

Do sin taxes work?

Rachel Griffith

Institute for Fiscal Studies (IFS)
and
University of Manchester

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Corrective Taxes

- ▶ Corrective taxes have long been seen as a tool to improve social welfare when consumption imposes costs on others
 - ▶ externalities (Pigou, 1920)
 - ▶ taxes on fuel, alcohol, tobacco, gambling are examples
- ▶ More recently have been advocated to reduce consumption that imposes costs on your future self (sin taxes)
 - ▶ **“internalities”**
 - ▶ Gruber and Koszegi, 2004; ODonoghue and Rabin, 2006; Haavio and Kotakorpi, 2011; Allcott, Mullainathan and Taubinsky, 2014, ...
- ▶ Soda taxes are a leading example
 - ▶ for this talk I will focus only on the internalities rationale for soda taxes

Corrective Taxes

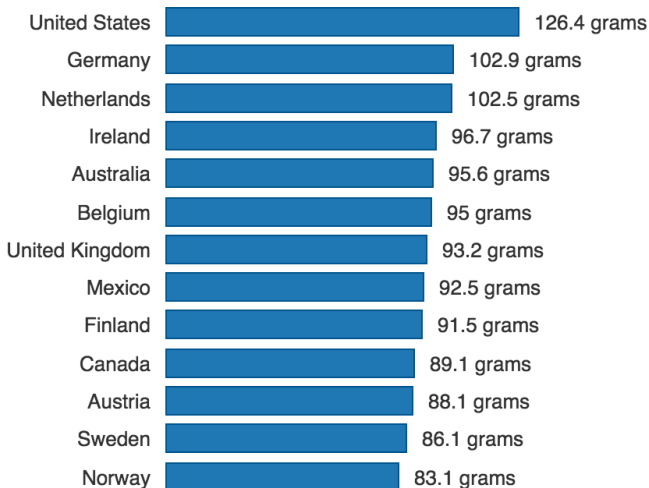
- ▶ There is a sharp divide between
 - ▶ libertarian view
 - ▶ harm accrues to the individuals themselves, so there is no rationale for government intervention
 - ▶ sin taxes are ineffective, regressive and largely aimed at raising revenue
 - ▶ paternalistic view
 - ▶ people make errors (due to cognitive constraints, inattention, ...), with information on when and how we can design policies to help them make better choices (e.g. O'Donoghue and Rabin, 2003, 2006)
 - ▶ *not to be confused with the public health literature* where health risks should be reduced, even where individuals are making optimal choices
- ▶ My interest: empirically evaluating the efficiency and equity implications of recently introduced soda taxes

Soda taxes

- ▶ Increased interest in soda taxes to reduce consumption of sugar
 - ▶ introduced in France in 2012, Mexico in 2013, UK in 2016
 - ▶ four cities in California (Albany, Berkeley, Oakland, and San Francisco)
 - ▶ Boulder, Philadelphia, Cook County in Illinois and the Navajo Nation
- ▶ World Health Organisation (WHO) in 2016 urged countries to tax sugary drinks to reduce sugar consumption, especially in children
 - ▶ considerable evidence that sugar is over consumed, and that this
 - ▶ leads to obesity, type 2 diabetes, heart disease, cancers, etc...
 - ▶ is associated with poor mental health and poor school performance, particularly in children
 - ▶ poor childhood nutrition thought to be an important determinant of later life health, social and economic outcomes and of persistent inequality

Overconsumption of sugar, mean consumption

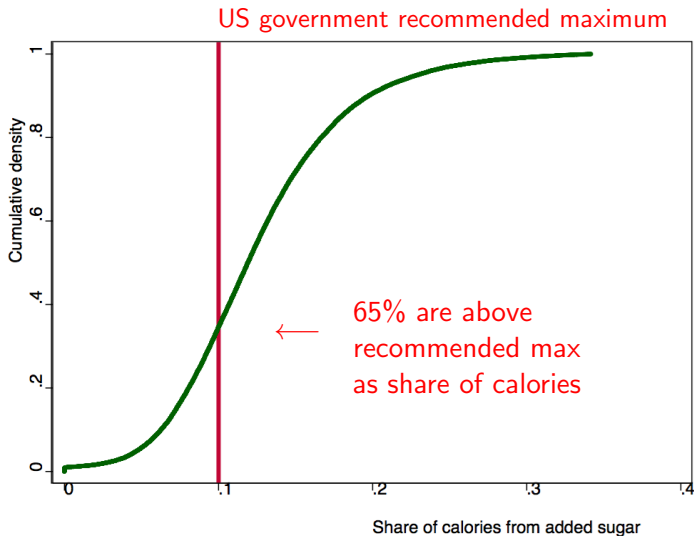
Recommended maximum is **37.5** grams for men and **25** grams for women



Source: Euromonitor

Overconsumption of sugar in the US

Cumulative density, share of calories from added sugar



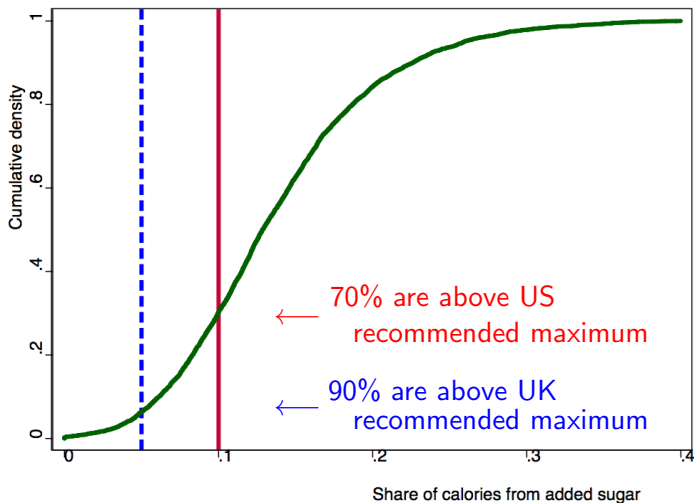
Source: NHANES

Overconsumption of sugar in the UK

Cumulative density, share of calories from added sugar

UK government recommended maximum

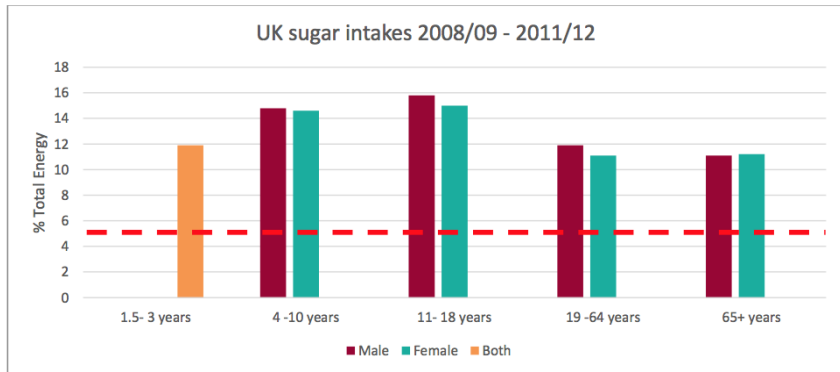
US government recommended maximum



Source: LCFS

Overconsumption of sugar in the UK

Mean by age group, sugar consumption particularly high amongst children



years old:

1.5-3

4-10

11-18

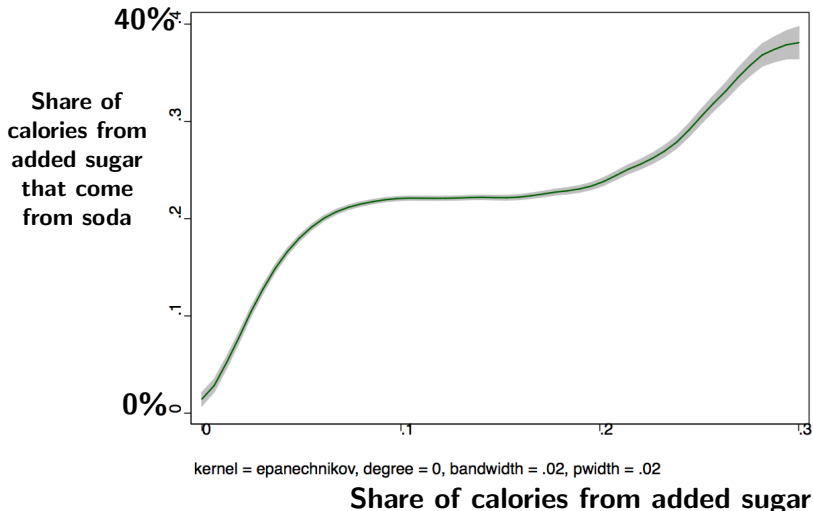
19-64

65+

Source: NDNS

Soda and overconsumption of sugar in the **US**

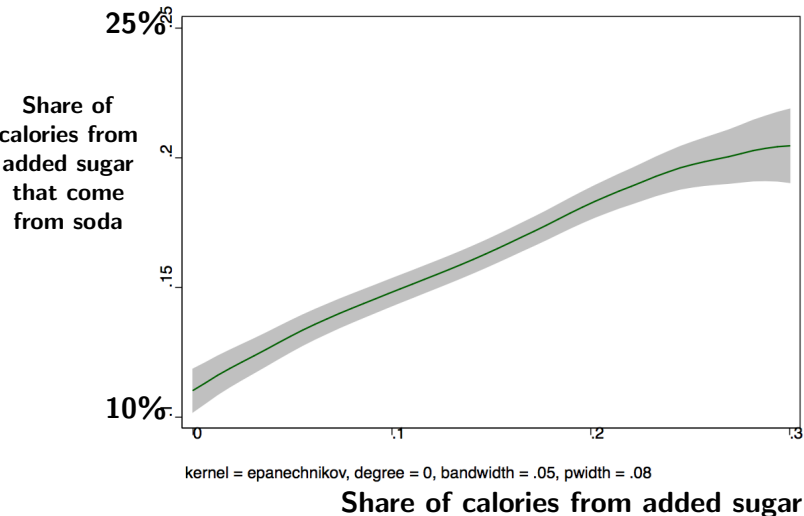
Sugar from soda represents a large share of calories from added sugar



Source: NHANES

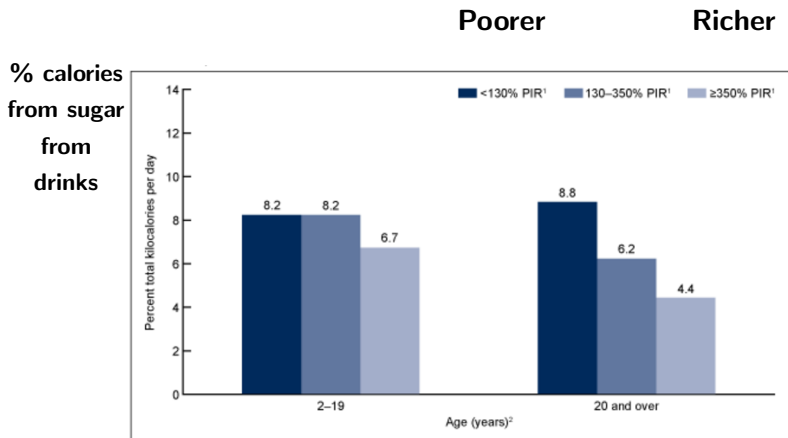
Soda and overconsumption of sugar in the UK

Sugar from soda represents a large share of calories from added sugar



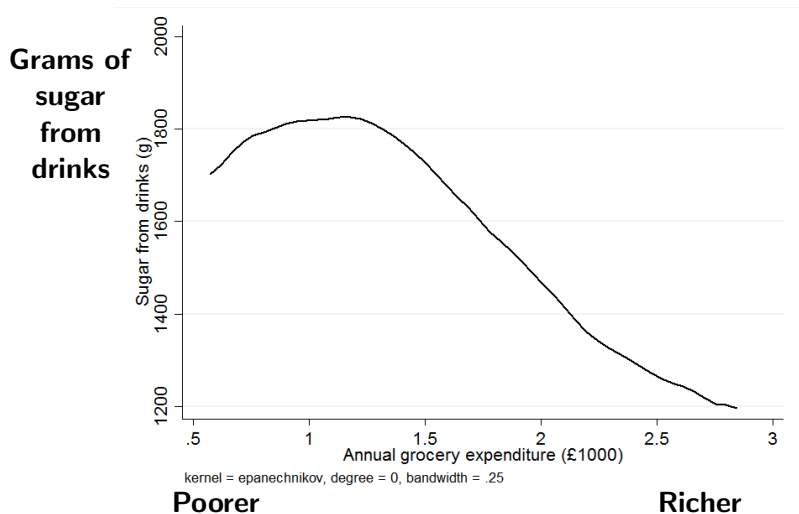
Source: LCFS

Potential for equity concerns US



Source: NHANES

Potential for equity concerns UK



Source: LCFS

Soda taxes

- ▶ Soda taxes look to be (potentially) well motivated
 - ▶ (very) high consumption of sugar
 - ▶ soda represents a substantial share of sugar consumption
 - ▶ soda consumption is higher for those consuming a lot of sugar
 - ▶ soda has no redeeming nutritional characteristics
- ▶ There is potential for equity concerns
 - ▶ consumption of sugar and soda are higher amongst lower income households
- ▶ We want to evaluate efficiency and equity implications of a soda tax
 - ▶ consider the form of an optimal tax
 - ▶ use that to identify the key empirical ingredients
 - ▶ I will describe a number of papers where we are **just starting** to learn about these things

Optimal corrective tax

- ▶ Efficiency

- ▶ with internalities (as with externalities) the tax should change the price by the amount that consumption raises *unaccounted for* costs and so reduce consumption to efficient levels
- ▶ first-best is that we set corrective taxes to achieve the efficient outcome, and use other policies to achieve any redistributive objectives

- ▶ Equity

Optimal corrective tax

- ▶ Denote sugar, the externality generating characteristic, (z), sugar is available in many products indexed by j
 - ▶ q_{ij} : consumer i 's demand for j
 - ▶ z_j : amount of sugar in product j
 - ▶ $Z_i = \sum_j z_j q_{ij}$: consumer i 's derived demand for sugar
 - ▶ $\phi_i(Z_i)$: externality function
 - ▶ will vary across individuals
 - ▶ assume increasing in Z , and probably non-linearly
- ▶ The aggregate externality function

$$\Phi = \sum_i \phi_i(Z_i)$$

Optimal corrective tax

- ▶ The social planner chooses a tax rate, τ^* , on Z to maximise
 - ▶ consumer surplus *plus* tax revenue *minus* internal costs of consumption
 - ▶ the optimal tax rate (Diamond, 1973) is

$$\tau^* = \underbrace{\bar{\phi}'}_{\text{average marginal}} + \underbrace{\frac{\text{cov}(\phi'_i, |Z'_i|)}{|\bar{Z}'|}}_{\text{covariance of marginal internality and slope of demand}}$$

average marginal
internality

covariance of
marginal internality
and
slope of demand

Optimal corrective tax - Efficiency

- ▶ Internalities treated just as externalities
- ▶ Corrective tax are more effective when the covariance of the marginal externality and the slope of demand is more positive
 - ▶ i.e. when consumers with a high externality are more price sensitive
 - ▶ lower income people consume more sugar and are generally more price sensitive, which would lead us to think soda taxes should be effective, but
 - ▶ if externalities driven by habits/addiction, a lack of self-control, inattention or lower cognition then this correlation may be small (or negative), leading policies to be ineffective at addressing the externality

Optimal corrective tax - Equity

- ▶ Internality taxes are rationalised as a way to help people who will later regret their consumption choices
 - ▶ if effective the tax will lead to fewer regrets about unhealthy choices, but they will also have less income
 - ▶ (we think) high internality individuals tend to be lower income
 - ▶ poverty, lack of self-control and low cognition are correlated (and possibly causally related)
 - ▶ tax might serve a self-control function that benefits lower income groups more
 - ▶ but only when they are more price sensitive so respond to the tax
 - ▶ if lower income consumers have inelastic demand (as could be with preference heterogeneity, if inattentive, with habits, ...) they may pay the tax while also bearing most of the internal costs
- ▶ Taxes will also fall on consumers with low internalities

Adding in equity considerations

- ▶ First-best is that we set corrective taxes to achieve efficient outcome, and use other policies to redistribute
 - ▶ however, we might want to consider the redistributive effects of the tax
- ▶ Adding redistributive considerations into the governments objective function we get extra terms that are a function of
 - ▶ $cov(\mu_i, \tau Z_i)$, the covariance of marginal utility of income (μ_i) with taxes (net of rebates) paid (τZ_i)
 - ▶ the slope of demand (responsiveness of consumers to the tax)
 - ▶ and some other stuff

$$\tau^* = \underbrace{\bar{\phi}' + \frac{cov(\phi'_i, |Z'_i|)}{|\bar{Z}'|}}_{\text{corrective term}} - \underbrace{f(cov(\mu_i, \tau Z_i), |Z'_i|, \dots)}_{\text{redistributive term}}$$

Optimal tax - summary

- ▶ The tax is corrective if
 - ▶ the elasticity of demand is high
 - ▶ the covariance of the marginal externality and the slope of demand, $cov(\phi'_i, |Z'_i|)$, is more positive
- ▶ The tax is ineffective if
 - ▶ elasticity of demand is low
 - ▶ the covariance of the marginal externality and the slope of demand, $cov(\phi'_i, |Z'_i|)$, is small (or negative)
- ▶ The tax is regressive if
 - ▶ the covariance of marginal utility of income with taxes paid (net of rebates), $cov(\mu_i, \tau Z_i)$, is high

Evaluating the impact of soda taxes

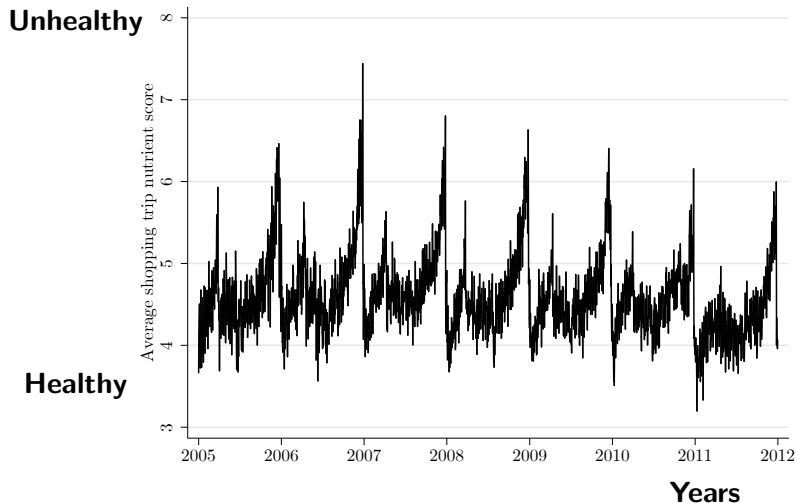
- ▶ To empirically study the impact of a soda tax and how well it addresses the internality problem, we need to know:
 - 1. what is the extent of internalities and how are they distributed**
 - ▶ with internalities it may be more difficult (compared to externalities) to estimate which costs are considered by the individual and which are not
 - 2. the shape of demand**
 - ▶ how responsive consumers are to price changes
 - ▶ the covariance of slope of demand with marginal internality
 - ▶ allowing for potential “behavioural” considerations that drive errors
 - ▶ supply side responses
 - 3. the distributional consequences**
 - ▶ covariance of marginal utility of income with taxes paid

What is the extent of internalities?

- ▶ Do consumers make optimisation errors, e.g. because they
 - ▶ suffer from temptation and a lack of self-control
 - ▶ lack the cognitive ability or will to evaluate information effectively
 - ▶ have habits or suffer from addiction to sugar
- ▶ *(and how does this correlate with demand characteristics)*
- ▶ Cherchye, De Rock, Griffith, O'Connell, Smith and Vermeulen (2017) "A new year, a new you? Temptation and self-control in food purchases"
- ▶ Griffith, O'Connell and Smith (2017) "Temptation and Sugar Consumption"
- ▶ Dubois, Griffith and O'Connell (2017) "The effects of banning advertising in junk food markets" forthcoming in *Review of Economic Studies*
- ▶ Dubois, Griffith and Nevo (2017) "Habit Formation in Sugar Consumption: Evidence from Consumer Migration"

Self-control problems?

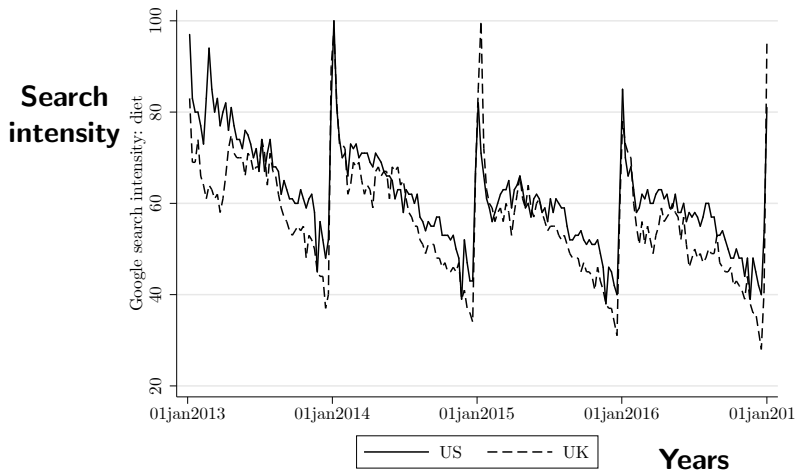
Nutritional quality improves in January and then declines over the year



Cherchye, De Rock, Griffith, O'Connell, Smith and Vermeulen (2017)

Self-control problems?

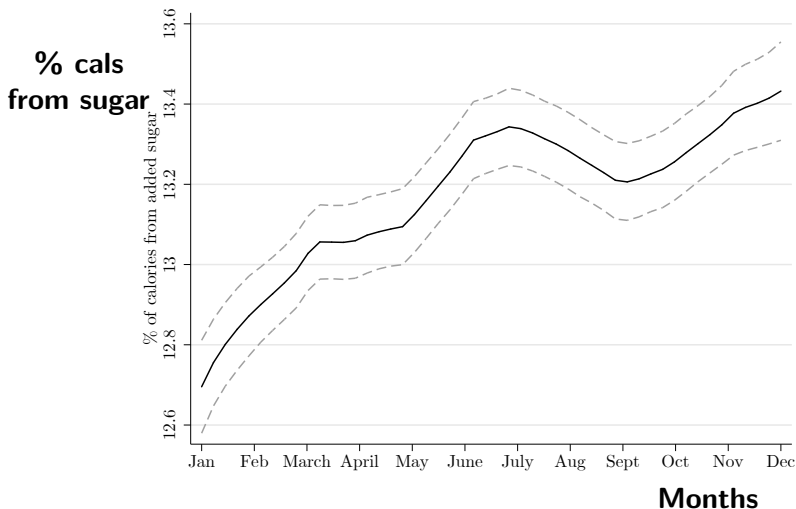
This correlates with google search intensity for “healthy food”



Cherchye, De Rock, Griffith, O'Connell, Smith and Vermeulen (2017)

Self-control problems?

Sugar consumption declines in January and then increases over the year



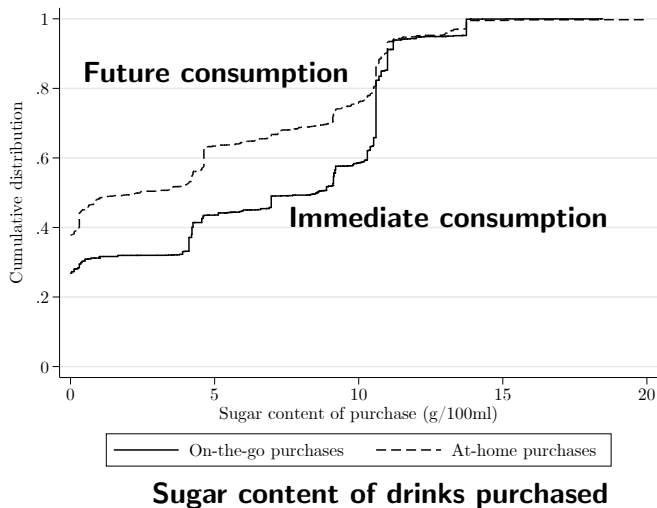
Cherchye, De Rock, Griffith, O'Connell, Smith and Vermeulen (2017)

A two-self model of temptation and self-control

- ▶ We use revealed preference tests to show that this behaviour can be well rationalised by a multi-selves model
 - ▶ most consumers have a “healthy” self and a “tempted” self that bargain with each other
 - ▶ we recover these bargaining weights, variation in these provide us with information on an individual’s (lack of) self-control, and we can related them to other consumer characteristics
 - ▶ Cherchye, De Rock, Griffith, O’Connell, Smith and Vermeulen (2017) “A new year, a new you? Temptation and self-control in food purchases”
- ▶ In related work, we estimate a structural model of demand for soft drinks where we contrast the same consumer making a choice for future consumption, with choices made for immediate consumption (where there is more temptation)
 - ▶ Griffith, O’Connell and Smith (2017) “Temptation and Sugar Consumption”

Self-control problems?

Individual's purchase more sugar when for immediate consumption than for future



Griffith, O'Connell and Smith (2017)

Inattention and advertising

- ▶ Firms might seek to exploit consumers' biases
- ▶ How does advertising affect consumer decision making?
 - ▶ we estimate demand for potato chips, and show that advertising shifts consumers' willingness to pay for healthier potato chips

	Advertising level		
	None	Medium	High
willingness to pay for healthier product, % of mean price	1.6 [1.2, 2.0]	-0.2 [-0.4, 0.2]	-1.5 [-1.8, -1.1]

numbers in [] are confidence intervals

Habits?

- ▶ US consumers have “sugar habits” that die out slowly over time
 - ▶ use information on entire grocery basket
 - ▶ people in high obesity regions consume significantly more sugar than people in low obesity regions
 - ▶ we compare migrants from high to low region to “similar” people

	migrants compared to:	
	high obesity (where born)	low obesity (where live)
calories from sugar	-3.5%	1.8%
calories from sugar in drinks	-7.1%	6.1%

- ▶ estimate demand model, use migration to identify habits from other factors, such as the economic environment
 - ▶ preferences change slowly over time

What is the extent of internalities?

Summary

- ▶ Evidence that (some) consumers
 - ▶ make inconsistent decisions over time
 - ▶ suffer from temptation and self-control
 - ▶ are distracted by advertising
 - ▶ have habits related to sugar
- ▶ this is a start, but we need to know more about
 - ▶ the distribution and form of these “errors” in optimisation
 - ▶ how they correlate with demand characteristics

Evaluating the impact of soda taxes

- ▶ To empirically study the impact of a soda tax and how well it addresses the internality problem, we need to know:
 1. what is the extent of internalities and how are they distributed
 - ▶ with internalities it may be more difficult (compared to externalities) to estimate which costs are considered by the individual and which are not
 2. **the shape of demand**
 - ▶ how responsive consumers are to price changes
 - ▶ the covariance of slope of demand with marginal internality
 - ▶ allowing for potential “behavioural” considerations that drive errors
 - ▶ supply side responses
 3. the distributional consequences
 - ▶ covariance of marginal utility of income with taxes paid

The shape of soda demand

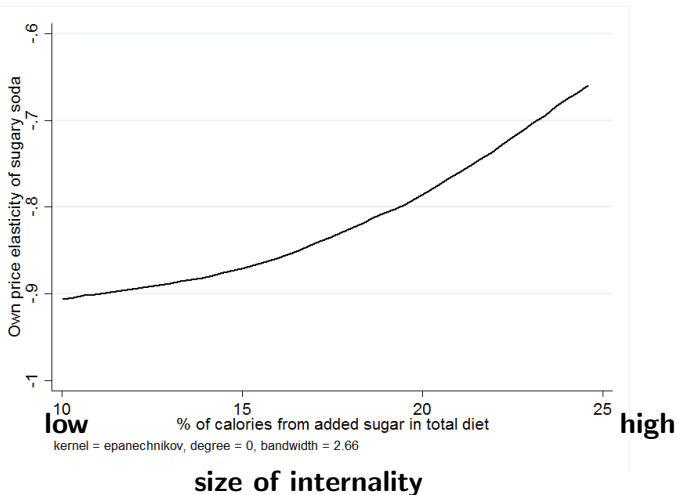
- ▶ Dubois, Griffith and O'Connell (2017) "How well targeted are soda taxes?"
- ▶ drinks are a differentiated product market
- ▶ we use a standard discrete choice random utility model with two differences
 - ▶ estimate demand for drinks for **immediate consumption** ("on-the-go")
 - ▶ exploit longitudinal data to identify **individual specific preference parameters** for price, sugar and soda
 - ▶ we can study marginal and joint distributions of preference parameters, without imposing functional form assumptions as is standard
 - ▶ and most importantly we can relate shape of consumer specific demands to other information about consumers (e.g. marginal internalities)
 - ▶ caveat: we don't measure internalities directly, we correlate with *total* sugar consumption (in grocery basket)
 - ▶ caveat: we don't structurally model "behavioural" biases

The shape of soda demand

- ▶ We estimate demand for soda and other soft drinks
 - ▶ Prices
 - ▶ consumers dislike higher prices, there is considerable heterogeneity, it is not normally distributed
 - ▶ poorer households dislike price more
 - ▶ Sugar
 - ▶ some consumers have (very) strong preferences for sugary soda, other for diet soda, it is not normally distributed
 - ▶ consumers who consume a lot of sugar overall (in their annual shopping basket) have stronger preferences for sugar in soda
 - ▶ Soda
 - ▶ some consumers have (very) strong preferences for soda (over other soft drinks like fruit juice, flavoured milk, water), others don't
- ▶ covariance matrix of preferences over price, soda and sugar is unrestricted (we do assume that individual preferences are stable over time)

High sugar consumers (high internality) are less price sensitive to changes in price of sugary soda

Price
elasticity
sugary
soda



Dubois, Griffith and O'Connell (2017)

Effects of a tax on sugar

- ▶ We simulate the effects of a tax similar in form to those implemented in Berkeley and the UK
 - ▶ increases price by approximately 45p per litre of sugary soda
- ▶ We assume it is fully passed through to consumers

Average effect of tax

Change in sugar following tax

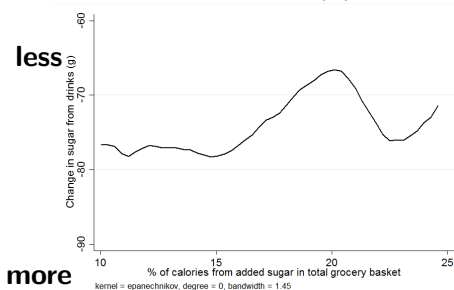
% reduction in sugar from soda	-5.8%
	[-6.15, -5.33]
% reduction in sugar from all drinks	-4.7%
	[-4.96, -4.34]

Welfare effect of tax

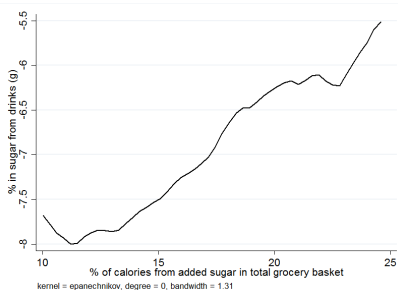
Consumer cost (compensating variation and taxes) (GBP /100g sugar reduction)	4.51
	[4.25, 4.89]
Net consumer cost (with revenue redistributed lump sum) (GBP / 100g sugar reduction)	0.13
	[0.13, 0.14]

Effect of tax not well targeted at high internality consumers

Change in sugar (g)



% change in sugar



low

high

low

high

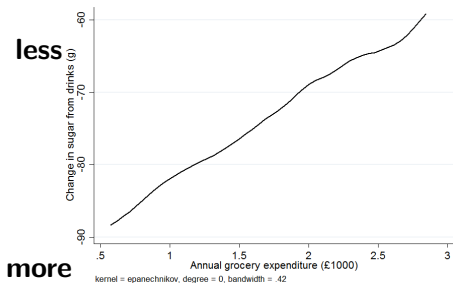
size of internality

Evaluating the impact of soda taxes

- ▶ To understand the impact of a soda tax and how well it addresses the internality problem, we need to know:
 1. what is the extent of internalities and how are they distributed
 2. the shape of demand
 - ▶ how responsive consumers are to price changes
 - ▶ how it correlates with extent of internalities (the covariance of slope of demand with marginal internality)
 - ▶ accounting for potential “behavioural” considerations (cognitive constraints, lack of self-control, incomplete information, ...)
 - ▶ supply side responses
 3. **the distributional consequences and welfare implications**
 - ▶ how the shape of demand varies with income (covariance of marginal utility of income with taxes paid)

The tax hits poorer households more than richer

Change in sugar (g)



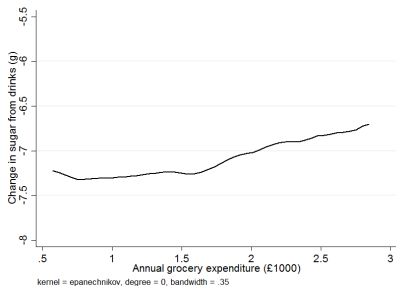
more

less

poorer

richer

% change in sugar

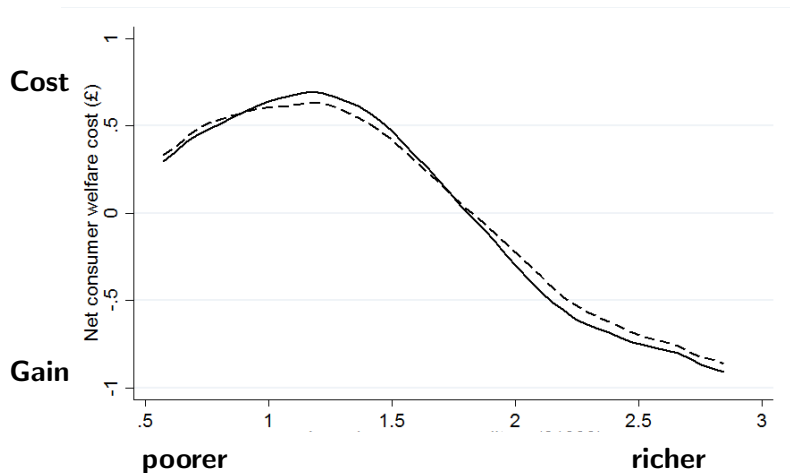


poorer

richer

Overall the tax is regressive

Net consumer cost (compensating variation with revenue redistributed lump sum)



Dubois, Griffith and O'Connell (2017)

“How well targeted are soda taxes?”

Dubois, Griffith and O’Connell (2017) Summary

- ▶ A tax on sugary soda induces switching away from sugary soda
 - ▶ leads to a reduction in sugar consumption at the mean
- ▶ But high sugar consumers (those who we presume have largest internalities) have strong preferences for sugar and they switch away from sugar less in % terms (the same in levels terms) compared to lower added sugar consumers
 - ▶ i.e. the covariance of the marginal externality and the slope of demand is not positive
- ▶ The welfare burden of the tax is concentrated on the poorest consumers
 - ▶ i.e. the covariance of the marginal utility of income and the tax paid (net of lump sum) is high

Can we improve on these taxes?

- ▶ So far we considered only a single tax rate
 - ▶ we know that individual tax rates (set equal to the individual's marginal externality) are optimal, but these are not feasible
- ▶ Griffith, O'Connell and Smith (2016) "Design of Optimal Corrective Taxes in the Alcohol Market"
 - ▶ we show that we can move a considerable way towards the optimal Pigouvian tax (in the alcohol market) by setting product level tax rates (e.g. on beer, wine, spirits....) that exploit correlations in preferences (demand curvature) with the marginal externality
 - ▶ requires that we know more about the marginal externality function (and demand shape) ...
 - ▶ ... work in progress for soda in Griffith, O'Connell and Smith (2017)

Final comments

- ▶ Increased public policy interest in using taxes to address paternalistic concerns about consumers who appear to make “mistakes”
 - ▶ standard economics tools (combined with rich data) mean that we have a lot to add to the debate
 - ▶ results presented today do not imply that we should not use corrective taxes, but that
 - ▶ they can have important redistributive effects
 - ▶ we need to know more about the shape of demand and the nature of externalities in order to apply the insights from optimal tax literature
- ▶ Promising avenues for future research