Economics 4230: Macro Modeling
Corrective Taxation: Externalities

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- "Non-pecuniary" vs. "Pecuniary" definition. Depends fundamentally on markets that are in place.
- We are only concerned about the "Non-pecuniary" externalities. The other ones are not really externalities.

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- Connection with public goods. Public goods are goods that have large-scale productive externalities.

Key questions about externalities

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2. **Empirical:** How to measure the size of externalities?

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- Social welfare: $W = u(X) + Z - c(X) - h\ B(X)$ (note how welfare takes into account all cars)

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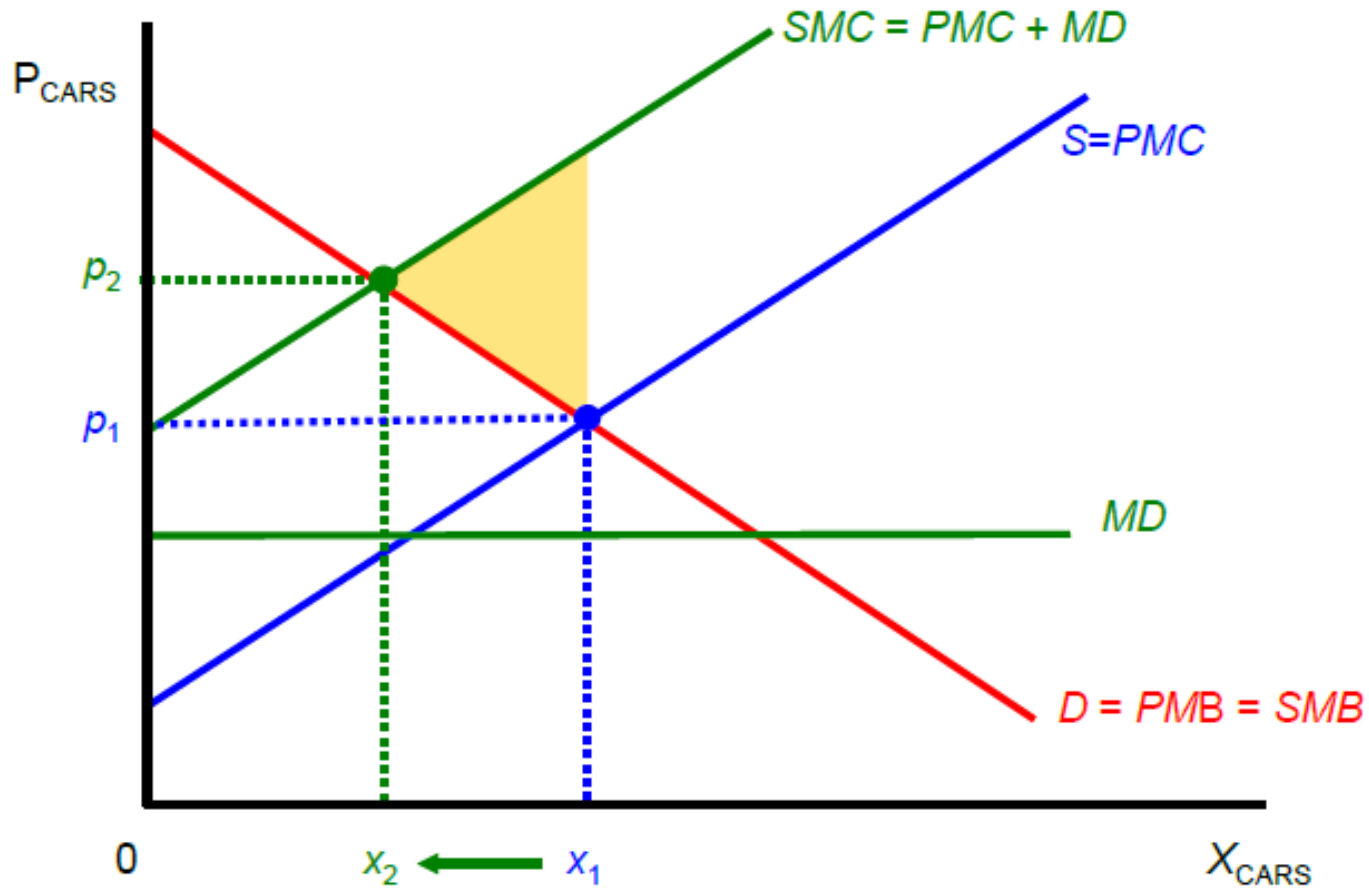
  - Social Marginal cost of production:

$$c'(X) + h > c'(X)$$

2. Correcting Externalities

- Why is there inefficiency? deadweight loss triangle (Gruber figure 1)

Figure 1 **Negative Production Externalities: Pollution**



Correcting Externalities: Math Argument

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  - Market outcome X^M such that

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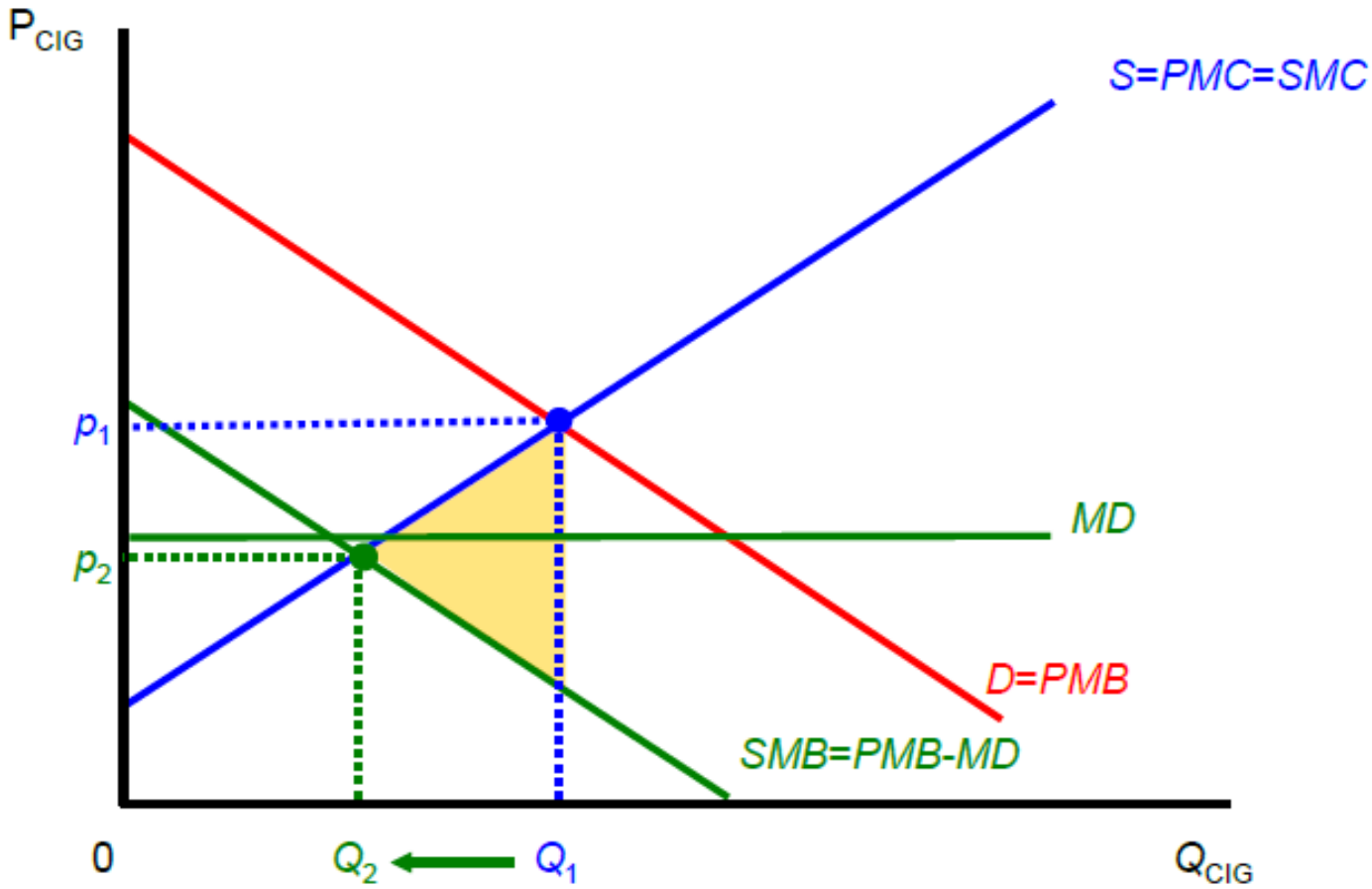
- DWL and Consumption externalities(Gruber figure 2)

Figure 2 **Negative Consumption Externalities: Cigarettes**



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- Zero pollution is not (necessarily) desirable.
- Need to know the shapes of MB, MPC, MD to implement X^*.
- Measurement of marginal damage MD is especially problematic because you cannot use revealed preference (no market that is why there is an externality).

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4. Permits (cap-and-trade).

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- General point: Creating a market for buying the right to pollute would lead to the Pareto efficient outcome.

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  - Assignment of property rights affects distribution but not efficiency $\rightarrow$ all that matters is that we need to create markets.

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3. There is a residual monopoly problem. **All** the owners of property rights have to be bought off. Incentive to hold off and be last to command a huge prize that extracts all the rents.

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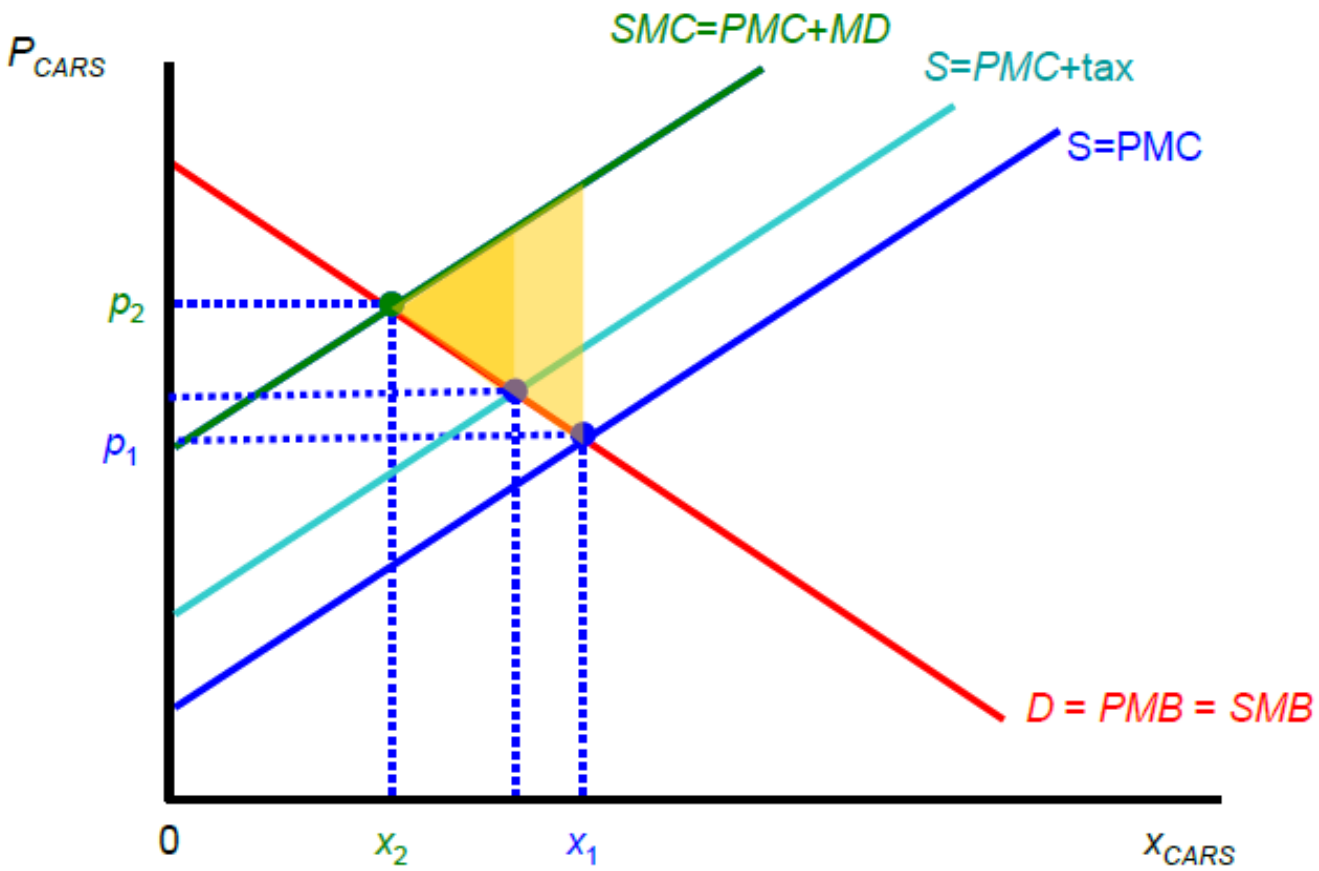
- General principle of optimal taxation in this context: set tax equal to wedge between marginal social cost of production and marginal private cost to restore production efficiency (i.e. set tax equal to marginal damage).

2. Correcting Externalities: Remedies for Externalities

2. Emission taxes (Pigouvian corrective taxation): Optimal pigouvian tax sets $t = MD(Q^*)$

Figure 3 Pigouvian Tax



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- When things are new (i.e. sugar, gas) how to compensate the losing groups?
- There is a lot of ideology and stigmatization (e.g. books good, cigarettes bad).

3 Regulation: Command and Control

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- But in general it does not do the job. How can the government command how much water or electricity people use?

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     - Inefficient allocation when there is heterogeneity in costs of pollution abatement across firms

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- Note that price mechanism (Pigouvian tax) also has these desirable properties with heterogeneity and dynamics.

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- Depends on the relative steepness of those curves

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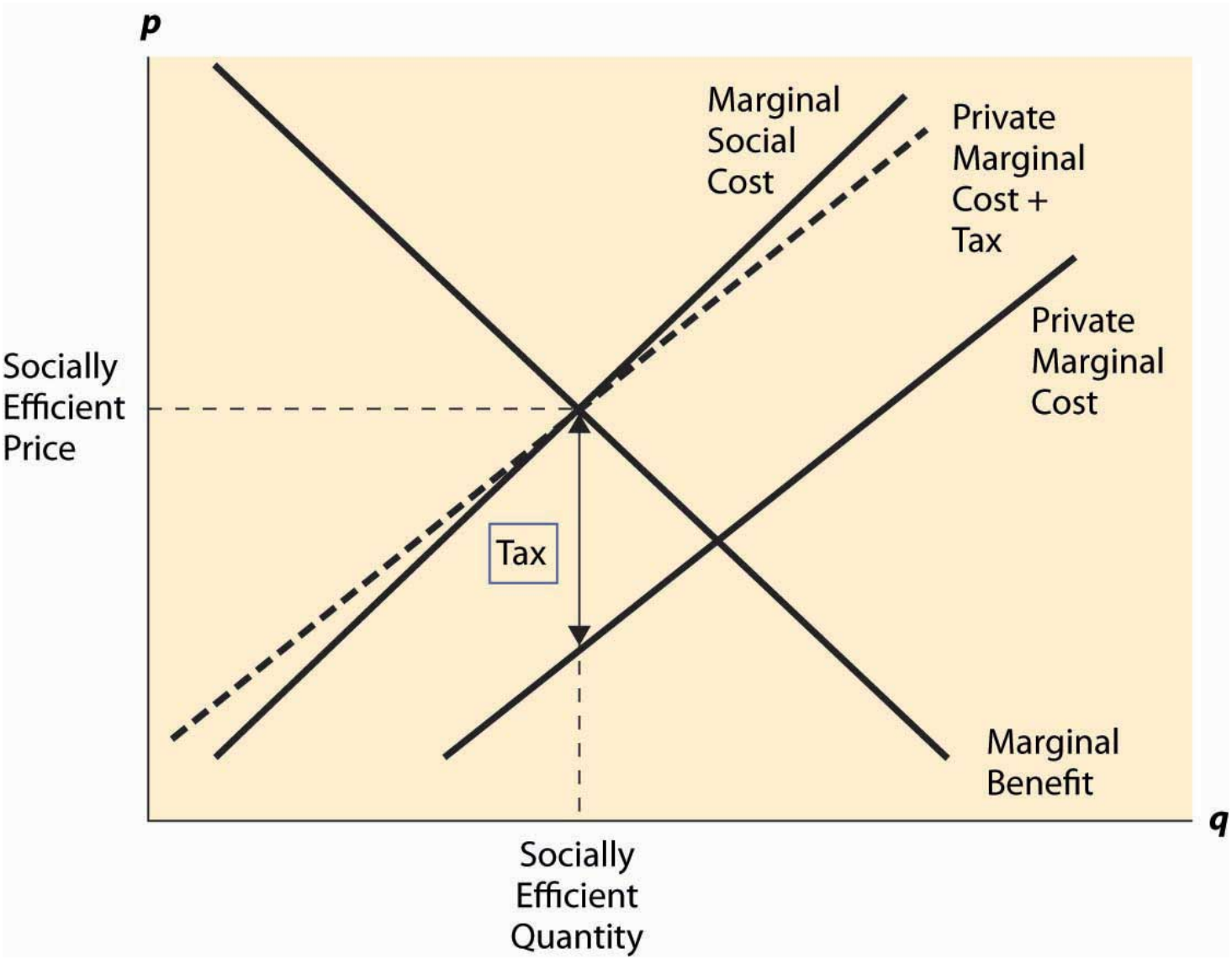
- Taxes should be set based on the marginal social harm associated with consumption.

Corrective tax = marginal externality



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A more formal look into Pigouvian Taxation: A Simple model

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

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What is the optimal τ in this case?

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3. restricted instruments available to government

Three principles of corrective taxation

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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:

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    - Around 1/3 domestic violence occurs when the perpetrator is under the influence of alcohol
    - About 30% of all traffic crash fatalities in the United States involve drunk drivers (with BACs of .08 g/dL or higher). In 2020 11,654 people were killed in these crashes, a 14% increase from 2019. Average over the 10-year period from 2011-2020, is about 10,500. (NHTSA)

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- 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:

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

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 that is 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:

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

- 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

- 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:

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- A drawback of a minimum unit price is that it leads to a fall in tax revenue and an increase in revenue going to the alcohol industry.
- But a simple reform to alcohol duties –taxing all alcohol in proportion to its alcohol content, with a higher rate on strong spirits – is almost as well targeted at the purchases of heavy drinkers and leads to a small increase in tax revenue.

Key findings in Scotland

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6. Even better if combination of both.

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  - 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

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- Read this summary.

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?

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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

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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

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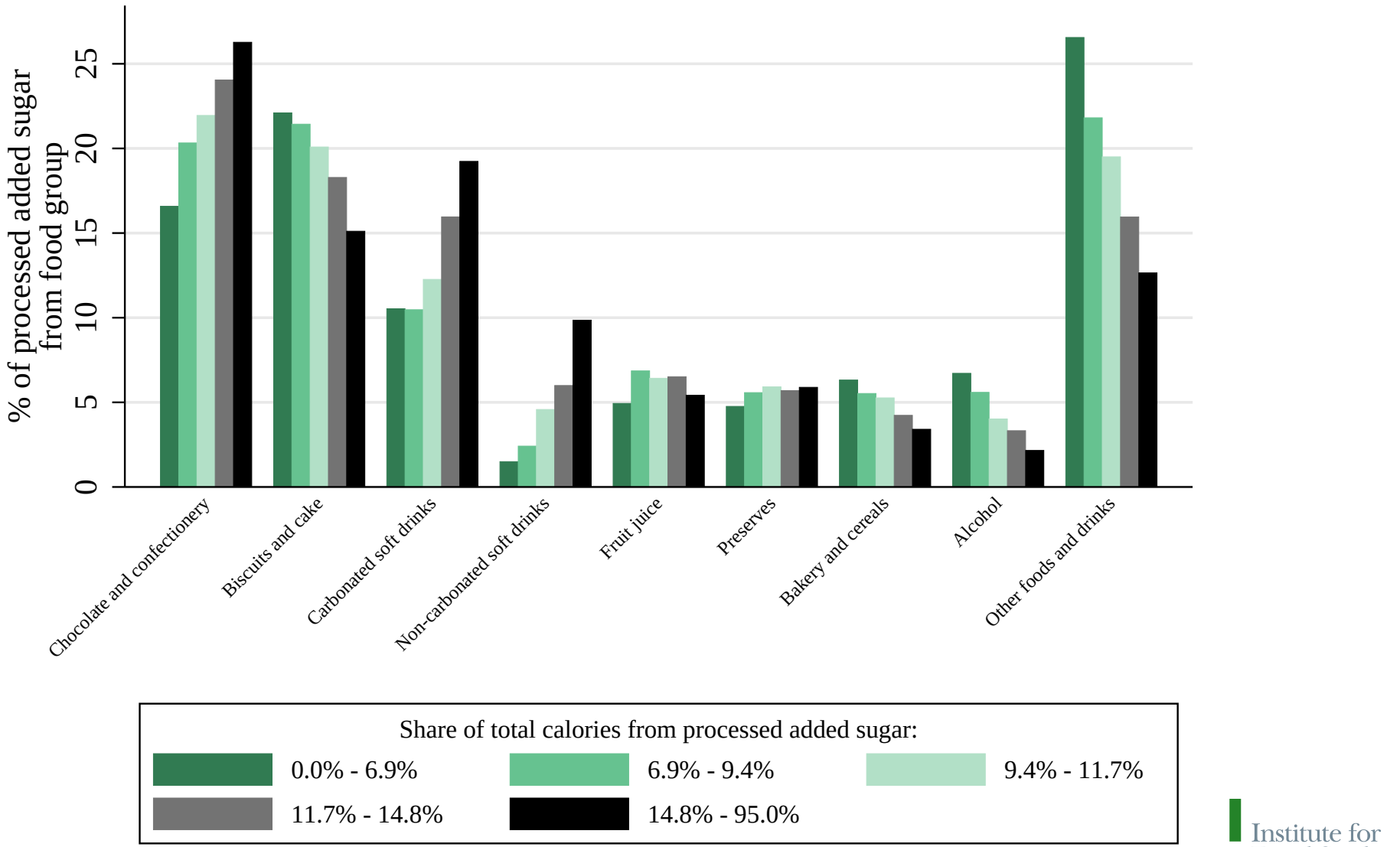
Sources of dietary sugar

By total added sugar purchases



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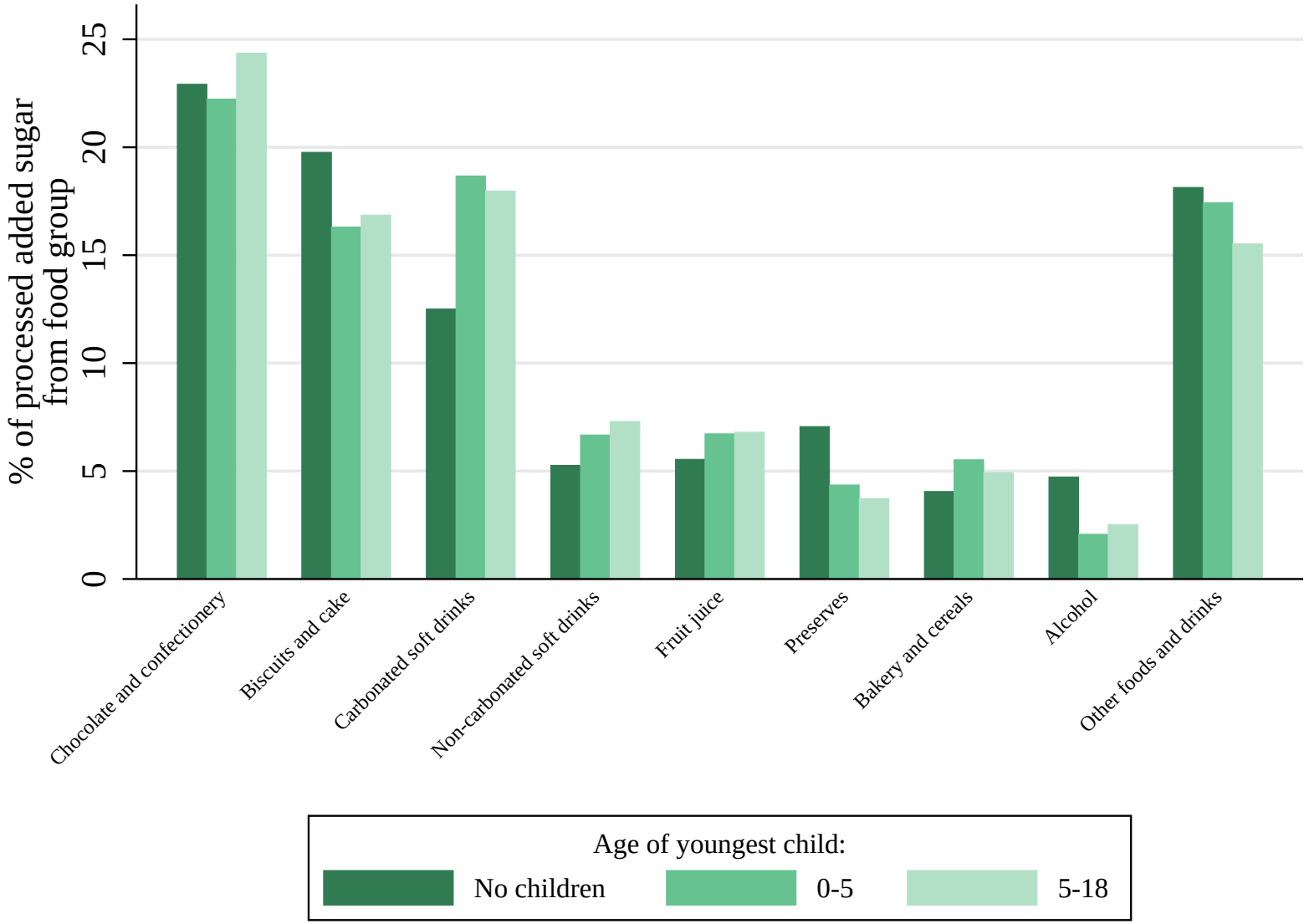
Sources of dietary sugar

By age of youngest child



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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

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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.

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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.

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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.

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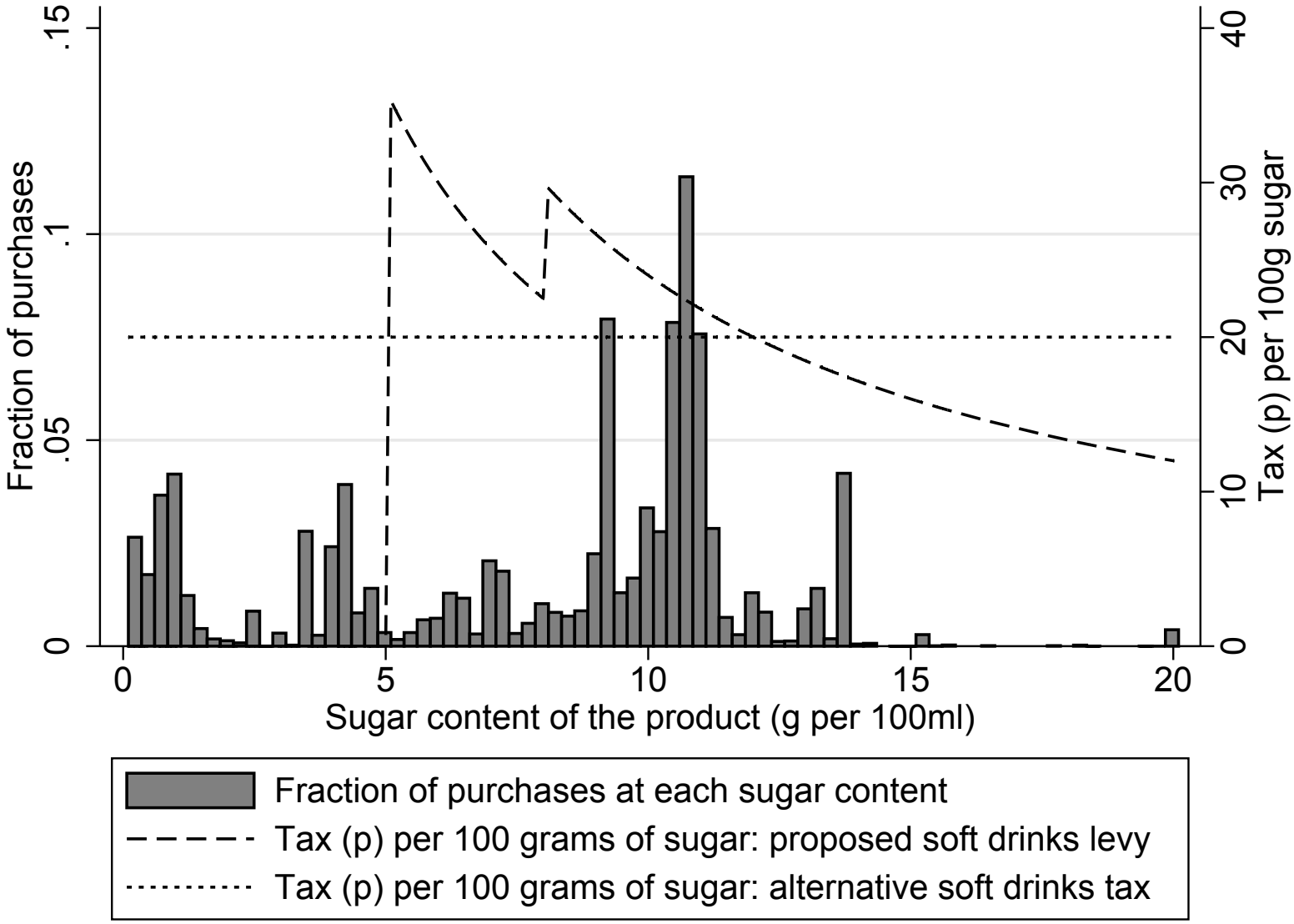
The design of the proposed 'Soft Drinks Levy'



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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

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