Did the junk food tax make the Hungarians eat healthier?

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Abstract

I analyse whether the introduction of the unhealthy food tax lead to significant improvements in the dietary habits of the Hungarian population. I focus on the consumption of processed and unprocessed food before and after the tax was levied on a range of food high in salt and sugar. Using data from a large scale household panel data set, I estimate the consumed quantities of processed food to decrease by 3.4% due to the unhealthy food tax, while the consumed quantities of unprocessed food increased by 1.1%. The lowest income groups were the most responsive to the introduction of the tax. Despite data limitations, the results indicate moderate improvement in population diet that is likely to be attributable to the tax.

Keywords: food tax, nutrition, demand analysis, Hungary

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1 Introduction

The junk food tax of Hungary which was introduced in 2011 is a unique approach to improve population health. The policy is unique in terms of the range of food covered by the tax, the rate of the tax, and the explicit aim of health improvement.

My aim in this paper is to estimate the effect of the Hungarian junk food tax on food consumption. I am interested in the overall effects and the effects by socioeconomic status. I take a broad approach in the sense that I do not focus on the consumption of particular items on which the tax was levied, but analyse broad consumption categories. I focus on how the consumption of processed and unprocessed food changed after the introduction of the junk food tax. Dietary guidelines[1] generally recommend the consumption of more fresh food and less unprocessed food, so as to reduce the consumption of sodium, solid fats, added sugars. The consumption of unprocessed food is generally known to reduce the risk of cancer and heart diseases.[2] Focusing on broad categories of food can reveal if the junk food tax lead to substantial changes in dietary patterns. If the taxed items are substituted with untaxed, but also unhealthy products then the tax does not achieve its final aim.

The analysis contributes to the knowledge of how governments could tackle obesity and diet related diseases of the population. The results of the paper suggest that taxing specific categories of unhealthy food can lead to some improvements in the dietary habits of the population, especially among the lower income groups. This is based on statistically robust albeit quantitatively moderate evidence for decreasing consumption of processed food after the junk food tax in Hungary was introduced. In the long run these dietary improvements

[1] See for example the guidelines of the U.S. Department of Agriculture and U.S. Department of Health and Human Services: USDA (2010).

[2] See for example the "Healthy Eating Plate" of the Harvard School of Public Health (2015).

are likely to lead to positive health effects.

2 Related literature

There are only few studies that assess based on natural experiments the efficiency of taxing a selected range of unhealthy food. This scarcity of the literature is mainly due to the fact that only few countries have introduced unhealthy food taxes. The taxation of sugar sweetened soft drinks is more widespread, among others, Finland, France, Norway, and several states of the US have introduced such taxes. According to Sturm et al. (2010), the existing small tax rates on sugar-sweetened beverages are not enough to affect the consumption of the targeted soft drinks and to reduce obesity, at least not among the youth. Apart from the Hungarian junk food tax, the Danish fat tax serves as a natural experiment for assessing the effects of taxing unhealthy food. Denmark introduced a tax on saturated fat in October 2011, which was abolished in January 2013. Jensen and Smed (2013) conclude that the Danish fat tax had a 10-15% negative short-run effect on the consumption of saturated fats. In Hungary the tax was levied on a broad range of food and drinks containing salt, sugar or caffeine, thus the estimated effects are not directly comparable but can complement the findings from Denmark. The existing results on the effects of the Hungarian junk food tax are discussed in section 3.2.

Another strand of the literature is based on modelling exercises. Mytton et al. (2012) provide a review of the existing evidence related to the effects of unhealthy food taxes. As they document, most of the results on the consumption and health effects of unhealthy food taxes are based on modelling exercises. This line of the literature suggests that unhealthy

food taxes have relatively small effects due to the small price-elasticity of food consumption, and also to substitution effects. Taxing sugar sweetened drinks seems to be more efficient.

The overall efficiency of unhealthy food taxes is still controversial. For example, in the model of Yaniv et al. (2009), a fat tax may increase obesity if the introduction of the tax reduces the time otherwise spent on physical activities because more time is spent on cooking and shopping. On the other hand, Miao et al. (2013) claim based on the analysis of a demand system that added-sugar tax is an efficient instrument if substitution possibilities are properly taken into account. As they point out, although there is evidence in the literature that consumers can substitute taxed unhealthy food with other unhealthy but untaxed food, they also can substitute low fat or low sugar items for high fat or high sugar items. Powell et al. (2013) conclude based on a review of the U.S. literature that changes in the relative prices of unhealthy and healthy foods and beverages can lead to significant dietary improvements and weight losses, particularly among those who are most at risk of obesity.

Experimental studies also provide mixed evidence. According to Epstein et al. (2012), there is consensus in the related experimental literature that tax or subsidy policies can achieve changes in the consumption of targeted food. However, due to substitution effects, the health effects of such policies are controversial.

I can address these controversies by the empirical analysis of the consumption effects of a unique tax policy, and by analysing the expenditures not only on those items that were affected by the junk food tax, but also those that could serve as substitutes. A novelty of this paper is to estimate the consumption effects of the Hungarian junk food tax based on large scale household level data. Due to data limitations, I analyse the effect of the Hungarian junk food tax only on the consumption of salty and sugary food but not of drinks high in

sugar or caffeine. Also, the relatively short time coverage of the data and the confounding influence of other factors do not make it possible to reliably estimate the health (and obesity) effects of the tax policy.

3 The unhealthy food tax in Hungary

3.1 Policy

After its legislation in July 2011, the junk food tax was introduced in September 2011. The tax is often called "chips tax" in the Hungarian media, the official naming is "Public Health Product Tax". The tax applies to certain categories of pre-packed food which are high in salt, sugar or caffeine. The official aim of the Hungarian Government was to improve the health of the population, and the income from the tax would be used for health improving policies (including wage increases of health workers). With the help of the tax the Government wished not only to reduce the consumption of products high in salt, sugar and caffeine, but also to improve the health behaviours of the population, and shift the food supply towards healthier products. Since 2012 the income from the tax flows to the public health insurance fund, making up around 1% of the fund's income.

The health status of the Hungarian population makes health improving policies reasonable. According to OECD statistics (OECD (2013)), ischemic heart disease, cerebrovascular disease and cancer mortality rates are one of the highest in Hungary among the OECD countries. Life expectancy in Hungary is about 5 years shorter than the OECD average. Adult obesity rates are close to the OECD average.

The junk food tax was followed by two other major regulations of the food industry in Hungary. First, from 18 February 2014, it is prohibited to release such a food product which contains more than 2% of trans fat within its total fat content. Second, a set of regulations came into effect in January 2015 which ensure that the food and drink offered at public canteens satisfy some health requirements. For example, sugared soft drinks and high fat meat are prohibited, and salt and sugar are forbidden to be displayed on the tables. Since these two regulations came into effect after the time coverage of the data I use in the empirical analysis, these do not interfere in my empirical results. Also, a regulation came into effect in 2012 which aims at general health improvements in schools, requiring among others the provision of healthy food in schools - without providing any further guidance.

Figure 1 shows the time series of daily consumption of nutrients in Hungary since 2001. Since around 2006 the intake of proteins, fat, carbohydrates and energy has been decreasing. Still, these intakes are higher than the guidelines of daily nutrient intakes, therefore there is a scope for improving the dietary habits of the population.[3]

Table 1 presents the rates of the junk food tax (1 EUR is approximately 300 HUF). The first column lists all the taxable products. The basis of the tax is the quantity of the product, not the price. Exemption applies if the merchant sells less than 50 litres or 50 kilograms per year of the otherwise taxable product.[4] Whether a product is taxable or not depends only on its ingredients, thus the tax does not discriminate for example among producers. Official statistics on the average prices of the taxed item categories are not available, therefore it is

[3]For example, for a 30 year-old low active woman with BMI of 25 and height of 1.6 m the Institute of Medicine of the National Academies (2002) published the following reference intake values: energy 8042 kJ, carbohydrate 130 g, protein 46 g, and fat intake should be as low as possible.

[4]Further information on the exact categories of the taxable products is provided by the National Tax and Customs Administration of Hungary (http://www.nav.gov.hu/nav/ado/nepegeszsegugyi_termekado).

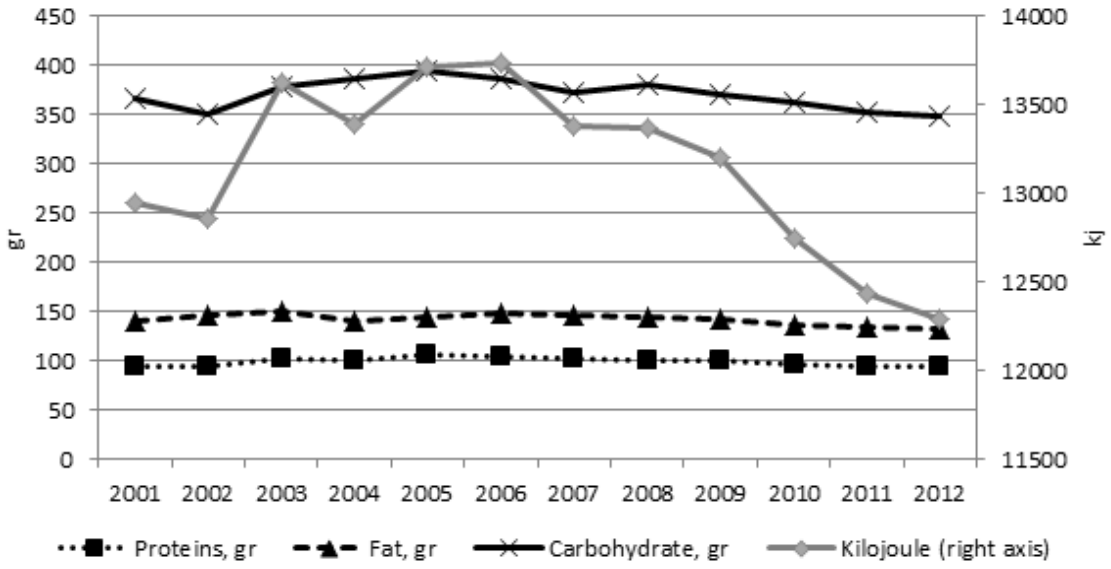

Figure 1: Per capita daily consumption of nutrients (source: Hungarian Central Statistical Office (2014c))

not possible to exactly measure the proportional magnitude of the tax. Nevertheless, to get an idea of the magnitude of the tax relative to the actual prices, in the final column of Table 1 I indicate the gross price of a taxable product within each product category. Although these items can be considered as widely known among the costumers, these are just ad hoc examples and do not represent the price levels for the whole product groups.

The nominal tax revenue was similar in 2012, 2013 and 2014, with an annual revenue of around 19-20 bn HUF (OEP (2014a and b)). Figure 2 shows the distribution of the tax revenue according to the taxable products. Pre-packed sweets have the largest share in the tax revenues, followed by salty snacks and salty seasonings. According to ECORYS (2014), the price increases in confectionery, salty snacks and sugar-sweetened beverages were comparable to the levied tax rates, whereas little price changes were seen for energy drinks, mainly

Taxable products	Taxable if	Tax rate since Sept 2011	Tax rate since Jan 2012	Gross price of a taxable item, Aug 2014*
Juice concentrate	sugar > 8 g/100 ml and fruit < 25%	0	200 HUF/l	"YO" raspberry flavoured concentrate: 1,427 HUF/l
Other juice	sugar > 8 g/100 ml and fruit < 25%, since Jan 2012: if milk < 50%	5 HUF/l	7 HUF/l	"SIÓ" lemon-lime juice: 279 HUF/l
Energy drink, year 2011	sugar > 8 g/100 ml or caffeine >10 mg/100 ml	250 HUF/l	-	"Red Bull" energy drink: 1,756 HUF/l
Energy drink since 2012	methylxanthine > 1 mg/100 ml or taurin > 100 mg/100 ml (sugar content not relevant)	-	250 HUF/l (since 2013: 40 HUF/l if no taurin but methylxanthine > 15 mg/100 ml)	
Pre-packed sweets without cocoa (including ice-creams)	sugar > 25 g/100 g	100 HUF/kg	130 HUF/kg	"Győri" layered biscuits with lemon: 1,644 HUF/kg
Pre-packed sweets with cocoa	sugar > 40 g/100 g and cocoa < 40 g/100 g, since Jan 2012: if milk < 50%	100 HUF/kg	130 HUF/kg	"Americana" milky bar with cocoa: 1,680 HUF/kg
Sugared cocoa powder	sugar > 40 g/100 g and cocoa < 40 g/100 g	100 HUF/kg	70 HUF/kg	"Nesquik" cocoa powder: 2,245 HUF/kg
Salty snack (exception since Jan 2012: bakery product with salt < 2 g/100 g)	salt > 1 g/100 g	200 HUF/kg	250 HUF/kg	"Chio" salted peanuts: 1,860 HUF/kg
Condiments, instant soup (exceptions: ketchup, mustard, ready to eat soup, infant formula)	salt > 5 g/100 g	200 HUF/kg	250 HUF/kg	"Vegeta" condiment: 1,899 HUF/kg
Aromatised beer	sugar > 5 g/100 ml	0	20 HUF/l	"Soproni" lime-mint radler: 398 HUF/l
Alcoholic refresher	sugar > 5 g/100 ml	0	20 HUF/l	"Bacardi" breezer: 1,996 HUF/l
Jam	sugar > 35 g/100 g	0	500 HUF/kg	"EKO" apricot jam: 1,656 HUF/kg

* The prices are based on the Hungarian Tesco online store (http://bevasarlas.tesco.hu/) as of 14 August 2014

Table 1: Junk food tax rates and indicative prices of the taxable products

due to the producers changing the ingredients.[5]

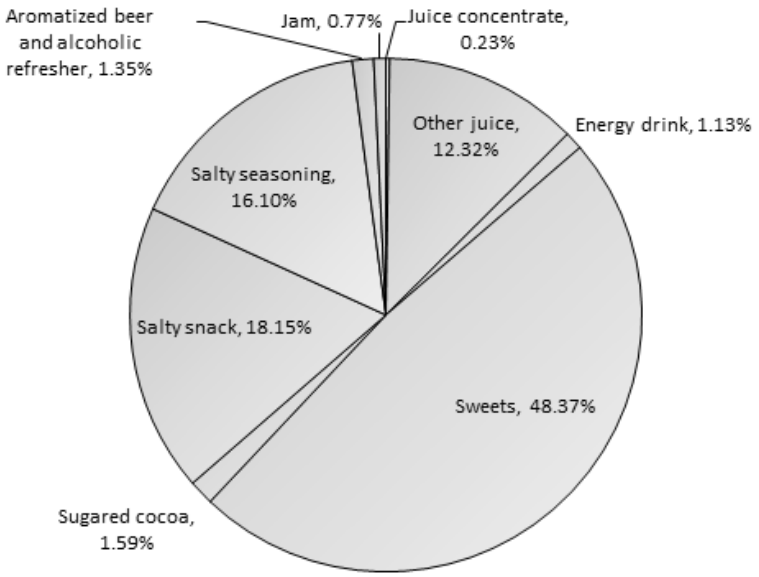

Figure 2: Distribution of the tax revenue by product categories, February - August 2012 (source: National Tax and Customs Administration of Hungary (2012)).

In the rest of the paper I focus only on food consumption, and not on drinks. This restriction is mainly due to data reasons, as I further explain in section 4.

3.2 Existing evidence on the consumption effects

There is no clear evidence on the efficiency of the Hungarian junk food tax.

On the one hand, an analysis by the National Institute for Health Development (OEFI (2013)) claims that the tax has achieved its aims as the consumption of the unhealthy products affected by the tax has declined. According to OEFI (2013), the turnover of the taxable goods

[5]ECORYS (2014) is a study conducted by an international research and consultancy company for the European Commission with the aim of assessing the impact of food taxes. Some further details are provided in section 3.2. ECORYS (2014) reports the following expected price changes (=tax rate×tax base as % of the pre-tax price) for years 2011 and 2012 combined: confectionery 5.4%, juice 2.7%, energy drinks 37.5%, salty snacks 18.1%.

decreased by 27% in a year, whereas their average prices increased by 29%. At the same time, 40% of the affected manufacturers modified their production formula so as to avoid the tax payment.[6] On the other hand, the main argument of the producers against the junk food tax is that it does not necessarily lead to a reduction of the consumption of salt and sugar, as for example home made snacks are exempt from the tax. The Federation of Hungarian Food Industries issued an announcement soon after the introduction of the junk food tax, claiming that the tax enforces the producers to substitute natural ingredients (salt and sugar) with artificial ingredients. This was followed by other announcements, stating that the tax is detrimental for the industry, resulting in financial losses and layoffs. The Hungarian Chocolate and Confectionery Manufacturers also claim that while the junk food tax has minor effect on the salt and sugar intake, it substantially increases the losses in the affected industries.[7]

The ECORYS (2014) provides a detailed overview of the effects of food taxes on the agri-food sector, using Hungary as a case study. The main conclusions of the ECORYS (2014) on the consumption effects of the junk food tax in Hungary are in line with the conclusions of the OEFI (2013), reporting negative effects on the taxed items. The ECORYS (2014) also reports that "consumers were able to replace the taxed products with ones not containing the taxed ingredients [...]. However, consumers were also able to substitute, in all product categories, to products which contain those nutrients targeted by the tax (salt, sugar etc.) but do not have product tax levied on them."

The main contributions of my study are the following. I use a large scale household

[6] These statistics are based on the responses of $30 - 40$ affected producers to an online survey conducted by the National Institute for Health Development (OEFI).

[7] Similar claims were raised by Danish producers related to the fat tax in Denmark (Snowdon (2013)), where cross-border shopping was an additional important channel for avoiding the tax.

panel survey based on which I can observe changes in consumption alongside a wide range of socioeconomic characteristics. Using large scale panel data is a novelty compared to the OEFI (2013) and ECORYS (2014) analyses, allowing a reliable estimation of the consumption effects of the Hungarian junk food tax. I estimate the effects of the tax on broad consumption categories which can reveal important dietary patterns. Also, the data I use make it possible to check for different effects of the tax across socioeconomic groups.

4 Data

I use data from the Hungarian Household Budget and Living Conditions Survey. The representative survey is administered by the Hungarian Central Statistical Office, it has been running in its current form since 2009, the data I use correspond to years 2008-2012. The annual sample covers around 10 thousand households, 26 thousand individuals. This gives overall 44,608 household level observations throughout the 5 survey waves. The survey is a 4-years rotational panel: each household remains in the sample for 4 years. The survey consists of an annual survey on socioeconomic status (based on an annual interview), and a monthly consumption diary. Each month, 1/12 of the households run a diary of the expenditures throughout the whole month. Only expenditures, quantities purchased and own produces are recorded, consumption not. In this paper I use expenditures and purchased quantities as proxy variables for consumption.

In the following empirical analysis I use household level data because the variables of main interest, the consumption indicators, are measured on the household level.

The 5-digit COICOP (Classification of Individual Consumption According to Purpose)

	mean	std.dev.
Annual per capita expenditures in HUF		
food	251,043	122,578
processed food	154,374	74,232
unprocessed food	96,669	67,902
possibly taxed food	29,309	24,514
untaxed food	221,734	111,912
taxed sweets	13,207	1,5971
untaxed sweets	7,477	10,114
Annual per capita purchases in kg		
food	770.799	439.374
processed food	536.258	304.241
unprocessed food	234.541	206.087
possibly taxed food	24.489	22.391
untaxed food	746.311	436.334
taxed sweets	4.626	7.451
untaxed sweets	20.002	28.617

Table 2: Descriptive statistics of the consumption measures generated from the consumption diary data, pooled sample

categories do not make it possible to precisely identify the taxed goods, therefore I focus only on broader categories of food consumption for which I provide descriptive statistics in Table 2. The descriptive statistics of the control variables used in the empirical models are available in the online appendix. The two baseline categories I focus on are processed and unprocessed food. There is no taxable product within the unprocessed food group. To get further insights into the results, I analyse further four food categories: food possibly affected and unaffected by the junk food tax, and sweet products affected and unaffected by the tax. Table 3 shows the exact composition of these categories, and it also indicates that purchased quantities are not observable for all products. The generated category of taxable products is a subset of processed food but still broader than the actually taxable goods because I cannot observe the exact ingredients of the goods consumed (e.g. the sugar content of a jam). The salty snacks that are affected by the junk food tax might belong to the categories bread

rolls, croissants, pastries; confectionery products with flour; processed pastries or processed potato. In case of the sweet products I can relatively well identify the taxable items based on the 5-digit COICOP codes, although sugar or salt contents are not observed.

I exclude the beverages from the empirical analysis because of two reasons. First, based on the COICOP categories it is not possible to differentiate the beverages with high fruit and low sugar content from the taxable beverages; also, the alcoholic refreshers and aromatised beer cannot be differentiated from other alcoholic drinks. Second, there is no available statistics of the consumption of tap water, which is one of the obvious substitutes for the taxable beverages.

Figures 3 and 4 illustrate the monthly consumption of the processed and unprocessed food categories over the analysed time period. These graphs do not indicate a clear effect of the junk food tax on these food categories. However, to arrive at a clearer picture, it is necessary to take into account seasonalities and time trends, and also control for possible composition effects of the households. The graphs also reveal that the monetary expenditures on and the purchases in kg of the analysed food categories differ substantially between the two categories, therefore it is reasonable to look at standardised consumption measures.

5 Estimation strategy

I compare the effect of the tax on "healthy" and "unhealthy" food categories. The selected food categories are detailed in Table 3. I call "healthy" food those items on which the junk food tax is not levied, and "unhealthy" food those that can be taxed. The "unhealthy" group is the broadest in the baseline specification (specification 1). Here I consider all

	"Unhealthy" food		"Healthy" food	
	Product category	COICOP	Product category	COICOP
1	**Processed food**	01.1 minus unprocessed food	**Unprocessed food**	
			beef and veal	01.1.2.1
			pork	01.1.2.2
			lamb and goat	01.1.2.3
			poultry	01.1.2.4
			beef, veal, pork offal	01.1.2.5.4
			poultry offal	01.1.2.5.5
			other fresh meat	01.1.2.7
			fresh or frozen fish	01.1.3.1
			fresh or frozen seafood	01.1.3.2
			egg	*0.1.1.4.7*
			fruit	01.1.6
			minus processed fruit	minus 01.1.6.9
			vegetables	01.1.7
			minus processed veg.	minus 01.1.7.7
			minus processed potato	minus 01.1.7.9
2	**Taxable products**		**Untaxed products**	01.1 minus taxable products
	bread rolls, croissants, pastries	01.1.1.2.2		
	confectionery products with flour	01.1.1.2.3		
	processed pastries	01.1.1.3.2		
	chocolate	01.1.8.3		
	candy, chewing-gum	*01.1.8.4*		
	ice cream	*01.1.8.5*		
	other sugar products	*01.1.8.6*		
	sauces, condiments	*01.1.9.1*		
	processed potato	01.1.7.9		
	cocoa powder	01.2.1.3		
	jam	0.1.18.2.1		
3	**Taxed sweets**		**Untaxed sweets**	
	confectionery products with flour	01.1.1.2.3	fresh confectionery	01.1.1.4
	chocolate	01.1.8.3	sugar	01.1.8.1.1
	candy, chewing-gum	*01.1.8.4*		
	ice cream	*01.1.8.5*		
	other sugar products	*01.1.8.6.1*		

Items in *italics:* quantities not measured, only expenditures

Table 3: Food consumption categories used in the empirical analysis

processed food as "unhealthy" and unprocessed food as "healthy". The taxable products are all processed food. The final aim of the tax is to improve diet, and unprocessed food is generally considered as healthier than processed food, therefore it is reasonable to divide

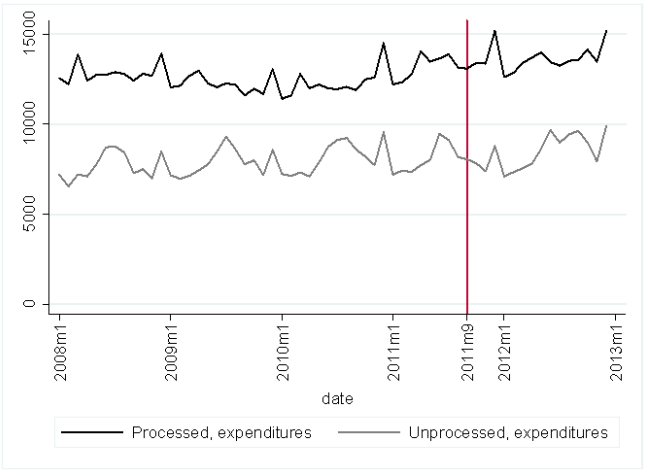

Figure 3: Monthly per capita expenditures on processed and unprocessed food, in HUF

the consumption into these two categories. I narrow down the "unhealthy" category under specification 2 to such products which can possibly be taxed. Under specification 3 I focus on a specific food category, the sweets. It is important to note here that the untaxed sweet products cannot be assumed to be healthier than the taxed pre-packed sweets. Also, fresh confectionery products and sugar are close substitutes of the taxable sweets. Thus although these results are relevant for the effects of the tax, cannot provide evidence for improvements in the dietary habits in terms of sugar intake. Still, specifications 2 and 3 can reveal some of the mechanisms underlying behind the baseline results.

Let C_{it} denote the food consumption by household i at time t. Depending on the specification, consumption is measured either in quantity (kg) or in nominal expenditures. For the sake of comparability, in all cases the consumption measures are standardised.[8] The variable *time* captures a linear trend measured in months. Vector X_{it} includes a set of household characteristics. The time specific indicator of taxation is $T_t = I\left(t \geq \text{ September 2011}\right)$. I

[8]The standardisation is based on the mean and standard deviation throughout the observation period, using the formula for variable x at time t: $\frac{x_t - mean(x)}{sd(x)}$.

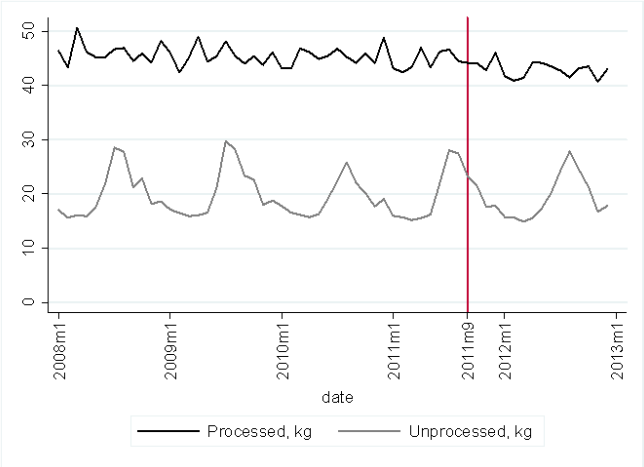

Figure 4: Monthly per capita purchases of processed and unprocessed food, in kg

estimate the following fixed effects models of consumption separately for each analysed consumption category, making use of the panel nature of the Hungarian Budget and Living Conditions Survey:

$$C_{it} = \alpha_0 + \beta T_t + \alpha_2 \cdot time + X_{it}\alpha_3 + a_i + u_{it}, \tag{1}$$

where a_i captures household fixed effects. The households fixed effects also capture the month effects because each household is interviewed and fill out the consumption diary always at the same month of the different survey waves. The drawback of this specification is that the treatment effect cannot be separated from the effect of concurrent aggregate shocks. Comparing the taxation effects on processed and unprocessed food can partly filter out the effects of common shocks. Thus I also estimate equation (1) with using as outcome variable the difference between the corresponding consumption category pairs (processed - unprocessed; possibly taxed - untaxed; taxed sweets - untaxed sweets).

In all specifications the COICOP categories that I consider as "unhealthy" food are

broader than the actually taxable items. If the true value of parameter β for the taxed items is negative then this measurement issue leads to an upward bias in β; the effect of the tax policy on the taxed goods will be underestimated.

6 Estimation results and discussion

6.1 Baseline and alternative food categories

6.1.1 Results

In the baseline specification I estimate fixed effects models of the standardised measures of processed and unprocessed food consumption, including as regressors the binary tax indicator, a linear trend and household characteristics. The estimated coefficients of the taxation dummy are presented in the first part of Table 4.[9]

Although the expenditures on processed food went up by 6.5% after the introduction of the junk food tax, the purchased quantities declined by 3.4%, while there were no significant changes in the purchased quantities of unprocessed food. The results imply a price elasticity of processed food of around 0.33.[10]

Under the second set of specifications I find that the junk food tax could not significantly shift the consumption from the possibly taxed food categories to the untaxed categories. Finally, I find weak evidence that the tax resulted in increased expenditures on untaxed sweet products, such as sugar and fresh bakery products, and decreased amounts of purchases of taxed pre-packed sweets.

[9] Detailed estimation results are available in the online appendix.

[10] Expenditures went up by 6.5%, quantities decreased by 3.4%, implying that prices went up by around 10.2%. Thus the price elasticity of processed food is around $3.4/10.2 = 0.33$.

Expenditures			**Quantities**		
Processed	Unprocessed	Difference	Processed	Unprocessed	Difference
0.065***	-0.024*	0.090***	-0.034**	0.011	-0.045***
(0.014)	(0.014)	(0.015)	(0.014)	(0.014)	(0.016)
Possibly taxed	Untaxed	Difference	Possibly taxed	Untaxed	Difference
0.017	0.025*	-0.008	-0.020	-0.017	-0.003
(0.014)	(0.014)	(0.016)	(0.015)	(0.013)	(0.018)
Taxed sweets	Untaxed sweets	Difference	Taxed sweets	Untaxed sweets	Difference
-0.006	0.030*	-0.037*	-0.040**	-0.013	-0.028
(0.014)	(0.018)	(0.022)	(0.017)	(0.017)	(0.023)

Standard errors in parentheses, * p<0.1; ** p<0.05; *** p<0.01
Household fixed effects and linear trend are included in all models. Number of observations in all models: 40,210.
Included household (hhd) characteristics: living area, if the head of hhd is at least a high school graduate, age composition and average age of the hhd, activity and average subjective health of the hhd, number of hhd members, income decile the hhd belongs to, and the three reported indicators of financial well being (as in the online appendix).

Table 4: Estimated effect of the junk food tax on standardised measures of food consumption

6.1.2 Discussion

The differences between the results for expenditures and quantities can partly be due to price changes, and partly to changes in the composition of consumption. For example, a shift from low quality products to high quality products increases the expenditures but keeps the quantities unchanged. The results are in line with such a change in food quality demanded.

The results of the second specification (possibly taxed versus untaxed items) suggest that the shift in consumption from processed food was caused mainly by the shift from processed items not directly affected by the junk food tax, like processed meat or processed dairy products. Hence it is likely that factors other than the introduction of the junk food tax contributed to the drop in the consumption of processed food. Price changes or shifting consumption preferences unrelated to the junk food tax could have played a role. Also, it is likely that substitutions took place within the possible taxable category, e.g. substituting highly salted snacks with unsalted or less salted ones. In this sense the insignificant results do not contradict the results of OEFI (2013) who document a drop in the consumption of the taxable items.

The results of the third specification (taxed versus untaxed sweets) indicate that substitutions took place between similar food categories so as to avoid the junk food tax. However, the explosion of sugar prices by more than 40% in 2011 is likely to influence these results, contributing to the increasing expenditures on untaxed sweet products. I return to the discussion of price effects in section 6.4.

6.2 Interaction effects

6.2.1 Specification and results

To gain further insights into the consumption effects of the junk food tax, I interact the binary indicator of the junk food tax being in power with selected household level characteristics. I re-estimate equation (1) with including an interaction term first with the age composition of the household, second with living area and third with whether the head of the household has high school level education. To avoid multicollinearity, these interaction terms are included one by one. Looking at the expenditures on and quantities of processed and unprocessed food, these extensions lead to inconclusive results, the interaction effects are mostly insignificant. Including interactions with the income quartiles provide the most insightful results, I focus only on those here.

Apart from the interaction effects, the specification is the same as the baseline specification. The estimated coefficients of interest are presented in Table 5.

	Processed, expenditures	Unprocessed, expenditures	Difference	Processed, quantities	Unprocessed, quantities	Difference
Tax	-0.092***	-0.145***	0.053**	-0.136***	-0.055**	-0.081***
	(0.024)	(0.024)	(0.026)	(0.024)	(0.023)	(0.028)
Tax ×	0.160***	0.087***	0.073**	0.108***	0.033	0.075**
quartile2	(0.030)	(0.031)	(0.033)	(0.031)	(0.030)	(0.036)
Tax ×	0.206***	0.164***	0.042	0.130***	0.082***	0.048
quartile3	(0.030)	(0.030)	(0.033)	(0.031)	(0.030)	(0.035)
Tax ×	0.237***	0.208***	0.029	0.153***	0.134***	0.019
quartile4	(0.029)	(0.029)	(0.032)	(0.030)	(0.029)	(0.034)

Standard errors in parentheses, * p<0.1; ** p<0.05; *** p<0.01. The same remarks apply as in Table 4.

Table 5: Estimated effects of the junk food tax on standardised measures of consumption, interaction with income quartiles

6.2.2 Discussion

The baseline results on the negative change in the consumption of processed food after the introduction of the food tax is mainly driven by the first income quartile, whereas the positive change in the expenditures on processed food is driven by the top two income quartiles. In the first income quartile the expenditures on and quantities purchased of processed and unprocessed food both declined after September 2011. While the decline in the expenditures was bigger for the unprocessed food, the decline in quantities purchased was bigger for the processed food.

If the aim of the policy was to significantly decrease the consumption of "unhealthy" food then the tax could achieve its aim only among the poorest households. The reasons behind this finding can be the higher price sensitivity of lower income groups (Sik (2000)), and that the households with higher income and thus possibly with higher education had followed healthier diet even before the introduction of the junk food tax (Futó (2000)).

6.3 Different effects after 2012

6.3.1 Specification and results

As Table 1 shows, the rates of the junk food tax were modified in January 2012 and the list of taxable items were extended. This change in the tax policy makes it reasonable to investigate whether the consumption effects of the junk food tax were different after January 2012. To analyse this change I modify the previously estimated fixed effects models the following way:

$$C_{it} = \alpha_0 + \beta_1 T_t^1 + \beta_2 T_t^2 + \alpha_2 \cdot time + X_{it}\alpha_3 + a_i + u_{it}, \tag{2}$$

where $T_t^1 = I\,(t \geq$ September 2011) and $T_t^2 = I\,(t \geq$ January 2012). The estimated β_1 and β_2 coefficients are presented in Table 6. Including two separate tax effects in the model decreases the statistical power of the estimation.

	Processed, expenditures	Unprocessed, expenditures	Difference	Processed, quantities	Unprocessed, quantities	Difference
Tax ×(time≥	0.077***	-0.122***	0.199***	-0.025	-0.002	-0.023
Sept 2011)	(0.018)	(0.018)	(0.020)	(0.019)	(0.018)	(0.021)
Tax ×(time≥	-0.017	0.151***	-0.168***	-0.014	0.020	-0.034
Jan 2012)	(0.018)	(0.018)	(0.020)	(0.018)	(0.018)	(0.021)

Standard errors in parentheses, * p<0.1; ** p<0.05; *** p<0.01. The same remarks apply as in Table 4.

Table 6: Estimated effects of the junk food tax on standardised measures of consumption, after September 2011 and January 2012

As the final specification check, I include year effects in the model instead of the linear time trend and the binary tax indicator. This specification allows more flexible time effects than the linear time trend of the baseline specification, however, it does not allow for any distinction between the time effects and the junk food tax effects in years 2011 and 2012. The results are presented in Table 7.

	Processed-unprocessed expenditures, difference	Processed-unprocessed quantities, difference
2009	-0.118***	-0.042**
	(0.017)	(0.019)
2010	-0.133***	0.005
	(0.020)	(0.021)
2011	0.073***	-0.069***
	(0.021)	(0.022)
2012	0.030	-0.126***
	(0.024)	(0.026)

Standard errors in parentheses, * p<0.1; ** p<0.05; *** p<0.01.

The same remarks apply as in Table 4, except for linear trend is not included

Table 7: Estimated year effects on the difference of standardised measures of consumption, reference year: 2008

6.3.2 Discussion

The results presented in Table 6 indicate that the junk food tax became more efficient after January 2012: the difference between the changes in consumption of processed and unprocessed food is negative after January 2012. The reason behind the negative difference is either a stronger growth in the expenditures on unprocessed items, or a decline in the consumption of the processed items, although the latter is statistically insignificant.

Table 7 shows that the difference between the expenditures on processed and unprocessed items is positive and significant only in year 2011, whereas the difference between the quantities purchased of processed and unprocessed goods is significant and negative both in years 2011 and 2012. These results reinforce that there was a shift towards the consumption of unprocessed food after 2011 (at least in terms of quantities), which became stronger after January 2012. Part of these effects could be due to the junk food tax.

6.4 Prices

The estimation strategy does not make it possible to perfectly distinguish the effect of the junk food tax from the effect of other factors that could influence consumption simultaneously with the introduction of the tax. Price changes are among the most important ones.

In Table 8 I present the annual price indices of food in total, some food categories that were affected by the junk food tax, and some categories of unprocessed food. Since official price statistics are not available for detailed categories of the taxable items, it is likely that the price increase in the taxable items was higher than what the table suggests. Nevertheless, I present the official statistics for food categories that correspond relatively well to the item

categories affected by the junk food tax. The table indicates that the food inflation rate was moderate between 2008-2013, but the prices of the potentially taxable items (confectionery products with flour, chocolate, cocoa, sauces, condiments) increased with a higher rate from year 2011 to 2012, i.e. after the introduction of the junk food tax. Then in 2013 the prices of these items increased along the average food inflation rate. The prices of agricultural products are very volatile, but in the years when the junk food tax came into effect the inflation rates of fruits and vegetables were moderate. On the other hand, the price of sugar increased drastically in 2011, mostly due to increases in the import price of sugar.

	2008	2009	2010	2011	2012	2013
Food	110.2	104.4	103.2	106.6	105.9	102.8
Chocolate, cocoa	107.9	106.9	103.9	106.6	117.0	97.2
Confectionery products with flour	108.9	109.9	102.4	105.2	113.5	103.2
Sauces, condiments	110.6	111.1	107.1	105.2	110.5	102.4
Fresh fruits	105.3	93.1	107.0	110.0	103.4	104.1
Fresh vegetables	99.0	105.0	125.4	92.0	103.3	109.1
Sugar	93.7	103.4	93.0	147.7	102.0	92.6

source: Hungarian Central Statistical Office (2014a)

Table 8: Time series of consumer price indices, previous year=100

Based on the Hungarian Household Budget and Living Conditions Survey, it is also possible to derive price levels as dividing the monthly averages of reported expenditures and quantities purchased. The advantage of this method is that price measures can be generated for the processed and unprocessed food categories. The disadvantages are that the derived indices are subject to measurement errors, and their magnitudes are not directly interpretable as the quantities purchased cover a narrower range of food items than the reported expenditures. Table 3 indicates in italics some COICOP categories for which quantities are not available. The derived monthly price levels are presented in Figure 5. The graph indicates moderate inflation rates for both food categories, although the prices of unprocessed food

are subject to strong seasonality, with prices being the lowest during the Summer months.

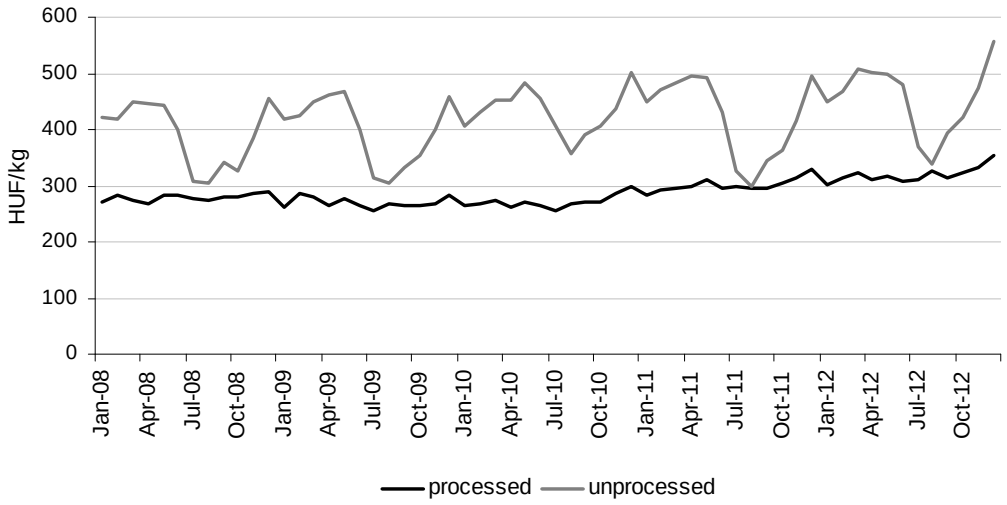

Figure 5: Average generated (indicative) price levels of processed and unprocessed food, own calculations based on the Hungarian Household Budget and Living Conditions Survey

The increasing sugar prices could have contributed to the decreasing demand for processed food. However, it is unlikely to have large effect on the results of this paper, as the generated time series of processed food prices do not show a significant increase in the average prices when the sugar price shock hit the markets, indicating that the sugar price inflation did not cause substantial shock to the average price of the processed food. Also, Table 2 indicates that in terms of the observed quantities purchased, sweet products (taxed and untaxed) make up less than 5% of the purchased quantities of processed food, thus again the adjustment of the consumption of sugary items due to the sugar price shock is unlikely to drive the estimated adjustment of the consumption of processed food. Overall, the price statistics do not indicate any price shocks hitting in after September 2011 that could be the main explanatory factor of the estimated 3.4% decrease in the quantities purchased of processed food.

7 Conclusions

I found some evidence that the junk food tax improved the dietary habits of the population in Hungary. After the introduction of the tax, the consumed quantities of processed food decreased significantly by 3.4%, while the consumed quantities of unprocessed food increased insignificantly by 1.1%. The results are qualitatively robust to specification checks. Throughout the paper I considered a shift towards the consumption of unprocessed food as a dietary improvement. The estimated changes reflect short run estimates, referring to average consumptions over 16 months after the introduction of the tax. Specifications with narrower food categories suggest that the changes were not solely the consequence of the introduction of the junk food tax. The estimated effects were driven by households belonging to the lowest income quartile, who are more responsive to increases in price. The effects of the junk food tax became stronger after January 2012, when the tax rates were increased and the range of taxable items was extended.

Due to the specific nature of the Hungarian junk food tax and to the unique empirical strategy, the estimated consumption effects are not directly comparable to the findings of the related literature. Nevertheless, the estimated dietary improvements correspond to the line of the literature which claims that taxing unhealthy food can lead to dietary improvements (Smed and Robertson (2012) for Denmark, Powell et al. (2013) for the US, among others). My results indicate that taxing a relatively wide range of salty and sugary food items can shift a part of the consumption towards healthier food. The estimated short run effects are of moderate magnitude. The price elasticity of processed food that is implied by the estimation results is around 0.33, which is somewhat lower than the mean price elasticity of

fast food (0.52) as reported by Powell et al. (2013), and even lower than their reported price elasticity of sugar sweetened beverages. For Hungary, ECORYS (2014) estimates higher price elasticity of salty snacks but lower of confectionery and chocolate. My results also support Mytton et al. (2012) in the sense that there is some evidence for substitutions taking place between taxed and untaxed but also unhealthy products, and that a moderate tax rate cannot achieve large consumption effects. Estimating stronger effects among the poorer households is also in line with Mytton et al. (2012), as they find that health related food taxes are likely to be progressive in terms of the health gains due to the higher incidence of diet related diseases and greater price sensitivity among the poor.

One reason for the relatively small estimated effects is that there is no evidence for hoarding taking place before the introduction of the junk food tax in Hungary. The consumption statistics do not indicate that the consumption of the taxed items substantially increased just before the introduction of the junk food tax. Another reason is that the estimates refer to processed and unprocessed food, rather than goods directly affected by the tax. Also, it would be difficult to quickly achieve major changes in dietary habits only with the taxation of a restricted range of food items. Although the estimated consumption effects are small, simulation studies in the literature suggest that small changes in consumption can lead to important health benefits on the population level. Mytton et al. (2007) estimate substantial reduction of cardiovascular disease deaths in the UK if the 17.5% VAT rate were extended to well selected food categories. Sacks et al. (2011) find that a 10% junk food tax would reduce mean weight in Australia by 1.6 kg and might result in a gain of over half a million healthy life years over the lifetime of the 14.5 million affected population. However, these findings are based on hypothetical interventions, have limited relevance for Hungary, and

contradicting results have also been found by other authors (Kuchler et al. (2005)).

The current analysis has a couple of limitations. First, it is not possible to completely disentangle the effect of the junk food tax from the simultaneous effect of other reasons of price changes or other aggregate consumption shocks. Second, I estimated the effect of the tax on the consumption of processed food as compared to unprocessed food, which results might underestimate the effect of the tax on the consumption of the taxed items. Substitutions might have occurred within the processed food category, and modifications of the food ingredients by the procedures could also decrease the intake of salt, sugar and caffeine. Therefore the health improving effect of the junk food tax is likely to be underestimated. Finally, due to data limitations I cannot estimate the effect of the tax on the consumption of sugary beverages and energy drinks.

Overall, despite the data limitations, there is some evidence for moderate improvements in the dietary habits especially among the poorer households as a result of the junk food tax. As the existing data do not allow the analysis of the long run consumption and health effects of the junk food tax, the current empirical results cannot entirely refute the arguments of the Hungarian food producers who argue that the junk food tax does not lead to improvements in the dietary habits of the population. Dietary habits depend among others on cultural, environmental and socio-economic background, in addition to food related regulations. Changing the dietary habits of the population requires a complex food policy, which also puts emphasis on education related to healthy eating. It remains to future research whether the newly introduced policies on trans fats and public canteens strengthen the consumption effects of the junk food tax.

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