Economics 244: Macro Modeling
Corrective Taxation: Externalities

José Víctor Ríos Rull

Spring Semester 2018

Material developed by Kate Smith (IFS)

University of Pennsylvania

What are corrective taxes?

Corrective (or "Pigouvian") taxes can be used to correct for the presence of externalities or "internalities" in a market:

- externality: costs imposed on others
- internality: costs imposed on the individual themselves that the government wants to reduce.

Corrective taxes are commonly implemented as "excise taxes":

- e.g. on motor fuels, tobacco, and alcohol
- taxes on these goods comprise 7.2% of total tax receipts (UK)

Taxes should be set based on the marginal social harm associated with consumption.

Introduction to corrective taxation

If there are externalities (and in the absence of government intervention) individuals will tend to consume a socially excessive quantity:

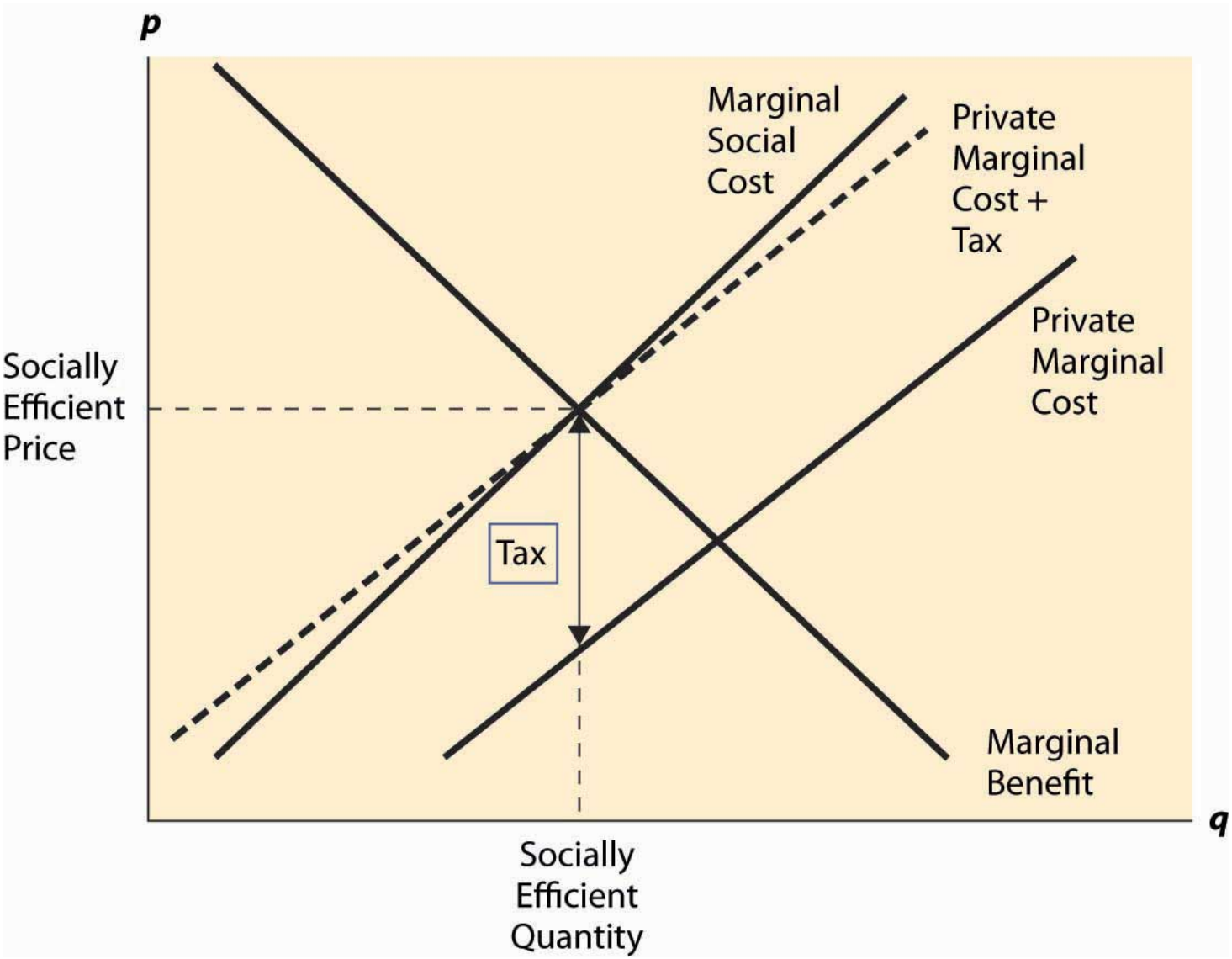
- they will equate their perceived marginal benefit from consumption to the perceived marginal cost (which includes the price)

The case for taxation rests on discouraging socially harmful consumption by aligning the perceived private marginal costs with its actual social costs.

A corrective tax raises the price by the amount of the marginal externality.

- which leads consumers to take account of the social cost associated with their behaviour.

Corrective tax = marginal externality



Institute for Fiscal Studies

Simple model

Consider a social planner who maximises the sum of consumer surplus, tax revenue minus the externality cost:

$$\max W(\tau) = \underbrace{\left[\frac{V(\tau)}{\alpha}\right]}_{\text{consumer surplus}} + \underbrace{R(\tau)}_{\text{tax revenue}} - \underbrace{\phi(Q(\tau))}_{\text{external costs}}$$

- τ is the tax policy
- α: marginal utility of income
- $V(\tau)$: indirect utility from consumption
- $Q(\tau)$: quantity consumed of externality generating good
- $\phi(Q(\tau))$: externality generated

What is the optimal τ in this case?

Pigouvian taxes

Differentiating $W(t)$ with respect to τ and additional manipulations (do not worry about them) yields the Pigouvian tax result:

$$\tau^* = \phi'[Q(\tau^*)]$$

i.e. the optimal tax equals the marginal externality of consumption at that tax rate.

This looks very simple, BUT, in reality there are complicating factors:

1. variation across consumers
2. measuring the externality
3. restricted instruments available to government

Three principles of corrective taxation

1. Tax should target the externality generating behaviour as directly as possible

2. Governments should not hesitate to set corrective taxes above the revenue maximising rate if the targeted activity is particularly harmful.

3. The regressivity of a corrective tax is not a sufficiently good reason for not implementing it. (Gambling, Gas, Alcohol)

An example: The externalities of alcohol consumption

Significant health costs:

- 5.9% global deaths, and 5.1% of the global burden of disease and injury is attributable to alcohol (WHO, 2014)
- Roughly 70% of liver cirrhosis is attributable to alcohol
- Linked to violence and crime:
  - Almost half of all violent crime is alcohol related
  - Around 1/3 domestic violence occurs when the perpetrator is under the influence of alcohol
  - The alcohol attributable fraction of road traffic deaths is 16.6% for men and 6.7% for women

Variation in the marginal externality

- There is a large amount of evidence that suggests that externalities are convex in alcohol consumption
  - i.e. the more you drink the greater the external cost associated with one more drink
- Threshold effect with some diseases: at low levels of alcohol consumption the risk is not elevated, but this risk increases sharply above a certain point.
- Higher levels of alcohol consumption create an exponential risk of accidents:
  - Odds of injury from 8 pints almost 18 times greater than the odds of injury from 1 pint

What is the optimal ethanol tax in this case?

- Recall that the optimal Pigouvian tax, that achieves the first best, is to set the tax equal to the marginal externality:

$$\tau^* = \phi'[Q(t)]$$

But if the marginal externality varies across consumers (indexed i) and we have to set a single tax rate for all consumers, we can no longer achieve the first best:

- some consumers will face a tax rate thats too high, and some too low Diamond (1973) showed that the second best ethanol tax in this case is to set the tax equal to a weighted average of the marginal externalities:

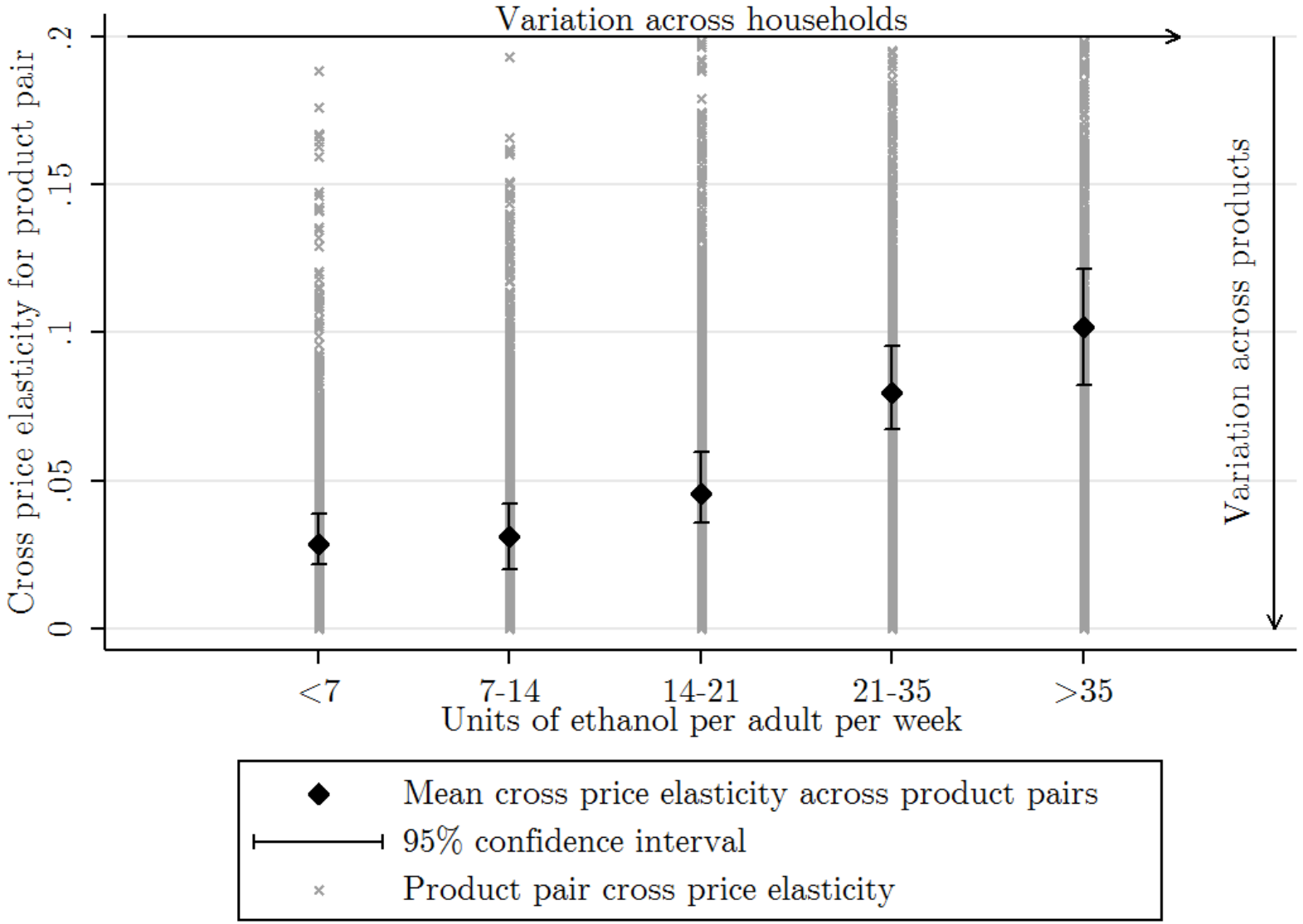
$$\tau^* = \sum_i \phi_i'[Q(\tau^*)]\ w_i$$

- But can we improve upon this?

Differentiating tax rates across products

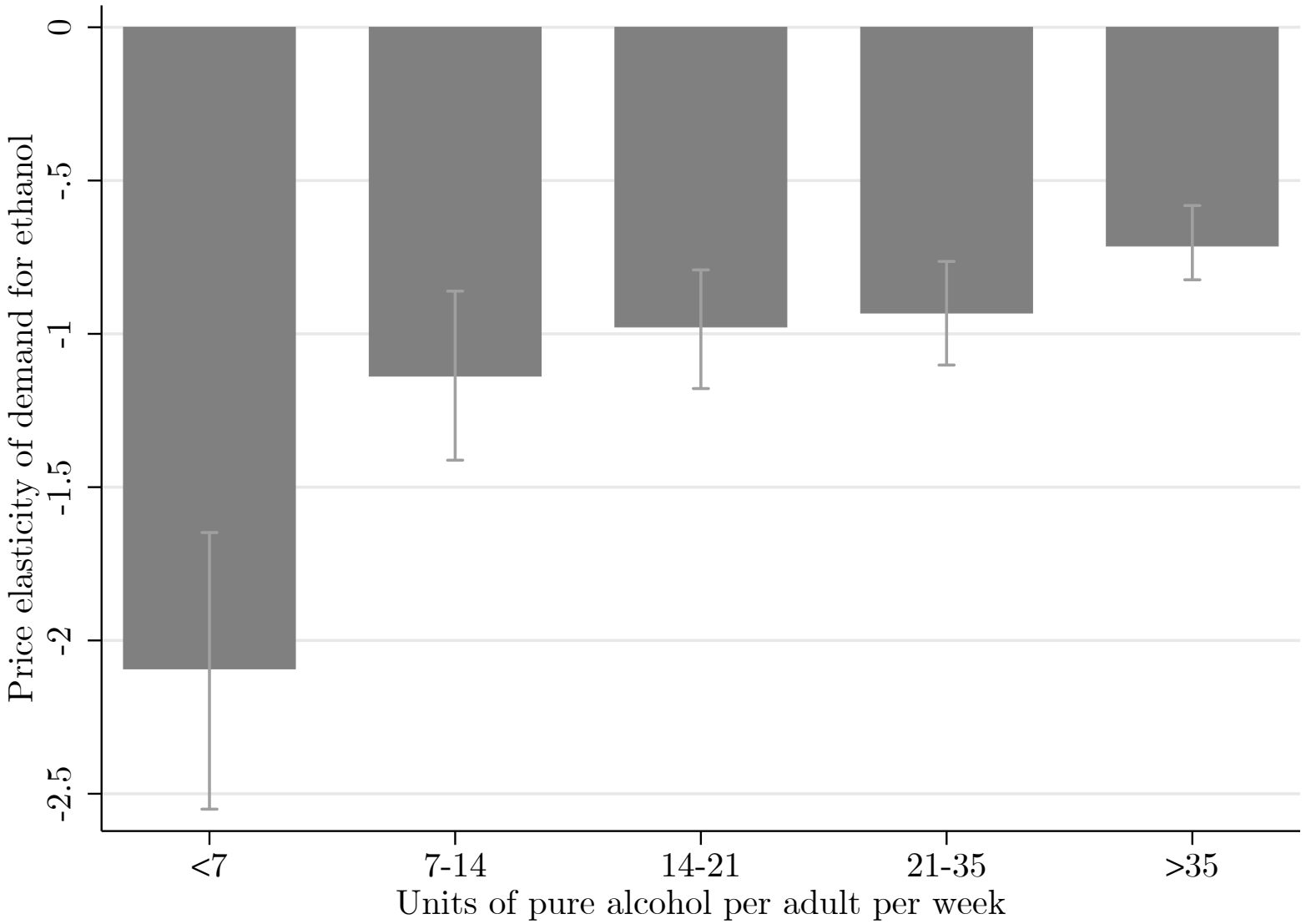
- Although ethanol (pure alcohol) consumption generates the externality, ethanol content is only one product characteristic that consumers value:
  - consumers have preferences over whether a product is beer, or a spirit, and if beer, whether it is lager or stout
  - these give rise to demands for distinct alcohol products
- Correlation between ethanol demand and demand for distinct alcohol products provides the opportunity to design feasible corrective taxes that can improve on the Diamond prescription:
  - higher tax rates on products preferred by high marginal externality individuals
  - if high marginal externality individuals have high cross price effects, this acts to lower optimal tax rates

Cross price elasticities and marginal externalities



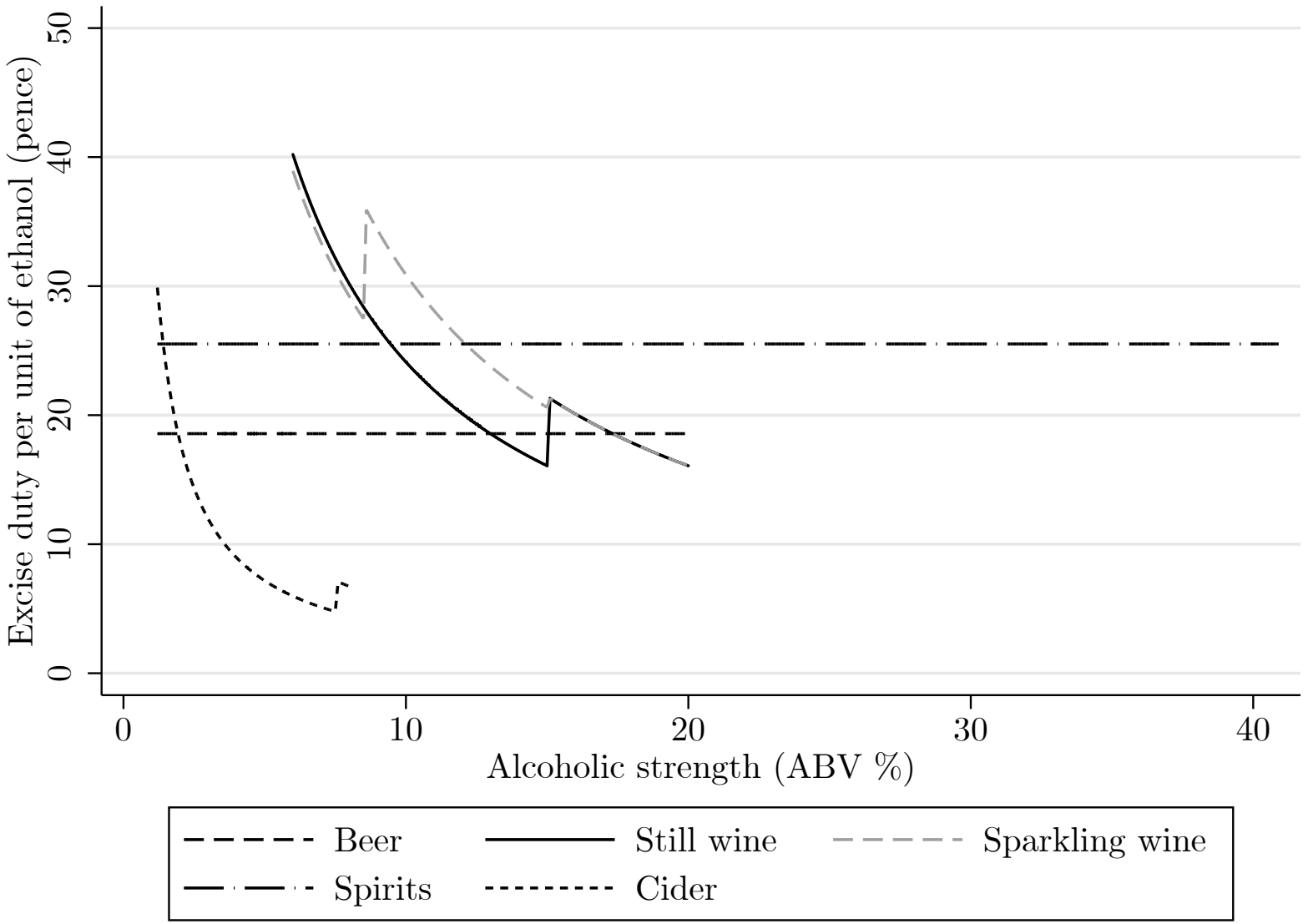
Institute for Fiscal Studies

Price elasticity of demand for ethanol



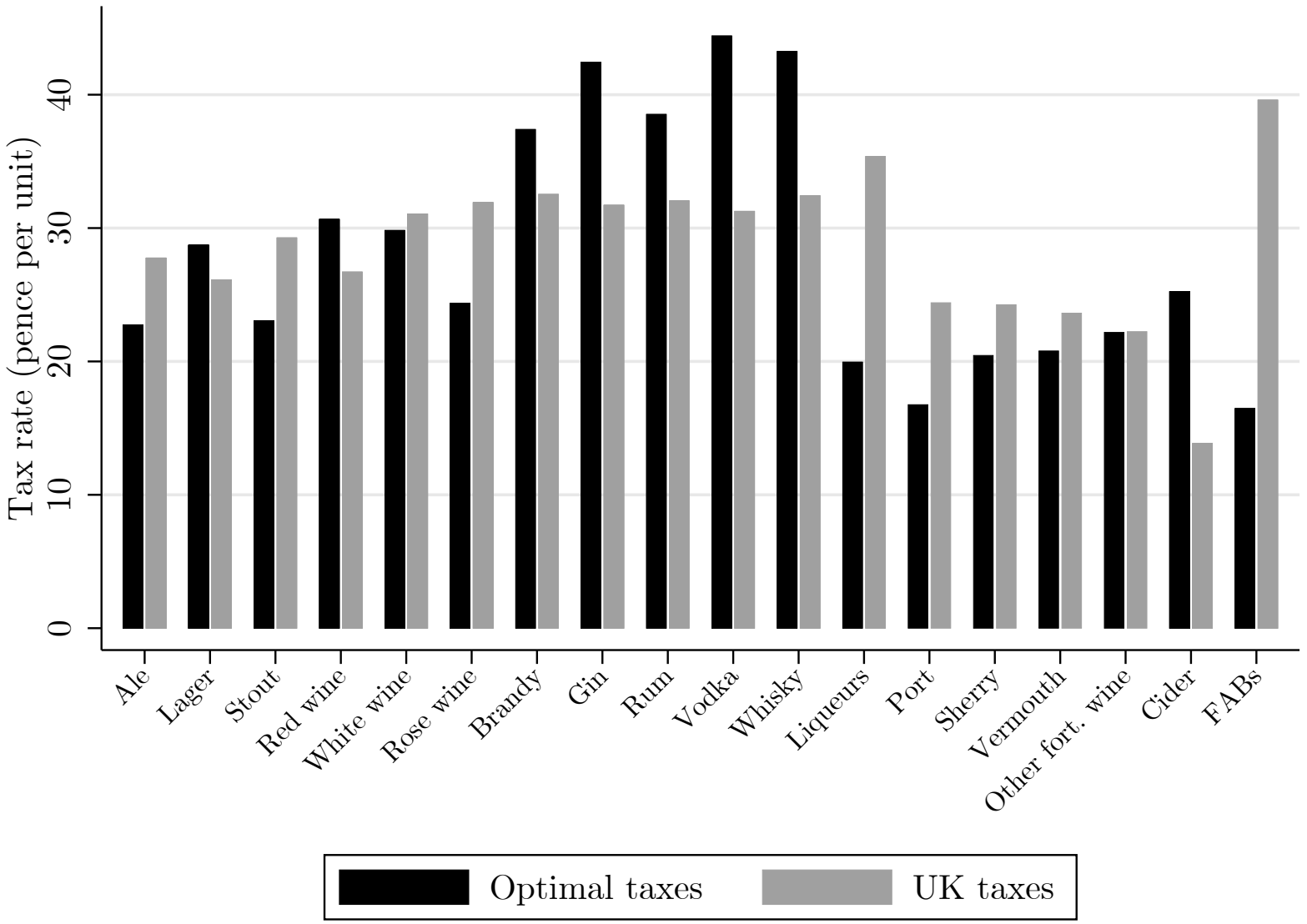
Institute for Fiscal Studies

Current UK alcohol tax system



Institute for Fiscal Studies

Optimal alcohol taxes



Institute for Fiscal Studies

The welfare impact of reforming alcohol taxation

£billion per year	(1) External cost	(2) Tax revenue	(3) Change in consumer surplus	(3) + (4) − (2) Change in consumer welfare
UK taxes	7.25	7.16	–	–
Ethanol tax	-2.00	0.31	-1.85	0.46
% difference	*-27.6*	*4.3*	–	–
Type taxes	-2.15	-0.48	-0.63	1.05
% difference	*-29.7*	*-6.7*	–	–
Consumer specific taxes	-1.38	0.57	0.19	2.14
% difference	*-19.0*	*8.0*	–	–

Institute for Fiscal Studies

Conclusion

- Corrective taxes are effective instruments for correcting for the presence of externalities or internalities in a market.
- Implementing them involves overcoming complicating factors:
  - variation in the marginal externality of consumption across individuals
  - often poor measurement of the external costs
  - legislative barriers to designing the taxes that would be optimal
- But we can use economic theory and empirical analysis to tackle these issues and help guide better corrective tax design.

Another Example

The case for Taxing Sugar

A tax on sugar?

In the March 2016 Budget, the government introduced a tax on sugar-sweetened soft drinks.

1. What is the economic justification for a sugar tax?

2. Is the proposed tax structure sensible?

Institute for Fiscal Studies

Rationale for policies to curb sugar consumption

Health risks:

- increases risk of consuming too many calories, hence obesity
- obesity increases risk of heart disease, type 2 diabetes, strokes
- linked to tooth decay in children

Many of the health costs are borne by the individual, but may also generate external costs borne by society (e.g. public health costs).

Also likely that the full costs of sugar consumption are not taken into account by the individual at the point of consumption.

- especially true for children
- evidence of self-control problems

Institute for Fiscal Studies

Taxing sugar

In order to correct for these excess costs, we need to set the tax equal to the marginal externality or internality.

But the marginal externality (or internality) is likely to vary across people and consumption occasions:

- compare an obese person and a competitive athlete eating the same chocolate bar

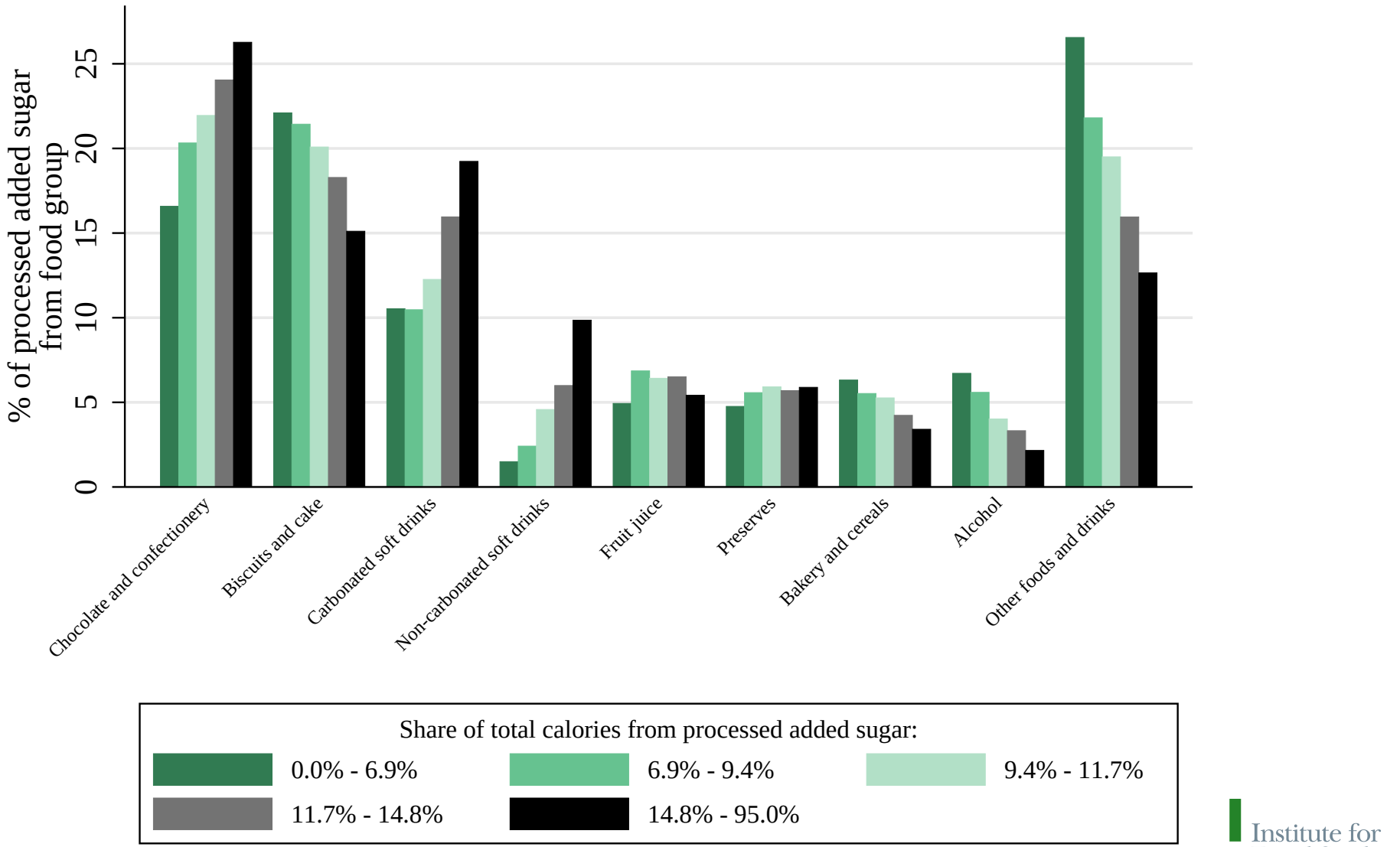
This means that there is a trade-off between reducing the consumption of people who consume more than is ideal and raising the prices faced by individuals whose behaviour does not generate external costs:

- suggests that we should target products disproportionately bought by those about whom we're particularly concerned

Institute for Fiscal Studies

Sources of dietary sugar

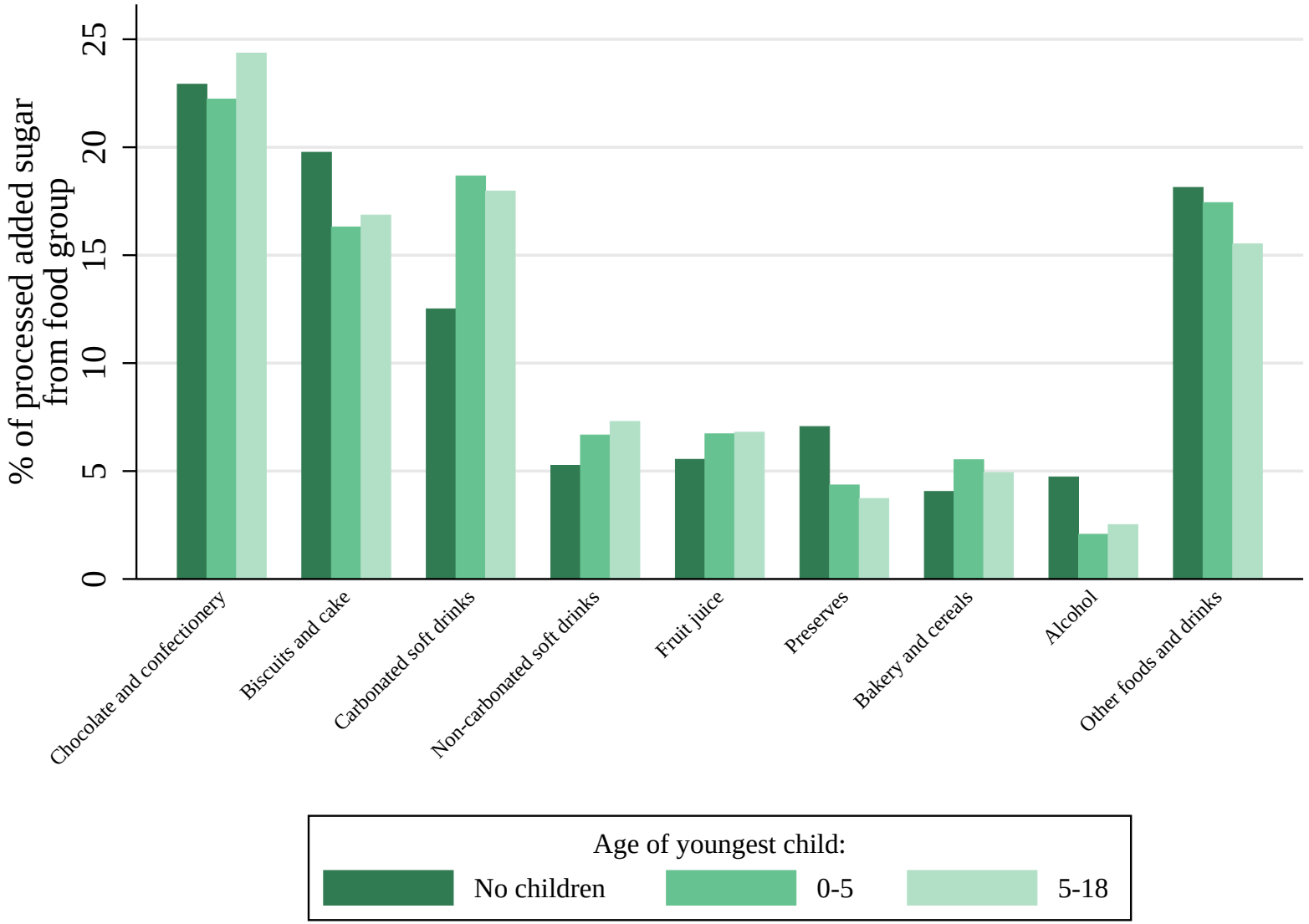
By total added sugar purchases



Institute for Fiscal Studies

Sources of dietary sugar

By age of youngest child



Institute for Fiscal Studies

Taxing sugary soft drinks

Households who consume too much sugar, and households with children, get a disproportionate amount of sugar from soft drinks

- suggests that a soft drinks tax might be reasonably well targeted

But how will consumers respond to the price changes induced by a tax?

- if they switch to chocolate or confectionery then this could offset the reduction in sugar from soft drinks

Institute for Fiscal Studies

Illustrative example

	Scenario: (1)	(2)	(3)	(4)
Taste for sugar				
For households that buy:				
high amount of added sugar	Weak	Moderate	Strong	Strong
low amount of added sugar	Weak	Moderate	Strong	Moderate
% change in total sugar				
For households that buy:				
high amount of added sugar	-3.0%	-2.4%	-1.6%	-1.6%
low amount of added sugar	-3.0%	-2.4%	-1.6%	-2.4%
Average	-3.0%	-2.4%	-1.6%	-2.1%

Notes: We assume that: a tax on sugary drinks (carbonated, non-carbonated and fruit juice) would lead to a price increase of 15%, the own-price elasticity of sugary drinks is -1.0, the cross price elasticities of chocolate and confectionery with respect to the change in the price of sugary drinks is 0 in scenario (1), 0.2 in scenario (2), 0.5 in scenario (3) and 0.5 for high added sugar households and 0.2 for low added sugar households in scenario (4). We consider households that purchase less/more than 15% of their calories from added sugar as households that buy a high/low amount of sugar.

Institute for Fiscal Studies

The 'Soft Drinks Levy'

Tax paid by producers and importers of soft drinks that contain added sugar implemented from April 2018 onwards

- excludes pure fruit juices and milk-based drinks

The tax will operate with a specific revenue target of £500 million for the second year of implementation (2019-20).

The OBR estimates that this implies levy rates of:

- main rate charge: 18p/litre for drinks with 5-8g of sugar per 100ml
- higher rate charge: 24p/litre for drinks with >8g sugar per 100ml

The tax is levied per litre of product, which means that tax per gram of sugar is lower for sugar products.

Institute for Fiscal Studies

Incentives for reformulation

The declared intention of the levy is to encourage manufacturers to reformulate their products.

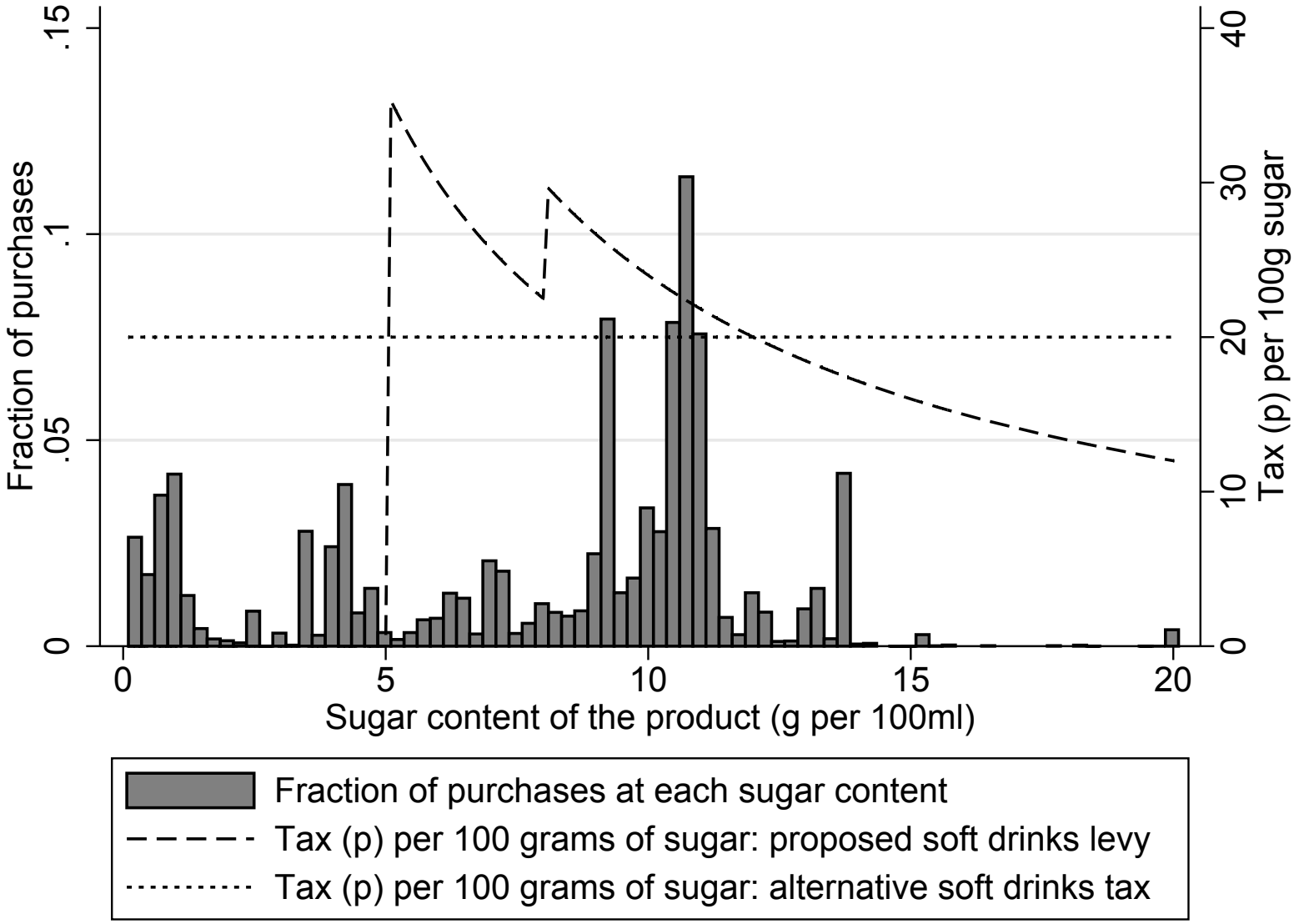
The proposed structure will only set limited incentives to reformulate:

- strong incentives to reformulate if the product is just above the 5g or 8g threshold
- for products further above the threshold, there are much weaker incentives for reformulation

If the tax were levied per gram of sugar, then there would be clearer incentives for all manufacturers to lower the sugar contents of their products.

Institute for Fiscal Studies

The design of the proposed 'Soft Drinks Levy'



Institute for Fiscal Studies

Other anomalies of the proposed design

Someone could pay less tax and consume more sugar by choosing different products:

- 3l Coca Cola: 318 grams of sugar, 72p of tax
- 2l Sainsbury's Orange Energy Drink: 318 grams of sugar, 48p of tax

Institute for Fiscal Studies