Public policy and food choices

Rachel Griffith, Martin O’Connell and Kate Smith

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Public policy

- A wide range of policies aim to alter food choices
  - some costs of excess consumption fall on others, e.g. through increased health care costs, lost productivity, etc.
  - some costs fall on the person themselves in the future, but are not fully accounted for, e.g. diet-related disease, child development, etc.
  - public policy can potentially improve welfare by helping people make better choices

- Policy include
  - regulation of location of fast food outlets, products at check out
  - taxes on specific goods such as alcohol or sugary soft drinks
  - restrict advertising of junk foods
  - labelling of food products
  - etc.
Understanding the effects of policy interventions

- The effect of policy will depend on
  - how individuals (consumers) respond
    - it is crucial to understand not only the impact on average, but also how policies affect different individuals
  - how producers and retailers respond
- we have well developed tools to do this
  - understand the determinants of inequalities in outcomes
  - not only evaluate existing policies, but study the reasons why policies work or don’t work, and so improve design
  - integrate insights from psychology, sociology, etc. into economic modelling
Research programme at IFS

- Preference formation
  - the role of home and environment in child preference formation
  - interactions between work and food choices

- Self-control and temptation
  - who has self-control problems
  - what factors influence this (advertising, labelling, ...)

- Advertising
  - what affects on consumer choice
  - what is the impact of restrictions or a ban

- Corrective taxes
  - soft drinks levy and sugar taxes
  - alcohol taxes
Alcohol tax design
Role of alcohol taxes

- Widely accepted that alcohol consumption is associated with “social costs”, including those imposed:
  - directly on others (e.g. victims of alcohol related crime)
  - on taxpayers (e.g. higher public health and policing costs)
  - on drinkers themselves in the future
- These provide a clear rationale for public policy to discourage socially harmful consumption
- Main role of alcohol tax system is to do this by raising prices and hence discouraging socially costly drinking
Role of alcohol taxes

➤ Challenge is to design system in way that most efficiently targets socially costly drinking

➤ Levying very high taxes imposes large costs on consumers, as people derive pleasure through consuming alcohol

➤ And may actually serve to harm those we’re most trying to assist through the policy

➤ e.g. if people that suffer in future from disease are very price inelastic
Role of alcohol taxes

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- Alcohol tax should target the most socially harmful drinking

- And rates will depend importantly on price responsiveness of different types of drinkers
Research question

- How can alcohol taxes best be designed to target problem drinking?
  - Write down and solve model of government’s task in setting alcohol tax rates
  - Use longitudinal data on representative sample of British households’ grocery purchases to estimate consumer choice in alcohol market
  - Combine to compute “optimal” alcohol taxes for UK
Government’s tax problem

- Consider government to set tax rates on ethanol content of alcohol products

- Aim is to discourage most socially costly alcohol consumption, taking account of fact that higher taxes also impose costs on consumers

- We consider a single ethanol tax rate
  - Optimal rate is increasing in the covariance of social harm drinkers create and how price sensitive their ethanol choices are to price increases

- And optimal “alcohol type” tax rates
  - These can improve on a single rate by allowing government to tax more highly products that problem drinkers will switch away from more strongly
Estimating consumer choice

- Optimal tax rates depend on consumer’s price sensitivities
  - If tax on one type of alcohol is raised, how strongly do people switch from it?
  - And to what alternatives and how strongly do they switch?
- Crucially we need to know not just average responses, but how they vary across different groups (e.g. heavy drinks, responsible for bulk of social costs, versus light drinkers)
Data

- We use data from Kantar Worldpanel:
  - Contain rich product information (including prices)
  - Many repeated observation for each household
- Panel of 11,634 households
- Use pre-sample period (2010) to group households into lightest to heaviest drinkers based on quintile of drinking distribution
- Estimate consumer choice using data for 2011
- Data cover off-trade market (grocery stores and off licenses) – covers around 77% of alcohol market
- We group 7000 UPCs into 69 product-sizes
Choice model

- Challenge in demand estimation arises when consumers select only one (or a small number) of options at one time

- Solutions include
  - Aggregate all alcohol together
    - Cannot obtain switching patterns between different types of alcohol
    - Estimate continuous demand over alcohol types
      - Statistical problem of zero demands
  - Discrete choice model
    - Advantage of latter is it is designed to capture people purchasing one or small number of products
    - And it’s very well suited to capture variation in parameters (and hence switching patterns) across people
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Choice model

- Model captures decision household makes when visiting the store over:
  - Whether or not to buy alcohol
  - Which product to buy (e.g. branded vodka vs. own brand gin)
  - How much to buy

- Yields estimates of own and cross price elasticities at product level
  - What is change in demand for 0.7l bottle of vodka if it’s price increases by a given amount
  - What is change in demand for other products (0.7l bottle of gin, 500ml of craft beer etc)

- Plus price effects for alcohol at a whole

- And crucially, how these price effects vary across people (e.g. with how much alcohol they purchase in the long run)
Price elasticities

▶ Product own price elasticities:

▶ As an example, price elasticity for 0.7l bottle of vodka is -4 for lightest group of drinkers and -3.7 for heaviest

▶ Variation across products is substantial; variation in average across drinkers modest

▶ Product cross price elasticities:

▶ As an example, cross price elasticity between 0.7l bottle of gin and vodka is 0.02 for lightest group of drinkers and 0.08 for heaviest

▶ Variation across products is substantial; variation in average across drinkers also large

▶ Overall ethonal price elasticity

▶ Ranges from -2.1 for lightest to -1.0 for heaviest drinkers
Product own price elasticities

Variation across households

Own price elasticity for product

Variation across products

Quintile of ethanol distribution

Mean own price elasticity across products

Product own price elasticity
Price elasticities

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Product cross price elasticities

![Graph showing variation across households and quintiles of ethanol distribution.](image)

- **Mean cross price elasticity across product pairs**
- **Product pair cross price elasticity**
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Computing alcohol tax rates

- We combine estimates of alcohol choice behaviour with evidence on how these choices map into social costs
- Exact quantitative results depend on how concentrated social costs are among heavy drinkers
- Qualitative results hold across broad range of calibrations
Current UK system

Excise duty (p per unit of ethanol) vs Alcohol by volume (%)

- Wine
- Beer
- Spirits
- Cider
Current UK system
Optimal single rate

![Graph showing excise duty vs alcohol by volume for different beverages.]

**Current:**
- Wine
- Beer
- Spirits
- Cider

**Optimal:**
- Single rate
Optimal multi rate

![Graph showing excise duty vs alcohol by volume for different alcoholic beverages.](image)
In this work we take leading edge economics and apply it directly to policy relevant question.

Important to capture how different people switch across products in response to price changes.

We show how UK tax system could be redesigned to substantially improve outcomes.

Project ties into broader agenda in which we also study self control problems, advertising, sugar policy, role played by industry ...
APPENDIX
Consumer demand

Consumer indirect utility:

\[ V_i(y_i, p, x) = \alpha_i y_i + v_i(p, x) \]

- \( i \) consumers; \( j \) alcohol products
- \( y_i \) income; \( \alpha_i \) marginal utility of income
- \( p = (p_1, \ldots, p_J)' \) post-tax prices
- \( x_j \) product characteristics; first element \( z_j \) ethanol

Yields demand functions:

\[ q_{ij} = f_{ij}(p, x) \]

which we collect in a vector, \( q_i = (q_{i1}, \ldots, q_{ij})' \)
Alcohol consumption generates costs that are not considered by the individual when making their consumption decision e.g. health care costs, crime costs.

We specify the external cost from consumption as a function of derived ethanol demand $Z_i = \sum_j z_j q_{ij}$.

The external cost associated with consumer $i$’s ethanol consumption is $\phi_i(Z_i)$, and total external costs are $\Phi = \sum_i \phi_i(Z_i)$.

Consumers ignore the externality when making choices; the goal of the planner is to use taxes to get consumers to internalise the externality.
Social planner’s problem

- The social planner trades off benefits of minimising social costs and minimising the reduction in consumer surplus that arises due to the higher prices.

\[
\max_{\tau} W(\tau) = \sum_{i} \left[ y_i + v_i(\tau) \alpha_i \right] \quad \text{consumer surplus} + R(\tau) \quad \text{tax revenue} - \Phi(\tau) \quad \text{external costs}
\]
Social planner’s problem

- The social planner trades off benefits of minimising social costs and minimising the reduction in consumer surplus that arises due to the higher prices

- The planner sets rates, $\tau$, levied per unit of ethanol

\[
\max \tau W(\tau) = \sum_i [y_i + v_i(\tau)] \alpha_i - \Phi(\tau) + R(\tau)
\]
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- The planner sets rates, $\tau$, levied per unit of ethanol.

- To maximise the sum of consumer surplus and tax revenue minus the externality cost:

$$\max_{\tau} W(\tau) = \sum_i \left[ y_i + \frac{v_i(\tau)}{\alpha_i} \right] + \underbrace{R(\tau)}_{\text{tax revenue}} - \underbrace{\Phi(\tau)}_{\text{external costs}}$$
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Where:
- $y_i$: consumer surplus
- $v_i(\tau)$: revenue
- $\alpha_i$: externality cost
- $R(\tau)$: tax revenue
- $\Phi(\tau)$: externality cost
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consumer surplus
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$$\max_{\tau} W(\tau) = \sum_i \left[ y_i + \frac{v_i(\tau)}{\alpha_i} \right] + R(\tau) - \Phi(\tau)$$

  - consumer surplus
  - tax revenue
  - external costs

- Notice under consumer specific taxes, we get first best

$$\tau_i^* = \phi_i'(Z_i(\tau_i^*))$$
Optimal tax policy

▶ Now suppose planner can set alcohol type tax rates $\tau = (\tau_1, ..., \tau_K)'$ (with $K \leq J$); rate $\tau_k$ applies to products in set $K_k$

▶ Define ethanol from alcohol type $k$ as $Z_{ik} = \sum_{j \in K_k} q_{ij}(\tau)z_j$

▶ Optimal tax rates pinned down by first order conditions for $l = 1, ..., K$

$$\sum_i \sum_k (\tau_k - \phi_i') \frac{\partial Z_{ik}}{\partial \tau_l} = 0$$
Optimal tax policy

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▶ Optimal tax rates pinned down by first order conditions for $l = 1, \ldots, K$

$$\sum_i \sum_k (\tau_k - \phi'_i) \frac{\partial Z_{ik}}{\partial \tau_l} = 0$$

▶ Optimal taxes will vary across $k$ as long as it is not the case that $\text{Cov}(\phi'_i, Z'_{ikl}) = 0 \ \forall (k, l)$ – i.e. as long as:

▶ There is heterogeneity in externalities ($\phi_i \neq \phi$),

▶ There is heterogeneity in demands ($Z_{ik} \neq Z_k \ \forall k$), and

▶ Both forms of heterogeneity are correlated
Discrete choice demand

- \( j \) product, \( s \) size; \( j = 0, s = 0 \) no purchase outside option

- Utility household \( i \) obtains from selecting option \((j, s)\) in period \( t \) is given by:
  \[
  u_{ijst} = \nu(p_{jst}, z_{js}, x_{jst}; \theta_i) + \epsilon_{ijst}
  \]
  where \( \epsilon_{ijst} \) is distributed Type I extreme value

- Households \( i \)'s demand for option \((j, s)\) is
  \[
  q_{ijst} = \frac{\exp(\nu(p_{jst}, z_{js}, x_{jst}; \theta_i))}{1 + \sum_{j' > 0, s' > 0} \exp(\nu(p_{j's't}, z_{j's'}, x_{j's't}; \theta_i))}
  \]

- And expected utility is
  \[
  \nu_{it}(p_{jt}, z_{jst}, x_{jst}) = \ln \sum_{j > 0, s > 0} \exp\{\nu(p_{jst}, z_{js}, x_{jst}; \theta_i)\} + C
  \]
Utility specification

- We model utility household $i$ obtains from selecting option $(j, s)$ in period $t$ as

$$
\nu(.) = \alpha_i p_{jst} + \beta_i w_j + \sum_{m=1}^{4} 1[j \in M_m] \cdot (\gamma_i,1mz_{js} + \gamma_i,2mz^2_{js}) + \xi_{ijt}.
$$

where $p$ is price, $w$ is strength, $z$ is ethanol and $m = 1, \ldots, 4$ indexes beer, wine, spirits and cider segments

- Unobserved product characteristic:

$$
\xi_{ijt} = \eta_{ij} + \zeta_{kjt}
$$
Distribution of drinkers

- 64% of households drink
- 17% of households drink
- 10% of households drink
- 6% of households drink
- 3% of households drink

Average drinks per adult per week:
- 64% drink
- 17% drink
- 10% drink
- 6% drink
- 3% drink