Appendix C3. SSB tax methods and assumptions

Introduction

The impact of a 20% excise tax applied to SSBs on BMI prevalence was modelled. This level of taxation is in keeping with current recommendations proposed by the UK Faculty of Public Health (1). We implemented a SSB tax in year 1 and modelled an exponential reduction in BMI, as a result of reduced SSBs consumption, over a 10-year period. Figure 1 outlines the pathway by which an excise tax applied to SSBs impacts on BMI. The key assumptions made at the various stages along this pathway are described below. The input data that were used to determine the BMI reduction to be modelled are summarised in the tables below.

Quantifying the effectiveness of a tax on SSBs on reducing SSBs consumption

The price of SSBs

The price of SSBs in each EConDA country were collected by country partners and came from a number of different data sources; it was not possible to obtain price data for Greece, Lithuania and Poland. The price of SSBs was identified from published data for all countries, with the exception of the UK for which it was calculated from survey data, as summarised in table 1.

In the case of the UK, the Living Costs and Food Survey (LCFS) was used to derive the current price of SSBs in the UK. The LCFS is a national UK survey that collects data from a daily food expenditure diary over a two-week period. Two survey categories from LCFS – 'soft drinks, concentrated, not low calorie' and 'soft drinks, not concentrated, not low calorie' were used to define SSBs in this project. This definition excluded diet or low calorie drinks as they do not contain the high sugar levels associated with regular varieties. Expenditure (in £/week/person) and purchase (in ml/week/person) data for both categories of SSBs were extracted from the 2012 LCFS and used to determine the average expenditure and average purchase of SSBs. The average price of sugar-sweetened drinks in the UK in 2012 was derived by dividing average expenditure by average purchase volume.

Table 1 – Prices of SSBs

Country	Price of SSBs per Litre	Year	Reference
Bulgaria	€ 0.40	2007	(2)
Finland	€ 1.79	2013	(3)
Greece	N/A	N/A	N/A
Lithuania	N/A	N/A	N/A
The Netherlands	€ 0.61	2013	(4)
Poland	N/A	N/A	N/A
Portugal	Price based on supermarket purchase: €1.88 (330mL can); €0.83 (2L bottle)	Not known	(5)
UK	£1.20	2012	(6)

Pass-on rate

The degree to which the price of a product changes in response to an imposed tax depends on the pass-through rate of the price change from the manufacturer to the consumer (7). Based on a variation in empirical evidence, it was considered reasonable to assume a pass-on rate of 100% (8), which indicates that the full price of the tax applied to SSBs would be passed through from the manufacturer to the consumer.

Baseline consumption of SSBs

With the exception of the UK, data on the consumption of SSBs in each EConDA country, were derived from 2012 data published by Eurostat (9). The following product category from the Eurostat database was considered to be in keeping with our definition of SSBs: "*Waters, with added sugar, other sweetening matter or flavoured, i.e. soft drinks (including mineral and aerated)*". Baseline consumption of SSBs was derived by taking account of the total volume of SSBs (in litres) imported, exported and produced annually by each country from which the quantity of sugar consumed was calculated on the basis that there are 35 grams (g) of sugar in every 330 millilitres (mL) can of Coca-Cola (10) (equivalent to 106g in every litre of Coca-Cola). Individual consumption of SSBs was calculated using 2015 UN World Population Prospects data (11) and finally, converted to consumption per day. Baseline consumption of SSBs (in grams/person/day) for the EConDA countries modelled are summarised in table 4 below.

Data on the consumption of SSBs in the UK were derived from the most recent National Diet and Nutrition Survey (NDNS) dataset, 2008-2011. The NDNS is a national survey of diet, nutrient intake and nutritional status of the UK population (12). Consumption of SSBs (in grams/person/day), was defined in the survey as 'soft drinks, not low calorie, concentrated', 'soft drinks, not low calorie, carbonated' and 'soft drinks not low calorie, ready to drink, still' (the latter two categories referred to as 'soft drinks, not concentrated, not low calorie' for this project to align with LCFS definitions). Consumption of SSBs in millilitres was converted into grams per day using the standard conversion rule that 1 millilitre is equivalent to 1 gram. Data on the baseline consumption of SSBs (in grams/person/day) for the UK are summarised in table 5 below.

Change in consumption of SSBs

In order to predict the effect a change in price would have on individual consumption, price elasticities were sought from the published literature. Country-specific price elasticities were identified in the case of Finland and The Netherlands only. However, it was not possible to utilise these data, as either the data were not specific for SSBs or not in the format required for inclusion in background calculations. Recently published price elasticities (PE) of demand for the whole UK population (13) were utilised for the UK and used as a proxy measure for the remaining EConDA countries.

To delineate the percentage change in consumption, the PEs (specifically own PEs for concentrated and not-concentrated SSBs in the case of the UK, and non-concentrated SSBs for the remaining EconDA countries) was multiplied by the change in SSB consumption (the percentage increase as a result of the tax). For example, for a 20% excise tax in the UK, the own PEs for concentrated and non-concentrated SSBs were added together and multiplied by 20. This calculation assumed that the purchase of SSBs would change to the same degree as consumption.

Change in energy intake as a result of fiscal policy applied to SSBs

In order to deduce the effect an excise tax would have in reducing daily energy intake from SSBs, the reduction in consumption of SSBs in grams was converted to kilojoules (kJ) using recently published energy densities for these beverages (13). Based on the assumption by Wang et al (14), it was assumed that for every 100kJ saved from not consuming SSBs, there would be a 60% net kJ reduction (with 40kJ being substituted by other food and beverage intake).

Change in body weight as a result of fiscal policy applied to SSBs

Change in body weight as a result of reduced total daily energy intake was calculated using the assumption that *"every change of 100kJ per day will lead to an eventual weight loss of 1kg" (*Hall et al, 2011) (15). The majority of the predicted weight loss (95%) would be achieved in approximately 3 years, with 50% and 45% of the total weight change being achieved within the first and second years, respectively, and the final 5% being achieved between the third and tenth years (15).

Table 2 – Summary of SSBs model assumptions

Parameter	Definition/quantity	Reference
Price elasticities for SSBs	*All EConDA countries (except UK)* – non-concentrated: -0.798 *UK* – concentrated: -0.742; non-concentrated: -0.798	13
Pass-on rate	100%	
Substitution effects	40% of calorie intake reduced from not consuming SSBs substituted by other food and beverage intake	14
Change in energy intake from SSBs	1.5kJ change in energy intake per 1 g reduction in consumption	13
Change in body weight	100kJ change in energy intake = 1 kg	15

Change in body mass index as a result of fiscal policy applied to SSBs

In order to estimate the change in individual BMI, the average height of an adult in metres (m) in each of the countries modelled was determined as outlined in table 3 and the change in BMI was calculated using the WHO reference calculation (BMI= kg/m^2) (16, 17).

Data on the average height of an adult in each of the EConDA countries were identified from a number of different data sources as outlined in table 3. For all countries except the UK, data on the average height of adult males and females separately were available. A weighted population average using UN World Population Prospects data (18, 19) was taken in order to determine the average height of an adult. The

average height of a UK adult was calculated using Health Survey for England (HSE) 2012 data (20), which was extracted using the UK Data Service database (21).

Table 3 – Average height of an adult

Country	Average height (m)	Reference
Bulgaria	1.69	22
Finland	1.71	23
Greece	1.71	24
Lithuania	1.74	25
The Netherlands	1.74	26
Poland	1.71	24
Portugal	1.67	24
UK	1.72	20

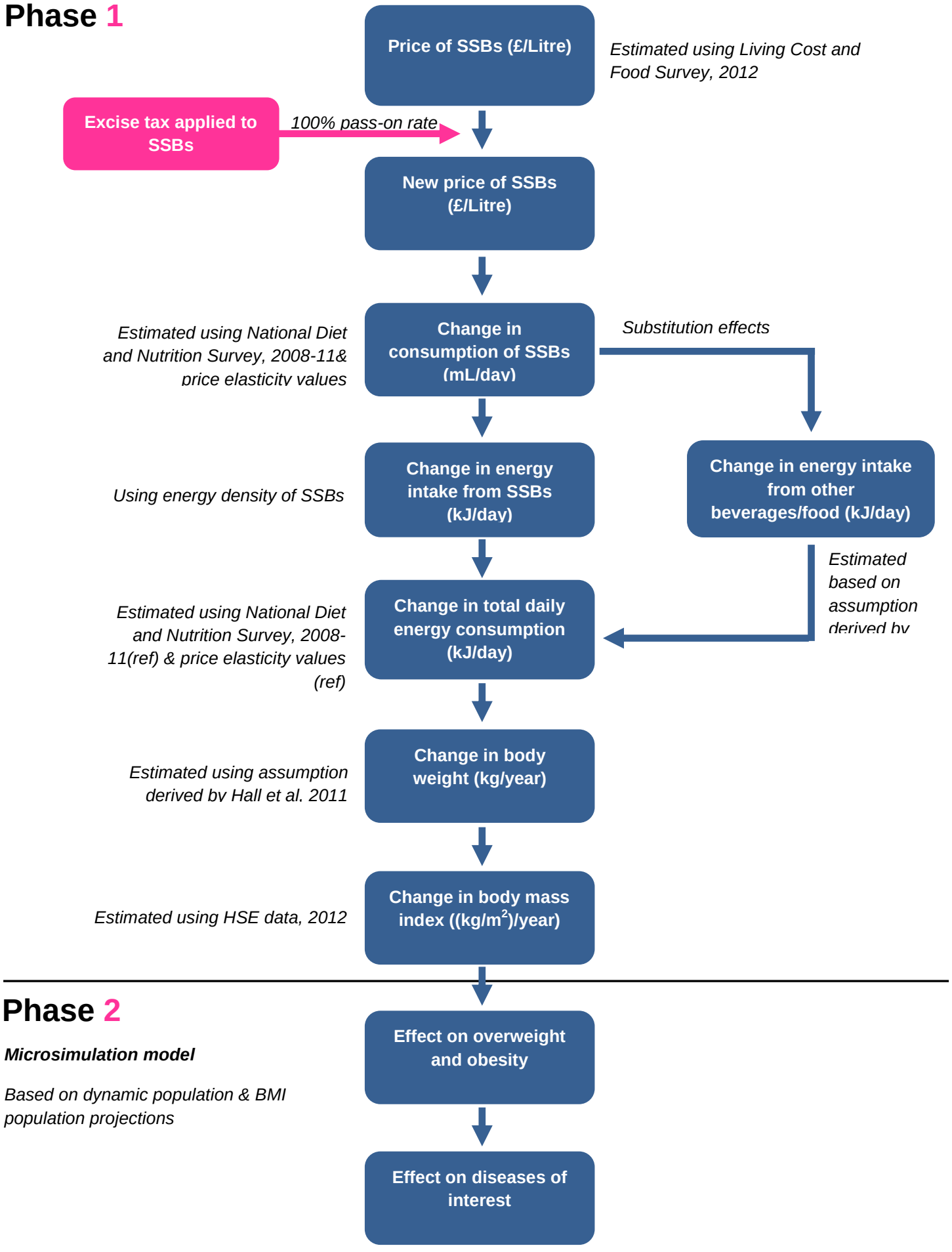
Table 4 – Estimated effect a 20% excise tax applied to SSBs would have on BMI (EConDA countries with the exception of the UK)

Country	Baseline consumption of SSB (g/day)	Post-tax consumption of SSBs (g/day)	Reduction in total energy intake accounting for substitutions (kJ/day)	Reduction in body weight (kg)	Reduction in bmi (kg/m2)
Bulgaria	19.92	16.74	-2.86	-0.03	-0.01
Finland	19.74	16.59	-2.84	-0.03	-0.01
Greece	13.10	11.01	-1.88	-0.02	-0.01
Lithuania	5.20	4.37	-0.75	-0.01	0.00
The Netherlands	37.38	31.42	-5.37	-0.05	-0.02
Poland	19.80	16.64	-2.84	-0.03	-0.01
Portugal	21.42	18.00	-3.08	-0.03	-0.01

Table 5 – Estimated effect a 20% excise tax applied to SSBs would have on BMI (UK)

Age	Baseline consumption of SSBs (g/day)		Post-tax consumption of SSBs (g/day)		Reduction in total energy intake accounting for substitutions (kJ/day)	Reduction in body weight (kg/year)	Reduction in BMI (kg/m^2) per year
	Concentrated	Not concentrated	Concentrated	Not concentrated			
20-39	65.56	107.44	55.83	90.29	24.19	0.24	0.08
40-59	34.49	56.51	29.37	47.49	12.72	0.13	0.04
60+	21.60	35.40	18.40	29.75	7.97	0.08	0.03
Average	40.55	66.45	34.53	55.85	14.96	0.15	0.05

Figure 1 – Flow diagram of the impact fiscal policy measures applied to SSBs has on health outcomes (Adapted from Briggs et al, 2012)



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