How to stimulate consumer orientation toward healthy foods using sugar tax

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Consumer orientation towards healthy foods depends on the coordination of companies, public policies area and the consumer's ability to make choices. At the same time, consumer orientation depends not only on consumer awareness - knowledge and ability to choose foods consciously, but also on the possibility of making this choice, which is ensured by coordinated actions of companies and state. In this research, we consider a problem of optimal regulatory policy design, where the task is to determine the sugar tax rate maximizing the social welfare and stimulate healthier consumer choice. Based on the literature review, a model for coordinating multidirectional interests of market players (state, companies and consumers) to ensure the regulation of sales of unhealthy foods has been proposed. We test the model using consumer panel data and draw conclusions for a specific local market. The model helps to determine optimal prices and taxes on relevant food products.

Keywords: healthy foods, consumer orientation, governmental regulation
Track: Methods, Modelling & Marketing Analytics

PROBLEM STATEMENT

Since the 2000s, interest in the problem of nutrition promotion in different countries is increasing. According to the World Health Organization (WHO), worldwide obesity has nearly tripled since 1975. In 2017, more than 1.9 billion adults were overweight. Of these, over 650 million were obese. Moreover, 41 million children under the age of 5 were overweight or obese in 2017 (Food and of the United Nations, 2017).In addition to obesity, adults, children and adolescents often face risks such as depletion, stunted growth, lack of vitamins and minerals, and nutritional non-communicable diseases (heart disease, stroke, diabetes, certain cancers) that affect their health in the short and long term periods. These risks may be consequences of harmful product consumption, caused by the widespread availability and marketing of calorie-dense and sugar-laden products (Ma et al., 2013)

According to Nielsen (2015), consumers increasingly become health conscious and seek fresh, natural and minimally processed foods. For example, people practice partial or complete rejection of products which are harmful to health, replacing them with healthy products (Nielsen, 2015). Consumers often pay attention to the composition and prefer organic products (Liu et al., 2019). Moreover, youth are ready to pay more for health attributes (Nielsen, 2015). These changes in behavioral trends are partly the result of governmental policies aimed at improving quality of nutrition.

It would seem that these changes in consumer behavior should be the subject of attention of companies-producers and retailers. Instead of its companies address 'fake' customer-orientation (Popov & Tretyak, 2014), expressed in a wider assortment in certain categories, comfort parking space, etc. Business processes aimed at increasing level of customer-orientation are a dead letter and are not actually implemented (Gulakova & Rebyazina, 2017). At the same time, real customer-orientation cannot be expressed only in providing better conditions for making a purchase but also takes into account consumption effects that influence the quality of customers' life and her health. First of all, it concerns consumption of food. Researchers note that real customer-orientation aimed at improving customers' health can help companies increase customer loyalty, which will have a positive effect on the client's life cycle and company revenue, subsequently (White & Dahl, 2006).

Unsurprisingly, policy makers look for ways to address these consequences. One possible way to decrease consumption of unhealthy products is the implementation of taxes (Elder et al., 2010). Products being taxed vary across different countries, such as taxes on junk food, fat taxes, or sugar (soda) taxes. For example, junk food taxes were introduced in Mexico, Chile, Japan, Hungary, and France[1], whereas Denmark and some US cities implemented a fat tax (Smed et al., 2016).

Country	Tax rate	Effective since
France	7.53 euro per 100 liters	2013
Chile	6, 25 grams of sugar per 0.1 liter → 16%	2014
Mexico	1 peso per liter	2014
Belgium	3.7284 euro per 100 liters	2013
Colombia	20% per liter	2016
India	40%	2017
Portugal	80 grams of sugar per liter → 16%	2017
Thailand	14% + 5-stage sugar tax according to sugar content	2017
Saudi Arabia	50%	2017
UAE	50%	2017
USA (several cities)	1-2 cents per ounce	2017
Ireland	5-8 grams of sugar per 0.1 liter → 21 cents; 8 grams of sugar per 0.1 liter → 31 cents	2018
South Africa	4 grams of sugar per 0.1 liter → 2.1 cents per gram of sugar per 0.1 liter	2018
UK	5-8 grams of sugar per 0.1 liter → 18%; 8 grams of sugar per 0.1 liter→ 24%	2018

Table 1: Sugar tax rates across countries

Compared to the above examples, sugar taxes are more common. France, Chile, Mexico, Belgium, Colombia, India, Portugal, Saudi Arabia, UAE, USA, South Africa, and many other countries use this tax in order to regulate consumption of sugar drinks[2]. A sugar tax implies that each liter of sugary drink will have an extra tax charge up to 50%, depending on how much sugar

[1] https://economictimes.indiatimes.com/slideshows/nation-world/eight-countries-that-have-declared-war-on-junk-food/slideshow/53245785.cms
[2] https://www.beveragedaily.com/Article/2017/12/20/Sugar-taxes-The-global-picture-in-2017

is in the drink[3]. Tax rates depend on government policy in a country and can be expressed in percentage or in monetary units. Moreover, taxation schemes vary from country to country and can be one-level or multi-level, see Table 1.

Notwithstanding their popularity, it remains unclear whether existing sugar tax schemes affect the consumption of sugar-containing drinks at all. Some researchers state that existing sugar tax approaches help to reduce consumption (Colchero et al., 2015; Falbe et al., 2016), while others argue the opposite (Jou and Techakehakij, 2012). For instance, Falbe and colleagues (2016) showed that consumption of sugar sweetened beverages decreased 21% in a tested city (Berkeley), and increased 4% in comparable cities. In contrast, water consumption increased more in Berkeley (+63%) than in other cities. Furthermore, in Mexico a 10% increase in the price of sugar beverages caused an 11.6% decrease in quantity consumed (Colchero et al., 2015). In contrast, Jou (2012) shows that in countries with high baseline tax rates, sugar taxes may not have a significant impact on consumption, and may even cause negative feedback from manufacturers and the general public. Thus, while sugar taxes are a popular tool among policy makers, the ambiguous academic results on their effectiveness leaves open the question if and when sugar taxes are effective.

While the question on the consequences of sugar taxes is popular among researchers, current studies only pay attention to either consumers, either companies, or either government. For instance, many researchers (Powell et al., 2009; Sturm et al., 2010; Bishai, 2015) model consumer welfare as healthy body weight taking into account government benefits generated by a tax policy. In contrast, other studies consider price elasticity as an indicator of consumer consumption patterns (Briggs et al., 2013; Colchero et al., 2015), but thereby ignore other factors (e.g. branding, promotions) that contribute to consumer choice. Generally, most publications mainly mention consumers' interests, ignoring all the other parties. In fact, researchers should also pay attention to role that government and companies play.

As a counterweight to previous research, we propose a method that takes into account interests of all stakeholders (consumers, companies, and government). It should be noted that aside from consumers, government and companies are also involved in the value chain towards improving public health and consumer well-being. This value chain creation is a challenging task for the

[3] https://www.bbc.com/news/health-35824071

governments, as inadequate nutrition increases health care costs, reduces productivity and slows economic growth. These consequences, in turn, are the basis for permanent poverty and poor population health (Food and of the United Nations, 2017).

RESEARCH OBJECTIVES

The main purpose of this study is to calculate an optimal sugar tax rate based on consumer preferences and company decisions. This purpose can be divided into several tasks: (1) to describe a model to coordinate the interests of all actors involved: government, companies and consumers; (2) to illustrate an example of model application with real data.

As far as all the stakeholders have different utilities, we come to a conflicting interest's problem. Our approach addresses these conflicting interests, maximizing utilities of every stakeholder and thereby increasing overall social welfare. Thus, our study is the first to give a holistic view of the consequences of sugar taxes, taking into account all actors involved. This way, we aim to resolve some of the ambiguous findings prior research has found. Moreover, our study provides results that benefit all actors involved, describing optimal tax design for governments, revenue impacts and response strategies for companies, and consumption impact for consumers.

METHOD AND DESIGN

We created a framework to compute the optimal one-level taxation scheme. The model was developed to determine optimal prices and tax rates to maximize social welfare. We incorporated actions of three actors (government, companies and consumers), taking into account interests of each group in order to maximize social welfare. For this purpose, a multi-level modeling approach based on a Stackelberg model (Von Stackelberg, 2010) was used, which reflects actions and potential gains (win or loss, i.e. positive or negative utility) of government, companies and consumers at three levels (Fig.1). We understand gains on each level as positive or negative utilities which will be described in more detail in next paragraphs.

On the first level, the government makes a decision about the tax rate for unhealthy (sugar-containing) products. Taking into account this rate, firms choose a product portfolio which consists of healthier and unhealthier products.

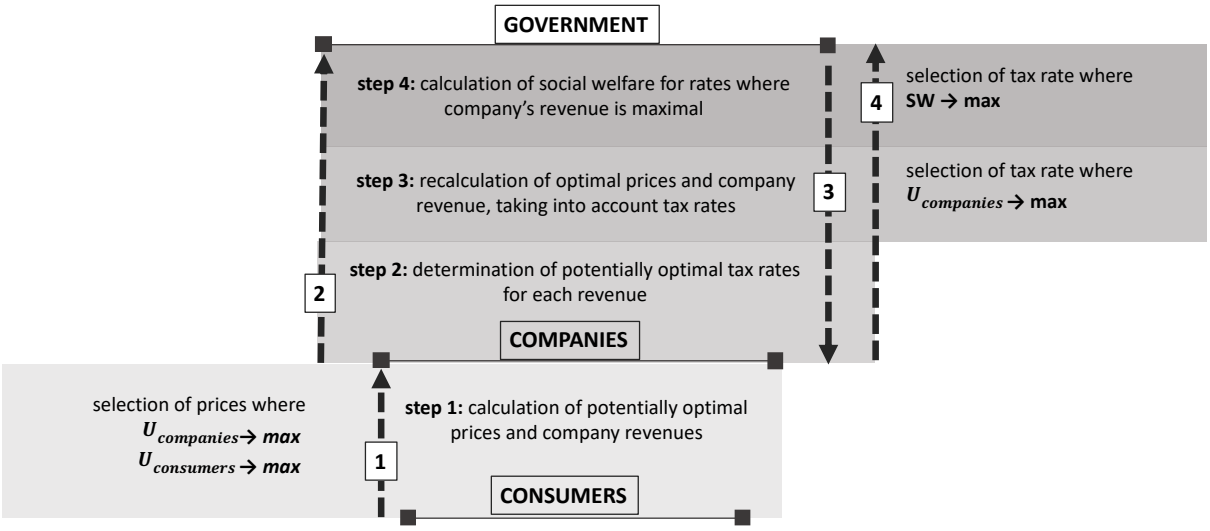

Figure 1: Scheme of multi-level optimization model, which allows to coordinate interests of government, companies, and consumers

Note: SW — Social welfare (utility of government); $U_{companies}$ — utility of companies; $U_{consumers}$ — utility of consumers. Arrows with numbers indicate the order of steps in the model.

At the same time, companies set prices for these products maximizing their utility equal to their revenues. Finally, consumers decide what product they want to buy according to their utility functions. As far as this model consists of three levels, it makes sense to describe each step in detail.

GOVERNMENT

We define social welfare through individual utilities of parties (companies plus consumers) as *functional* dependence on utilities of customers and companies. This utility function is taken from outstanding economic literature (Bernoulli, 2011). All in all, the model should define optimal prices and taxes in order to maximize social welfare:

$$SW = (U_{consumers} + U_{companies} + taxes) \rightarrow max, \quad (1)$$

where $U_{customers}$ is total utility of all consumers, $U_{companies}$ is total utility of all companies.

COMPANIES

On the second level of our model, companies maximize their own utilities (revenues). Companies do so by paying attention to the tax rate, but also take into account consumers' utilities (i.e. preferences) in order to maximize final demand.

$$U_{companies} = (\sum_i (1-\alpha)(D_{i,1} \cdot P_1 \cdot x_{i,1}) + \sum_i (D_{i,2} \cdot P_2 \cdot x_{i,2})) \to max, \quad (2)$$

where $D_{i,j}$ is demand of i-consumer on product j, P_j is price on product j, $x_{i,k}$ is a decision of i consumer to buy or not to buy j product, $0 \leq \alpha \leq 1$ is the rate of sugar tax established by the government

CONSUMERS

In our model, we assume that each consumer has his own utility function. This means that consumers are heterogeneous in nature and it is worth to take into account their features to set optimal prices on products. In the marketing literature, there are various models describing behavior and individual utilities of the consumers for a product. The vast majority of the models are linear in the product price. We chose consumer utility function suggested in (Holtrop et al., 2017) because of its complexity. This function consists of (1) a constant which includes different psychological, economical, and sociological factors such as brand loyalty, consumer's budget, readiness to pay etc; (2) a term depending on the number of claims and nutritional values which are written on product packages, e.g., labels as "low in fat", "high in fiber" and other which may influence consumer's choice; and (3) deduction of the price related factor:

$$u_{i,j} = \left(\beta_{i,j} + \beta'_{\text{ij}} \cdot p_j\right)^+. \quad (3)$$

Here, $\beta_{i,j}$, β'_{ij} are the coefficients determined by a multinominal choice model[4] and p_j is the price of product j. Notice, the intercept $\beta_{i,j}$ is a constant including factors causing heterogeneity across the consumers.

At the same time, we work under a classic assumption of diminishing marginal utilities of consumers. Therefore, the utility maximization for all consumers is as follows:

$$U_{consumers} = (\sum_{i,j} ln(1 + u_{i,j}) \cdot x_{i,j}) \to max, \quad (4)$$

where $u_{i,j}$ is utility of i consumer $x_{i,j}$ is a decision of i consumer to buy or not to buy j product.

It should be mentioned that all utility functions are taken from classical economic and marketing literature (Bernoulli, 2011; Holtrop et al., 2017). This ensures the universality of the approach and its applicability not only to the category of soft drinks but also to other categories that may

[4] https://eml.berkeley.edu/books/choice2.html

influence consumers' health.

For testing the model, we used consumer panel data provided by Aimark with consumers' demand on soft drinks, places of purchase, and current prices of the tested drinks.

RESULTS

In this work, it was revealed that the presence of the coordinated interests of market players is a necessary condition for launching heathy food products. As a result, we justified the use of multi-level modeling to coordinate interests of players in the value chain. It is also proved that the coordinated interaction of market players can be achieved by the implementation of a well-defined sequence of practices of both state regulation and marketing practices of companies.

In this study, we proposed a model which can help policy makers to increase social welfare in context of proper nutrition taking into account interests of companies and consumers. The proposed method helps to maximize the utility on each level and, as a result, social welfare. The model relies on information on both consumer buying behavior and on company revenues. It should be noted the model uses heterogeneous consumer utility functions. This helps to find more accurate tax rates and prices which may refocus customers' attention on healthier drinks.

The model was tested on real consumer panel data using the example of the Netherlands. Based on these data we provide recommendations regarding a tax policy in the soft drinks' category. Moreover, we draw conclusions on pricing of taxable products and their healthier substitutes, which could be useful for producers and retailers.

IMPLICATIONS

Consumer well-being has become a very hot topic among academics for the last few years (Khan et al., 2016; Ma et al., 2013). Nevertheless, most of existing articles consider consumers separately, ignoring other value chain participants such as government and companies. In contrast, in our model we pay attention to individual consumer well-being as well as to social welfare, and include companies as an often-overlooked actor in tax execution.

The proposed model is based on information about consumer buying behavior and company revenues. As a result, it gives a clear understanding of motives for the behavior of these players, which

helps in the formation of state tax policy. This approach can be used by both companies and government to determine optimal tax rate and prices on drinks, in order to stimulate consumers to buy healthier drinks. The model is applicable not only to the calculation of taxes, but also to other similar regulations (for example, subsidies). Companies, in turn, can use the embedded two-level model of interaction with consumers to determine the optimal prices for manufactured products.

Additionally, we propose a tool that policy makers can use to evaluate different tax schemes, and assists in determining the optimal scheme given company's and consumer's response. This tool not only maximizes consumer welfare, but also that of companies (i.e. revenues). Coordinating the interests of these different parties, we consider a whole value chain and can efficiently maximize the overall social welfare and consumer well-being. This helps in increasing the acceptance of taxation schemes which will really work. Failure to do so has been shown to decrease effectiveness of such schemes (Jou and Techakehakij, 2012). All in all, our approach is comprehensive and it considers interests of every part of society.

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