the model as observed household heterogeneity as not all households buy soft drinks during promotions.

B. Estimating Elasticities

The demand model used comprised of the budget shares of household, *h,* on category is given by

$$w_h = \sum_{r=0}^{5} b_r y_h^r + AlnP_h + Cz_n + DPr_h + u_h \quad (5)$$

Where the index *h* correspond to a household; w_h, is a *j* vector of commodity budget shares; y^h is the total real expenditure shares, log prices lnP is the j vector of commodity price indices in (2); *Pr* is a vector of promotional indices faced by household *h*; z is a an *n* vector of sociodemographic characteristics; u_h is the error term which captures unobserved household heterogeneity. *A, C, D and* b_r are matrices and vector of parameters to be estimated.

The real food expenditure y^h as deflated by the Stone index is given by:

$$y^h = ln(x^h) - p'_h w_h \quad (6)$$

Where x^h is the total nominal expenditures.

The real food expenditure (y^h) makes the budget share equation to be linear[6] in parameters. For the demand model to be consistent with theory the budget shares equations w_h are required to satisfy the properties of adding up and homogeneity through:

$$1'_j A = 1'_j B = 0_j;$$

and

$$1'_j b_0 = 1,\ 1'_j b_r = 0 \quad \forall_r \neq 0 \quad 7$$

Finally, Slutsky symmetry is ensured by the symmetry of the *j x j matrices* of *A.*

The EASI demand system was estimated using iterative 3-Stage least Squares to account for endogeneity. There are two sources of endogeneity. First, the presence of budget shares in the stone index makes this index to be endogenous however, according to (Lewbel and Pendakur, 2009) this type of endogeneity is numerically unimportant. The second source of endogeneity is that the real food expenditure y^h is a function of the endogenous food group expenditure (x^h). We have controlled for this form of endogeneity following the approach proposed by Lewbel and Pendakur (2009) by using the real food expenditure $\bar{y}^h$ (estimated by replacing the budget shares w_j, with the mean budget shares $\overline{w}_j$) to instrument for food groups expenditure (x^h).

[6] A comparisons between the actual model and the linear approximation used here by Lewbel and Pendakur (2009) show that there is not major differences between parameter from both model.

$$\bar{y}^h = ln(x^h) - \sum_{k=1}^{J} ln(P_{kj})\,\bar{w}_j \quad (8)$$

Demand analyses considered five different household groups: (1) the entire sample; (2) Scottish Index of Multiple Deprivation (SIMD); (3) Rural-Urban classification (4) household income ranges and (5) life stage group. The final model

Expenditure elasticities, Hicksian and Marshallian price elasticities as well as promotional elasticities were derived from (5) following Castellón, Boonsaeng, and Carpio, (2015) and Lewbel and Pendakur (2009). The compensated Hicksian price elasticity of demand for good *k* with respect to the price of the good *j* was derived by

$$\in = \bar{w}^{-1}(B) + \Omega\bar{w} - I \quad (8)$$

where $\in$ is an *n x n* matrix of compensated demand elasticities, $\bar{w}$ is an identity matrix where the ones have been replaced by the group budget shares, Ω is an *n x n* matrix of ones and I is an identity matrix.

The vector of expenditure elasticities $\boldsymbol{\vartheta}$ were subsequently derived by

$$\vartheta = (\bar{w})^{-1}(\mathrm{I} + Ap')^{-1}A + 1_n \quad (9)$$

where ϑ is the *J X 1* vector of estimated expenditure elasticities, *A* are the expenditure semi-elasticity coefficients which is $\sum_{r=0}^{5} A_r y^r$, *p* is vector of mean prices and 1_j is a $J \times 1$ vector of ones.

The matrix of uncompensated Marshallian elasticities, ε, were derived from the Slutsky equation given by

$$\varepsilon = \in - \bar{w}\vartheta \quad (10)$$

The matrix of promotional elasticities, θ were derived using

$$\theta = \bar{w}^{-1}(D) * \overline{Pr} \quad (11)$$

Where *D* are *J X J* matrix of promotional coefficients, and $\overline{Pr}$ is an identity matrix where the ones have been replaced by the mean promotional indices, and $\bar{w}$ is an identity matrix where the ones have been replaced by the group budget shares.

Simulations

The aim of the present paper is to evaluate the effectiveness of eliminating promotions on soft drinks and compared the results to a tax imposition on soft drinks based on UK's soft drinks industry levy assuming a pass-through effect of 50 per cent. The impacts were quantified in terms of changes in weekly energy and nutritional purchases.

In contrast to the soft drinks industry levy, the study proposes the elimination of promotions[7] (excluding temporary price reductions) on soft drinks sold in retail shops in Scotland. The impact of the policy was estimated on nutrient purchases from beverages. To estimate the impact of eliminating promotions, we started by setting the promotional index on soft drinks to zero (i.e. $Pr = 0$). Assuming that prices and expenditure are constant, changes in calories and nutrient h, for food group g can be estimated as

$$\Delta N_{hg} = \left[\frac{\left(-\sum_{j=1}^{D} D_{gk}.\overline{Pr_j}\right).\bar{X}}{\overline{P_g}}\right].\aleph_{hg} \quad (12)$$

Where $\bar{X}$ is the average total weekly expenditure, $\bar{P}_g$ is the average price of category g and $\aleph_{hg}$ is the nutrient h coefficient of food group g.

The second simulation involves estimating the nutritional impact of imposing a tax equivalent to the soft drink industry level on soft drinks. The levy was based on tiers: drinks with sugar content less than 5 g/100 ml – no tax; drinks with sugar content 5-8 g/100 ml – basic level tax (£0.18 per litre); more than 8 g/100 ml – higher level tax (£0.24 per litre). Table 3 shows that the average sugar content of 1 litre soft drinks is 78.54 grams. This falls within the basic tax level and hence a tax of £0.18 per litre was used to simulate the post-tax changes in caloric and nutrient intakes. We have assumed that the pass-through effect of the tax will be100 per cent.

Changes in nutrient ΔN_h, was estimated using:

$$\Delta N_h = [diag(Q.\gamma.T)].\aleph \quad (13)$$

Where Q is *n x j* matrix of quantities, γ is a *j x j* matrix whose diagonals are replaced by the vector of price elasticities of food group g, T is a *j x j* matrix of zeros where the diagonal corresponding to soft drinks has been replaced by the tax rate[8], and $\aleph$ is a matrix whose diagonal are replaced by the nutritional coefficients, *h*.

[7] Note this does not mean that prices cannot change, only that they cannot be promoted/advertised.
[8] A tax of £0.18 per litre was imposed on soft drinks which corresponds to a tax rate of 13 per cent assuming a 100 per cent pass through effect.

Results

Price, Expenditure and Promotional Elasticities

Table 4 presents the price and expenditure elasticities of the average sample. All own price elasticities and expenditure elasticities are significant at the 5 per cent significant level. Seventeen out of the 30 cross-price elasticities are significant at the 5 per cent level. Among the five beverages, the mineral water, juices, other drinks and drinks with healthy claims are elastic whilst soft drinks are inelastic. Price elasticity for mineral water tallies with result found in Mexico (Colchero et al., 2015), however the own price elasticity for soft drinks differs from results found in Chile (Guerrero-López, Unar-Munguía, and Colchero, 2017) and Mexico (Colchero et al., 2015). This result suggest UK consumers are less responsive to changes in prices in soft drinks compared to consumers in Mexico and Chile. All expenditure elasticities are inelastic, suggesting that consumers consider these beverages as necessities, however, since mineral water is less inelastic and approximately 1, it can be considered be a luxury for some consumers.

Paste Table 4 here

Table 5 presents the promotional elasticities for the average sample. All own price promotional elasticities are positive and significant at 5 per cent level. Among the beverages, other drinks are the most responsive to promotions whilst mineral water is the least responsive to promotions. The cross promotional elasticities for soft drinks show that increase in promotions will reduce promotions for mineral water, juices, and drinks with healthy claims. On the contrary, an increase in promotions for soft drinks will also increase promotions for other drinks.

Paste Table 5 here

Average household comparison

Changes in total demand, nutrients, and calories: banning promotions vs taxation

Figure 1 compares the changes in demand, nutrients, calories when soft drinks are taxed verses when promotions on soft drinks are restricted. In general, restricting promotions on soft drinks results in larger changes in total calories purchased than taxing soft drinks. For instance, restricting promotions on soft drinks reduces weekly household average caloric intake by 303.5 kcal whilst taxing soft drinks reduces calorie purchase by 127.2 kcal. Similarly, restricting promotions on soft drinks will decrease total weekly expenditure by 0.31 pounds whereas taxing soft drinks reduces total weekly expenditure by 0.031 pounds. Among the demand variables, restricting promotions will change average weekly household expenditure shares and quantity by 1.0 per cent, 0.4 kg, respectively. On the contrary, taxing soft drinks reduces total household expenditure shares, and quantity demanded by 0.1 per cent and 0.03 kg. Comparisons based on sugar and carbohydrate purchases show that taxation reduces weekly total household sugar intake by 30.3 grams and carbohydrate by 32.0 grams whilst restricting promotions decreases sugar intake by 52.9 grams and carbohydrate intake by 56.5 grams. In summary, results presented in Figure 1 suggest that restricting promotions will be a more effective policy than taxing soft drinks. The current results support the argument that price promotions increase the consumption of unhealthy foods (Watt et al., 2020). Results also support augment that taxing unhealthy foods is effective (Briggs et al., 2017; Guerrero-López et al., 2017) of reducing the consumption of unhealthy foods. However, combing both taxation and banning promotions will be more effective in reducing caloric and sugar intake.

Paste Figure 1 here

Scottish Index of Multiple Deprivation (SIMD): *Changes in demand, nutrient and calories – banning promotions vs taxation*

Figure 2 and Figure 3 presents the distributional effects of restricting promotions and taxing soft drinks, respectively. We compared both results for different households based on their SIMD quintiles. In general, restricting promotions has larger effect on weekly caloric purchases than taxing soft drinks. For the promotional policy, decreases from caloric intake is highest for households in the least deprived areas (SIMD 5) (457 kcal) and lowest for households in highly deprived areas (SIMD 1) (98.5 kcal). For taxing soft drinks, decreases from caloric purchase is highest for respondents in the second most deprived areas (SIMD 2) (210.7 kcal) and lowest for respondents in the most deprived areas (SIMD 1) (83.6 kcal). This suggest that the promotional policy will be more effective on households living in least deprived areas whilst the tax policy will be more effective on households in the more deprived areas. Households in the most deprived areas (SIMD 1) are less responsive to both the tax and promotional policy.

Decline in sugar purchase was higher for the promotional policy (89 grams for households in the least deprived areas (SIMD5) and 8.1 grams for households in the most deprived area (SIMD 1)) than the tax policy (49.9 grams for households in the third quartile and 22.3 grams for households in the first quintile).

Finally, restricting promotions decreased the overall weekly average expenditure share by 1.3 per cent for households in the second quintile (equivalent to 0.18 pounds and 0.22 kg increase in expenditure and quantity, respectively) and by 0.8 per cent for households in the first quintile (i.e. to 33 pounds and 0.4 kg increase in expenditure and quantity, respectively). On the contrary, taxing soft drinks reduced overall weekly average expenditure share by 0.19 per cent for households in the second quintile (equivalent to 0.049 pounds and 0.051 kg decrease in expenditure and quantity, respectively) and by 0.01 per cent for households in the first quintile (equivalent to 0.014 pounds and 0.019 kg decrease in expenditure and quantity, respectively). In summary, restricting promotions on soft drinks has larger effect on household demand than taxing soft drinks. Also, households in the least deprived areas are more responsive to both policies than households living in most deprived areas. This conclusion support studies that showed that unhealthy drinking (high alcohol) consumption is highest in the most deprived areas in Scotland (Beeston et al., 2011; Katikireddi et al., 2017).

Paste Figure 2 here

Paste Figure 3 here

Location: *changes in demand, nutrient and calories – banning promotional vs taxation*

Figure 4 and Figure 5 show the distributional effects of restricting promotions on and taxing soft drinks, respectively. Restricting promotions on soft drinks decreases demand and caloric purchase more than taxing soft drinks. This support argument that that promotions increase the consumption of unhealthy foods (Watt et al., 2020).

Specifically, for the promotional policy, decrease in caloric purchases was highest for households in the accessible rural areas (567 kcal) but lowest for households in remote small towns (169 kcal). However, the tax policy has lower impact on overall caloric intake; decline in total average caloric purchases was highest for respondents living in accessible rural areas (137.5 kcal) and lowest for respondents living in remote small towns (39.3 kcal). This suggest that households living in accessible rural areas are more responsive to both policies than households living in remote small towns.

Restricting promotions decreased sugar purchase by 106.2 grams (highest) for households in the accessible rural areas and 19.9 grams (lowest) for households in remote small towns. Similarly, taxing soft drinks decreases sugar purchase by 32.6 grams (highest) for households living in accessible rural areas and 11.8 grams (lowest) for households living in remote small towns.

Finally, restricting promotions decreased the weekly average expenditure share by 1.4 per cent (equivalent to 0.42 pounds and 0.55 kg increase in expenditure and quantity, respectively) for households living in accessible small towns and by 0.8 per cent (equivalent to 0.22 pounds and 0.28 kg increase in expenditure and quantity, respectively) for households living in remote small towns. However, taxing soft drinks decreases weekly average expenditure share by 0.2 per cent (equivalent to 0.042 pounds and 0.038 kg decrease in expenditure and quantity, respectively) for households in accessible small towns and 0.01 per cent (equivalent to 0.008 pounds and 0.010 kg decrease in expenditure and quantity, respectively) for households living in remote small towns. Similar to Colchero, Molina, and Guerrero-López (2017), results from the present study suggest that effect of food policies may vary by location of the household. In conclusion, for the policy to have the greatest effect, the tax level should vary by location.

Paste Figure 4 here

Paste Figure 5 here

Life Stage: *changes in demand, nutrient and calories - banning promotional vs taxation*

Figure 6 and Figure 7 compares the effects of restricting promotions on and taxing soft drinks by life stages. Both policies result in decreases in caloric purchase, however, the promotional policy is more effective. For the promotional policy, decreases in total caloric intake is highest for household heads 45+ without children (374.4 kcal) but lowest for older families (171.7 kcal). Also, taxing soft drinks reduces total caloric purchase by 204.2 kcal for household classified as pre-family and 67.5 kcal for older families. The results suggest that the tax policy is more effect on households classified as pre-family whilst restricting promotions is more effect on household heads 45+ without children. However, both policies are less effective on older family households.

Sugar purchase decreases for the promotional policy (69.2 grams for households 45+ without children and 18.5 grams for the older family group) more than the tax policy (47.4 grams for the pre-family group and 20.7 grams for the older family group). This suggest that sugar tax will be more effective on pre-family groups whilst policies that restrict promotions on soft drinks are likely to be more effective on households 45+ without children.

Finally, restricting promotions on soft drinks result in larger change in demand than when soft drinks are tax. Specifically, restricting promotions decreased the overall weekly average expenditure share by 1.4 per cent (equivalent to 0.42 pounds and 0.56 kg increase in expenditure and quantity, respectively) for pre-family groups and by 0.9 per cent (i.e. 0.21 pounds and 0.26 kg increase in expenditure and quantity, respectively) for the middle family

group. On the contrary, taxing soft drinks reduced weekly average expenditure share by 0.24 per cent for the middle family group (equivalent to 0.043 pounds and 0.043 kg decrease in expenditure and quantity, respectively) and by 0.051 per cent (equivalent to 0.009 pounds and 0.014 kg increase in expenditure and quantity, respectively) for the older family group.
Garcia-Muros et al. (2017) accessed the distributional effects of a carbon-based taxes in Spain, they found that the tax incidence differs by the life stage of the household head. This confirms our results that fiscal policy measures like taxes and restrictions on promotion will have different impact on households based on their life stage. Just like Briggs et al. (2013) the tax is more effective on younger households (pre-family) than other household types.

Paste Figure 6 here

Paste Figure 7 here

Income Groups: *changes in demand, nutrient and calories - banning promotional vs taxation*

Figure 8 and Figure 9 compares the distributional effects of restricting promotions on and taxing soft drinks by income ranges. In general, restricting promotions and taxing soft drinks decreases the demand for calories and nutrient purchased, however, the promotional policy is more effective.
First, for the promotional policy, decreases in caloric intake is highest for households with income range £40,000 - £49,999 (446.9 kcal) but lowest for households with income range £50,000 - £59,999 (90.6 kcal). Taxing soft drinks, however, decline in average calorie intake was 132.8 kcal for households with income range £0,000 - £29,999 and 15.2 kcal for households with income range £50,000 - £59,999. The tax policy is more effective on lower income household as a major share of their budget is spent on energy dense foods (Arantxa Colchero et al., 2017). However, a study by Briggs et al. (2013) in the UK did not find significant differences across different income groups.
Second, changes in sugar purchases is higher for the promotional policy (87.6 grams for households earning £40,000 - £49,999 and 3.9 grams for households earning £50,000 - £59,999) than the tax policy (32.6 grams for households with income range £0,000 - £29,999 and 6.0 grams for households earning £50,000 - £59,999).
Finally, restricting promotions decreased the average expenditure share by 1.3 per cent (equivalent to 0.42 pounds and 0.56 kg increase in expenditure and quantity, respectively) for households earning £40,000 - £49,999 and by 0.8 per cent (equivalent 0.25 pounds and 0.34 kg increase in expenditure and quantity, respectively) for households earning £40,000 -

£49,999. On the contrary, taxing soft drinks reduced average expenditure share by 0.2 per cent (equivalent to 0.43 pounds and 0.41 kg decrease in expenditure and quantity, respectively) for households earning £40,000 - £49,999 and by 0.01 per cent (equivalent 0.003 pounds decrease in expenditure and 0.04 kg increase quantity, respectively) for households with income range £50,000 - £59,999.

We conclude from the results presented that restricting promotions is more effective on households with higher income than lower income households. However, soft drinks taxes are more effective on lower income household than higher income households.

Paste Figure 8 here

Paste Figure 9 here

Conclusion

Our paper provides results on the heterogeneity of changes in household caloric purchases of beverages when soft drinks are taxed and/or promotions are restricted. The results from the present study provide empirical estimates for policy makers to compare the effectiveness of banning promotions on soft drinks verses taxing soft drinks based on their sugar contents. For instance, we have shown that restricting promotions on soft drinks is more effective in reducing caloric and sugar purchases than taxing soft drinks. Tax policies and promotional policies are also less effective on higher income households, older family households, remote small towns, and household living in most deprived areas in Scotland. This clearly advocate for targeted policies instead of the usual one-for-all government policy.

The rationale for implementing policies that restrict promotions on soft drinks is clearly presented in this paper. Given the similarities in the consumption between Scotland and the UK, the results provide a clear guideline for both Scottish and UK food and drink policy makers. In summary, the paper advocate for restricting promotions to effectively control the soaring rates of overweight and obesity in Scotland.

Funding

This work was supported as part of the Strategic Research Programme of the Scottish Government Rural and Environment Science and Analytical Services (RESAS) division, Theme 3: Food and Health (Work packages 3.1, 3.2, and 3.3).

Acknowledgments

This work was supported by the Scottish Government Rural and Environment Science and Analytical Services (RESAS) division

References

APS Group Scotland. *A Healthier Future - Scotland's Diet & Healthy Weight Delivery Plan*. Edinburgh. 2018. https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2018/07/healthier-future-scotlands-diet-healthy-weight-delivery-plan/documents/00537708-pdf/00537708-pdf/govscot%3Adocument/00537708.pdf (Accessed 28 October 2020).

Backholer, K., G. Sacks, and A. J. Cameron. 'Food and Beverage Price Promotions: an Untapped Policy Target for Improving Population Diets and Health'. *Current Nutrition Reports*. Current Science Inc.

Bandy, L. K., P. Scarborough, R. A. Harrington, M. Rayner, and S. A. Jebb. 'Reductions in sugar sales from soft drinks in the UK from 2015 to 2018'. *BMC Medicine* 18,1(January 2020):20.

Beeston, C., M. Robinson, N. Craig, and L. Graham. *Monitoring and Evaluating Scotland's Alcohol Strategy. Setting the Scene: Theory of change and baseline picture*. Edinburgh. 2011. http://www.healthscotland.com/uploads/documents/15580-MESASsettingTheSceneReport.pdf (Accessed 20 January 2021).

Berardi, N., P. Sevestre, M. Tepaut, and A. Vigneron. 'The impact of a 'soda tax'on prices: evidence from French micro data'. *Applied Economics* 48,41(2016):3976–3994.

Briggs, A. D. M., O. T. Mytton, A. Kehlbacher, R. Tiffin, A. Elhussein, M. Rayner, … P. Scarborough. 'Health impact assessment of the UK soft drinks industry levy: a comparative risk assessment modelling study'. *The Lancet Public Health* 2,1(January 2017):e15–e22.

Briggs, A. D. M., O. T. Mytton, A. Kehlbacher, R. Tiffin, M. Rayner, and P. Scarborough. 'Overall and income specific effect on prevalence of overweight and obesity of 20% sugar sweetened drink tax in UK: Econometric and comparative risk assessment modelling study'. *BMJ (Online)* 347(October 2013).

British Soft Drinks Association (BSDA). *Leading the way*. London. 2016. https://www.britishsoftdrinks.com/write/MediaUploads/Publications/BSDA_Annual_report_2016.pdf (Accessed 21 January 2021).

Castellón, C. E., T. Boonsaeng, and C. E. Carpio. ‘Demand system estimation in the absence of price data: an application of Stone-Lewbel price indices’. *Applied Economics* 47,6(2015):553–568.

Chandon, P. ‘Consumer research on sales promotions: A state-of-the-art literature review’. *Journal of Marketing Management* 11,5(1995):419–441.

Colchero, A. M., B. M. Popkin, J. A. Rivera, and S. W. Ng. ‘Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study’. *BMJ* 352(January 2016):h6704.

Colchero, M. A., J. C. Salgado, M. Unar-Munguía, M. Hernández-Ávila, and J. A. Rivera-Dommarco. ‘Price elasticity of the demand for sugar sweetened beverages and soft drinks in Mexico’. *Economics and Human Biology* 19(December 2015):129–137.

Colchero, M Arantxa, M. Molina, and C. M. Guerrero-López. ‘After Mexico Implemented a Tax, Purchases of Sugar-Sweetened Beverages Decreased and Water Increased: Difference by Place of Residence, Household Composition, and Income Level’. *The Journal of Nutrition* 147,8(August 2017):1552–1557.

Escobar, M. A. C., J. L. Veerman, S. M. Tollman, M. Y. Bertram, and K. J. Hofman. ‘Evidence that a tax on sugar sweetened beverages reduces the obesity rate: a meta-analysis’. *BMC Public Health* 13,1(2013):1072.

Garc\'\ia-Muros, X., A. Markandya, D. Romero-Jordán, and M. González-Eguino. ‘The distributional effects of carbon-based food taxes’. *Journal of Cleaner Production* 140(2017):996–1006.

Guerrero-López, C. M., M. Unar-Munguía, and M. A. Colchero. ‘Price elasticity of the demand for soft drinks, other sugar-sweetened beverages and energy dense food in Chile’. *BMC Public Health* 17,1(February 2017):180.

Gupta, S. ‘Impact of Sales Promotions on when, what, and how Much to Buy’. *Journal of Marketing Research* 25,4(November 1988):342–355.

Hagenaars, L. L., P. P. T. Jeurissen, and N. S. Klazinga. ‘The taxation of unhealthy energy-dense foods (EDFs) and sugar-sweetened beverages (SSBs): An overview of patterns observed in the policy content and policy context of 13 case studies’. *Health Policy*. Elsevier Ireland Ltd.

Hu, F. B. ‘Resolved: There is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases’. *Obesity Reviews* 14,8(August 2013):606–619.

Huse, O., J. Ananthapavan, G. Sacks, A. J. Cameron, C. Zorbas, A. Peeters, … K. Backholer. ‘The potential cost-effectiveness of mandatory restrictions on price promotions for sugar-sweetened beverages in Australia’. *International Journal of Obesity* 44,5(May 2020):1011–1020.

Jensen, J. D., S. Smed, L. Aarup, and E. Nielsen. ‘Effects of the Danish saturated fat tax on the demand for meat and dairy products’. *Public Health Nutrition* 19,17(December 2016):3085–3094.

Katikireddi, S. V., E. Whitley, J. Lewsey, L. Gray, and A. H. Leyland. ‘Socioeconomic status as an effect modifier of alcohol consumption and harm: analysis of linked cohort data’. *The Lancet Public Health* 2,6(June 2017):e267–e276.

Krishnamurthi, L., and S. P. Raj. ‘A Model of Brand Choice and Purchase Quantity Price Sensitivities’. *Marketing Science* 7,1(February 1988):1–20.

Leeflang, P. S. H., and J. Parreño-Selva. ‘Cross-category demand effects of price promotions’. *Journal of the Academy of Marketing Science* 40,4(July 2012):572–586.

Lewbel, A., and K. Pendakur. ‘Tricks with Hicks: The EASI demand system’. *The American Economic Review* 99,3(2009):827–863.

Ludbrook, A. ‘Fiscal measures to promote healthier choices: an economic perspective on price-based interventions’. *Public Health* 169(April 2019):180–187.

Manchanda, P., A. Ansari, and S. Gupta. ‘The “shopping basket”: A model for multicategory purchase incidence decisions’. *Marketing Science* 18,2(1999):95–114.

Mason, J. ‘Lipton Ice Tea reduces sugar and updates range’. 2015, April 6. https://www.morningadvertiser.co.uk/Article/2015/04/17/Lipton-Ice-Tea-reduces-sugar-and-updates-range (Accessed 18 January 2021).

Mishra, M., and S. Mishra. ‘Sugar-Sweetened Beverages: General and Oral Health Hazards in Children and Adolescents’. *International Journal of Clinical Pediatric Dentistry* 4,2(August 2011):119–123.

Nijs, V. R., M. G. Dekimpe, J. B. E. M. Steenkamp, and D. M. Hanssens. 'The category-demand effects of price promotions'. *Marketing Science* 20,1(2001):1–22.

OBESITY ACTION SCOTLAND. *BRIEFING PROMOTIONS*. Scotland. 2019. https://www.obesityactionscotland.org/media/1024/promotions-sept-update.pdf (Accessed 28 October 2020).

Pell, D., T. Penney, D. Hammond, L. Vanderlee, M. White, and J. Adams. 'Support for, and perceived effectiveness of, the UK soft drinks industry levy among UK adults: cross-sectional analysis of the International Food Policy Study'. *BMJ Open* 9,3(March 2019):e026698.

Pomeranz, J. L. 'Sugary beverage tax policy: Lessons learned from tobacco'. *American Journal of Public Health* 104,3(March 2014).

Smed, S. 'Financial penalties on foods: the fat tax in Denmark'. *Nutrition Bulletin* 37,2(2012):142–147.

Sun, B., S. A. Neslin, and K. Srinivasan. 'Measuring the Impact of Promotions on Brand Switching when Consumers Are Forward Looking'. *Journal of Marketing Research* 40,4(November 2003):389–405.

Vartanian, L. R., M. B. Schwartz, and K. D. Brownell. 'Effects of soft drink consumption on nutrition and health: A systematic review and meta-analysis'. *American Journal of Public Health*. American Public Health Association.

Watt, T. L. S., W. Beckert, R. D. Smith, and L. Cornelsen. 'Reducing consumption of unhealthy foods and beverages through banning price promotions: What is the evidence and will it work?' *Public Health Nutrition*. Cambridge University Press.

Zorbas, C., B. Gilham, T. Boelsen-Robinson, M. R. C. Blake, A. Peeters, A. J. Cameron, … K. Backholer. 'The frequency and magnitude of price-promoted beverages available for sale in Australian supermarkets'. *Australian and New Zealand Journal of Public Health* 43,4(June 2019):1753-6405.12899.

Table 1. Mean budget shares, prices, and promotional indices of purchases from 2013 to 2017

Food Products	Shares (%)	Prices	Promotional index
Mineral water	0.38	0.57	1.28
Soft drinks	1.22	1.39	2.32
Juices	0.34	0.92	1.29

Other drinks	0.26	1.55	1.16
Drinks with healthy claims	1.84	1.28	3.61
Numeraire category	95.96	7.11	2.06

Source: Own *computation based on Kanter Worldpanel data, 2020*

Table 2 Average Household Characteristics

Demographics	**Distribution (%)**	**Std. dev.**	**95% Interval**	**confidence**
Life Stage				
Pre-family	13.62%	0.004	0.129	0.144
Young family	11.65%	0.004	0.110	0.123
Middle family	7.93%	0.003	0.073	0.085
Older family	8.92%	0.003	0.083	0.095
45+ no children	57.87%	0.004	0.110	0.123
Scottish Deprivation Multiple Index				
SIMD quintile 1	16.50%	0.004	0.157	0.173
SIMD quintile 2	21.46%	0.005	0.206	0.223
SIMD quintile 3	20.53%	0.004	0.197	0.214
SIMD quintile 4	21.04%	0.004	0.202	0.219
SIMD quintile 5	18.40%	0.004	0.176	0.192
N/A	2.08%	0.002	0.018	0.024
Location				
Large Urban Areas	28.27%	0.005	0.273	0.292
Other Urban Areas	39.20%	0.005	0.381	0.403
Accessible Small Towns	8.93%	0.003	0.083	0.096
Remote Small Towns	3.42%	0.002	0.030	0.038
Accessible Rural Areas	13.81%	0.004	0.131	0.146
Remote Rural Areas	6.36%	0.003	0.058	0.069
Income Groups				
£0 - £29,999	58.49%	0.003	0.083	0.095
£30,000 - £39,999	17.55%	0.005	0.234	0.252
£40,000 - £49,999	11.89%	0.005	0.231	0.250
£50,000 - £59,999	6.22%	0.004	0.164	0.180
£60,000 - over	5.85%	0.004	0.109	0.123
Gender (=1 if male)	27.48%	0.005	0.265	0.284
Age	51.13	0.150	50.840	51.427
Average number of children	0.48	0.009	0.465	0.502
Average number of adults	2.08	0.022	2.033	2.120

Table 3. Caloric and nutritional contents of beverages consumed in Scotland

All the sample	**Mineral water**	**Soft drinks**	**Juices**	**Other drinks**	**Drinks with healthy claims**
Energy(kcal)	28.77	341.01	367.17	369.55	32.44
Protein(G)	0.89	0.08	3.45	6.34	0.22
Carbohydrate(G)	4.36	83.15	82.55	76.45	4.92

Sugar(G)	4.06	78.54	80.39	70.07	4.36
Fat(G)	0.50	0.03	0.38	2.55	0.07
Saturates(G)	0.07	0.01	0.06	1.45	0.04
Fibre(G)	0.16	0.21	2.06	2.65	0.19
Sodium(G)	0.00	0.04	0.37	0.21	0.11

Source: Own *computation based on Kanter Worldpanel data, 2020*

Table 4. Mean Price and Expenditure Elasticities

Product	**Mineral Water**		**Soft drinks**		**Juices**		**Other drinks**		**Drinks with healthy claims**		**Others**	
Mineral Water	-1.463	*	0.096	*	-0.154	*	0.112	*	0.079	*	-0.267	*
Soft drinks	0.031	*	-0.914	*	0.019	.	0.019	*	0.062	*	0.517	*
Juices	-0.174	*	0.065	.	-1.100	*	0.048	*	-0.187	*	-0.193	.
Other drinks	0.168	*	0.087	*	0.064	.	-1.431	*	0.092	*	0.193	*
Drinks with healthy claims	0.017	.	0.040	.	-0.034	.	0.013	*	-1.063	*	0.170	*
Others	-0.001	.	0.003	.	-0.001	.	0.000	.	-0.001	.	-0.991	*
Expenditure	0.930	*	0.672	*	0.832	*	0.769	*	0.785	*	0.990	*

*suggest significant at 5 %.

Source: Own *computation based on Kanter Worldpanel data, 2020*

Table 5 Mean Promotional Elasticities

Products	**Mineral Water**		**Soft drinks**		**Juices**		**Other drinks**		**Drinks with healthy claims**		**Numeraire**	
Mineral Water	0.313	*	-0.008	.	-0.025	.	-0.009	.	-0.007	*	-0.001	.
Soft drinks	-0.014	.	0.457	*	-0.047	.	0.006	.	-0.061	*	-0.004	.
Juices	-0.038	*	-0.026	.	0.483	*	-0.003	.	-0.013	*	-0.001	.
Other drinks	0.044	*	0.009	.	-0.031	.	0.658	*	0.004	*	-0.002	.
Drinks with healthy claims	-0.024	*	-0.092	.	-0.094	.	-0.071	*	0.354	*	-0.005	*
Numeraire	-0.495	*	-0.315	*	-0.580	*	-1.116	*	-0.124	*	0.013	*

Source: Own *computation based on Kanter Worldpanel data, 2020*

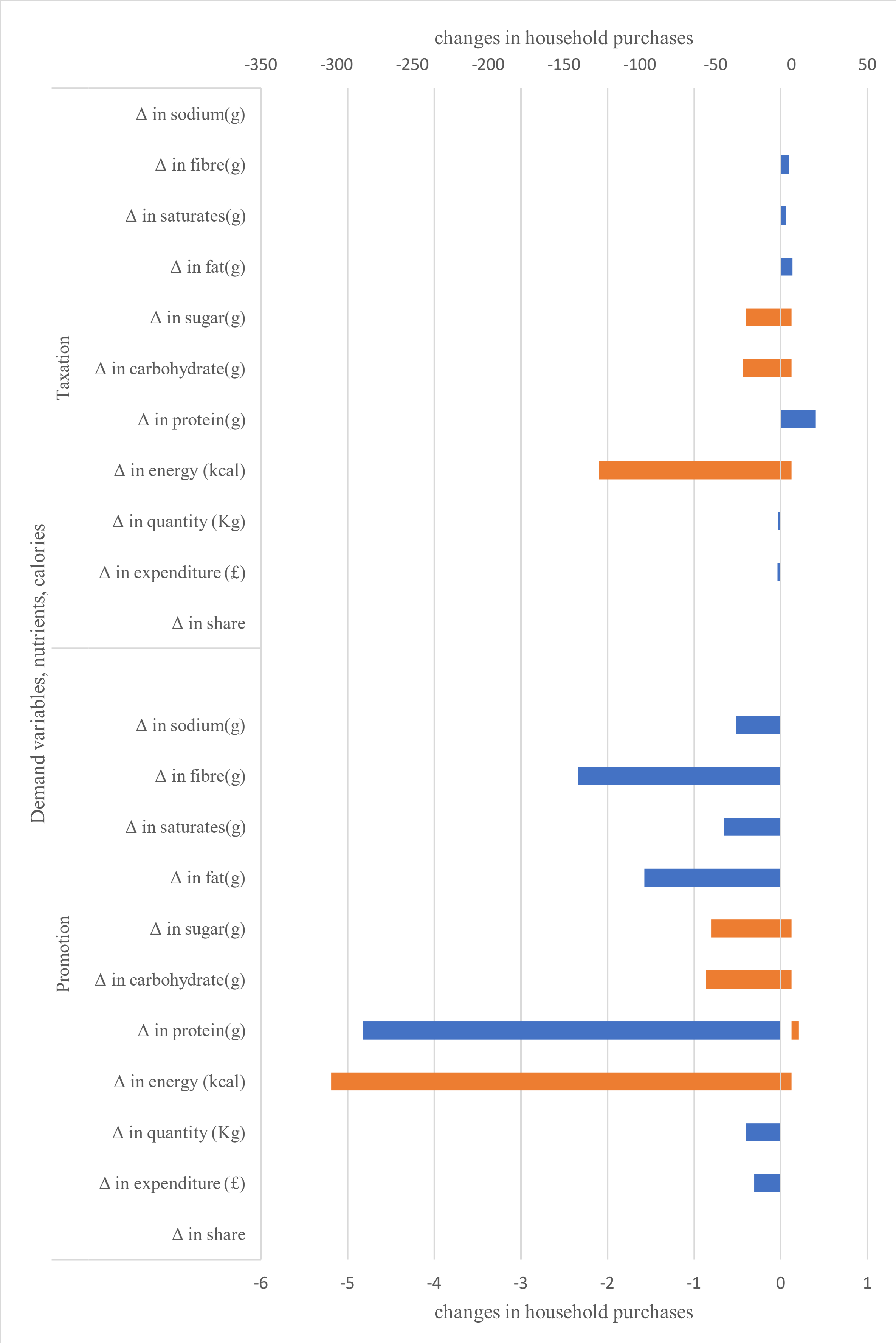

Figure 1 Compares changes in nutrients, calories, and demand variables for tax policy and banning promotions

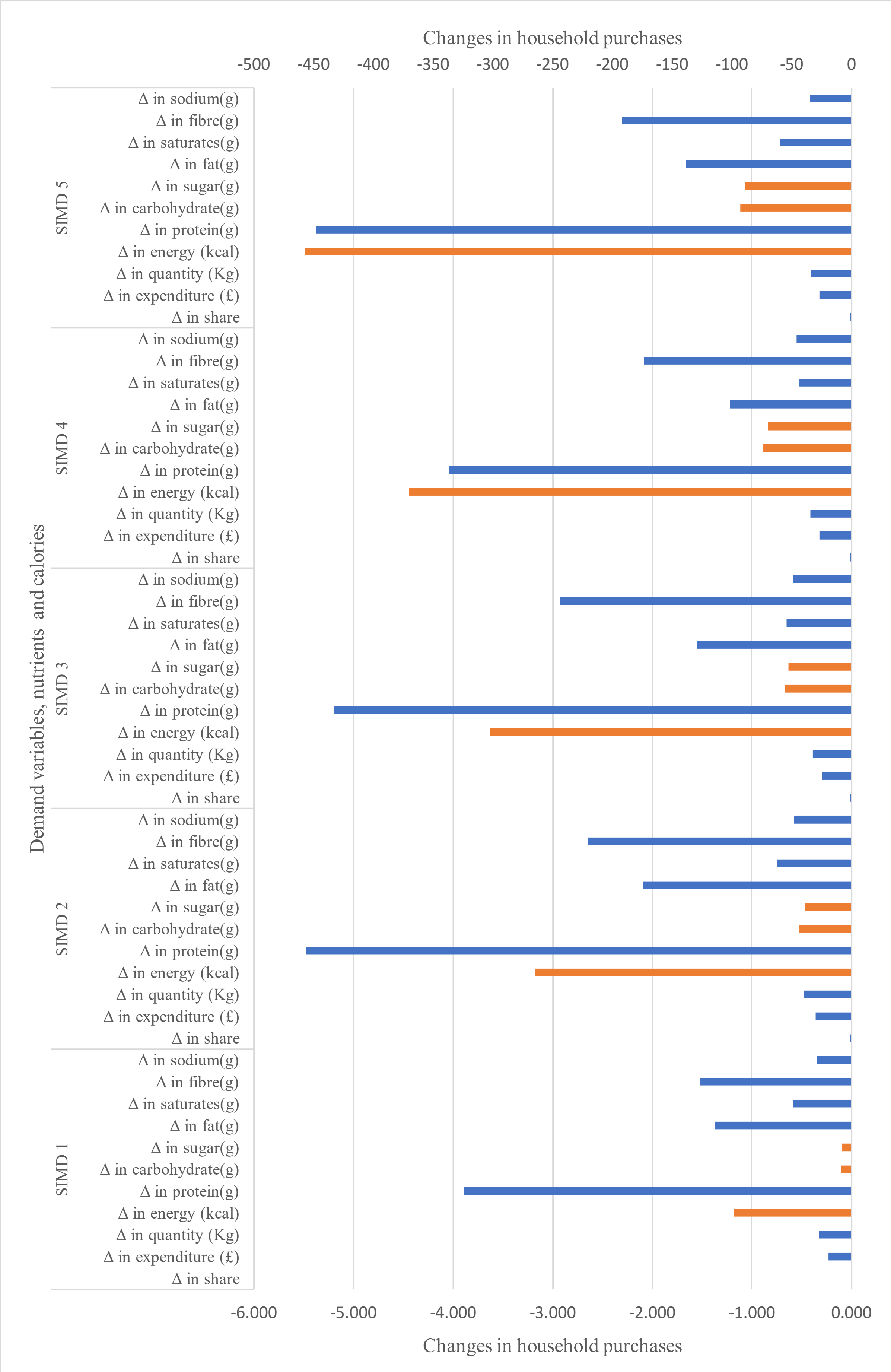

Figure 2 Changes in demand, nutrients and calories for households based on SIMD

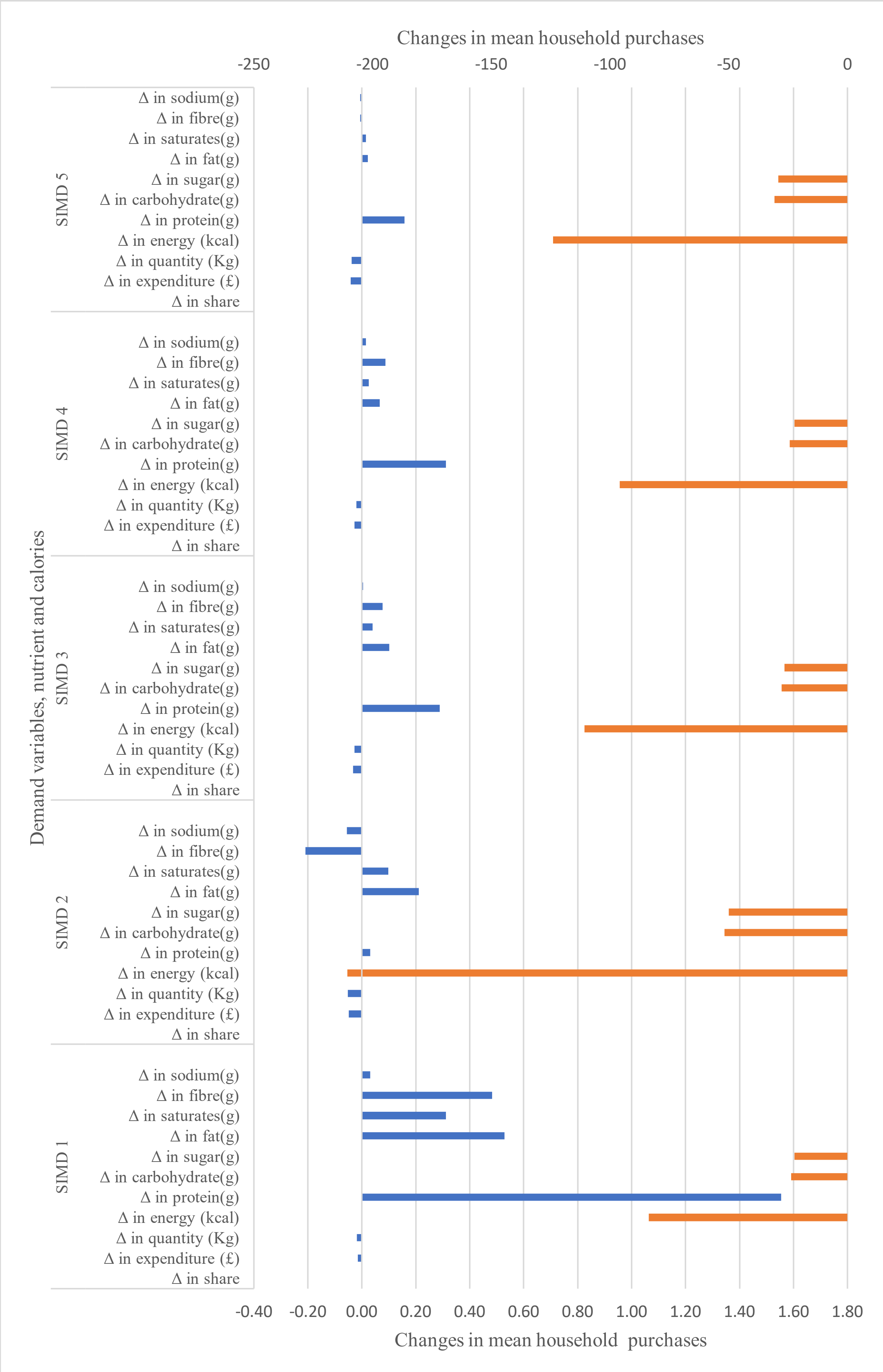

Figure 3 Changes in total nutrients, calories, and demand variables for beverages based on SIMD

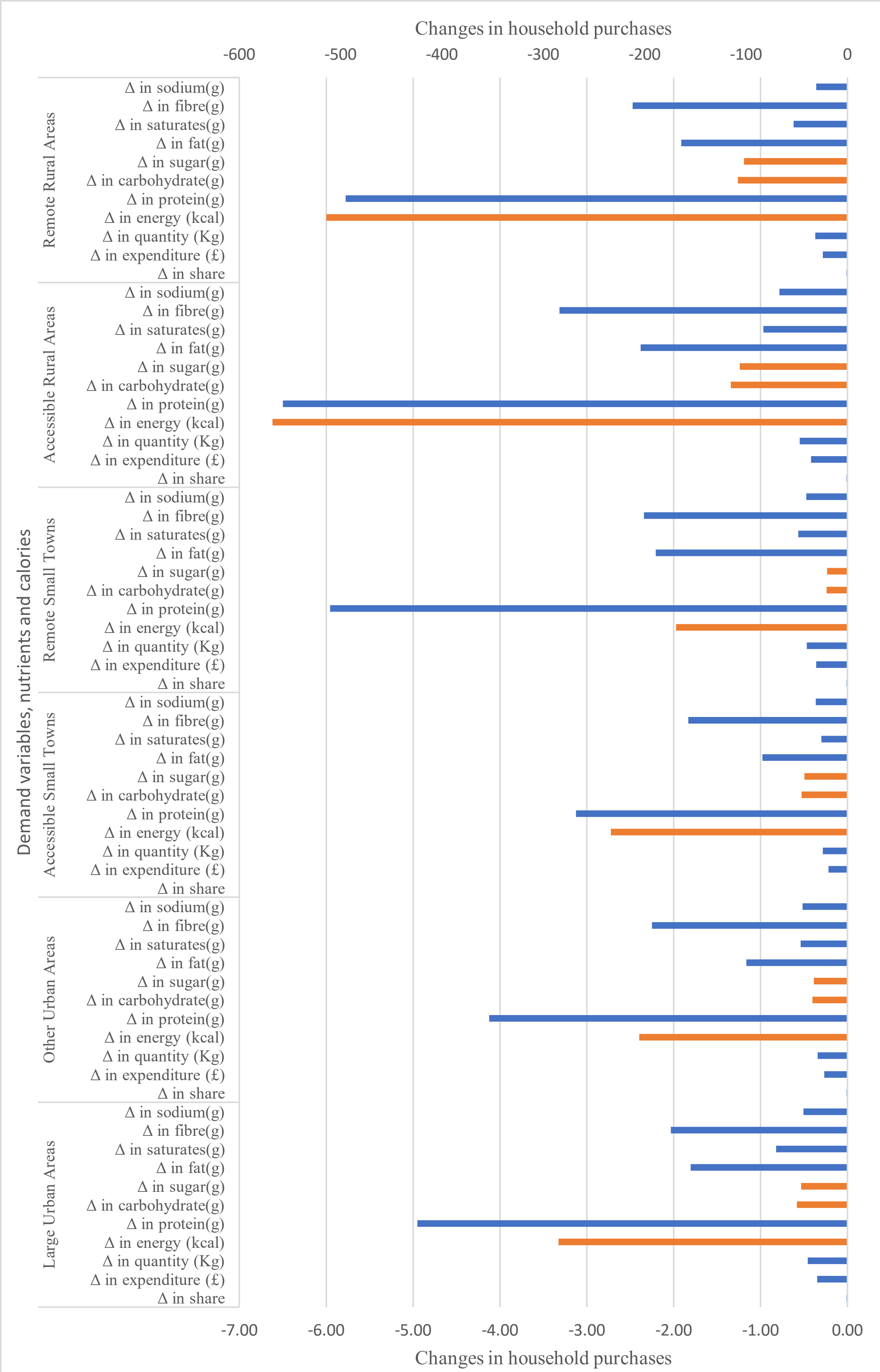

Figure 4 Changes in total nutrients, calories, and demand variables for all beverages based on location

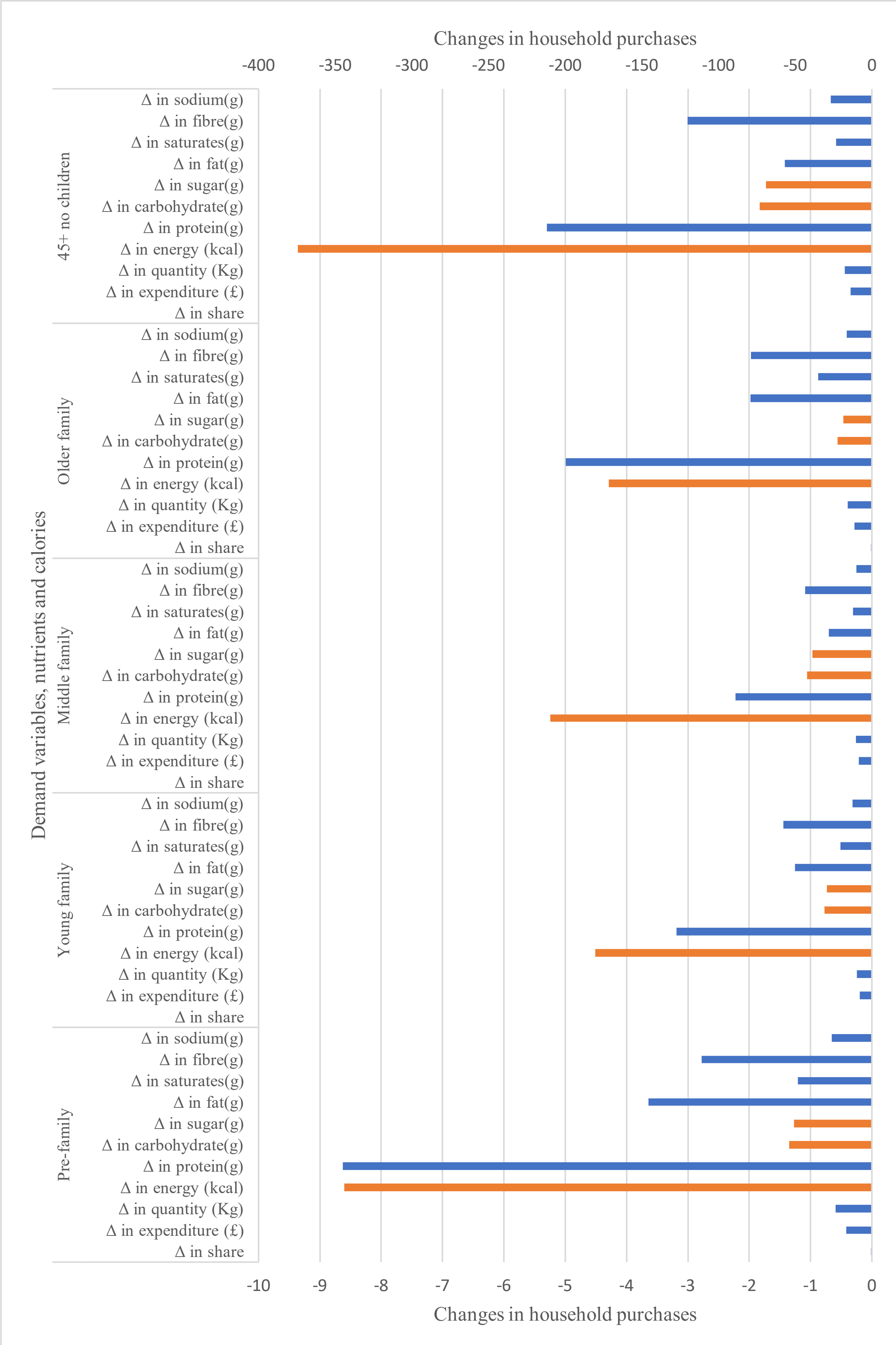

Figure 5 Changes in nutrient, calories and demand for beverages by households based on their life cycle (Eliminating Promotions on Soft Drinks)

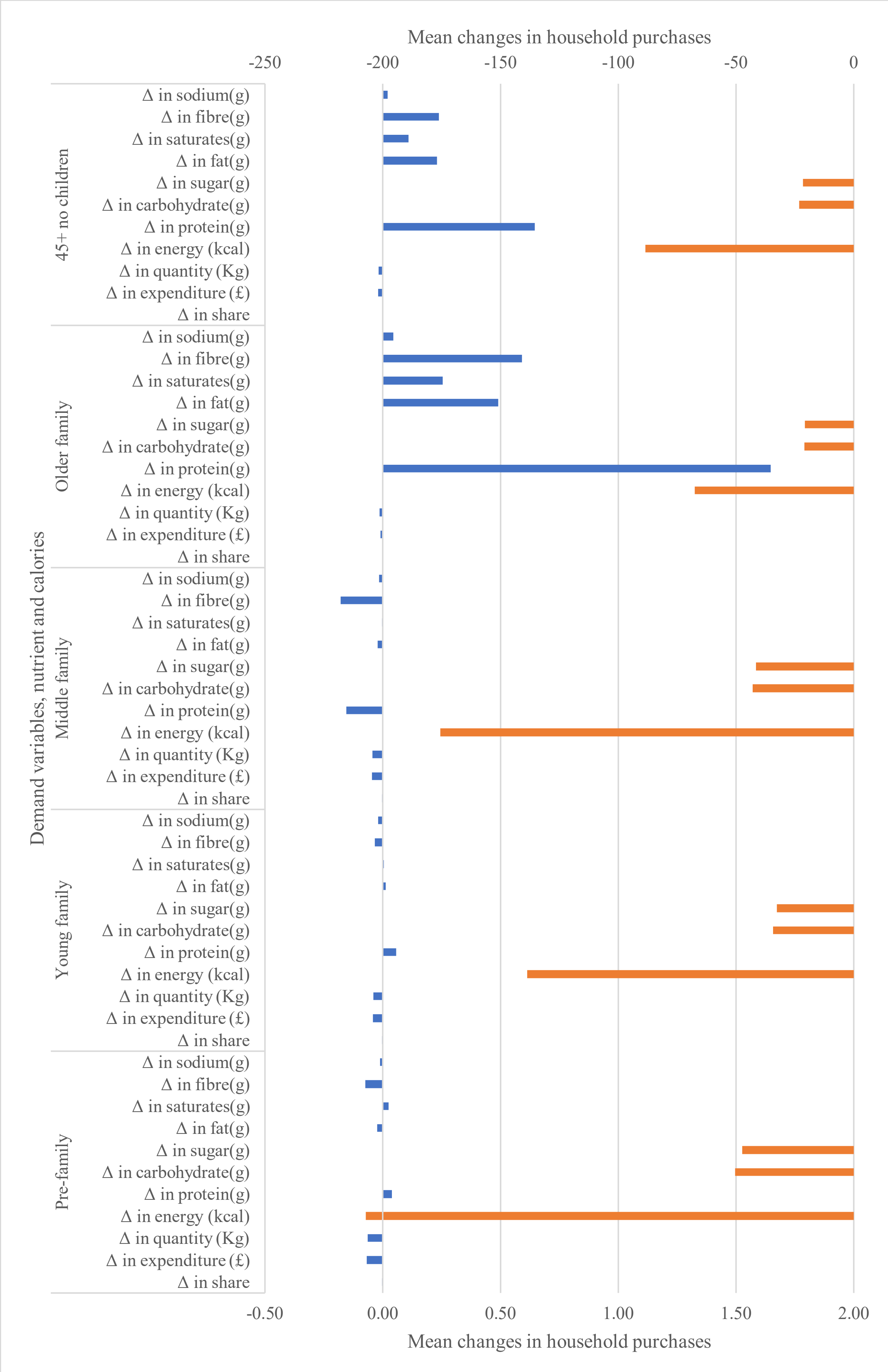

Figure 6 Post-tax changes in nutrient, calories, and demand for beverages by households based on their life cycle

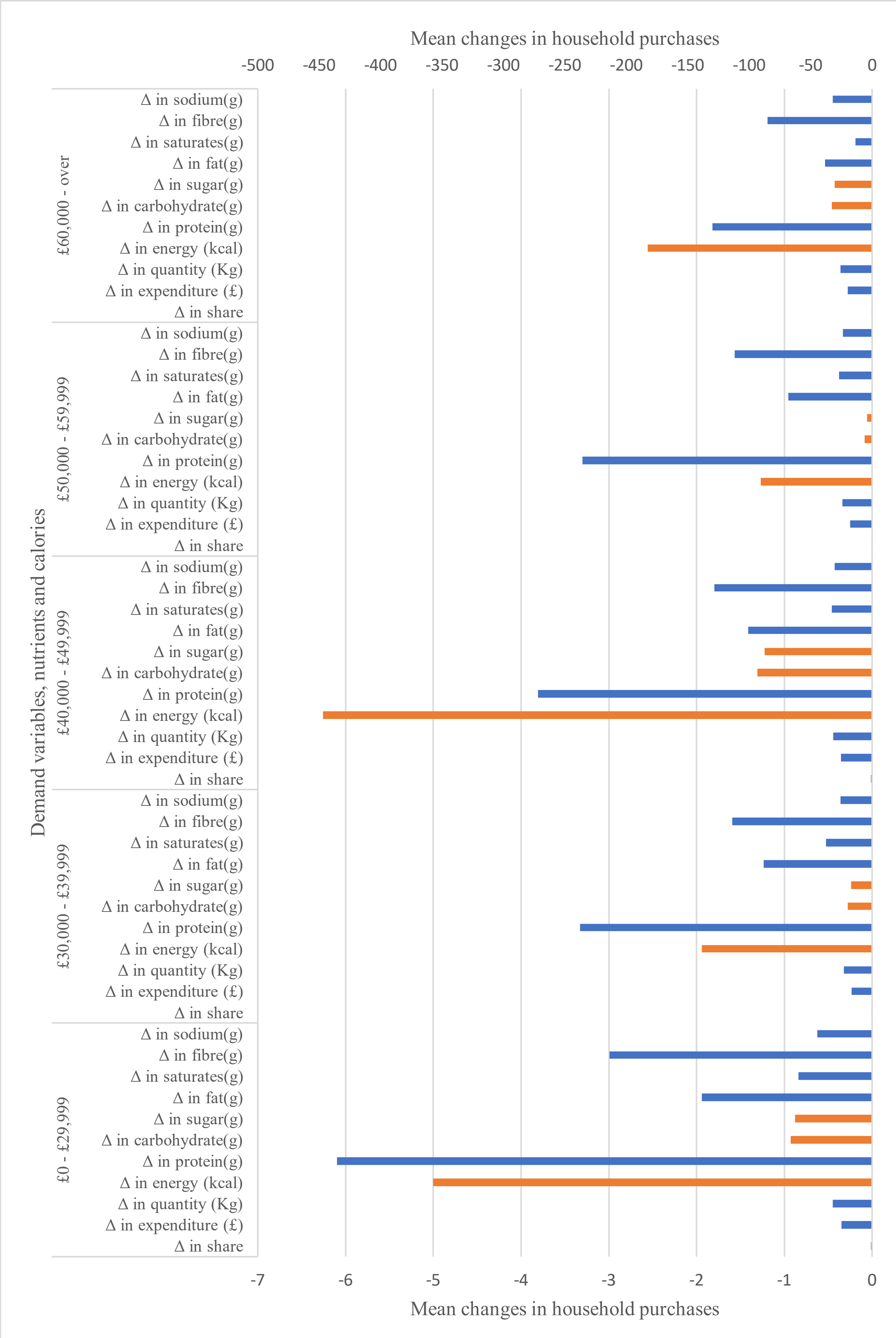

Figure 7 Changes in nutrient, calories, and demand for beverages by households based on their income ranges (Eliminating Promotions on Soft Drinks)

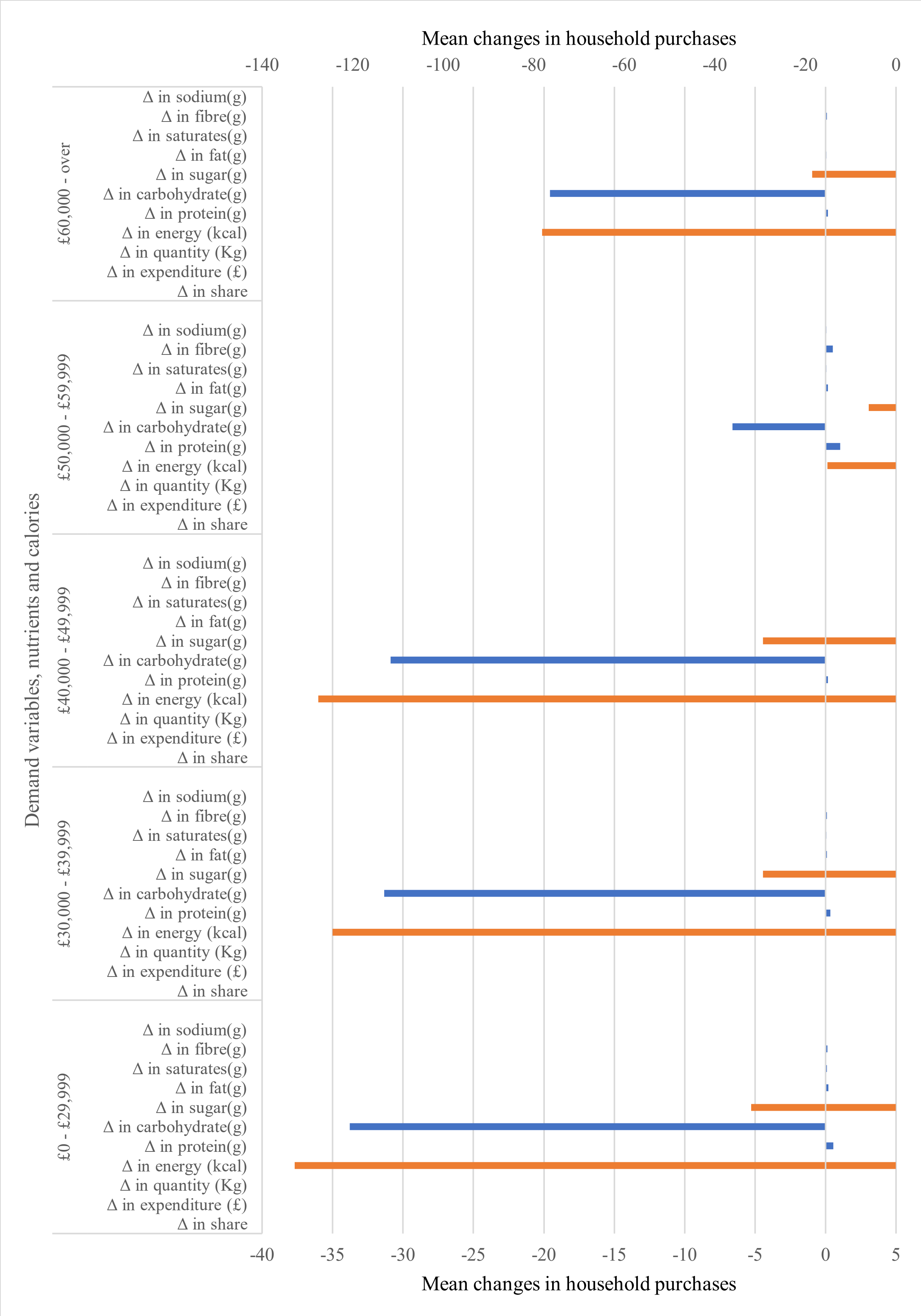

Figure 8 Post-tax changes in nutrient, calories, and demand for beverages by households based on their income ranges