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Junio, 2013

CRES-UPF Working Paper #201306-75
Edited with the collaboration of

Obra Social "la Caixa"

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Abstract

By means of a systematic literature review this paper aims at shedding more light on the potentialities of unhealthy food taxation in changing eating patterns and life styles and hence combating the obesity epidemic. One remarkable point that emerges when assessing the set of selected papers is the existence of a wide diversity of objectives, methodologies, settings and datasets, policies implemented and results achieved by all these studies, which undoubtedly adds complexity to any attempt to draw a general conclusion on fast food taxation. Most of the examined studies predict a rather modest fiscal impact on unhealthy food and drinks consumption and/or nutrition intake and consequently a poor result on weight loss and obesity, by the interplay of several factors among them the effects of cross-price elasticities.

1. Introduction

Obesity -a complex and multi-factorial chronic disease involving genetic, perinatal and environmental components- is an issue of primary public health concern in many developed countries. Excess weight is associated with an increased incidence of a range of chronic illnesses (including, cardiovascular disease, hypertension, type 2 diabetes mellitus, stroke, cholesterol, stroke, gallbladder disease, biliary calculus, narcolepsy, osteoarthritis, asthma, apnoea, gout and certain cancers) that tend to reduce the quality of life and ultimately result in death (Must et al., 1999). Additionally, a significant number of obese patients tend to suffer mental disorders and social rejection leading to a loss of self-esteem, a particularly sensitive issue in the case of children (Allison et al., 2009; Gariepy et al., 2010). The latest estimates in EU countries indicate that overweight affects between 30-70% and obesity affects 10-30% of adults. According to EASO (European Association for the Study of Obesity) data the prevalence of overweight (including obesity) in schoolchildren vary between 16-22% in the EU25, of which the obesity rate is 4-6%. The rise in child overweight has been particularly strong in most recent years. The worldwide prevalence of the condition nearly doubled between 1990 and 2008.

There exists a wide array of policies to tackle the obesity epidemic. Whereas some are based on non-economic incentives others rest on the economic rationality of consumers and suppliers. Among the former we find interventions seeking to provide better nutritional information to consumers to help them to make more informed decisions (for instance via mass media campaigns to raise awareness on health risks); actions to incentive participation in school nutrition programs intended to reinforce or develop a healthy eating or to change unhealthy food habits within households (e.g., the School Breakfast Program and the National School Lunch Program in the US where meals must meet federal nutritional requirements); the establishment of limits on certain categories of foods and on some form of availability (e.g., banning soda machines and vending machines containing unhealthy snacks at schools) or the regulation of food advertisement targeted to children; the promotion of physical exertion specially among children population at schools, parks or sportive clubs. Regarding the economic based interventions, one could even distinguish between positive monetary policies like financial aids, subsidies or tax exemptions to healthy food and food services production, and negative monetary policies like taxes on unhealthy food/drinks and food services production.

This paper is concerned with the later type of fiscal action. We aim at shedding more light on the potentialities of food taxation in changing eating patterns and hence combating

obesity and overweight. Through a systematic literature review, this paper analyses the objectives, policy designs implemented and main results achieved by a set of studies retrieved with the aim to extract some valid general policy recommendations. Three kinds of targets are disentangled from the reviewed studies: i) unhealthy food; ii) sugar sweetened beverages (SSBs), and; iii) alcoholic drinks.

The paper is structured as follows. Section 2 briefly presents some arguments put in place by the literature to justify the taxation of unhealthy food, while Section 3 describes the procedure used to extract the papers assessed and analyses their main contributions. Section 4 concludes with some policy recommendations.

2. Should we tax unhealthy consumption? A controversy

There is not a general agreement among economists about using fast food taxes to reduce the obesity epidemic. Advocates of taxation point out several arguments which justify government intervention to correct certain market failures. First, technological change in agriculture has lowered the cost of eating calories with a consequent increase in the intake of energy dense food and drinks (Philipson and Posner, 1999). An inverse relationship between fast-food prices and adult BMI for both adults and teenagers has been actually verified (Chou, Grossman and Saffer, 2004; Powell 2009). Similarly, about 40% of the increase of weight over the last decades in the US was found to be due to the expansion in the supply of food via agriculture innovations that lowered food prices (Lakdawalla and Philipson, 2002). Hence, taxing foods and drinks rich in calories should then rise unhealthy food prices relative to prices of healthier food and discourage the intake of the former products.[1] Note that current affordability of fresh fruits and vegetables in the US is extremely lower than sugar and sweets or carbonated drinks (Brownell and Frieden, 2009). Thus, increasing prices of unhealthy food without decreasing the cost of fruits and vegetables would imply a regressive taxing policy.

Second, due to the importance of the obesity-related diseases obese population tend to cause a negative externality on the non-obese in the form of higher utilization of healthcare resources and associated costs (Cawley, 2011). Although some costs are internalised by the obese employees (lower wages or labour market discrimination) other costs are externalised in

[1] However, other researchers attribute to the reduction in time costs of preparing meals (processed food, food packing and transport and kitchen appliances) the key factor explaining the rise in obesity levels (Cutler, Glaeser and Shapiro, 2003).

the form of extra taxes or insurance premiums, since the latter are not based on obesity status.[2] Not to mention other more indirect effects as higher labour absenteeism, work inefficiency, lower productivity affecting firms' profitability.[3] Proponents of the tax argue that would help individuals to make more informed lifestyle decisions contributing to reduce the size of the externality. Notwithstanding, opponents to such measures argue that most costs are, however, internalized since obese individuals tend to die earlier than healthy-weight individuals, claim less pension benefits and receive lower retirement income from the Social Security system (i.e., shorter labour careers and lower wages).[4] Some even argue that there would be little reason to tax all consumers of sodas and fast foods who do not become obese, and whose consumption do not cause any social (external) costs (Posner, 2009).

A third justification for caloric taxes is related to a lack of information. Some argue that the growing prevalence of obesity is partly due to ignorance of consumers, particularly children, about the harmful health consequences of consuming many calories (Brownell and Frieden, 2009). Others allege a problem of lacking self-control in their eating habits or the existence of a time inconsistency of assigning a higher preference for the short-term benefits of consuming more calories (and investing less in exercise) over their long-term costs (Komlos, Smith and Bogin, 2004; Smith, Bogin and Bishai, 2005). Therefore, a tax on unhealthy foods/drinks could contribute to better appreciate the true association between higher food prices and inadequate diets.[5] Against this reasoning some argue that lack of information is highly associated with educational attainment levels and household income. Then, given that unhealthy foods are mostly consumed by the less educated and/or poorest households, taxing unhealthy foods would have an additional negative impact on their disposable income. The introduction of a fat tax can be extremely regressive, as Allais, Bertail and Nichèle (2010) illustrated for sugar-fat products. Another interesting issue here is to know to what type of expenditures these extra

[2] Against this argument, Bhattacharya and Sood (2013) suggest that any subsidy obese people receive via pooled health insurance is offset by wage differentials. Interestingly, they indicate that the wage gap (in detriment of the obese) holds only in jobs that provide health insurance and has a close linked with the difference in expected medical expenditures between obese and thin individuals.

[3] Another external cost caused by obese adults (usually not considered) refers to those children that as a result of a parenting failure (lack of enough parental guidance and care) become more ignorant on the consequences of high calorie intake or have been transmitted unhealthy lifestyles and hence obesity. The lack of an insurance against parents' inappropriate care giving leads children bearing the costs.

[4] Similarly, against this externality argument Becker (2009) writes "Would those who advocate taxes on beverages and other foods, because obese persons make use of publicly funded health services, support a subsidy to smoking if smoking cuts the use of health care and social security benefits? Clearly not, and nor should they".

[5] However, other public actions could be more effective in dealing with the lack of sufficient information. For instance, food providers could be required to publicize the nutritional and caloric content of the foods sold (e.g., the Nutrition Labelling and Education Act of 1990 in the US) or requiring calorie labelling on menus in restaurants. Posner (2009) prefers imposing bans on very aggressive advertising campaigns targeted to children, although this intervention could lead to higher prices if entry to the industry is reduced.

funds are to be allocated given the regressivity of the tax. It would be at least desirable to achieve higher levels of progressivity by the expenditure side in order to (partly) offset the fiscal regressivity introduced by the taxation.

Fourth and, finally, it is commonly accepted that the determinants of any observed outcome can be disentangled into two components: exogenous circumstances to the individual (parental background or social gradient) and those derived from individual efforts. In fact, equity is achieved when outcomes do not depend on the environment but on individual choice. The current debate in the health political arena, thus, is about the priority of individuals based on their healthy lifestyle behaviours which are difficult to be observed or measured. Two additional controversial factors arise from what is naturally expected: (i) intergenerational responsibilities (e.g. smoking parents' children are less responsible than those from non-smoking parents), and; (ii) genetic characteristics condition lifestyle habits. In this sense, Jusot, Tubeuf and Trannoy (2013) evidence for a French sample that the contribution of circumstances and demographics to inequalities in health is around 45%, whereas the contribution of efforts is around 7%. That is, individual effort seems to play a minor role.

The different views maintained by experts regarding the role played by taxation in combating obesity, is also seen with respect to their impact on consumers' behaviours. Fiscal intervention advocates claim that caloric taxes will bring a significant reduction of total calorie intake and therefore a decrease in body weight, while opponents point out a much modest effect on BMI as long as consumers who like sugary products can substitute toward other (non-taxed) sugary products or eat other food which could be even more caloric. Interestingly, Becker (2009) remarks that these substitutions, induced by taxation, could even increase fat and sugar consumption and raise obesity if consumers do not only purchase products on the basis of their sugar or fat content. This means that other aspects (e.g., colour, taste, fashioned products, etc.) highly modifiable by the industry matters in the decisions of consumers. In addition, as was mentioned above, the assumed (positive) impact of the tax on prices is not guaranteed or can be further questioned since this depends on a set of incidence assumptions that cannot be generalised as they come out from both the demand and the supply reactions (relative elasticities).

In contrast to taxing say, saturated fat, less discrepancy among experts seem to exist regarding taxation of the excess of sugar content in some beverages. In addition to the fact that under a nutritional point of view this consumption is worthless, if we accept that the demand of sodas has a low price elasticity, under the 'indemnity purpose', supporters of the efficient

taxation principle should defend such taxes since the generated excess burden will be minimized (Ramsey principle). In addition, firms' profitability would be hardly affected if sales are not excessively altered. However, its implementation is not easy and some opposition from the industry should be expected. A positive aspect not always recognised could be that penalising sugared drinks low cost substitutes are healthier. To avoid this makes for a powerful incentive for the industry to develop low calorie products to offset sales. Even part of the public funds collected by these taxes could be devoted to subsidize this kind of innovations.

It is worthy to stress here some points to bear in mind before reviewing the literature. First, it seems clear that taxes on unhealthy consumption should be judged as a successful policy action if the revenues raised are low, this meaning that they have radically reduced (or even motivated to abandon) consumption. This is clearly in contrast with the view of taxing addictions¸ this being, to raise enough revenues from the present consumers under cost indemnity purposes and to fund prevention programs against potential future consumers. In the first case, the logic of the intervention is to allocate the maximum burden of the tax on those individuals who are sensitive enough to the relative price changes. For most addicted consumers (low or zero price elasticity) the purpose is to make them assume a larger part of the healthcare consequences derived from the consumption. Second, if this is true we need to point-out that the final impact of the calorie food taxation will depend on the available set of substitutive goods, which in this case (compared to addiction goods) is wider and less needed of further control policies. Thirdly, the impact on final consumer prices depends on a set of tax incidence assumptions that cannot be directly extrapolated from other situation experiences, since these effects will ultimately depend on the specific time and place circumstances. They may affect not only of the demand side but also of the supply reaction of the industry and more generally of the entire general re-adjustment of the economy. Fourthly, some even question that the intakes themselves should be taxed. This is due to the fact that more importantly that an unhealthy diet (in-take) behind the obesity epidemic, are the lifestyles (out-takes) associated to such unbalance eating. Actually, some experts point-out the need to distort through pigouvian taxes the production technologies at present at work (e.g., less manual work, less physical effort exertion at work, etc.) favouring an "obesogenic" environment, since this is seen as the main factor contributing to the rapid raise of obesity in the last decades. Hence, interventions should be targeted in combating sedentary behaviours and the current productive model, instead of taxing calorie foods, since these (excessive intake and sedentary life style) are not always equally complementary for all those targeted individuals of the population.

3. Literature Review

The systematic review was performed using the MEDLINE research database (EBSCOHost Research Databases). The criteria for the initial selection of the literature were that the study was published in peer-reviewed journals, covered the last 15 years (between 1st January 1998 and 2013) and in English. We searched for the terms "fat tax" and "beverage tax" included in abstracts. This search returned 50 papers. Another author restricted even further this initial selection (dropping 19 papers) on the basis of content grounds. To this list of papers and by applying an inverse searching procedure we added other studies –subject to the same criteria conditions– via the references included in papers judged of interest by the authors. Finally, a number of 48 articles form the basis of our systematic review.

The first remarkable point that emerges when assessing the set of selected papers analysing the taxation of unhealthy food is the existence of a wide diversity of objectives, methodologies, settings and datasets, policies implemented and results achieved by all these studies, which undoubtedly adds complexity to any attempt to draw a general conclusion on fast food taxation. For instance, an important issue is to decide what type of fast food tax best achieves the desired objectives. Do we need to tax specific unhealthy foods/drinks or alternatively should the policy maker opt for taxing the nutrient content of foods (e.g., fat or salt content)? A tax on calories has been also proposed, although this option may be more difficult to implement. Do we need to introduce an explicit fat tax (e.g., a specific tax on foods whose content of saturated exceeds 2.3g/100g was introduced in Denmark in Oct. 2012 or the taxation of large soda drinks proposal in the state of New York) or apply a VAT extension? Others suggest that taxing all consumers is unfair and propose to tax overconsumption of fat. Another interesting issue is to decide which products are taxed and exempted, given the pressures of the food industry. Indeed, a constant re-evaluation of tax rates is perhaps needed, as the reaction of the industry may be to change the fat content quite frequently.

The analysis of the literature review is presented under three subsections, namely: unhealthy food (3.1); caloric drinks and specifically sugar sweetened beverages (SSBs) (3.2), and alcohol drinks (3.3). We survey in the next sections available evidence, strengths and pitfalls from taxing unhealthy consumption. Our focus address mostly taxes on fats and sugar sweetened drinks, but a section on taxing alcohols is viewed too, despite the fact that their addictive nature, as commented, opens different roads for the analysis.

3.1 Taxation of unhealthy food

To examine whether food taxes are an effective health policy tool to fight obesity and other health diseases, a first group of selected papers is concerned with estimating the likely response of consumers to this fiscal intervention. For instance, Kuchler, Abebayehu and Michael-Harris (2005) estimated the impacts of several ad-valorem taxes on the demand of salty snacks by estimating demand equations and using information from the AC Nielsen HomeScan panel database. They found low price elasticity values implying a very small effect on quantities purchased. Hence, the impacts on dietary quality were rather small and negligible at the lower tax rates. Even larger taxes would hardly affect the overall dietary quality of the average consumer. While ineffective means of altering diet, these taxes could however be used to raise earmarked revenues for funding information programs. Similarly, Chouinard et al. (2007) estimated a system of demand equations for fourteen dairy products (a generalised Almost Ideal Demand System –AIDS– model) by non-linear 3SLS, aimed at analysing the incidence of an ad-valorem tax on the fat content of each food. From the calculated own- and cross- prices elasticities, the authors reported a very small fiscal effect (even with a 10% tax) on quantities and fat consumption. Again, due to the low price elasticity of these goods fat taxes become an effective means of raising revenues, but were extremely regressive as elderly and poor individuals suffered comparatively much greater welfare losses.

Interestingly, the study of Mytton et al (2007) pointed out unintended detrimental consequences on health caused by taxation if cross-price elasticities are not accounted for. By means of data on at-home food consumption taken from the UK National Food Nutritional Survey 2000 and other external sources, concluded that extending the 17.5% VAT rate to the main sources of dietary saturated fat is unlikely to reduce the incidence of CVD (in contrast to Marshall's, 2010, findings), because the reduction in saturated fat was offset by a rise in salt consumption. However, the taxation of a wider group of unhealthy foods could avert more deaths from CVD. Hence, the scope for significantly altering the national diet by use of the VAT seems limited. Only large tax increases could be effective.[6] In the same vein, but under a different setting, Allais, Bertail and Nichèle (2010) estimated a system of demand equations (AIDS model) and simulated the introduction of a fat tax on a set of foods high in calories. Their main conclusion was that a 10% tax on such foods led to small changes in the intake of unhealthy nutrients among French households in the short run (greater effects were devised in

[6] However, the authors recognise some limitations of their study. For instance, no attention is given to the effect of other nutrients on health or the fact that food eaten outside home is not affected by taxation.

the long run); although this policy was judged extremely regressive falling disproportionally on poor consumers. Using i) US NHANES data, ii) existing estimates of price and income elasticities, iii) a wide range of foods and subcategories within groups and iv) allowing substitution by consumers between nutrients (i.e., low fat for high fat; low sugar for high sugar) the study by Miao, Beghin and Jensen (2012) calibrated the impact of taxing calories from added sugars and solid fats via a two-stage modelling strategy (first assume a linear quadratic demand system and second a CES for four subcategories of nutrients). Interestingly, they found that consumers respond toward leaner and lighter choices to abate the taxes. Specifically, a larger estimated reduction on calorie intake from taxing added sugar and oil fat is found once accounting for nutrients substitutions.

Given the adverse regressive distributional consequences of taxing unhealthy foods or nutrients, a number of policy makers and researchers turned the attention to institute subsidies ("thin subsidies") to the healthiest foods. Cash, Sunding and Zilberman (2005) investigated the health effects induced by thin subsidies on retail prices of broad categories of fruits and vegetables. The article found that a 1% decrease in the average price of all fruits and vegetables meant a mean decrease of more than 6,000 cases of coronary heart disease and almost 3000 ischaemic strokes, for a total of 9,689 prevented cases of disease.

Another group of identified studies examined the combination of taxes and subsidies to modify nutrition habits and improve health issues. On one hand, Nnoaham et al (2009) examined the impact of several policies combining taxes and subsidies from survey expenditure data (years 1998-2000) and supplementary datasets within a UK context. They found evidence that taxing saturated fat did not reduce CVD and cancer illnesses and taxing less unhealthy foods even increased the incidence of these diseases. Only the taxation of caloric foods with subsidizing the consumption of fruits and vegetables was found to have a significant effect in combating CVD and cancer deaths. In contrast, Tiffin and Arnoult (2011) simulated the impacts of a tax on saturated fat content jointly with a subsidy on fruit and vegetables using individual-level data from the UK Expenditure and Food Survey. While the tax was unable to set the overconsumption of fat at the recommendable levels, the subsidy policy achieved these goals. Notwithstanding, a negligible impact on diet-related diseases was found to cause this policy intervention. Within this framework of combining fiscal measures, Nordström and Thunström (2011) simulated the incidence of several fully funded tax reforms to raise consumers' fibre intake using a rich Swedish dataset. They estimated a demand system of grain products (a Quasi-Almost Ideal Demand System –QUAIDS- model) under the inevitable "weak separability"

assumption in grain consumption, and used a two-step Heckman sample selection model to account for the zero mass problem (infrequent consumption). Modest results implied by these revenue neutral fiscal policies were reported. Specifically, these interventions failed to increase significantly the consumption of fibre, more importantly, among the households who had a low level of fibre intake before the reform (families with children). These families with children also appeared to be more affected financially (paying higher taxes and facing higher price levels) although they experienced reductions in the intake of added sugar and saturated fat.

3.2 Taxation of Sugar-Sweetened Beverages

Increasing taxation of SSBs is one of the most promising public policies for obesity prevention. Indeed, projections show significant increases in tax revenues and aggregate reductions in SSBs consumptions for the period 2010-2015 using US 2009 regional consumption levels (Andreyeva, Chaloupka and Brownell, 2011). However, these findings are not confirmed by means of individual data. Moreover, although specifically for adolescents, Powell and Chaloupka (2009) showed no statistically significance association between current state level taxes and adolescent weight. In this regard, only a very high excise tax is needed in order to have a significant impact on adolescent weight (Brownell and Frieden, 2009). Sturm (2010) confirmed that small taxes did not affect states soda consumption levels.

We should note that US states sales taxes differ considerably from one state to another (Chriqui et al., 2007). Likewise, differences across countries should be taken into account. Jou and Techakehakij (2012), using data from 19 countries, suggested that SSBs or soft drinks taxation policy would be more effective when obesity prevalence and soft drink consumption levels are high and the baseline tax rate is low. Thus, given that most of literature refers to US, previous evidence should be taken with caution when translating to other economies.

Specifically with regards to price elasticities, Andreyeva, Long and Brownell (2010) carried out a meta-analysis for the period 1937-2007 and estimated -0.79 price elasticity for soft drinks based on 14 studies although the confidence interval ranges from -0.33 to -1.24. However, since 2007 literature on taxing effects on SSBs consumption has consistently improved either in methodological procedures or the availability of individual data (Fletcher, Frisvold and Tefft, 2010; Dharmasena and Capps, 2012; Miao, Beghin and Jensen, 2012). These improvements basically consists in the consideration of repeated cross-section models using very complete datasets (such the Nielsen HomeScan or the combination of US national-level data sources) and the estimation of cross-price elasticities by means of complete demand systems allowing

relationships between alternative beverages (milk, fruit drinks, fruit juices, bottled water, coffee, etc.) such as the LINQUAD demand system.

A word of caution may be told here: so high range of observed results of price elasticity estimation remind us that most of the effects depend on multiple circumstances that make us to be aware of the problems of reliability of taxation policies

In general, smaller reductions of soft drinks consumption and overall tax revenues are expected after increasing taxes on SSBs. Modest significant impacts on consumption are evidenced after rising taxes around 20% although its impact on daily caloric intakes is pretty small. Finkelstein et al. (2010), using the Nielsen HomeScan Panel database, estimated 7.8 kcal/d reductions after increasing taxes on carbonated SSBs in 40%. Finkelstein et al. (2013) revised previous findings for the same database obtaining higher estimates for consumption reduction (24.3 kcal/d) once increasing taxes 20% through the use of a two-part model estimation procedure and correcting for endogeneity problems. Using the same database, Lin et al. (2011) estimated a significantly lower impact of 20% increase tax in sugar-sweetened beverages on children loss weight once dynamics was accounted for.

Interestingly we should note that these small taxation impacts on consumption mainly rely on the presence of substitution effects. Although individuals do not seem to shift to alternative sugary products (Finkelstein et al., 2013) higher taxes on SSBs make individuals increase their consumption of alternative high caloric beverages such as whole milk among children and adolescents (Fletcher, Frisvold and Tefft, 2010), higher caffeine intakes (Dharmasena and Capps, 2012) or to alternative within-group substitution beverages with dissimilar nutritional content - based on low fat vs. high fat and low sugar vs. high sugar (Miao, Beghin and Jensen, 2012).

3.3 Taxation of alcoholic beverages

The literature analysing the effects of taxing alcoholic drinks should be differentiated based on the explored outcomes. On the one hand, several papers tackle mortality rates. On the other hand, the most interesting for our paper's research scope is the estimation of price elasticities to changes in taxing schemes and prices.

Firstly, with regards to death rates, literature mostly used time series methodology (ARIMA) or alternatively quasi-experimental procedures accounting for other states as controls (Maldonado-Molina and Wagenaar, 2010; Delcher, Maldonado-Molina and Wagenaar, 2012; Chikritzhs, Stockwell and Pascal, 2005). Findings basically evidence that death rates decreased

2.2% after 10% tax increases in Florida (Maldonado-Molina and Wagenaar, 2010) and 7% after the 1990 tax increase in the New York State. The exception constitutes Chikritzhs, Stockwell and Pascal (2005) that evidenced a 36.6% decrease of death rates in the Northern Territory in Canada after introducing the Living with Alcohol program in 1992 to reduce alcohol consumption basically among indigenous population and being financed by the federal government until 2002. However, these authors evidenced very dissimilar effects once different subgroups such indigenous vs. non-indigenous were considered which makes doubt of previous findings once heterogeneity is accounted for.

Secondly, literature has also estimated price elasticities. The most comprehensive paper is the meta-analysis carried out by Wagenaar, Salois and Komro (2009) using 112 studies and 1,003 estimates. Authors reported dissimilar price/tax elasticities for different kinds of alcoholic drinks. The highest values were evidenced for spirits (-0.8) and wine (-0.69) whereas other drinks such as beer showed a lower demand elasticity (-0.46). Heavy drinking was not so affected by price increases (-0.28). These findings demonstrate that public policies rising alcohol taxes are effective but have dissimilar effects depending on the kind of alcoholic beverage.

However, two aspects are worthy of mention for a successful fiscal design. On the one hand, we should note that individuals might shift their consumption to alternative non-taxed products. In this sense, Ponicki et al. (1997) studied the effects of altering alcohol price by ethanol content in Sweden in 1992. Although it refers to one country experience and post-tax period data is not so long as the pre-treatment one, these authors showed that consumers shifted away from beverage brands that were more expensive. Thus, consumers' choice is myopic in the sense that the quality of the beverages is not taken into account when shifting their consumption to alternative products. Policy makers should be aware of this issue because the intake of lower quality products might induce, in the long term, riskier health problems and in consequence greater health costs. On the other hand, Byrnes et al. (2012) proposed to simplify the current taxation system in Australia. After examining four scenarios of taxation, these authors defend a volumetric tax, which taxes alcohol equally across all beverage types. Their argument is that this tax scheme is less distortive of consumer preferences and more efficient at reducing alcohol consumption. That is, a common taxation based on the volume of alcohol and irrespective to the beverage would avoid shifts in individual choices of alcohol consumption. Notwithstanding, Byrnes et al. (2010) find out the presence of a heterogeneous response to consumption based on ageing, income groups or risky drinkers.

Then, taxing policies could provoke benefits in the sense of a reduction of alcohol consumption apart from a significant increase in annual taxation revenues but might have a dissimilar effect on population groups. Apart from this, social benefits are expected: lower number of accidents, criminality reduction, lower drugs consumption, etc. In this regard, more recent literature in the European context analyses the effects of taxation on underage binge drinking which constitutes a new health policy issue. Two papers referring to German adolescents are worthy of mention. Note that Germany is one of the countries with a lower taxation on alcoholic drinks and as evidenced by Adams and Effertz (2010), alcoholic beverages became 29.41% cheaper during the period 1970-2009 in that country. Their simulations of levying taxes up to the European average level would reduce underage binge drinking by more than 37%. However, based on observational data, Müller et al. (2010) examined the introduction of an extra tax on alcocops (sweet, ready-mixed soft drinks containing between 5% and 7% alcohol by volume) in Germany in July 2004. This extra tax was also introduced at the same time in several neighbouring countries (France and Switzerland). Müller et al. (2010), using GLM models and multinomial logistic for changes in beverage preference and ESPAD 2003 wave, evidenced that German adolescents substituted alcocops by other alcoholic beverages which are riskier. This result confirms Byrnes et al. (2012) findings that taxes should be increased equally across all beverage types because, otherwise, individuals react shifting their consumption to eventually riskier alcoholic drinks.

4. Discussion

Taxing unhealthy food has become, mainly in the US, one of the most debated public health policies to fight the obesity pandemia. While regional tax revenues have increased significantly, Federal actions targeted to promoting physical activity or healthy food at schools have generated costs. The short-term effectiveness of these programs at primary ages have made them very promising. In contrast, our literature review leads us to conclude that the consumption of unhealthy food (fast food, soda drinks and alcoholic beverages) has not been significantly affected by the introduction (extension) of new (pre-existing) taxing schemes. In general, only high tax rates (around 20%) are required to slightly change individual consumption behaviour. Additionally, these small changes in purchases have also implied insignificant changes in daily energy intakes once researchers have taken into account cross-price elasticities and used procedures that allows for the substitution effect within and between food categories.

In consequence, small changes are also expected in BMI and overweight and obesity prevalence rates.

Some literature has proposed the combination of subsidies (to encourage healthy food) and taxes (to discourage caloric eating) to transform the diet of the average consumer. Among the products to be subsidized fruits and vegetables are the most promising given its lower current affordability and their lower (not saturated) fat concentration compared to other food products. Likewise, children living in disadvantage households are more price sensitive for these kind of products compared with their non-poor and not-at-risk counterparts (Powell and Chaloupka, 2009). However, not only subsidies should be applied but also promotional activities favouring their consumption at initial ages (Cuffe et al., 2012). It has been shown that the treatment of obesity in adult life via the introduction of changes in lifestyles is extremely difficult (Hill, 2009). For this reason, many interventions aimed at modifying food habits and promoting physical activity so as to reduce the prevalence of obesity, have targeted schoolchildren. In any case, either taxes or subsidies are not free of labour and administrative costs and erroneous farm subsidies might increase obesity rates (see Faulkner et al., 2011 for a review). Not to mention the fact that subsidies may be capitalised without producing the expected effect of reducing prices of healthy food.

Given the aim of using tax policies is to change unhealthy behaviours, it should be clear that they should focus more price sensitive consumers, likely to be those low income groups and young people. The effect for them may be reinforced by applying part of the revenues to education and programs for accompanying changes in their life styles. Without this, the regressive redistribution nature of the income impacts may question a general implementation of the policy.

However, the most worrying aspect is that individuals tend to substitute alcoholic beverages by low quality ones and unhealthy food by alternative products with the same nutrients or even riskier ones for their health. Specifically for the case of alcoholic beverages, the latter is especially worrying for those adolescents who participate in binge drinking. The solution provided by literature seems to be the implementation of a volumetric tax that affects equally across all beverage types.

Another issue constitutes the fact that these new taxing schemes are extremely regressive, as obesity is mostly concentrated in the lower income deciles (Costa-Font and Gil, 2009). The latter is linked with the lack of information problem. Low income households and individuals with lower educational levels would react showing myopia in their purchasing

decisions. In this sense, it is recommendable to introduce new taxing schemes but also advertising campaigns basically at schools to reduce unintended substitutions of current products by others with a similar or worst risk for individual health. Note that changes in lifestyle behaviours are more likely to occur at initial ages rather than in adulthood.

Not surprisingly, the industry has become reluctant to the introduction of fat taxes and has even promoted anti-tax campaigns in the case of SSBs taxes. The recent abolition of the world's first tax on saturated fats (imposed in 2012) by the Danish government has also been widely celebrated by farmers, retailers and shoppers for some sided effects.[7] However, if governments are not introducing these new taxes to solve their deficits in public budgets, extra revenues can be returned in the way of tax deductions to the industry to promote R&D in healthier products. This proposal constitutes a Pigouvian tax internalizing the externality and adjusted to the Ramsey rule that minimizes the excess burden with higher tax rates inversely proportional to the demand elasticity. This makes the tax more socially accepted because and being less regressive.

All the reviewed studies seem to have neglected one aspect that can be considered crucial for the understanding of the real impact of fast food taxes, but the literature of smoking has however highlighted. Namely, the likely reaction of the food/drinks industry, some of them under powerful oligopolistic settings, to modify prices or whenever possible the introduction of new varieties in order to accommodate the impact of higher tax rates. These set of responses would clearly work in the direction of attenuating the impact of the taxation policies and avoiding changes in the consumption patterns.

To conclude, the assessed research mostly refers to the US. A general critique for some part of the literature is that some studies are based on elasticity values extracted from other contexts and time periods, which may be at least questionable. General speaking, elasticities which describe consumers' reactions to prices are country and cultural specific. For instance, complements and substitutive goods tend to be diverse across countries: while pizza is eaten with soda in some countries the same pizza is usually consumed with wine in other cultural contexts. This simple difference has obvious consequence s on cross-price elasticities and the final impact of the taxation. In this sense, country specific effects must be accounted for when estimating price elasticities of these kinds of products. Thus, there is room for more country analyses and experiments to investigate individual reactions to changes in prices/taxes.

[7] One study found 48% of Danes doing some cross-border shopping to Germany and/or Sweden to avoid the tax (The Economist, 16/05/2013).

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