Effects of Economic Policies Aimed at Encouraging a Healthier Grain Consumption

Jonas Nordström [1] and Linda Thunström [2]
[1]Department of Consumption, Health and Ethics, University of Copenhagen, Denmark
[2] Department of Economics, Umeå University, Sweden
jonas.nordstrom@econ.umu.se ; Linda.Thunstrom@econ.umu.se

Paper prepared for presentation at the 1st International European Forum on Innovation and System Dynamics in Food Networks
Officially endorsed by the European Association of Agricultural Economists (EAAE), Innsbruck-Igls, Austria
February 15-17, 2007

Effects of Economic Policies Aimed at Encouraging a Healthier Grain Consumption*[1]

Jonas Nordström [1] and Linda Thunström [2]

[1]*Department of Consumption, Health and Ethics, University of Copenhagen, Denmark*

[2] *Department of Economics, Umeå University, Sweden*

jonas.nordstrom@econ.umu.se ; Linda.Thunstrom@econ.umu.se

Abstract

In this paper, we evaluate the effects of policy reforms aimed at achieving two policy objectives for grain consumption; (a) to double the intake of bread and breakfast cereals and (b) to ensure that half of the bread and breakfast cereals consumed are whole grain products. The overall aim of these policy objectives are to increase the dietary fibre intake from grain consumption so as to significantly contribute to the general recommended (minimum) increase of the fibre intake. Based on parameter estimates from a demand system we simulate the resulting changes in volumes purchased and fibre intake from two policy reforms entailing differentiated VAT on grain products. In the first reform we remove the VAT on "keyhole labelled" bread and breakfast cereals, in the second reform we consider a more extensive policy package of subsidizing the keyhole labelled bread and breakfast cereals by 20 percent while removing the VAT on all other grain products. Our results indicate that both reforms are likely to be successful in ensuring that the consumers attain the nutrition recommendations that half of the bread and breakfast cereals consumed are whole grain products, but that additional policy instruments are needed to reach the recommendation that the intake of bread and breakfast cereals should be doubled.

1. Introduction

Over the last few decades, technological change has contributed to advances both in food production and transportation, leading to a more cost-efficient food production and higher availability of processed and pre-prepared foods. As a result, welfare has been enhanced by falling relative prices of food, measured both in time and money. The other side of the coin is that the modern diet, combined with a more sedentary life-style, has proven to be an important determinant of a number of severe illnesses, such as diabetes, several types of cancer, heart diseases and also overweight and obesity, themselves major risk factors of the illnesses mentioned. The negative health effects caused by modern food consumption therefore impose a burden on health care budgets and, hence, on tax payers. For 2003, the direct costs on the Swedish health care system caused by obesity and overweight has been estimated to 3,6 billion SEK (Persson et al. 2004), and indirect costs has been estimated to be 12,4 billion SEK (Persson et al. 2005). Should current trends prevail, these costs will increase even further.

1. * The financial support of the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning is gratefully acknowledged.

The externalities imposed on tax payers could justify government intervention aimed at encouraging a healthier food consumption[1].

An important improvement of the dietary quality of modern consumers would be an increased intake of dietary fibre. A high intake of dietary fibre has several health promoting effects, such as helping to keep a healthy body weight (Burton-Freeman, 2000, Liu et al., 2003), controlling and preventing heart diseases (Liu, 1999, Mann, 2002), diabetes (Brand-Miller et al., 2003, Schulze et al., 2004, Willet et al., 2002), colon cancer (Larsson et al., 2005) and even gum disease (Merchant et al., 2006). Due to the positive health effects from a diet high in fibre, the Swedish National Food Administration (SLV) recommends that the average Swedish consumer severely increases his/her fibre intake. The average woman is recommended to increase her intake by a minimum of 56 percent, whereas the average man is recommended to increase his intake by a minimum of 38 percent.[2]

Grain products are, along with fruit and vegetables, the most important source of dietary fibre. Grain products are also the food group that contributes the most to our daily energy intake, as well as perhaps contains the greatest variety of food products.[3] Whole grain products in particular are considered to be part of a healthy diet, whereas white, highly refined grain products are often classified as so called “empty calories”, food that is energy dense and at the same time low in nutritional content. To increase the dietary fibre intake from grain products, and thereby the quality of the overall diet, it is recommended that the average Swedish consumer doubled his/her overall intake of bread and breakfast cereals, and also that half of the bread and breakfast cereals consumed carry the so called “Keyhole”, a nutrition symbol certified to whole grain products by the SLV.[4]

The purpose of this paper is to analyze the effects of commodity subsidies aimed at directing the fibre intake from grain consumption towards nutrition recommendations by public authorities. Taken together, the nutrition recommendations provide us with the following policy objectives: *(a) double the overall intake of bread and breakfast cereals, while (b) ensuring that half of the bread and breakfast cereal consumption is keyhole labelled*. The overall aim of these policy objectives is, though, to increase the fibre intake from grain consumption by a minimum of 38 percent[5].

1. For a comprehensive review of, among other things, arguments that could justify policy interventions to improve the dietary quality, see Strnad (2004).
2. The average woman consumes 112 grams of dietary fibre per week, whereas the average man consumes 126 grams per week (Riksmaten 1997-98). Recommended weekly levels are at around 175-245 grams of dietary fibre for both men and women (SNR 1997).
3. According to statistics collected by the Swedish Board of Agriculture, the consumption of grain products makes up around a third of the total energy intake for the average Swedish consumer, per day.
4. If breakfast cereals fulfil the following criteria, it is certified with the Keyhole by the SLV: fat content: max 7g/100g, sugar content: max 13g/100g, sodium content: max 500mg/100g and fibre: min 1,9g/100 kcal. For soft bread, the criteria that need to be fulfilled are fat content: max 7g/100g, sugar content: max 10g/100g, sodium content: max 600mg/100g and fibre: min 1,9g/100 kcal, whereas the certification criteria for hard bread are fat content: max 8g/100g, sodium content: max 600mg/100g and fibre: min 1,9g/100 kcal.
5. Worth mentioning is that the recommended increase in the fibre intake does not have to be due to an increase in grain consumption; it could just as well be due to an increase in fruit or vegetable consumption. However, assuming that we would like to increase the fibre intake from all product groups by about the same proportion, we set the policy objective at a minimum of a 38 percent increase in the fibre intake from grain products, for simplicity for the average consumer, i.e. regardless of sex.

There is a growing theoretical literature on the effects of economic policy instruments designed to improve health (see for example O'Donoghue and Rabin (2003) and Aronsson and Thunström (2006)), but the empirical research on the subject is very limited. To the best of our knowledge, the most comprehensive study on the subject has been conducted by Smed et al. (2005). They estimate a full demand system of food consumed, on data from a Danish consumer panel, and show that differentiated VAT rates, aimed at reducing the consumption of total fat, saturated fats and sugar, respectively, reduce the intake of these food components, as well as the intake of overall energy. Chouinard et al. (2005) analyse the effect of a 10 percent tax on diary consumption and conclude that consumers shift away from higher to lower fat diary products, if a tax is imposed. In another study, Kuchler et al. (2005) use existing estimates of food elasticities and show that small taxes on snack foods would only have marginal effects on consumer behaviour.

There are some countries, though, where small, additional, taxes on particularly unhealthy foods, such as soft drinks, snacks or junk food, have been imposed (Australia, Canada, Finland, Norway and the U.S., for example). However, the taxes imposed are generally aimed at generating public revenues, rather than affecting consumer behaviour (Jacobson and Brownell, 2000). The fact that countries have already imposed differentiated VAT rates, based on the health status of foods, further enhances the importance of empirical research on the effects of such policy measures. In Sweden, retail food products are taxed with the same VAT rate: 12.5 percent on the producer price.

Considering the limited number of empirical studies on the subject of economic instruments and their impact on food consumption, this paper will provide unique and valuable insights into the effects from policy reforms that are designed to encourage a healthier food consumption. In sections 2 and 3, we present the data and the modelling framework. Section 4 contains the results of the analysis and section 5 concludes.

2. Data

The data used for the analysis is a combination of three data sources. We combine private market research data, from GfK Sweden, with household expenditure data (HUT) from Statistics Sweden, as well as with data on food characteristics from the nutrition database kept by the SLV.

The GfK data is based on diary recordings of grain product purchases for the full year 2003 by the 1336 households. The data contains information on annual purchases of bakeries, bread, breakfast cereals, frozen ready-to-eat food, pasta, rice as well as flours. Household characteristics include family size, number of children under the age of 16, family income, as well as sex, education and crude measures of occupation of the person in charge of food purchases.

The information on products purchased by the GfK households is detailed and includes type, price and size of the products bought. An exception here is soft bread, though, for which the GfK households are only requested to state if they have purchased the product (i.e. "soft bread"), leaving out all other product specific information. In order to gain more information on the type of bread purchased, we therefore make use of household expenditure data (HUT) from Statistics Sweden, which provides information on the amounts of types of bread (white or dark) purchased, as well as a price index for bread prices. We only had access to the purchases and price index from 1996, though.

The level of product detail in the GfK household panel allows us to match grain products purchased with their nutritional content, by using the nutrition database provided by the SLV.

Finally, we divide the households into four income categories, based on the yearly income per (adult) head, where the lowest income group earns a maximum of 130.000 SEK per adult head, the next lowest income group 131.000-200.000 SEK, the next highest income group 201.000-300.000 SEK and, finally, the highest income group earns 301.000 SEK and above.

Descriptive statistics on grain product purchases by different income groups are shown in Table 1.

Table 1. Descriptive statistics

	AVERAG	INCOME GROUP			
	household	Lowest	Next lowest	Next highest	Highest
Share of keyhole labelled bread and breakfast	**47.11**	**46.67**	**46.79**	**48.12**	**50.58**
Fat/100 gr grain purchases	2.17	2.15	2.23	2.16	2.27
Saturated fat/100 gr grain purchase	0.53	0.53	0.53	0.54	0.52
Sugars/100 gr grain purchase	2.85	2.90	2.91	2.71	3.09
Added sugars/100 gr grain purchases	1.02	1.09	0.98	0.90	1.11
Salt in mg/100 gr grain purchases	264.05	261.55	263.09	274.41	224.42
Fibre/100 gr grain purchases	3.29	3.37	3.27	3.24	3.77

The first row of Table 1 shows the grams of keyhole labelled bread and breakfast cereals purchased, as a share of total bread and breakfast cereals purchased. Noteworthy is that this share increases over income, with the highest income group already reaching the nutrition recommendation of half the bread and breakfast cereals consumed being nutrition labelled. Table 1 also shows the average content of fat, saturated fats, sugars, added sugars, salt and fibre per 100 gram grain products purchased by the different income groups. The differences over income groups are generally small, although the density of fat, sugars and fibre in grain products purchased by the highest income group seems to be slightly higher than for the other groups. The higher fibre density of the products purchased by the highest income group should be expected, given the fact that half of bread and breakfast cereal purchased by this income group is keyhole labelled.

3. The Modelling Framework

Figure 1 and 2 illustrates the process households are assumed to go through, including the different allocation stages, when deciding on how to allocate their resources to grain product purchases and, in the end, the grain products to buy. We use the figures as the basis for the grain product demand system in our analysis.

As shown by the figure, the decision process consists of several steps, where households first allocate their expenditures on three broad food categories; ready-to-eat meals, pre-prepared food and food for cooking. In a second stage, the household decides which food products to purchase within the group. For ready to eat meals the food products consists of pizza, pancakes,

pirogues, spring roles and other ready-to-eat food products. For pre-prepared food the decision process consists of three steps, where the household in a second steep allocates its expenditures on broader food groups such as pasta, rice, breakfast cereals, bread and bakeries. Then, in a final third step, the household allocates its expenditures on specific food within the groups, which for pasta consist of fresh filled pasta, fresh unfilled pasta, filled pasta, unfilled pasta and whole grain pasta. As a result of a more comprehensive data set for bread consumption in HUT, the household's allocation of bread expenditures is assumed to take part in four steps, where the household in the third step allocates its total bread expenditures on hard bread and soft bread, and then, in a final fourth step, allocates the group expenditures on the specific product within the group. For hard bread, the products within the group consist of keyhole labelled hard bread, white wheat hard bread and dark hard bread. Additional information about the specific food products that have been included in the different groups can be found in Figure 2.

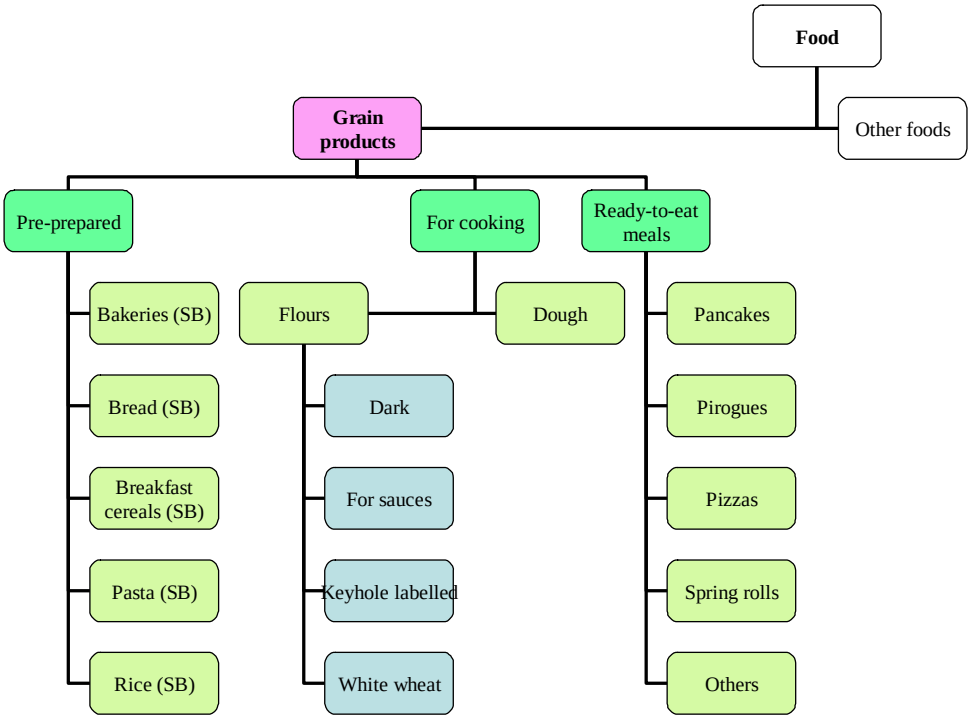

Figure 1. The Decision making process

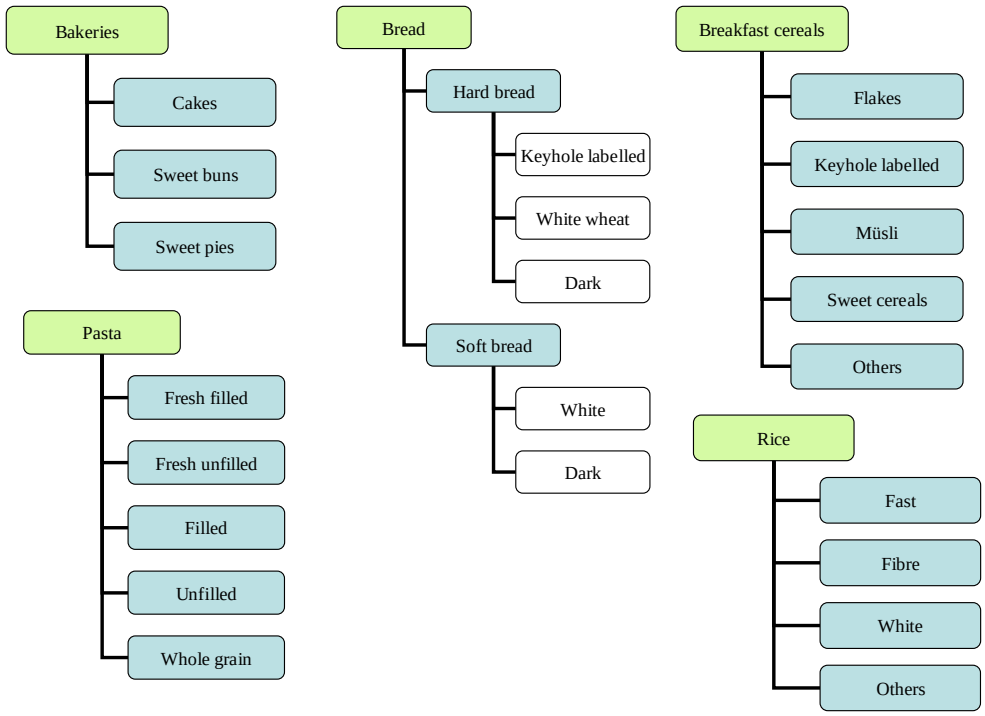

Figure 2. Sub-groups (SB) of bakeries, bread, breakfast cereals, pasta and rice

To model the demand for grain products we use the microeconomic data sets that are described in Section 2. Consumer demand patterns typically found in micro-data sets vary considerably across households with different household characteristics and with different levels of income. As indicated in Banks, Blundell & Lewbel (1997) expenditures on some goods are non-linear in total expenditure (or income) while some are linear. Furthermore, the welfare effect of an indirect tax reform is biased when a non-linear expenditure pattern is approximated with a demand system linear in total expenditure (Banks et al. 1997). Although we cannot observe the households total consumption of grain products (some are consumed outside the home in restaurants and school refectories and there may also be some underreporting in the consumer surveys) there are good reasons to believe that the relative intake of different grain products is well reflected in the data set. Theses facts suggest that a demand system based on budget shares is preferred to a demand system based on quantities or expenditures for the goods.

A flexible functional form of consumer preferences, which is based on budget shares and can handle non-linear expenditure effects, is the quadratic extension (Banks et al. 1997) to Deaton & Muellbauer's (1980) almost ideal model (AIDS). We therefore take the quadratic AIDS (QAIDS) model as our basic specification and model the differences in consumption patterns between different household categories, by adding intercept and slope parameters in the budget share equations of the demand system.

The preferences are characterised in such a way that household *h* makes decisions on how much to consume of the grain goods 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:

$$s_k^h = \alpha_k(\mathbf{d}^h) + \sum_l \gamma_{kl} \ln p_l^h + \beta_k(\mathbf{d}^h) \times \ln\left[x^h / a^h(p,d)\right] + \left(\delta_k(\mathbf{d}^h)/b^h(p)\right) \times \left(\ln\left[x^h / a^h(p,d)\right]\right)^2, \quad k = 1,\ldots,n, \tag{1}$$

where p_l^h is the price of good l, x^h, is household h's total expenditure on the k =1,…,n grain products and $\ln a^h(\cdot)$ and $\ln b^h(\cdot)$ are defined by

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

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

The demand system for the second stage of expenditure allocation has the same functional form as (1), and can be written as

$$s_{(k)i}^h = \alpha_{(k)i}(\mathbf{d}^h) + \sum_j \gamma_{(k)ij} \ln p_{(k)j}^h + \beta_{(k)i}(\mathbf{d}^h) \times \ln\left[x_k^h / a_k^h(p,d)\right] + \left(\delta_{(k)i}(\mathbf{d}^h)/b_k^h(p)\right) \times \left(\ln\left[x_k^h / a_k^h(p,d)\right]\right)^2, \quad i = 1,\ldots,m, \tag{4}$$

where $s_{(k)i}^h$ is household h budget share for good i within group k, $p_{(k)j}$ is the price of good j in group k, and x_k^h is 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 sub-demand systems when we have three stage and four stage allocation of expenditures on grain products.

Econometric considerations

There is a rather large occurrence of zero expenditure in the diary recording on grain products. Whether the zeros are a result of infrequencies of purchases or a result of non consumption is difficult to say. To allow for infrequencies of purchases, Blundell & Meghir (1987) presented a bivariate alternative to the Tobit model with separate processes determining the censoring rule and the continuous observations. But 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 get consistent parameter estimates we follow Heckman's (1979) two-step procedure and estimate separate probit and truncated regression models for each commodity group.

In the estimation the homogeneity restrictions are imposed in a first stage, whereas cross-equation symmetry-restrictions are imposed in a second stage, by a minimum distance estimator. Instead of specifying a particular form of the heteroscedasticity we employ White's (1980) approach to calculate the standard errors.

To simplify the simulations, we follow Blundell, Pashardes and Weber (1993) and use the household specific Stone price index, $\ln P^h = \sum_k s_k^h \ln p_k$, instead of the translog form price index, $\ln a^h(p,d)$, and set the price aggregator, $\ln b^h(p,d)$, equal to one.

4. Simulations

The empirical model from Section 3 is used to illustrate responses and impacts on different households due to non-marginal changes of the value added tax (VAT) on different food products. The type of model used here is specifically useful in such an analysis. A non-marginal tax change, which has a significant effect on prices, will affect the households' real income. A demand system of the type used here takes this income effect into account. In addition, the model employed includes non-linear income effects, which may be important when large tax changes are considered. The substitution effects may also be large as a result of the changed VAT rates, and these effects are also handled by the demand system.

We simulate the results from two policy reforms aimed at improving the dietary quality of grain consumption. The baseline scenario is a 12.5 VAT rate on the producer price of all grain products.

- *The first reform* considers removing the VAT on bread and breakfast cereals that are keyhole labelled, while keeping the VAT on all other grain products at the initial 12.5 percent.
- *The second reform* is more extensive and considers subsidizing the consumer price of keyhole labelled bread and breakfast cereals with 20 percent, while removing the VAT on all other grain products.

We are interested in simulating the changes in volumes purchased, as well as the change in fibre intake, resulting from these policy reforms.

4.1 Simulation method

The simulation method can be described as follows. The percentage price change on good *i* is calculated according to the following formula, $(\Delta p_i / p_i^0) = (t_i^1 - t_i^0)/(1 + t_i^0)$, where the superscript denotes the tax regime (0 is the baseline) and *t* is the *VAT* rate for good *i*. The price level for household *h* for good *i* after the tax change is then equal to:

$$p_i^{h1} = (1 + \frac{\Delta p_i^h}{p_i^{h0}}) \cdot p_i^{h0} \quad , \tag{5}$$

which means that the after-tax change Stone price index at the first-stage budgeting process for household *h* (or expenditure deflator) equals:

$$\ln P^{h1} = \sum_k s_k^h \ln p_k^{h1} \quad , \tag{6}$$

where, as previously, s_k^h is household *h*'s initial expenditure share on good *k*. It should be noted that we do not allow for possible general equilibrium effects. That is, we assume that

taxes are shifted completely on consumer prices.

Substituting expression (5) and (6) into the demand system representing the first-stage budgeting process gives us the new allocation across the different commodity groups for household *h*. The new consumption vector is given by:

$$s_{(k)}^{h1} = \hat{\alpha}_{(k)}\tilde{\mathbf{d}}^h + \left(\sum_l \hat{\gamma}_{kl} \ln p_l^1\right) + \hat{\beta}_{(k)}\tilde{\mathbf{d}}^h \times \ln[x^{h0} / P^{h1}] + \hat{\delta}_{(k)}\tilde{\mathbf{d}}^h \times \left(\ln[x^{h0} / P^{h1}]\right)^2 + \hat{\varepsilon}_{(k)}^{h0}, \quad (7)$$

where a ^ denotes an estimate and $\tilde{\mathbf{d}}^h$ is the vector of household characteristics. The superscript 0 indicates the point of reference. In the simulations we keep nominal expenditure (*x*) unchanged. The last term in equation (7), $\hat{\varepsilon}^{h0}$, represents unexplained household-specific effects not accounted for in the estimations, and the effect of non purchase. The latter are assumed to remain constant over simulations.

Given the new group shares, according to equation (7), we get by definition the new expenditure on each group as, $x_{(k)}^{h1} = s_{(k)}^{h1} \cdot x^{h0}$, $k = 1,\ldots, n$, which are substituted into the demand system representing the second stage of the budgeting process.[1] Given the new budget shares for good *i* in subsystem *k*, $s_{(k)i}^{h1}$, we can define the real expenditures $\tilde{x}_i$ on good *i* and the volume V_i of good *i* for each household after the tax change as:

$$\tilde{x}_i^1 = s_{(k)i}^1 \times (x_{(k)}^1 / p_{(i)}^1),$$
$$V_i^1 = \tilde{x}_i^1 / p_{(i)}^1. \quad (8)$$

The change in the nutrient intake for household *h*, ΔN_m^h, can then be calculated as, $\Delta N_m^h = \sum_i \omega_{im}\left(V_i^1 - V_i^0\right)$, where ω_{im} is the content of a specific nutrient *m* (fat, saturated fat, sugar, added sugar, salt, fibre or kilo joule) in product *i*. The results from the simulations are given in the next section.

5. Results

Our results, presented in Table 2, imply that removing the VAT on nutrition labelled bread and breakfast cereals would lead to all income groups attaining the nutrition recommendation of half the bread and breakfast cereal consumption being labelled with the nutrition label; 50.87 percent of bread and breakfast purchases by the lowest income group would consist of keyhole labelled products. The corresponding share of keyhole labelled bread and breakfast cereal products, as part of the total bread and breakfast cereal purchases, would rise to almost 55 percent for the highest income group.

1. In the case of additional sub-groups, or allocation stages, the above procedure is repeated for each allocation stage.

Table 2. Results from removing the VAT on Keyhole labelled bread and breakfast cereals

	AVERAG	INCOME GROUP			
	household	Lowest	Next lowest	Next highest	Highest
Share of keyhole labelled bread and BC, BR	47.11	46.67	46.79	48.12	50.58
Share of keyhole labelled bread and BC, AR	**51.52**	**50.87**	**51.43**	**52.67**	**54.94**
Percentage change of bread and BC	**3.60**	**3.60**	**3.43**	**3.66**	**4.20**
Fibre/100 gr grain purchase, BR	3.29	3.37	3.27	3.24	3.77
Fibre/100 gr grain purchase, AR	**3.35**	**3.43**	**3.33**	**3.30**	**3.84**
Percentage change of fibre consumption	**4.60**	**4.51**	**4.60**	**4.69**	**5.00**

Note: BC = breakfast cereals, BR = before reform, AR = after reform

Our results imply that the reform has little impact on volumes purchased; total bread and breakfast cereal purchases increases by 4 percent for the average consumer. This also manifests itself in the relatively small percentage change of total grams of fibre from grain products that results from the reform; the fibre intake increases by around 5 percent for all income groups. The difference is small across income groups, but noteworthy is that the reform seems to have the greatest impact on the purchases made by the highest income group, even though this income group already in the baseline scenario achieved the recommendation of half the bread and breakfast cereals being keyhole labelled. Finally, the reform increases the fibre density of average grain purchases, from 3.29 to 3.35 grams of fibre per 100 gram grain purchased. The changes in the density of the other nutrients are minor and therefore not reported.

Table 3. Results from subsidizing keyhole labelled bread and breakfast cereals and removing the VAT on all other grain products

	AVERAG	INCOME GROUP			
	household	Lowest	Next lowest	Next highest	Highest
Share of keyhole labelled bread and BC, BR	47.11	46.67	46.79	48.12	50.58
Share of keyhole labelled bread and BC, AR	**51.90**	**51.12**	**52.00**	**53.09**	**55.33**
Percentage change of bread and BC	**11.28**	**11.09**	**11.20**	**11.28**	**11.90**
Fibre/100 gr grain purchase, BR	3.29	3.37	3.27	3.24	3.77
Fibre/100 gr grain purchase, AR	**3.27**	**3.34**	**3.26**	**3.21**	**3.75**
Percentage change of fibre consumption	**15.82**	**15.63**	**15.53**	**16.03**	**15.84**

Note: BC = breakfast cereals, BR = before reform, AR = after reform

Table 3 shows the results of the second, more extensive, policy reform. Our results imply that subsidizing keyhole labelled bread and breakfast cereals by 20 percent, while removing the VAT on all other grain products, would result in the average consumer attaining the nutrition recommendation of half the bread and breakfast cereal consumption being keyhole labelled, whereas, the change in volumes from this reform is also far from recommended levels; the bread and breakfast cereal consumption increases by, on average, 11 percent and the average overall fibre intake from grain products increases by 15.82 percent. Again, differences between income groups are small. Noteworthy is that even though the fibre intake increases, the fibre density of the average grain purchase decreases, although marginally, from 3.29 to 3.27 grams of fibre per 100 grams grain purchased.

6. Conclusions

In this paper, we evaluated the effects of policy reforms aimed at achieving two policy objectives for grain consumption; (a) to double the intake of bread and breakfast cereals and (b) to ensure that half of the bread and breakfast cereals consumed are whole grain products, i.e. carrying the "Keyhole", a nutrition symbol certified by the Swedish National Food Administration (SLV). The overall aim of these policy objectives are to increase the dietary fibre intake from grain consumption so as to significantly contribute to the general recommended (minimum) increase of the fibre intake of 38 percent.

We simulated the resulting changes in volumes purchased and fibre intake from two policy reforms entailing differentiated VAT rates on grain products. First, we simulated the results from a policy package that contains zero VAT on keyhole labelled bread and breakfast cereals and, the initial, 12.5 percent VAT on all other grain products. Secondly, we simulated the results of a more extensive policy package that contains a 20 percent subsidy of keyhole labelled bread and breakfast cereals and zero VAT on all other grain products.

Our results imply that both policy reforms are likely to be successful in ensuring that consumers attain the nutrition recommendation of half the grain consumption being keyhole labelled. However, and perhaps more importantly, our results also imply that consumer demand is fairly insensitive to price changes in grain products, meaning that both policy reforms simulated in this paper are likely to fail in directing grain consumptions towards levels recommended by the SLV. This means that none of the policy reforms leads to consumers attaining the nutrition recommendations of doubling their bread and breakfast cereal consumption, or increasing their fibre intake by 38 percent (assuming that the fibre intake from grain products should increase with the same proportion as the fibre intake from food groups outside this study). Our results imply that removing the VAT on keyhole labelled bread and breakfast cereals increases the average intake of fibre from grain products by around 5 percent, whereas the more extensive policy package of subsidizing the keyhole labelled bread and breakfast cereals by 20 percent while removing the VAT on all other grain products results in an increase of the fibre intake by 16 percent. Worth noting, though, is that our results also imply an increase in the fibre density of grams of grain products purchased from the first policy reform, while the more extensive reform decreases the fibre density of grain grams purchased. This result is likely to be due to overall volume adjustments, in healthy and unhealthy grain products, as a result of the more sizeable income effect from the second reform.

This study shows that using price instruments alone might not be sufficient if wanting to encourage consumers to increase their fibre consumption so as to reach nutrition recommendations. In order to do so, other policy instruments are likely to be part of an efficient policy package, such as measures directed towards other product groups, increased public information or other designs of economic policy instruments that affect the prices of particularly healthy grain products, such as, for instance, a subsidy of the fibre content, rather than of commodities. Also, in this paper, we show that imposing commodity subsidies on healthy grain products is likely to have a similar impact on the dietary quality of all income groups. However, it would be of interest to determine welfare effects over consumer groups. In addition, when analyzing the impact of policies designed to improve the dietary quality, there might be other consumer groups that deserve special attention by policy makers, such as for instance families with children. Finally, this paper has not addressed the costs of the policy packages included in the analysis. The-

se, and other issues related to policies aimed at improving the dietary quality, are left for future research.

7. References

Aronsson, T. and Thunström, L. (2006), "Optimal Paternalism: Sin Taxes and Health Subsidies" *Scandinavian Working Papers in Economics*, No 662

Baker, P., McKay, S., and Symons, E. (1990), The Simulation of Indirect Tax Reforms: The IFS Simulation Program for Indirect Taxation (SPIT), IFS Report Series No. W90/11, Institute for Fiscal Studies, London.

Banks, J., Blundell, R. and Lewbel, A. (1997), Quadratic Engel Curves and Consumer Demand, *The Review of Economics and Statistics*, 527-539.

Blundell, R. and Meghir, C. (1987), Bivariate Alternative to the Tobit Model, *Journal of Econometrics*, 34, 179-200.

Blundell, R., Pashardes, P. and Weber, G. (1993), What Do we Learn About Consumer Demand Patterns from Micro Data? *The American Economic Review*, 83, 570-597.

Blundell, R. and Walker, I. (1982), Modeling the Joint Determination of Household Labour Supplies and Commodity Demands, *Economic Journal*, 92, 351-364.

Brand-Miller, J. et al. (2003), "Low-glycemic index diets in the management of diabetes: a meta-analysis of randomized controlled trials" *Diabetes Care*, 26:2261-7

Burton-Freeman, B. (2000), "Dietary fibre and energy regulation", *Journal of Nutrition*, 130 (2): 272S-275S

Chouinard, H.H., Davis, D.E., LaFrance, J.T. and Perloff, J.M. (2005), "The Effects of a Fat Tax on Dairy Products", *Working Paper 1007*, Department of Agricultural and Resource Economics and Policy, University of California

Deaton, A. and Muellbauer, J. (1980), An Almost Ideal Demand System, *The American Economic Review*, 70, 312-326.

Heckman, J. (1979), Sample Selection Bias as a Specification Error, *Econometrica*, 47, 153-161.

Jacobson, M.F. and Brownell, K.D. (2000), "Small taxes on soft drinks and snack foods to promote health", *American Journal of Public Health*, 90:6, 854-857

Kant, A. K. (2000), "Consumption of energy-dense, nutrient-poor foods by adult Americans: nutritional and health complications. The third National Helath and Nutrition Examination Survey, 1988-1994", *American Journal of Clinical Nutrition*, 72:929-36

Kuchler, F., Tegene, A. and Harris, M. (2005), "Taxing Snack Foods: Manipulating Diet Quality or Financing Information Programs?", *Review of Agricultural Economics*, 27(1):4-20

Leung, S.F. and Yu, S. (1996), On the Choice Between Sample Selection and Two-Part Models, *Journal of Econometrics*, 72, 197-229.

Liu S. et al. (1999), "Whole-grain consumption and risk of coronary heart disease: results from the Nurses' Health Study", *American Journal of Clinical Nutrition*, 70(3):412-9.

Liu S. et al. (2003), "Relation between changes in intake of dietary fibre and grain products and changes in weight and development of obesity among middle-aged women", *American Journal of Clinical Nutrition*, 78:920-927.

Mann, J. (2002), "Diet and risk of coronary heart disease and type 2 diabetes", *The Lancet*, 360:9335, 783-790.

O'Donoghue, T. and Rabin, M. (2003), "Studying Optimal Paternalism, Illustrated by a Model of Sin Taxes" *American Economic Review*, 93(2): 186-191

Persson U, Svensson M och Ödegaard K (2004), "Kostnadsutveckling i svensk sjukvård relaterad till övervikt och fetma – några scenarier. Vårdens resursbehov och utmaningar på längre sikt." Stockholm: Landstingsförbundet

Persson, Ulf och Ödegaard, Knut (2005), ”Indirekta kostnader till följd av sjukdomar relaterade till övervikt och fetma”, *IHE e-rapport* 2005:3

Rolls, B. (2000), “The Role of Energy Density in the Overconsumption of Fat”, *Journal of Nutrition*, 130:268S-271S.

Schulze, M.B. et al. (2004), “Glycemic Index, Glycemic Load, and dietary fibre intake and incidence of type 2 diabetes in younger and middle-aged women”, *American Journal of Clinical Nutrition*, 80:348-56.

Smed, S. and Denver, S. (2005), Taxing as Economic Tools in Health Policy, Paper presented at the 97th AEER Seminar at the University of Reading.

Strnad, J. (2004), “Conceptualizing the “fat tax”: the role of food taxes in developed economies”, John M Olin Program in Law and Economics, *Working Paper 286*

White, H. (1980), A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity, *Econometrica*, 48, 817-838.

Willet, W. et al. (2002), “Glycemic Index, Glycemic Load, and risk of type 2 diabetes”, *American Journal of Clinical Nutrition*, 76:274S-80S.