The Impact on Different Household Types of Economic Policies Designed to Increase the Fiber Intake from Grain Consumption*

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Abstract

This paper simulates the impact across household types of fully funded tax reforms designed to increase consumers' fiber intake from grain consumption. Our results suggest that household types with the highest initial consumption share of fiber-rich products – i.e., households without children (seniors, couples without children, and single women without children) – experience the highest increase in fiber intake from these reforms. However, they also experience high increases in unhealthy nutrients from the reforms, making the net health effects difficult to evaluate. Seniors and couples without children also gain the most financially, paying less food taxes and facing, depending on the reform, either a lower price level than before the reform or a lower increase in the price level than the average household. These household types also face the lowest initial price level. Households with the lowest initial consumption share of fiber-rich products – families with children – appear to gain the least financially from the reforms: they pay more food taxes and face relatively high increases in price levels. Further, in general they experience an increase in fiber intake smaller than the average household. However, they do generally see reductions in the intake of added sugar, and in many cases saturated fat, which positively affects the health of families with children, who often overconsume these nutrients.

Key words: consumer economics, food, health, taxation

JEL classification: D12, H23, I18

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1. Introduction

In most Western countries, as well as in many transition economies, the prevalence of illnesses related to the modern diet and a more sedentary lifestyle has increased markedly over the last few decades. The modern diet is often rich in empty calories and fat, and has proven to be a significant risk factor for several types of cancer, cardiovascular disease, diabetes, osteoporosis, and dental caries as well as overweight and obesity, themselves major risk factors of many of these diseases. The World Health Organization states that "improving nutrition could be the single most important contributor to reducing the burden of disease in the WHO European Region" (WHO, 2004, p.27). Poor diet is estimated to cause, for instance, about one third of European cancer deaths and one third of all cardiovascular disease. Cancer and cardiovascular diseases account for almost two thirds of Europe's total disease burden, measured by losses of years of healthy life (WHO, 2004).

In the U.S., direct costs on healthcare (costs of in- and outpatient care and pharmaceutical therapy) from poor nutrition and insufficient exercise are estimated to account for 7 percent of personal healthcare expenditures (Kenkel and Manning, 1999). In Sweden, direct and indirect costs[1] solely of obesity and overweight (i.e., disregarding all other illnesses caused by poor nutrition) have been estimated at SEK 3.6 billion (Persson et al. 2004) and SEK 12.4 billion (Persson and Ödegaard, 2005), which is about 3 percent of the total costs (direct and indirect) of all illness (Socialstyrelsen, 2003). These costs may be even higher in the future due to the time lag between the prevalence of obesity and overweight and the serious illnesses that often follow. The externalities imposed on tax payers could justify government intervention aimed at encouraging healthier food consumption.

Increasing the intake of dietary fiber would constitute an important improvement of the nutritional quality of modern diets. A diet high in fiber has several health-promoting effects: helping to maintain a healthy body weight (Burton-Freeman, 2000, Liu et al., 2003), and controlling and preventing heart diseases (Liu et al., 1999, Mann, 2002), diabetes (Brand-Miller et al., 2003, Schulze et al., 2004, Willet et al., 2002), and colorectal cancer (Schatzkin

[1] Here, indirect costs are defined as the value of lost production, sickness absence, disability pension, and premature death.

et al., 2007). The Swedish National Food Administration (SLV) therefore recommends that the average Swedish consumer substantially increases his/her fiber intake. The average woman is recommended to increase her intake by a minimum of 56 percent, and the average man by a minimum of 38 percent.[2] Along with fruit and vegetables, grain products are the most important source of dietary fiber. To increase the fiber intake from grain products specifically, the SLV recommends that the average household should ensure that half of the volume of bread and breakfast cereals it consumes are "Keyhole" labeled. The "Keyhole" is a nutrition symbol for products certified as whole grain by the SLV. [3]

Using grain consumption data, Nordström and Thunström (2009) simulate the effect of tax reforms aimed at encouraging the average household to increase its fiber consumption by the minimum recommended 38 percent. The authors found that *a 50 percent VAT reduction for Keyhole-labeled bread and breakfast cereals or a SEK 0.046 subsidy per gram of fiber per kilogram of grain product increased the fiber intake of the average household by 38 percent.* However, Nordström and Thunström also show that subsidies in isolation are costly, in terms of tax revenues lost, and that subsidies increase not only the intake of fiber but also the intake of nutrients that are often overconsumed (fat, saturated fat, sugar, added sugar, salt). The authors therefore simulated reforms that are fully funded. They found that a 50 percent subsidy of Keyhole-labeled bread and breakfast cereals could be fully funded by 113.8 percent VAT on bakery goods and ready meals. They also simulated the effects on the average household's consumption of a SEK −0.0460 fiber subsidy funded by excise duties on either total fat, saturated fat, sugar, or added sugar. The authors conclude that the revenue-neutral tax scheme that appears to be most efficient in redirecting consumption to healthier levels is a subsidy on fiber, funded either by an excise duty of SEK 0.182 per gram of added sugar or an excise duty on saturated fat of SEK 0.325 per gram in each kilogram of product. Building on the results in Nordström and Thunström (2009), we will here analyze the effect across household types of reforms designed to increase the fiber intake from grain consumption. We will simulate the following four revenue-neutral policy reforms:

[2] The average woman consumes 112 grams of dietary fiber per week, and the average man 126 grams (Becker and Pearson, 2002). Recommended weekly levels are 175–245 grams of dietary fiber for both men and women (SNR, 1997).

[3] Breakfast cereals that meet the following criteria can be certified with the Keyhole logo issued by the SLV: fat max. 7g/100g, sugar max. 13g/100g, sodium max. 500mg/100g, fiber min. 1.9g/100 kcal. For soft bread the criteria are as follows: fat max. 7g/100g, sugar max. 10g/100g, sodium max. 600mg/100g, fiber min. 1.9g/100 kcal. For crisp bread, the certification criteria are: fat max. 8g/100g, sodium max. 600mg/100g, and fiber min. 1.9g/100 kcal.

i *A revenue-neutral VAT reform* entailing zero VAT on Keyhole-labeled bread and breakfast cereals funded by VAT on bakery goods and ready meals of 34.2 percent, while maintaining the VAT on all other grain products at the initial 10.71 percent.[4]

ii *A revenue-neutral VAT reform* entailing a 50 percent subsidy of the consumer price of Keyhole-labeled bread and breakfast cereals funded by 113.8 percent VAT on bakery goods and ready meals, while keeping the VAT on all other grain products at the initial 10.71 percent.

iii *A revenue-neutral excise duty reform* entailing a SEK 0.046 subsidy per gram of fiber per kilogram of grain product, funded by an excise duty of SEK 0.182 per gram of added sugar.

iv *A revenue-neutral excise duty reform* entailing a SEK 0.046 subsidy per gram of fiber per kilogram of grain product, funded by an excise duty of SEK 0.325 per gram of saturated fat.

Our focal points when analyzing the impact of these policy reforms across household categories is the impact on the intake of fiber and other nutrients, the volumes consumed, changes in tax payments by different household types, and the change in the price level faced by the household types. To perform the analysis, we estimate a demand system for grain products and thereafter simulate the results of the above tax reforms.

Empirical literature on the effects of economic policies aimed at improving the nutritional content of food consumed is limited, especially for studies analyzing the effects across different household types. Smed et al. (2007) conducted a comprehensive study on the impact of economic instruments on the intake of fiber, saturated fat, and sugar across age and income groups. They found that young households have a higher elasticity of demand for saturated fat, whereas middle-aged households have a higher elasticity of demand for sugar. In general, the lowest income group is found to be the most responsive to food price changes. Chouinard et al. (2007) analyzed the effect of a 10 percent ad valorem tax on the percentage of fat in diary consumption. They conclude that the tax has little effect on fat consumption and would also lead to particularly large welfare losses for elderly and poorer households.

[4] Subsidies are not applied to Keyhole-labeled flours that could be used for bread making, since they could also be used for other, less healthy, purposes.

Some countries, including Australia, Canada, Finland, and Norway, have implemented taxes on unhealthy foods (soft drinks, snacks, or junk food). Similarly, many states in the U.S. tax unhealthy foods or exclude such foods from food tax exemptions. However, such taxes are generally not expected to substantially change consumer behavior (Jacobson and Brownell, 2000). Nevertheless, the fact that countries have already imposed differentiated VAT rates, based on nutritional content, makes empirical research on the impact of such policy measures essential.

To the best of our knowledge, this is the first study to analyze the distributional effects of policy instruments designed to direct consumption towards specific nutritional recommendations. It is also the first study to examine the distributional effects of revenue-neutral tax schemes incorporating combinations of excise duties on nutrients. This paper therefore provides a valuable insight into the effects of different designs of tax schemes that could be used to improve the quality of the modern diet.

In sections 2 and 3, we present the data and the modeling framework; section 4 contains the results of the analysis and section 5 concludes the study.

2. Data

To estimate the demand system for grain products, we use private market research data from GfK Sweden[5] and household expenditure data (HUT) on bread purchases from Statistics Sweden. The GfK data are based on diary recordings of grain product purchases for 2003. Our sample consists of the 1336 households who participated in the panel for the whole year. The data contain information on daily retail purchases of bakery goods, bread, breakfast cereals, frozen and fresh ready-to-eat food, pasta, rice, and flours. The product information is detailed, including the type, price, and size of the products bought. An exception is soft bread, however, for which the GfK households are only requested to state the total expenditures on soft bread. To obtain more information on the type of bread purchased, we therefore use the 1996 household expenditure data (HUT) from Statistics Sweden, which includes information on the amounts of types of soft bread (white or dark) purchased, as well as a price index for bread prices.

[5] GfK stands for “Growth from Knowledge.”

The GfK data also contain information on the number of children, the number of adults, sex and the age of the head of the household. Based on this information, we control for nine different household categories in the estimation and simulations of the tax reforms: single woman without children, single woman with children, single man with or without children, couple without children, couple with one child, couple with two children, couple with three or more children, three or more cohabiting adults (minimum 17 years of age) and pensioner households, of any number of adults and children.

The HUT data comprise 1104 households, and contains the same demographic information as the GfK data set, as well as two additional categories: unknown household type with children, and unknown household type without children. In addition to the household categories defined above for the GfK data these are also controlled for in the estimation.

Appendix A gives descriptive statistics on the average budget shares for each household category. For all household categories, prepared foods (bakery goods, bread, breakfast cereals, pasta, and rice) represent the dominant group for grain consumption, with at least 80 percent of total expenditure on grain products. For the average household, the rest of the budget is fairly evenly distributed across ready meals and staple goods for cooking. The budget share for ready meals is particularly low for couples with two children, whereas it is particularly high for single women without children. For staple goods for cooking, households of three or more adults devote the greatest budget share to this product group, whereas single women with children spend the smallest budget share on these foods.

The two major food groups in ready meals are “pirogues and pan pizzas” and “pizza, pasta, lasagna.” As the table reveal Families with more children per adult head devote a higher proportion of their expenditures on ready meals to the foods that are the least time consuming to prepare, namely “pirogues and pan pizzas” (all pirogues included in the sample are for microwave cooking).

In prepared foods, households devote most of their expenditures to bread, constituting 66 percent of total prepared food expenditures for the average household. The second largest food group is breakfast cereals, for which the average budget share is 17 percent. However, families with a higher number of children per adult head have a lower budget share for bread

and a higher budget share for breakfast cereals. Within the bread group, households on average devote 88 percent of their expenditures to soft bread. Seniors is the household category that devotes the largest proportion of its expenditures to crisp bread. Within the crisp bread group, Keyhole-labeled crisp bread is clearly dominant for all household types.

Within the breakfast cereal group, flakes is the dominating group for the average household, whereas expenditures devoted to Keyhole-labeled breakfast cereals are fairly small in comparison. Another large group is muesli, for which households without children seem to have an especially high budget share. As might be expected, households with a greater number of children have a much higher budget share for sweetened cereals than other household categories.

Households with children also devote a greater proportion of their expenditures than other households to pasta and rice. However, all household categories devote most of their expenditures on these two product groups to non-wholegrain varieties.

The products purchased by the GfK and HUT households are matched with their product contents using the information on nutritional value provided by the nutrient database maintained by the SLV. The level of detail in the GfK data allows us to match a product of a specific brand ("brand product") to its product content. The brand products are thereafter grouped into somewhat more aggregated categories (for example all dry, non-wholegrain, wheat pasta of various brands is aggregated into a single product, unfilled pasta). The product content is the weighted average of the contents of the brand products, where the share of purchases of different brands are used as weights. The nutrient contents that have been matched with the products are energy density (kilojoules per 100 grams), grams of total fat, grams of saturated fat, grams of sugar, grams of added sugar, grams of salt and, finally, grams of fiber, per 100 grams of product. For convenience, we will refer to fat, saturated fat, sugar, added sugar, and salt as the "unhealthy" nutrients, due to the fact that the average household is likely to overconsume these nutrients. For a household with low food consumption, an increased intake of these nutrients might, however, be health enhancing. Descriptive statistics of the product contents are given in Table 2.1.

Insert Table 2.1 here.

As expected, the energy density of bakery goods is the highest of all the product groups, but the individual product with the highest energy density seems to be white wheat crisp bread. The highest fat content is found in dough (almost 40 grams per 100 grams), which is mainly due to this product consisting almost exclusively of puff paste. Cakes, sweet buns, pirogues and pan pizzas also contain high amounts of fat (24, 20, and 23 grams per 100 grams, respectively). The product with the highest fiber content per 100 grams is Keyhole-labeled crisp bread, with more than 14 grams of fiber per 100 grams of bread.

It is noteworthy in Table 2.1 that the product dark crisp bread on *average* fulfills the criteria for Keyhole labeling. However, none of the individual products in this product group fulfills these criteria and, hence, they are not included in the Keyhole-labeled group.

Table 2.2 shows the proportion of Keyhole-labeled bread and breakfast cereals consumed relative to total bread and breakfast cereal consumption by household type, as well as the proportions of bakery goods and ready meals consumed relative to total household consumption of grain products.

Insert Table 2.2. here.

For the average household, the proportion of Keyhole-labeled bread and breakfast cereals purchased, of total bread and breakfast cereal purchases, is 47 percent. Households without children (single women, couples, and seniors) all achieve the nutritional recommendation that half of the bread and breakfast cereals they consume should be Keyhole labeled.[6] Families with children are far from reaching this recommendation, however, and the more children per adult head, the lower the share of Keyhole-labeled bread and breakfast cereals purchased. The relatively poor nutrition of families with children is reflected by studies suggesting that children overconsume fat and sugar (see e.g., Rasmussen et al., 2004) as well as that adults in families with children generally seem to have a higher intake of added sugar and a lower intake of fiber than adults in households with no children. This pattern seems to be more pronounced for adult women than for adult men (Enghardt Barbieri and Lindvall, 2003).

[6] Note that the household category ***Single male*** refers to households consisting of a single adult man, with or without children.

3. The Modeling Framework

In the modeling of grain consumption we assume that the decision process take part in multiple steps, according to Figure 1. At the highest level in the decision process, the household allocates its (total) resources for grain expenditures between three broad product categories: prepared foods, ready meals, and staple goods for cooking. When the household has determined the expenditures for each category, it decides how to allocate these expenditures between the product groups within each category.

Insert Figure 1 here.

We are unable to observe total household consumption of grain products since some are consumed outside the home (e.g., in restaurants and at school). The relative consumption of different grain products is, however, likely to be well reflected in the data set. A model that is based on budget shares is therefore likely to capture the expenditure pattern in a good way. Our basic model specification is therefore the quadratic extension (Banks et al. 1997) to Deaton and Muellbauer's (1980) almost ideal demand system – the QAIDS. The QAIDS provides a flexible functional form of consumer preferences, based on relative consumption (budget shares). Another appealing feature of the QAIDS is that it handles non-linear expenditure (or income) effects, which may be particularly important when simulating the impact of reforms that lead to large price effects. We take into account the differences in consumption patterns between household categories by adding intercept and slope parameters in the budget share equations of the demand system. As we cannot observe the households' consumption of other goods, we have to assume that household preferences are weakly separable in grain consumption and other goods. To reduce the number of estimated parameters, we also assume that household preferences are weakly separable into ready meals, staple goods for cooking, and prepared foods.[7] The full decision process and the separability assumptions that follow from this process are shown in Figure 1.

[7] Although the separability assumption imposes restrictions on the substitution possibilities between goods in different subgroups, there is no restriction on the substitution possibility between the goods within a subgroup. As we use very disaggregated data in this study, with a healthy alternative within most subgroups, we believe that we are able to estimate the main substitution effects with this model. Separability does not imply that price changes of goods in different groups do not affect each other, but merely that such effects are channeled through the group expenditures, via changes in group prices and expenditure levels at the upper allocations stage (Deaton and Muellbauer, 1980b, pp. 127-133).

Accordingly, at the first allocation step household h decides how much of grain products to consume (i.e., the resource allocation over staple goods for cooking, prepared foods, and ready meals), conditional on various household characteristics, **d**. Household h's budget share for good k, s_k^h, in the first allocation stage then takes the form

$$\begin{aligned} s_k^h &= a_k(\mathbf{d}^h) + \sum_l g_{kl} \ln p_l^h + b_k(\mathbf{d}^h) \times \ln\left[x^h / a^h(p,\mathbf{d})\right] \\ &\quad + \left(d_k(\mathbf{d}^h) / b^h(p,\mathbf{d})\right) \times \left(\ln\left[x^h / a^h(p,\mathbf{d})\right]\right)^2 \end{aligned} \qquad \begin{matrix} k = 1,\ldots,\mathrm{n} \\ h = 1,\ldots,\mathrm{r} \end{matrix} \tag{1}$$

where p_l^h is the price of good l, x^h is household h's total expenditure on the k =1,…,n grain product groups, and **d** is a vector of household characteristics, containing the household categories defined in the data section, and $\ln a^h(\cdot)$ and $\ln b^h(\cdot)$ are defined by

$$\ln a^h(p,\mathbf{d}) = \sum_l a_l(\mathbf{d}^h) \ln p_l^h + \frac{1}{2} \sum_k \sum_l g_{kl} \ln p_k^h \ln p_l^h \tag{2}$$

$$\ln b^h(p,\mathbf{d}) = \sum_{k=1} b_k(\mathbf{d}^h) \ln p_k^h \tag{3}$$

The reference household consists of a full-time working single woman without children.

An econometric consideration arises as not all of the households in the sample purchased all of the goods in 2003. For example, for fresh filled and fresh unfilled pasta, the occurrence of zero expenditure is as high as 92 and 83 percent. Whether the zeros are a result of infrequencies of purchases or of non-consumption is difficult to say. To allow for infrequencies of purchases, Blundell and Meghir (1987) presented a bivariate alternative to the Tobit model (Tobin, 1958, and Amemiya, 1974) with separate processes determining the censoring rule and the continuous observations. It is also reasonable to assume that there are separate processes determining the zero-one decision of buying a good and the decision of how many units to actually buy. Therefore, to obtain consistent parameter estimates, we follow Heckman's (1979) two-step procedure and estimate separate probit and truncated regression models for each commodity group.

Following Blundell et al. (1993), we simplify the simulations by specifying $\ln a^h(p,d)$ as the household-specific Stone price index, $\ln P^h = \sum_k s_k^h \ln p_k$, and setting the price aggregator, $\ln b^h(p,d)$, equal to one. The estimated demand system for household *h* can therefore be rewritten as

$$\begin{aligned} s_k^h &= a_k(\mathbf{d}^h) + \sum_l g_{kl} \ln p_l^h + b_k(\mathbf{d}^h) \times \ln[x^h / P^h] \\ &\quad + d_k(\mathbf{d}^h) \times \left(\ln\left[x^h / P^h\right]\right)^2 + j_k \hat{l}_k^h + e_k^h \end{aligned} \qquad \begin{aligned} k &= 1,\ldots,\mathrm{n} \\ h &= 1,\ldots,\mathrm{r} \end{aligned} \qquad (4)$$

where e_k^h is an error term reflecting unobserved taste variation and *r* denotes the subsample for which $s_k^h > 0$. In addition, $\hat{l}_k^h = f(\hat{y}_k \mathbf{z}_k^h) / \Phi(\hat{y}_k \mathbf{z}_k^h)$ is the estimated inverse Mills ratio, with $\hat{y}_k$ estimated in a first step from a univariate probit model for group *k* (see e.g., Leung and Yu, 1996). The explanatory variables included in $\mathbf{z}_k$ are the prices of the products in equation *k*, the household income, and the same set of dummy variables as those contained in the **d** vector. Although the notation in equation (2) refers to the demand for the *k* goods in the first allocation stage, the same procedure is used in the estimation of all subdemand systems, see Figure 1. For instance, the demand system for the second stage of expenditure allocation has the same functional form as (2), and can be written as

$$\begin{aligned} s_{(k)i}^h &= a_{(k)i}(\mathbf{d}^h) + \sum_l g_{(k)ij} \ln p_{(k)j}^h + b_{(k)i}(\mathbf{d}^h) \times \ln[x_k^h / P_k^h] \\ &\quad + d_{(k)i}(\mathbf{d}^h) \times \left(\ln\left[x_k^h / P_k^h\right]\right)^2 + j_i \hat{l}_i^h + e_i^h \end{aligned} \qquad i = 1,\ldots,\mathrm{m} \qquad (5)$$

where $s_{(k)i}^h$ is household *h*'s budget share for good *i* within group *k*, $p_{(k)j}$ is the price of good *j* in group *k*, and x_k^h are the total expenditures that household *h* has allocated to the goods in group *k* in the first-stage allocation problem. This procedure extends in a natural way to similar subdemand systems when we have three-stage and four-stage allocation of expenditures on grain products.

The expenditure system has a set of within-equation and cross-equation restrictions that we impose. These are homogeneity, which gives rise only to within-equation restrictions, and symmetry, which gives rise to cross-equation restrictions. Homogeneity can thus be imposed in a first stage by estimating single equations. Since the number of observations will differ for different goods after the selection of $s_k^h > 0$, we use a minimum distance estimator (see Ferguson, 1958) to impose the cross-equation restrictions in a second stage.[8] If we estimated the regression system simultaneously we would lose information, as only households with $s_k^h > 0, \forall k$ would be included in the regression. Instead of specifying a particular form of the heteroscedasticity, we employ White's (1980) approach to calculate the standard errors.

3.1 Simulating the reforms

In the simulations we start by calculating the percentage price change due to a specific tax reform. The VAT on food in Sweden is 10.71 percent of the consumer price (or, equivalently, 12 percent of the producer price), which constitutes the baseline for the analysis. It is noteworthy that the VAT reforms only affect prices of Keyhole-labeled bread and breakfast cereals, and prices of bakery goods and ready meals. The excise duty reforms, however, affect all grain product prices, since all products contain fiber, saturated fat, and added sugar, which have a substantial impact on most prices. For instance, if we introduce the SEK 0.046 fiber subsidy funded by the SEK 0.182 excise duty on added sugar, the price of Keyhole-labeled flour (which is low in added sugar but high in fiber) decreases to 61 percent of the baseline price, whereas the price of sweetened cereals more than doubles. For a thorough overview of price changes due to the reforms, see Nordström and Thunström (2009).

The post-reform Stone price indices are then calculated. The estimated parameters from the demand system and the post-reform Stone price index, as well as the estimated error terms, for the first allocation stage are thereafter substituted into the expenditure equations for the first allocation stage (as specified by equation (4)), and new budget shares are calculated. Assuming separability between grain consumption and other consumption, the post-reform total nominal expenditures are the same as the ex ante reform nominal expenditures on grain consumption. We therefore multiply the post-reform budget shares from the first allocation

[8] The minimum distance estimator is only applied to the price parameters, meaning that the other parameters in the demand system will not be affected.

stage by the pre-reform nominal expenditures for total grain consumption, which gives us the post-reform nominal expenditures for prepared food, staple goods for cooking, and ready meals. These expenditures and the new Stone price indices are, in turn, substituted into the estimated equations representing the second allocation stage, and new budget shares are calculated. In the case of additional subgroups, the procedure is repeated for the subsequent allocation stages.

In addition to calculating new budget shares, we also calculate the change in the consumption volume for each product. The change in the intake of different nutrients (e.g., fiber, added fat, or added sugar) due to the reform, can then be obtained by multiplying the change in consumption volume of a certain product by the content per kilogram of a specific nutrient in that particular product (see Table 2.2). In the simulations we also calculate the percentage change in tax payments for the household. For a more comprehensive description of the simulation procedure, see Nordström and Thunström (2009).

4. Estimation and simulation results

F-tests indicate that the estimates of the parameters of the b and d functions, in the original specification, are not significantly different from zero. We have therefore reduced the number of estimated parameters in the final specification of the model and excluded the household-specific parameters from these functions. The estimation results suggest that it is important to account for non-linear expenditure effects and control for non-consumption. In 35 of 42 cases the estimated parameters for the non-linear expenditure variable are significantly different from zero, at a 5 percent significance level, and 22 percent of the estimated parameters related to the inverse Mills ratio are significantly different from zero.

Likelihood ratio tests suggest that the homogeneity restriction generally cannot be rejected. Chi-square tests indicate that the symmetry restrictions are rejected for only two (pasta and bread) of the nine estimated demand systems, at a 5 percent significance level. The adjusted *R*-square is generally high and ranges from 0.2 to 0.6. Overall, the model fit is found to be good.

All own price elasticities are negative and in line with elasticities reported by previous studies (e.g., Chouinard et al., 2007, and Kuchler et al., 2005). The uncompensated own price elasticities range from -0.21 for wholegrain pasta to -1.56 for "other" breakfast cereals. There seems to be little difference in the price sensitivity for Keyhole-labeled bread or breakfast cereals compared to non-Keyhole products. The price sensitivity for the more unhealthy bakery products seems to be relatively low (around 0.60 for all subgroups) but the price sensitivity for ready meals seems to be well in line with the price sensitivity for other groups. The rich set of cross-price elasticities is not reported in the table but is, as expected, much smaller in absolute value than the own price elasticities. Expenditure elasticities are also of the expected sign, ranging from 0.13 and 0.15 for filled pasta and white wheat crisp bread to 1.16 and 1.45 for muesli and white wheat flour.

In subsection 4.1 below, we report the impact of the different reforms on consumption and nutritional intake. Subsection 4.2 contains an analysis of the tax effects on the price level for different household types.

4.1 The impact on consumption and tax payments of the simulated reforms

(i) A removal of VAT on Keyhole-labeled bread and breakfast cereals funded by 34.2 percent VAT on bakery goods and ready meals

Removing the VAT on Keyhole-labeled products, and fully funding the reform by a tax on bakery goods and ready meals of 34.2 percent, results in only marginal increases in fiber intake, varying between 2 and 3 percent across the household categories (see Appendix B). In addition, the effect of this reform on the price level facing different household types (as determined by their consumption basket) is minor. We therefore expect that removing the VAT on Keyhole-labeled products, while taxing bakery goods and ready meals, would have little if any effect on public health. We will focus our comments on the results of the more extensive tax reforms.

Insert Tables 4.2a and 4.2b here.

(ii) A 50 percent subsidy of Keyhole-labeled bread and breakfast cereals funded by 113.8 percent VAT on bakery goods and ready meals

Tables 4.2a and b show the results of the more extensive revenue-neutral VAT reform, where Keyhole-labeled bread and breakfast cereals are subsidized by 50 percent, and bakery goods and ready meals are taxed with 113.8 percent VAT. The simulation suggests that this reform results in all households, except couples with three or more children, attaining the recommendation of half of bread and breakfast cereal consumption being Keyhole labeled. Three household types experience an increase in fiber intake greater than the average household (35 percent) as a result of this reform – seniors, single women without children, and couples without children – and seniors even achieve the minimum recommended 38 percent increase. The smallest increase in fiber intake is noted for households consisting of a single woman with children. The generally large increase in fiber intake is a result of all household types substantially increasing their proportions of Keyhole-labeled bread and breakfast cereals consumed. The increase in the fiber intake is, however, accompanied by increases in the intake of kilojoules and unhealthy nutrients (fat, saturated fat, salt, sugar and added sugar), even if the consumption share of bakery goods and ready meals shrinks for all household types. The latter is true for all household types except households consisting of two adults and three or more children and households of three or more adults.

Even though all households experience sizeable increases in the intake of unhealthy nutrients, those that experience the highest increase in the intake of fiber also experience the highest increase in the intake in the unhealthy nutrients, and vice versa. This result implies that healthier, i.e., Keyhole-labeled, products contain both healthy and unhealthy ingredients, and that post-reform households choose a grain product basket that is not only higher in fiber but also higher in other nutrients. For instance, for pensioner households, the increase in the intake of salt and sugar is as high as 29 and 25 percent, respectively. Although increases are smaller for other household types, the pattern is similar. The net health effects on different household types of this reform are therefore uncertain.[9]

[9] It should also be remembered that the initial nutritional quality of the diet of families with children is relatively poor compared to families without children. For these families, even relatively small increases of unhealthy nutrients might therefore be important.

Further, our results suggest that the household types that gain financially from the reform are couples without children and seniors, measured by a decrease in VAT payments. They seem to adjust their consumption such that their VAT payments from grain products decrease by 16 and 61 percent, respectively. All families with children, as well as single women without children and single men, experience substantial increases in VAT payments as a result of this reform.

(iii) A SEK 0.046 subsidy per gram of fiber per kilogram of grain product funded by an excise duty of SEK 0.182 per gram of added sugar

Changes that may more efficiently control the intake of unhealthy nutrients could be excise duty reforms that directly target the nutrients, i.e., a subsidy of the fiber content funded by a tax on some, or some combination of, unhealthy nutrient(s). Here, we simulate the results across household types of the SEK 0.046 subsidy per gram of fiber per kilogram of grain product, funded by either an excise duty on added sugar, amounting to SEK 0.182 per gram of added sugar in grain products, or an excise duty on saturated fat, amounting to 0.325 per gram of saturated fat. Tables 4.3a-4.3b show the simulated results across household types of the SEK 0.046 fiber subsidy funded by a SEK 0.182 excise duty per gram of added sugar.[10]

Insert Tables 4.3a-4.3b here.

With the SEK 0.046 subsidy per gram of fiber per kilogram of product, funded by a SEK 0.182 excise duty on each gram of added sugar, we find that single men and households consisting of three or more adults attain the recommendation of half of bread and breakfast cereal consumption being Keyhole labeled. However, for the other household types that did not attain this recommendation before the reform, and who initially had the lowest consumption share of Keyhole-labeled bread and breakfast cereals (households with children, i.e., single women with children, and couples with one, two, three, or more children), the reform does not achieve the recommendation of half of bread and breakfast cereal consumption being Keyhole labeled. Further, across all household types, our results suggest

[10] Note that the SEK 0.046 fiber subsidy results in the same increase in fiber intake for the average household (the minimum recommended 38 percent) as the 50 percent subsidy of Keyhole-labeled bread and breakfast cereals. Nordström and Thunström (2009) show that the fiber subsidy is more cost efficient than the subsidy of Keyhole-labeled products. Here, both reforms are revenue neutral, however, since the subsidy of Keyhole-labeled bread and breakfast cereals is funded by taxes on bakery goods and ready meals, and the fiber subsidy is funded by an excise duty on either added sugar or saturated fat.

that the increase in fiber intake is lower than that achieved by the extensive VAT reform. However, the increase in unhealthy nutrients is also lower, with all household types even experiencing a decrease in the intake of added sugar. Those household categories with the highest consumption share of Keyhole-labeled products already, namely couples without children and seniors, show an increase in fiber intake from this reform higher than the average household (15 percent): our results suggest that the increase in fiber intake for couples without children would be 17 percent, and for seniors even higher, 20 percent. Again, however, those households with the largest increases in fiber intake also experience larger than average increases in their consumption of fat, saturated fat, kilojoules, and salt. In contrast, fiber intake increases only marginally for households with many children per adult. For households consisting of a single woman with one or more children, the fiber intake increases by 2 percent, whereas for households consisting of two adults with three or more children the fiber intake increases by only 1 percent. At the same time, the decrease in the intake of added sugar is particularly marked for these households: 22 percent for single women with children and 32 percent for two adults with three or more children.

Similar to the VAT reform, couples without children and seniors are best off financially from the reform, since implementing the reform means a decrease in VAT and excise duty payments of 14 and 32 percent, respectively, for these household types. Generally, the increase in food tax payments by the other household types was still pronounced, though smaller than the increase from the VAT reform, the exception being households consisting of a couple with three or more children or households of three or more adults, who experience greater increases in food tax payments.

(iv) A SEK 0.046 subsidy per gram of fiber per kilogram of grain product funded by an excise duty of SEK 0.325 per gram of saturated fat.

Tables 4.4a-4.4b show the results across household types of the SEK 0.046 subsidy per gram of fiber funded by an excise duty of SEK 0.325 per gram of saturated fat.

Insert Tables 4.4a-4.4b here.

Simulating the impact of an SEK 0.046 subsidy per gram of fiber per kilogram of product, funded by an excise duty of SEK 0.325 per gram of saturated fat, we again find that the

reform does not result in those households with the lowest initial consumption shares of Keyhole-labeled bread and breakfast cereals (households with children – single women with children, couples with one, two, three, or more children) achieving the recommendation of half of bread and breakfast cereal consumption being Keyhole labeled. And, again, for all household types the fiber intake increased by less than the increase under the VAT reform. Further, for most household types, the fiber intake increased by less than under the corresponding excise duty reform with an excise duty on added sugar, single women with children and couples with three or more children being the exception. However, for these household categories, the increase in fiber intake from this reform is still small (3 and 4 percent, respectively) and, again, the only household types experiencing an above average increase in fiber intake are couples without children and seniors (increases of 13 and 15 percent, respectively). All household types except seniors see a reduction in intake of both saturated fat and added sugar as a result of this reform, and most household types, with the exception of couples without children and seniors, see a reduction in fat intake. For seniors, the reform results in increases in all unhealthy ingredients, though the increases in saturated fat, added sugar, and sugar are marginal (1-2 percent). For single women without children and couples without children, too, we find increases in the majority of unhealthy ingredients. For the other household types, the general finding is that the intake of unhealthy ingredients decreases as a result of the reform.

As with the VAT reform simulations and the excise duty reform with excise duty on added sugar, seniors and couples without children are financially better off after the above reform compared to baseline. VAT and excise duty payments by these households would decrease by 27 and 14 percent, respectively, if the reform were implemented. Other household types would be financially worse off compared to baseline. Compared to the VAT reform, however, all households would be financially better off after this reform except for couples with three or more children, couples without children, and seniors. Compared to the excise duty reform with duty on added sugar, the reform with duty on saturated fat results in much higher increases in food tax for single women without children and single men, whereas single women with children, and couples with two, three, or more children would experience a much lower increase in food tax payments.

4.2 Effects on price levels for different household types

Insert Table 4.5 here.

Table 4.5 shows both the initial price levels faced by different household types and the relative change in price level (as measured by the antilog of Stone's price index) as a result of household reallocations of consumption after the policy reforms. As shown by column 1 in Table 4.5, seniors and couples without children face the lowest initial price levels, whereas single women without children and single men with or without children face the highest price levels.

Our results suggest that couples without children, couples with three or more children, and seniors would all face lower price levels than at baseline if the more extensive VAT reform (50 percent subsidy of Keyhole-labeled products, 113.8 percent VAT on bakery goods and ready meals) were implemented. The opposite is the case for all other household types. Best off are the seniors, who face a post-reform price level of 94 percent of the pre-reform level. The household types facing the highest increase in price level are single men with or without children and couples with two children; both groups face an increase in price level of 3 percent compared to baseline.

All household categories would see an increase in the price level they face for grain products if the SEK 0.046 fiber subsidy funded by a SEK 0.182 excise duty on added sugar were implemented, as shown by column 3 in Table 4.5. Further, all household types experience a higher increase in price level relative to the simulated price level increase from the VAT reform. The highest price increases are found for families with children, rising as much as 20 percent for families of two adults and three or more children. For seniors and couples without children, the excise duty reform entailing a fiber subsidy funded by a tax on added sugar results in a smaller increase in price level than for the average household. For all other household types, the price level increases by more than for the average household.

If we introduce the same fiber subsidy, funded instead by SEK 0.325 excise duty on saturated fat, the increase in the overall price level for different groups is less pronounced. Compared to

the VAT reform, increases in the price level faced by all households are higher from this reform. Compared to an excise duty on added sugar, however, increases are lower, except for single men with or without children. Compared to baseline, the highest price increases are, nevertheless, again experienced by families with children. And compared to the other household types, the price increase for single men, with or without children, is relatively sizeable too, 5 percent.

5. Conclusions

We estimated a demand system on grain consumption and thereafter simulated the effect across household types of four fully funded policy reforms designed to improve the quality of the grain diet. The policy objectives used in the paper are derived from nutritional recommendations for grain products of the Swedish National Food Administration (SLV). These recommendations are that the average consumer should double his/her consumption of bread and breakfast cereals, ensuring that half of the consumption is Keyhole labeled, as part of an overall objective of increasing the fiber intake by a minimum of 38 percent.

The reforms simulated are: (a) a relatively small VAT reform of zero VAT on Keyhole-labeled bread and breakfast cereals and 34.2 percent VAT on bakery goods and ready meals, while keeping the VAT on all other grain products at the initial 10.71 percent; (b) a more extensive VAT reform entailing a 50 percent subsidy of Keyhole-labeled products funded by 113.8 percent VAT on bakery goods and ready meals; (c) an excise duty reform entailing a SEK 0.046 subsidy per gram of fiber per kilogram of grain product, funded by SEK 0.182 excise duty per gram of added sugar per kilogram of product; and (d) an excise duty reform entailing a SEK 0.046 subsidy per gram of fiber per kilogram of product funded by SEK 0.325 excise duty per gram of saturated fat per kilogram of grain product.

The general findings for all the simulated reforms are that those households that see the greatest improvement in fiber intake and consumption of Keyhole-labeled bread and breakfast cereals – i.e., *households without children* (seniors, couples without children, and single women without children) – are those that already consume the highest proportion of Keyhole-labeled products. In addition, our results suggest that seniors and couples without children are the household types that gain the most financially from all reforms simulated here compared

to baseline. They would pay less food taxes if the reforms were implemented, and if the VAT reform were implemented, they would face a lower price level than before the reform, while for the excise duty reforms, they would see a lower increase in the price level than that experienced by the average household. These household types also face the lowest initial price level for grain products.

Households that initially consumed the lowest proportions of fiber-rich products (and generally consume less of nutritious food) – namely, *families with children* (single parents with one or more children and couples with one, two, or three and more children) – generally seem to gain the least financially from the reforms simulated here. Compared to baseline, they pay more food taxes if the reforms are implemented, and the reforms also result in relatively high increases in the price level they face, with this increase in price level generally higher than that experienced by the average household. Further, they generally experience an increase in fiber intake that is smaller than for the average household. However, all the reforms simulated here result in a reduced intake of added sugar for families with children (and in many cases also reductions in the intake of saturated fat), positively affecting the nutritional quality of their food consumption. Families with children are generally likely to overconsume both added sugar and saturated fat.

However, any sizeable increase in the intake of fiber as a result of the reforms simulated here is generally accompanied by an increase in kilojoules and unhealthy nutrients (fat, saturated fat, salt, and sugar), even though the subsidies of fiber-rich products or the fiber content are funded by taxes on unhealthy nutrients. The higher the increase in the intake of fiber, the higher the increase in the intake of unhealthy nutrients. This means for example that seniors who experience high increases in the intake of fiber from all reforms also experience high increases in their intake of unhealthy nutrients. This might be due to fiber-rich products not only containing fiber, but also other ingredients (see Table 2.1), the intake of which will increase if the consumption of fiber-rich products increases. This result generally makes it difficult to evaluate the net health effect of implementing policy reforms designed to increase fiber intake. However, controlling the intake of unhealthy nutrients appears easier with excise duty reforms than with VAT reforms, and for some household types the intake of unhealthy nutrients even decreases. Unfortunately, excise duty reforms are harder to implement than VAT reforms.

In contrast to Chouinard et al. (2007), we find no evidence of elderly people being particularly worse off financially compared to other groups from reforms designed to increase the nutritional content of the food intake. (It should be stressed, however, that Chouinard et al. (2007) analyze the results of a tax on fat, based on diary product data.) Our findings suggest that the elderly (seniors) and couples without children are the winners should tax reforms designed to encourage healthier grain consumption be implemented. These households gain the most, both nutritionally from increased fiber intake and financially from paying less food taxes – depending on the reform, facing either a lower price level than before the reform or a lower increase in the price level than that faced by the average household. Those who seem to gain least from the reforms simulated here are families with children, who generally see a smaller than average increase in fiber intake, pay more food taxes, and face relatively high increases in price levels.

The study has limitations in that it focuses only on grain consumption and assumes weak separability between grain and other consumption. Preferably, the demand system would be extended to include all household consumption. For instance, the difference between our results and those of Chouinard et al. (2007) could be due to analyses of different food groups. Also, financial measures are insufficient here in measuring welfare. The study assumes implicitly that health increases welfare and that increasing the fiber intake positively affects health, while increasing the intake of unhealthy nutrients negatively affects health. Ideally, we would know the net health effects of increases/decreases in the intake of different nutrients, and thereby be able to calculate welfare effects of the simulated reforms. Finally, it is important to consider distributional effects across other household dimensions, such as income groups. We will leave these and other issues to future research.

Tables and figures

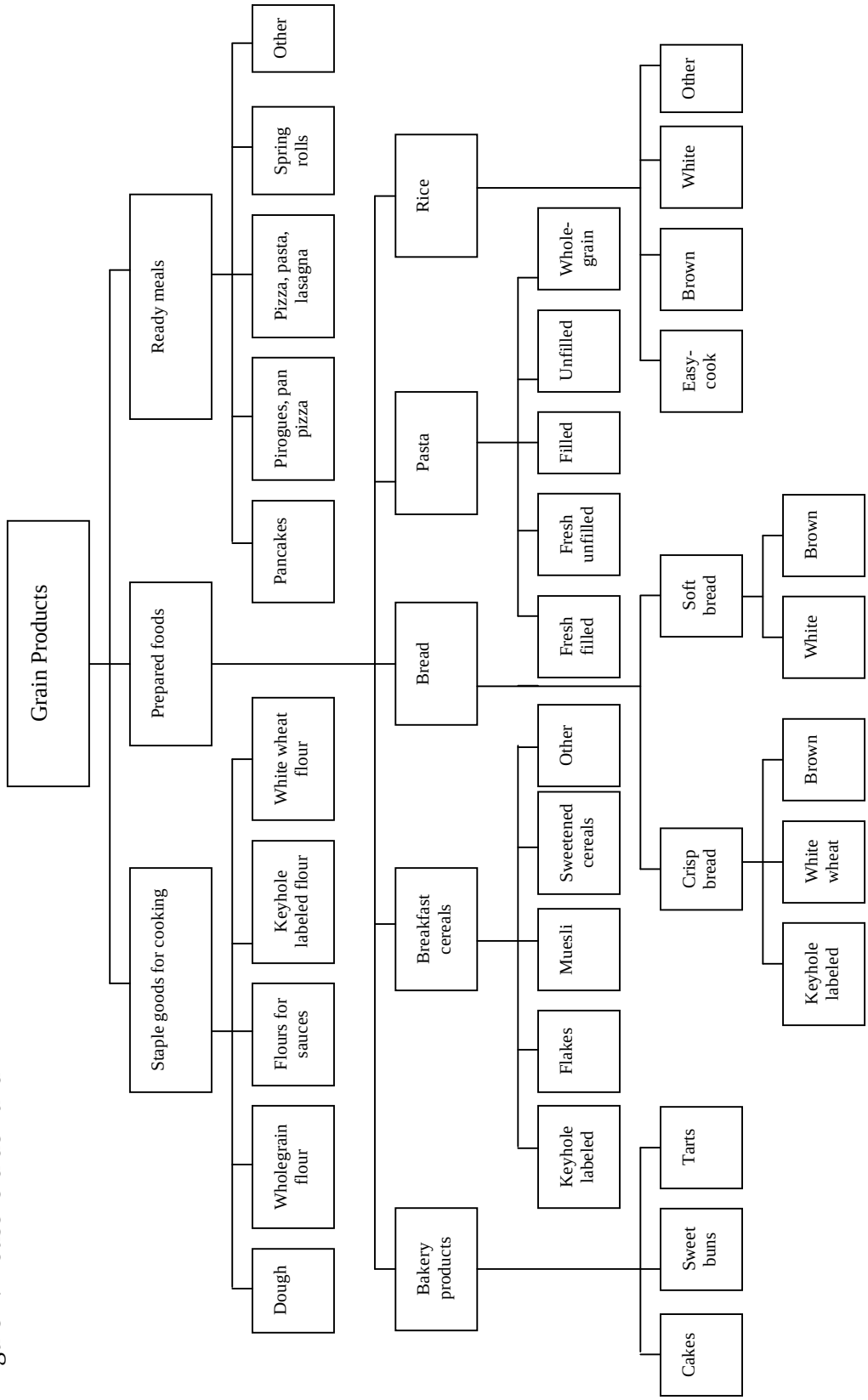

Figure 1. Household demand

Table 2.1. Average contents of product groups, per 100 grams

	KJ	Total fat	Saturated fat	Sugar	Added sugar	Salt	Fiber
Bakery goods							
Cakes	1631.71	24.29	6.33	27.89	25.35	164.26	2.25
Sweet buns	1633.77	20.12	8.23	11.64	6.32	267.47	2.12
Tarts	1084.16	13.62	6.21	17.23	13.45	133.76	1.60
Breakfast cereals							
Flakes	1568.93	1.95	0.35	13.46	10.12	895.30	4.23
Keyhole-labeled	1448.28	3.67	0.51	2.65	1.73	199.00	9.88
Muesli	1578.77	9.26	3.41	23.37	15.14	256.96	10.80
Sweetened cereals	1614.75	1.26	0.25	38.39	28.86	467.08	2.56
Others	1567.01	4.30	1.24	21.44	16.60	368.64	6.21
Flours and dough							
Wholegrain flour	1417.67	2.33	0.28	2.74	0.43	2.64	4.62
Flour for sauces	1407.06	0.69	0.09	1.13	0.51	4.48	3.03
Keyhole-labeled flour	1344.52	3.33	0.48	1.24	0.65	3.41	10.89
White wheat flour	1504.68	1.88	0.26	1.53	0.26	0.80	3.60
Dough	2340.20	39.51	17.08	1.10	0.12	309.44	1.60
Crisp bread							
Keyhole-labeled	1359.82	2.61	0.38	1.73	0.43	470.20	14.29
White wheat	1636.54	7.41	1.79	4.52	0.42	417.19	5.38
Brown	1425.18	3.98	0.99	3.56	0.29	540.53	11.78
Pasta							
Fresh filled	708.24	9.15	4.07	0.98	0.14	522.37	0.83
Fresh unfilled	877.06	1.61	0.42	1.01	0.10	297.63	1.78
Filled	767.16	9.90	4.38	1.03	0.18	569.30	1.03
Unfilled	528.50	0.50	0.05	0.20	0.10	1.00	1.12
Wholegrain	473.30	0.52	0.06	0.17	0.10	0.10	3.04
Ready meals							
Pancakes	807.95	8.81	3.73	4.37	0.01	331.15	0.77
Pirogues, pan pizza	1541.16	23.43	10.11	1.82	0.31	533.81	1.36
Pizza, pasta, lasagne	910.06	9.73	4.14	2.20	0.20	472.06	1.43
Spring rolls	896.20	10.80	2.94	2.80	0.20	510.00	1.20
Others	1024.73	13.26	5.88	2.07	0.25	462.82	1.36
Rice							
Easy-cook	490.91	0.30	0.07	0.32	0.28	270.07	0.50
Brown	443.54	0.70	0.18	0.49	0.32	2.62	1.12
White	515.25	0.34	0.10	0.15	0.15	307.07	0.48
Others	520.56	0.29	0.10	0.09	0.11	171.77	0.36
Soft bread							
Brown	1025.82	3.07	0.55	6.03	0.31	358.77	6.47
White	1160.12	4.11	0.81	4.07	0.21	404.35	3.62

Table 2.2. Household shares of healthy and unhealthy products

Household type	Share of Keyhole-labeled bread and breakfast cereals	Share of bakery goods and ready meals
Average household	0.47	0.03
Single woman	0.52	0.05
Single woman with children	0.33	0.03
Single man with/without children	0.47	0.07
Couple	0.52	0.02
Couple with 1 child	0.39	0.03
Couple with 2 children	0.39	0.03
Couple with ≥ 3 children	0.32	0.02
Three adults	0.45	0.03
Seniors	0.52	0.03

Table 4.2a. Results of policy reform (ii), a 50 percent subsidy of Keyhole-labeled bread and breakfast cereals funded by 113.8 percent VAT on bakery goods and ready meals

		HOUSEHOLD CATEGORY			
	Average household	Single women	Single women with ch.	Single men[a]	Couple
Share of Keyhole-labeled bread and breakfast cereals, BR[b]	0.47	0.52	0.33	0.47	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR[b]	0.69	0.71	0.56	0.69	0.72
Share of bakery goods and ready meals, BR[b]	0.03	0.05	0.03	0.07	0.02
Share of bakery goods and ready meals, AR[b]	0.02	0.04	0.02	0.05	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.38	0.41	0.22	0.35	0.42
Volumes of bakery goods and ready meals	-0.10	-0.16	-0.02	-0.28	-0.06
Fiber	0.35	0.35	0.21	0.31	0.36
Fat	0.12	0.10	0.02	0.04	0.15
Saturated fat	0.05	0.02	-0.04	-0.03	0.09
Kilojoules	0.17	0.16	0.07	0.12	0.18
Salt	0.21	0.19	0.08	0.15	0.24
Sugar	0.21	0.19	0.09	0.20	0.23
Added sugar	0.07	0.05	-0.01	0.08	0.10
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.00	0.91	1.08	1.78	-0.37

Note: [a] with and without children. ch. = children, [b] BR = before reform, AR = after reform.

Table 4.2b. Results of policy reform (ii), a 50 percent subsidy of Keyhole-labeled bread and breakfast cereals funded by 113.8 percent VAT on bakery goods and ready meals

	HOUSEHOLD CATEGORY				
	Couple, 1 child	Couple, 2 children	Couple, ≥ 3 children	Three adults	Seniors
Share of Keyhole-labeled bread and breakfast cereals, BR [b]	0.39	0.39	0.32	0.41	0.55
Share of Keyhole-labeled bread and breakfast cereals, AR [b]	0.61	0.62	0.46	0.63	0.75
Share of bakery goods and ready meals, BR [b]	0.03	0.03	0.02	0.02	0.03
Share of bakery goods and ready meals, AR [b]	0.02	0.02	0.01	0.02	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.30	0.32	0.33	0.35	0.45
Volumes of bakery goods and ready meals	-0.11	-0.11	0.09	0.10	-0.11
Fiber	0.26	0.25	0.23	0.30	0.38
Fat	0.04	0.02	0.04	0.09	0.16
Saturated fat	-0.02	-0.04	-0.02	0.02	0.10
Kilojoules	0.10	0.09	0.10	0.14	0.20
Salt	0.13	0.11	0.10	0.15	0.29
Sugar	0.11	0.14	0.06	0.15	0.25
Added sugar	-0.01	0.00	-0.04	0.03	0.10
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.78	1.06	0.20	0.02	-0.61

Note: [b] BR = before reform, AR = after reform.

Table 4.3a. Results of policy reform (iii), a fiber subsidy of SEK 0.046 funded by an excise duty per gram of added sugar of SEK 0.182

		HOUSEHOLD CATEGORY			
	Average household	Single women	Single women with ch.	Single men[a]	Couple
Share of Keyhole-labeled bread and breakfast cereals, BR[b]	0.47	0.52	0.33	0.47	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR[b]	0.54	0.59	0.40	0.53	0.58
Share of bakery goods and ready meals, BR[b]	0.03	0.05	0.03	0.07	0.02
Share of bakery goods and ready meals, AR[b]	0.03	0.05	0.03	0.07	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.03	0.05	-0.05	0.02	0.05
Volumes of bakery goods and ready meals	-0.10	-0.07	-0.13	-0.03	-0.09
Fiber	0.15	0.14	0.02	0.08	0.17
Fat	0.05	0.05	-0.03	0.00	0.08
Saturated fat	0.00	0.00	-0.07	-0.03	0.02
Kilojoules	0.10	0.09	0.00	0.04	0.12
Salt	0.01	0.01	-0.05	0.02	0.02
Sugar	-0.04	-0.05	-0.17	-0.06	-0.02
Added sugar	-0.11	-0.10	-0.22	-0.10	-0.09
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.00	0.11	0.55	0.15	-0.14

Note: [a] with and without children. ch. = children. [b] BR = before reform, AR = after reform.

Table 4.3b. Results of policy reform (iii), a fiber subsidy of SEK 0.046 funded by an excise duty per gram of added sugar of SEK 0.182

	HOUSEHOLD CATEGORY				
	Couple, 1 child	Couple, 2 children	Couple, ≥ 3 children	Three adults	Seniors
Share of Keyhole-labeled bread and breakfast cereals, BR [b]	0.39	0.39	0.32	0.41	0.55
Share of Keyhole-labeled bread and breakfast cereals, AR [b]	0.47	0.47	0.44	0.50	0.62
Share of bakery goods and ready meals, BR [b]	0.03	0.03	0.02	0.02	0.03
Share of bakery goods and ready meals, AR [b]	0.03	0.03	0.02	0.02	0.03
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	-0.02	-0.02	-0.28	0.01	0.07
Volumes of bakery goods and ready meals	-0.11	-0.11	-0.25	-0.18	-0.12
Fiber	0.09	0.07	0.01	0.12	0.20
Fat	-0.01	0.00	-0.07	0.02	0.11
Saturated fat	-0.06	-0.05	-0.13	-0.03	0.05
Kilojoules	0.04	0.03	-0.02	0.07	0.16
Salt	-0.04	-0.05	-0.10	-0.04	0.04
Sugar	-0.14	-0.13	-0.22	-0.11	0.01
Added sugar	-0.22	-0.22	-0.32	-0.20	-0.05
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.38	0.33	2.13	0.13	-0.32

Note: [b] BR = before reform, AR = after reform.

Table 4.4a. Results of policy reform (iv), a fiber subsidy of SEK 0.046 funded by an excise duty per gram of saturated fat of SEK 0.325

		HOUSEHOLD CATEGORY			
	Average household	Single women	Single women with ch.	Single men[a]	Couple
Share of Keyhole-labeled bread and breakfast cereals, BR[b]	0.47	0.52	0.33	0.47	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR[b]	0.52	0.57	0.37	0.52	0.57
Share of bakery goods and ready meals, BR[b]	0.03	0.05	0.03	0.07	0.02
Share of bakery goods and ready meals, AR[b]	0.02	0.05	0.03	0.06	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.04	0.06	-0.01	0.03	0.06
Volumes of bakery goods and ready meals	-0.06	-0.07	-0.02	-0.14	-0.03
Fiber	0.11	0.11	0.03	0.06	0.13
Fat	0.01	0.00	-0.06	-0.05	0.03
Saturated fat	-0.03	-0.04	-0.09	-0.08	-0.01
Kilojoules	0.05	0.04	-0.01	0.00	0.07
Salt	0.02	0.02	-0.02	0.00	0.04
Sugar	0.00	0.00	-0.05	-0.02	0.01
Added sugar	-0.01	-0.02	-0.05	-0.02	-0.01
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.00	0.13	0.30	0.36	-0.14

Note: [a] with and without children. ch. = children. [b] BR = before reform, AR = after reform.

Table 4.4b. Results of policy reform (iv), a fiber subsidy of SEK 0.046 funded by an excise duty per gram of saturated fat of SEK 0.325

	HOUSEHOLD CATEGORY				
	Couple, 1 child	Couple, 2 children	Couple, ≥ 3 children	Three adults	Seniors
Share of Keyhole-labeled bread and breakfast cereals, BR [b]	0.39	0.39	0.32	0.41	0.55
Share of Keyhole-labeled bread and breakfast cereals, AR [b]	0.44	0.44	0.26	0.46	0.60
Share of bakery goods and ready meals, BR [b]	0.03	0.03	0.02	0.02	0.03
Share of bakery goods and ready meals, AR [b]	0.02	0.02	0.02	0.02	0.03
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.01	0.01	-0.14	0.04	0.07
Volumes of bakery goods and ready meals	-0.06	-0.08	-0.02	0.02	-0.05
Fiber	0.07	0.04	0.04	0.09	0.15
Fat	-0.04	-0.06	-0.05	-0.01	0.05
Saturated fat	-0.08	-0.10	-0.09	-0.05	0.01
Kilojoules	0.02	0.00	0.01	0.04	0.09
Salt	-0.01	-0.02	-0.03	0.01	0.05
Sugar	-0.04	-0.04	-0.04	-0.02	0.02
Added sugar	-0.06	-0.05	-0.07	-0.04	0.01
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.24	0.36	0.89	0.01	-0.27

Note: [b] BR = before reform, AR = after reform.

Table 4.5. Overall price changes for different household categories as a result of policy reforms

		RELATIVE PRICE CHANGES AS A RESULT OF		
	Average price level, baseline	VAT reform	Subsidizing fiber, taxing added sugar	Subsidizing fiber, taxing saturated fat
Average household	34.87	0.97	1.04	1.02
Single women	38.48	1.01	1.04	1.03
Single women with children	35.30	1.02	1.15	1.05
Single men with/without children	39.27	1.03	1.04	1.05
Couple	34.17	0.95	1.03	1.01
Couple with 1 child	35.42	1.02	1.10	1.04
Couple with 2 children	34.88	1.03	1.09	1.06
Couple with ≥ 3 children	34.19	0.99	1.20	1.05
Three adults	34.76	1.00	1.09	1.04
Seniors	33.81	0.94	1.01	0.99

Note: Excise duty reform (2a)F entails a SEK -0.046 excise duty per gram of fiber, funded by a SEK 0.182 excise duty on added sugar. Excise duty reform (2b) entails a SEK -0.046 excise duty on fiber funded by a SEK 0.325 excise duty on saturated fat.

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Appendix A

Table A1. Grain purchases (1st allocation step)

	Shares of total grain product expenditures		
	Ready meals	Staple goods for cooking	Prepared foods
Average household	0.082	0.079	0.839
Single women	0.116	0.081	0.804
Single women with children	0.078	0.045	0.877
Single men with/without children	0.064	0.060	0.876
Couple	0.078	0.080	0.842
Couple with one child	0.092	0.080	0.828
Couple with two children	0.055	0.101	0.844
Couple with ≥ 3 children	0.077	0.069	0.854
Three adults	0.082	0.107	0.811
Seniors	0.079	0.079	0.842

Table A2. Ready meals (2nd allocation step)

	Shares of total expenditures on ready meals				
	Pancakes	Pirogues & pan pizza	Pizza, pasta & lasagne	Spring rolls	Others
Average household	0.073	0.236	0.556	0.076	0.060
Single women	0.084	0.162	0.612	0.045	0.097
Single women with children	0.023	0.325	0.526	0.096	0.030
Single men with/without children	0.133	0.224	0.554	0.046	0.043
Couple	0.077	0.183	0.563	0.108	0.070
Couple with one child	0.075	0.271	0.509	0.087	0.058
Couple with two children	0.037	0.445	0.433	0.074	0.011
Couple with ≥ 3 children	0.032	0.473	0.434	0.045	0.016
Three adults	0.002	0.445	0.382	0.137	0.033
Seniors	0.102	0.180	0.578	0.074	0.067

Table A3. Staple goods for cooking (2nd allocation step)

	Shares of total flour and dough expenditures				
	Brown flour	Flour for sauces	Keyhole-labeled flour	White wheat flour	Dough
Average household	0.085	0.133	0.070	0.679	0.033
Single women	0.089	0.142	0.084	0.656	0.029
Single women with children	0.063	0.065	0.062	0.786	0.024
Single men with/without children	0.092	0.160	0.096	0.638	0.013
Couple	0.109	0.150	0.072	0.632	0.037
Couple with one child	0.066	0.163	0.068	0.633	0.071
Couple with two children	0.076	0.148	0.056	0.664	0.056
Couple with ≥ 3 children	0.079	0.069	0.037	0.746	0.069
Three adults	0.075	0.101	0.034	0.696	0.095
Seniors	0.076	0.125	0.071	0.708	0.021

Table A4. Prepared foods (2nd allocation step)

	Shares of total prepared food expenditures				
	Bakery goods	Bread	Breakfast cereals	Pasta	Rice
Average household	0.024	0.657	0.173	0.079	0.067
Single women	0.031	0.658	0.162	0.080	0.069
Single women with children	0.016	0.541	0.266	0.100	0.077
Single men with/without children	0.018	0.693	0.147	0.078	0.063
Couple	0.021	0.660	0.163	0.088	0.069
Couple with one child	0.026	0.555	0.221	0.119	0.079
Couple with two children	0.013	0.558	0.233	0.121	0.075
Couple with ≥ 3 children	0.015	0.476	0.325	0.120	0.064
Three adults	0.018	0.568	0.254	0.098	0.062
Seniors	0.027	0.723	0.142	0.051	0.057

Table A5. Bakery goods (3rd allocation step)

	Shares of total bakery expenditures		
	Cakes	Sweet buns	Tarts
Average household	0.734	0.176	0.090
Single women	0.693	0.209	0.098
Single women with children	0.655	0.314	0.031
Single men with/without children	0.674	0.077	0.249
Couple	0.824	0.111	0.064
Couple with one child	0.638	0.171	0.191
Couple with two children	0.859	0.125	0.016
Couple with ≥ 3 children	0.751	0.219	0.029
Three adults	0.519	0.446	0.035
Seniors	0.733	0.170	0.097

Table A6. Bread (3rd allocation step)

	Shares of total bread expenditures	
	Crisp bread	Soft bread
Average household	0.119	0.881
Single women	0.166	0.834
Single women with children	0.078	0.922
Single men with/without children	0.082	0.918
Couple	0.140	0.860
Couple with one child	0.128	0.872
Couple with two children	0.118	0.882
Couple with ≥ 3 children	0.118	0.882
Three adults	0.150	0.850
Seniors	0.252	0.748

Table A7. Crisp bread (4th allocation step)

	Shares of total crisp bread expenditures		
	Keyhole-labeled	White wheat	Brown
Average household	0.786	0.193	0.021
Single women	0.791	0.194	0.015
Single women with children	0.677	0.323	0.000
Single men with/without children	0.809	0.189	0.002
Couple	0.787	0.177	0.035
Couple with one child	0.707	0.260	0.033
Couple with two children	0.741	0.241	0.018
Couple with ≥ 3 children	0.648	0.335	0.017
Three adults	0.805	0.149	0.046
Seniors	0.814	0.171	0.015

Table A8. Soft bread (4th allocation step)

	Shares of total soft bread expenditures	
	Brown	White
Average household	0.483	0.517
Single women	0.549	0.451
Single women with children	0.383	0.617
Single men with/without children	0.481	0.519
Couple	0.505	0.495
Couple with one child	0.440	0.560
Couple with two children	0.415	0.585
Couple with ≥ 3 children	0.464	0.536
Three adults	0.486	0.514
Seniors	0.554	0.446

Table A9. Breakfast cereals (3rd allocation step)

	Shares of total breakfast cereal expenditures				
	Flakes	Keyhole-labeled	Muesli	Sweetened cereals	Others
Average household	0.411	0.035	0.362	0.141	0.051
Single women	0.438	0.057	0.387	0.072	0.046
Single women with children	0.276	0.044	0.292	0.281	0.106
Single men with/without children	0.280	0.056	0.454	0.176	0.034
Couple	0.451	0.022	0.398	0.087	0.043
Couple with one child	0.338	0.018	0.304	0.291	0.049
Couple with two children	0.367	0.031	0.282	0.261	0.059
Couple with ≥ 3 children	0.279	0.036	0.250	0.383	0.052
Three adults	0.384	0.024	0.426	0.153	0.014
Seniors	0.439	0.043	0.376	0.092	0.050

Table A10. Pasta (3rd allocation step)

	Shares of total pasta expenditures				
	Fresh filled	Fresh unfilled	Filled	Unfilled	Whole grain
Average household	0.030	0.084	0.024	0.853	0.010
Single women	0.039	0.119	0.023	0.804	0.015
Single women with children	0.025	0.044	0.030	0.898	0.004
Single men with/without children	0.011	0.067	0.058	0.852	0.011
Couple	0.046	0.118	0.017	0.811	0.008
Couple with one child	0.037	0.072	0.031	0.856	0.005
Couple with two children	0.015	0.067	0.024	0.891	0.003
Couple with ≥ 3 children	0.023	0.031	0.039	0.906	0.001
Three adults	0.019	0.059	0.022	0.864	0.037
Seniors	0.019	0.076	0.019	0.874	0.012

Table A11. Rice (3rd allocation step)

	Shares of total rice expenditures			
	Easy-cook	Brown	White	Others
Average household	0.078	0.066	0.681	0.175
Single women	0.113	0.124	0.667	0.097
Single women with children	0.051	0.021	0.731	0.197
Single men with/without children	0.095	0.126	0.727	0.052
Couple	0.068	0.071	0.697	0.164
Couple with one child	0.083	0.056	0.752	0.109
Couple with two children	0.025	0.024	0.839	0.112
Couple with ≥ 3 children	0.020	0.045	0.732	0.203
Three adults	0.011	0.015	0.868	0.106
Seniors	0.098	0.071	0.566	0.265

Appendix B

Table Ba. Results of policy reform (i), zero VAT on Keyhole-labeled bread and breakfast cereals funded by 34.2 percent VAT on bakery goods and ready meals

		HOUSEHOLD CATEGORY			
	Average household	Single women	Single women with ch.	Single men [a]	Couple
Share of Keyhole-labeled bread and breakfast cereals, BR [b]	0.47	0.52	0.33	0.47	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR [b]	0.50	0.55	0.36	0.51	0.55
Share of bakery goods and ready meals, BR [b]	0.03	0.05	0.03	0.07	0.02
Share of bakery goods and ready meals, AR [b]	0.03	0.05	0.03	0.06	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.03	0.03	0.01	0.03	0.03
Volumes of bakery goods and ready meals	-0.01	-0.04	0.02	-0.09	0.01
Fiber	0.03	0.03	0.02	0.03	0.03
Fat	0.00	-0.01	-0.02	-0.02	0.00
Saturated fat	-0.01	-0.02	-0.03	-0.03	0.00
Kilojoules	0.01	0.01	0.00	0.00	0.02
Salt	0.01	0.01	-0.01	0.00	0.01
Sugar	0.01	0.01	0.00	0.01	0.02
Added sugar	0.00	-0.01	-0.01	0.00	0.01
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	00.00	0.16	0.22	0.36	-0.08

Note: [a] with and without children. ch. = children. [b] BR = before reform, AR = after reform.

Table Bb. Results of policy reform (i), zero VAT on Keyhole-labeled bread and breakfast cereals funded by 34.2 percent VAT on bakery goods and ready meals

	HOUSEHOLD CATEGORY				
	Couple, one child	Couple, 2 children	Couple, 3 children	Three adults	Seniors
Share of Keyhole-labeled bread and breakfast cereals, BR [b]	0.39	0.39	0.32	0.45	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR [b]	0.42	0.43	0.21	0.49	0.55
Share of bakery goods and ready meals, BR [b]	0.03	0.03	0.02	0.03	0.03
Share of bakery goods and ready meals, AR [b]	0.02	0.03	0.02	0.02	0.03
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.02	0.02	0.02	0.02	0.03
Volumes of bakery goods and ready meals	-0.02	-0.01	0.07	0.01	-0.02
Fiber	0.02	0.02	0.02	0.03	0.03
Fat	-0.01	-0.02	-0.01	0.00	0.00
Saturated fat	-0.03	-0.03	-0.02	-0.01	-0.01
Kilojoules	0.00	0.00	0.01	0.01	0.01
Salt	0.00	0.00	0.00	0.01	0.01
Sugar	0.00	0.01	0.00	0.02	0.01
Added sugar	-0.01	-0.01	-0.01	0.01	0.00
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.15	0.23	0.05	-0.10	-0.02

Note: [b] BR = before reform, AR = after reform.