Institute for Fiscal Studies

Tax design in the alcohol market

Rachel Griffith, Martin O'Connell and Kate Smith

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Motivation

- Taxes have the potential to improve welfare when consumption generates externalities
  - this motivates many taxes including on alcoholic drinks, and more recently on sugary drinks
- 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 (e.g. poor health)
- Main role of alcohol tax system is to raise prices in such a way that discourages socially costly drinking
  - existing tax systems do this relatively poorly, and could easily be improved

Motivation

- Pigou (1920): if the marginal externality is constant and equal across consumers then a tax can fully correct for the externality.
- However, marginal externalities from consumption often vary
  - externalities may be nonlinear in quantity consumed
  - conditional on quantity, some people may be more prone to socially costly behaviour
- Diamond (1973) considers the case of heterogeneous marginal externalities and a homogeneous good:
  - a linear tax can no longer achieve the first best
  - optimal tax rate equals weighted average marginal externality

Motivation

- In this paper we:
  - consider optimal corrective taxes when there are many differentiated products and consumers are heterogeneous in tastes and externalities
  - apply the framework empirically in the UK alcohol market
- Challenge is to design system in way that most efficiently targets socially costly drinking
  - levying very high taxes imposes large costs on consumers who derive pleasure through consuming alcohol
  - alcohol tax should target the most socially harmful consumption
  - the appropriate level of tax rates will depend on price responsiveness of different types of consumers

Our contribution

We characterise optimal taxes when the externality generating characteristic (ethanol) is available in many differentiated products:

- varying tax rates across products can improve welfare
- if consumers' product demand curves are correlated with their marginal externality from ethanol consumption then:
  - higher tax rates on alcohol products disproportionately preferred by high marginal externality consumers...
  - ... allows the planner to specifically target high externality generating consumption
- we abstract from redistribution objectives
- we assume perfect competition; we base the objective function on consumer surplus and do not include producer surplus

▸ Details

Our contribution

We show that these theoretical results have empirical relevance when applied to the UK market for alcoholic beverages

- we estimate a flexible model of demand using longitudinal data:
  - heavy drinkers buy a different mix of products to lighter drinkers
  - and are more willing to switch between products when prices change

We consider alternative optimal systems (single rate, multiple rates)

- optimal single rate is increasing in the covariance of social harm drinkers create and how price sensitive their ethanol demand is
- a multi rate system can improve on a single rate by allowing government to tax more highly products that problem drinkers will switch away from more strongly
  - similar to Akerlof (1978), in lieu of household vary taxes rates, we use correlation in preferences and marginal externalities to tag and target consumption that is likely to have high marginal external costs

Consumer demand

Consumer indirect utility:

$$V_i(y_i, \mathbf{p}, \mathbf{z}, \mathbf{x}) = \alpha_i y_i + v_i(\mathbf{p}, \mathbf{z}, \mathbf{x})$$

- i consumers; j alcohol products
- y_i income; α_i marginal utility of income
- $\mathbf{p} = (p_{i]1}, \ldots, p_J)'$ post-tax prices
- z_j ethanol (pure alcohol); $\mathbf{x}_j$ other characteristics

Yields demand functions:

$$q_{ij} = f_{ij}(\mathbf{p}, \mathbf{z}, \mathbf{x}),$$

which we collect in a vector, $\mathbf{q}_i = (q_{i1}, \ldots, q_{iJ})'$

External costs of alcohol consumption

Alcohol consumption generates costs that are not considered by the individual when making their consumption decision

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

Total external cost from all consumers in the market:

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

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

Social planner chooses:

- a vector of tax rates (levied per unit of ethanol), $\boldsymbol{\tau}$

to maximise:

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

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

Optimal tax policies

Consumer specific taxes: set the rate equal to the marginal externality:

$$\tau_i^* = \phi_i'(Z_i(\tau_i^*))$$

This achieves the first best (Pigou, 1920)

Single ethanol tax rate: the optimal rate is:

$$\tau^* = \underbrace{\bar{\phi}'}_{\substack{\text{Average} \\ \text{marginal} \\ \text{externality}}} + \underbrace{\frac{\text{cov}(\phi_i', |Z_i|))}{|\bar{Z}'|}}_{\substack{\text{covariance of the marginal externality} \\ \text{and slope of ethanol demands}}}$$

where $Z_i' = \sum_j z_j \frac{\partial q_{ij}}{\partial \tau}$ (Diamond, 1973)

Optimal tax policies

Product level tax rates: the optimal tax rates will solve the first order conditions for each τ_j:

$$\frac{\partial W}{\partial \tau_l} = \sum_i \sum_k (\tau_k - \phi_i') \frac{\partial Z_{ik}}{\partial \tau_l}$$

All else equal, the tax rate on a given product is:

1. higher if it is highly demanded by high marginal externality consumers
2. higher the stronger is the correlation between the marginal externality and the own-price elasticity
3. lower the stronger the correlation between the marginal externality and cross slopes of demand

UK alcohol market - data

We focus on the UK off trade alcohol market (alcohol purchased in supermarkets and off-licences)

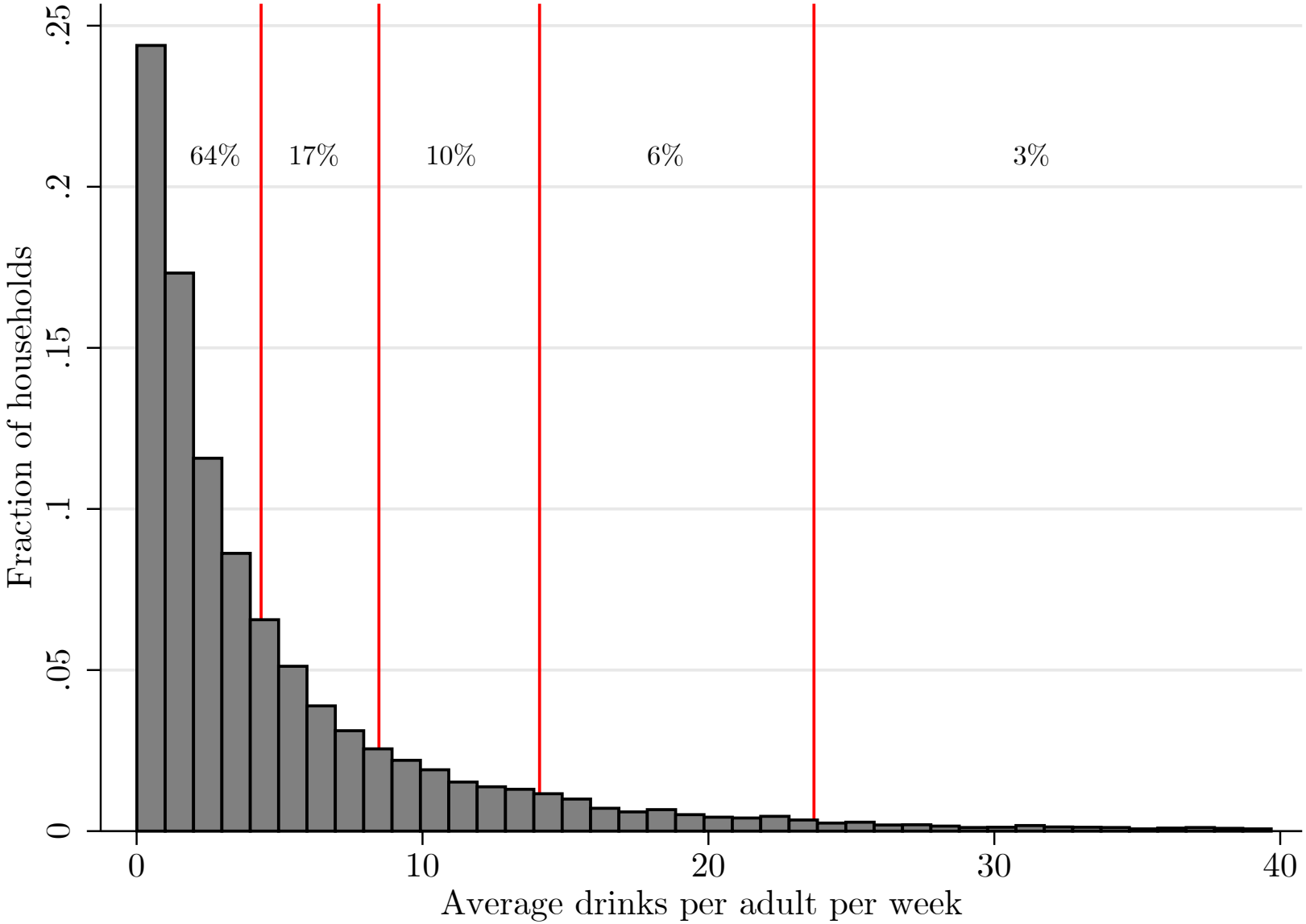
- accounts for 77% of ethanol purchased

  ▸ Comparison of on and off trade purchases

We use household scanner data from the Kantar Worldpanel

- nationally representative ▸ Demographics similar in Kantar and LCFS
- panel of 18,713 households observed over 2010-2011
- 11,634 buy alcohol in both years
- we estimate demand on 2011 data
- we use 2010 as pre-sample information to identify persistently heavy drinkers

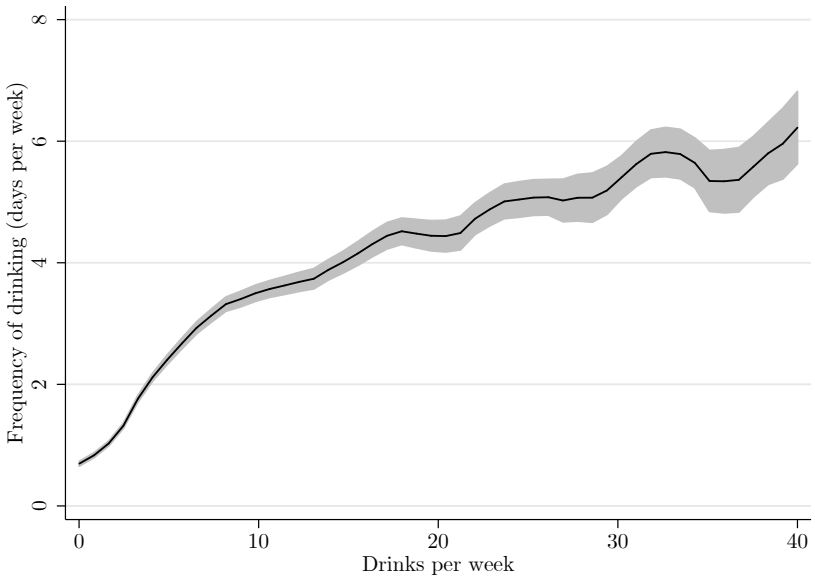
Pre-sample distribution of alcohol purchases



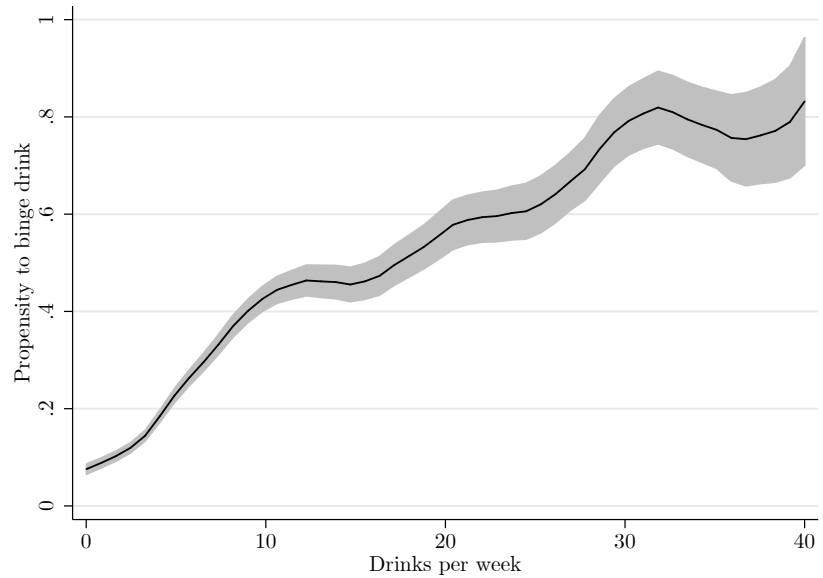
Ethanol purchases correlate with other measures of excess consumption

frequency of drinking and binge drinking

(a) Frequency of drinking



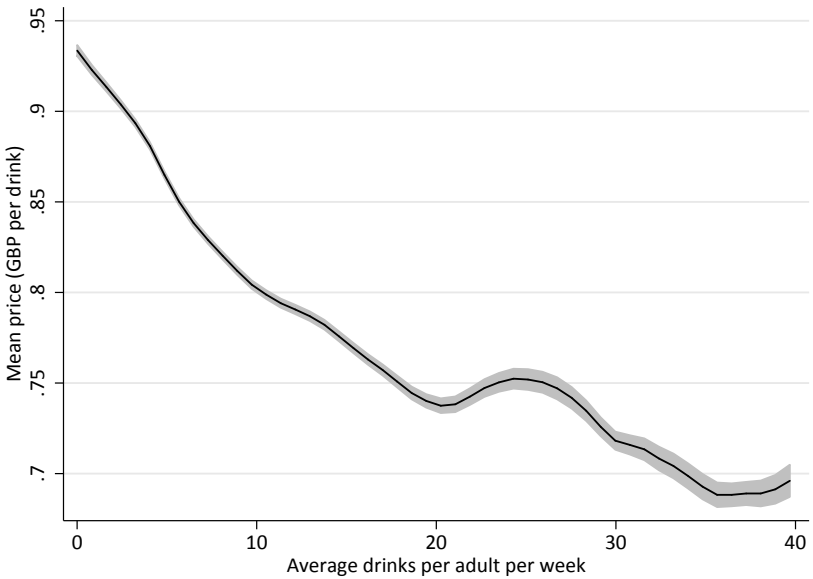
(b) Binge drinking



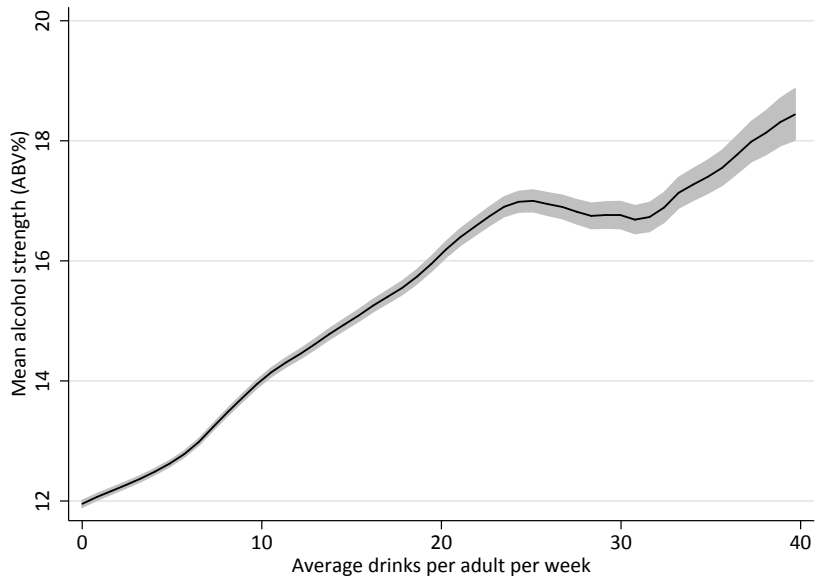
Source: Health Survey for England (HSE)

Products purchased vary across distribution of drinkers

(a) Price



(b) Alcoholic strength



Empirical model of alcohol demand

- It is common in the literature to aggregate products into a relatively small number of categories (e.g. beer, wine etc.)
  - but this masks the considerable variation in price and alcoholic strength within category

  We estimate a discrete choice demand model:
  - switching between disaggregate alcohol products
  - correlation between product demands and total ethanol demand
  - avoids the curse of dimensionality
  - rationalises zero purchases
  - well suited for incorporating rich preference heterogeneity

Data - products

There are 7000+ alcohol UPCs (barcodes) and 3000 brands

- estimating a choice model is infeasible
- we aggregate to 32 "products"
  - available in different sizes, 69 product-sizes
- focus on the margins of substitution that are most relevant to our application
- these capture heterogeneity in the shape of demand for sets of UPCs that are impacted similarly by alcohol tax changes

Product definition and characteristics

(1) Product definition	(2) Top brand and within-product share (%)	(3) No. brands	(4) Mean ABV	(5) Market share (%)	(6) No. sizes
Beer					
Premium beer; ABV $<$ 5%	Newcastle Brown Ale (6.1)	386	4.4	1.8	3
Premium beer; ABV $\geq$ 5%	Old Speckled Hen (16.5)	238	5.5	2.1	3
Mid-range bottled beer	Budweiser Lager (19.6)	94	4.7	4.6	3
Mid-range canned beer; ABV $<$ 4.5%	Carlsberg Lager (28.8)	17	3.9	5.8	3
Mid-range canned beer; ABV $\geq$ 4.5%	Stella Artois Lager (72.0)	15	5.0	2.7	3
Budget beer	John Smiths Bitter (23.6)	72	4.2	3.2	3
Wine					
Red wine	Tesco Wine (6.2)	439	12.6	18.4	4
White wine	Tesco Red Wine (7.8)	327	12.1	17.1	4
Rose wine	Echo Falls Wine (8.6)	67	11.5	4.2	2
Sparkling wine	Lambrini Sparkling Wine (8.4)	125	9.2	3.1	2
Champagne	Lanson Champagne (12.7)	42	11.8	0.8	1
Port	Dows Port (22.0)	23	19.8	0.7	1
Sherry	Harveys Bristol Cream (18.7)	25	16.8	1.2	1
Vermouth	Martini Extra Dry (11.8)	33	15.0	0.6	1
Other fortified wines	Tesco Fortified Wine (21.8)	37	14.6	0.9	1

Product definition and characteristics

(1) Product definition	(2) Top brand and within-product share (%)	(3) No. brands	(4) Mean ABV	(5) Market share (%)	(6) No. sizes
Spirits					
Premium gin	Gordons Gin (59.6)	21	38.3	1.6	2
Budget gin	Tesco Gin (22.3)	15	38.3	1.3	2
Premium vodka	Smirnoff Red Vodka (39.0)	54	37.6	3.1	2
Budget vodka	Tesco Vodka (31.4)	17	37.5	1.8	2
Premium whiskey	Jack Daniels Bourbon/Rye (19.6)	80	40.5	2.1	2
Budget whiskey	Bells Scotch Whiskey (18.7)	56	40.0	8.1	2
Liqueurs; ABV $<30\%$	Baileys (25.9)	203	18.4	3.1	2
Liqueurs; ABV $\geq 30\%$	Southern Comfort (27.2)	41	37.0	0.8	2
Brandy	Tesco Brandy (22.1)	55	37.3	2.4	2
Rum	Bacardi White Rum (29.1)	58	37.1	2.0	2
Pre-mixed spirits	Gordons Gin+Tonic (14.7)	43	6.1	0.2	1
Alcopops	Smirnoff Ice Vodka Mix (17.3)	147	4.8	0.8	1
Cider					
Apple cider, $<5\%$ ABV	Magners Original Cider (26.9)	52	4.4	1.6	3
Apple cider, 5-6% ABV	Strongbow Cider (63.1)	49	5.3	2.0	3
Apple cider, $>6\%$ ABV	Scrumpy Jack Cider (18.7)	71	7.0	0.8	2
Pear cider	Bulmers Pear Cider (24.2)	33	4.9	0.7	2
Fruit cider	Jacques Fruit Cider (21.4)	48	4.4	0.5	2

Discrete choice demand model

- on a choice occasion consumer selects from 69 alcohol options or an outside option (no purchase)
  - embed decision to purchase alcohol or not, what product to choose and what quantity
- preference heterogeneity over taste for product characteristics (strength, alcohol type, total alcohol content) and disutility from price captured by random coefficients
  - we allow the preference distributions to vary across the pre-sample measure of whether a heavy drinker (quintiles of total ethanol in previous year)

Discrete choice demand

- Indirect utility

$$u_{ijst} = \nu(p_{jsrt}, \mathbf{x}_{jst}; \boldsymbol{\theta}_i) + \epsilon_{ijst}$$

  - i household, j product, s pack size, r region; $j = 0, s = 0$ no purchase outside option
  - ϵ_{ijst} is distributed Type I extreme value

- Households i's demand for option (j, s):

$$q_{ijst} = \frac{\exp(\nu(p_{jsrt}, \mathbf{x}_{jst}; \boldsymbol{\theta}_i))}{1 + \sum_{j'>0, s'>0} \exp(\nu(p_{j's'rt}, \mathbf{x}_{j's't}; \boldsymbol{\theta}_i))}$$

- expected utility is

$$v_{it}(\mathbf{p}_{rt}, \mathbf{x}_t) = \ln \sum_{j>0, s>0} \exp\{\nu(p_{jsrt}, \mathbf{x}_{jst}; \boldsymbol{\theta}_i)\} + C$$

Utility specification

- We assume indirect utility takes the form:

$$\nu(p_{jsrt}, \mathbf{x}_{jst}; \boldsymbol{\theta}_i) = \alpha_i p_{jsrt} + \beta_i w_j + \sum_{m=1}^{4} 1[j \in \mathcal{M}_m] \cdot (\gamma_{im1} z_{js} + \gamma_{im2} z_{js}^2) + \xi_{ijt}$$

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

- $\alpha_i, \beta_i, \boldsymbol{\gamma}_{i1}, \boldsymbol{\gamma}_{i2}$ are random coefficients

  $\boldsymbol{\gamma}_{i1} = (\gamma_{i11}, ..., \gamma_{i1M})'$ and $\boldsymbol{\gamma}_{i2} = (\gamma_{i21}, ..., \gamma_{i2M})'$

Observable product attributes

- preferences over observed attributes follow a multivariate normal distribution
  - conditional on pre-sample household alcohol quintile, $d = 1, \ldots, 5$
  - allows both the mean and the covariances of the preference parameters to vary across lighter and heavier drinkers

$$\begin{pmatrix} \alpha_i \\ \beta_i \\ \gamma_{i1} \\ \gamma_{i2} \end{pmatrix} \Bigg| d \sim \mathcal{N}\left(\begin{pmatrix} \bar{\alpha}^d \\ \bar{\beta}^d \\ \bar{\gamma}^d_{i1} \\ \bar{\gamma}^d_{i2} \end{pmatrix}, \begin{pmatrix} \sigma^d_{\alpha\alpha} & \sigma^d_{\alpha\beta} & \sigma^d_{\alpha\gamma} & 0 \\ \sigma^d_{\alpha\beta} & \sigma^d_{\beta\beta} & \sigma^d_{\beta\gamma} & 0 \\ \sigma^d_{\alpha\gamma} & \sigma^d_{\beta\gamma} & \sigma^d_{\gamma\gamma} & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \right)$$

Unobserved product characteristic

$$\xi_{ijt} = \eta_{ij} + \chi^d_{kt}$$

- η_{ij} time-invariant product effect, $\bar{\boldsymbol{\eta}}_{im}|d \sim \mathcal{N}(\bar{\boldsymbol{\eta}}^d_m, \sigma^d_m)$
  - product effects vary across the five household quintiles, capturing the possibility that preferences over unobserved product attributes are correlated with how heavily a household consumes alcohol
  - random component that is common across products within each of the four segments of the market; allows for the possibility that households willingness to substitute between products in each of these segments differs from their willingness to switch between products in different segments
- χ^d_{kt} alcohol type (k=beer, wine, spirits, cider) time effect that varies with pre-sample alcohol consumption quintile

Identification of price effects

We control for rich preference heterogeneity

- consumer specific (random) coefficients on observed product attributes and on unobserved product attribute
  - modelled as a mixture of conditional normal distributions (where conditioning is on pre sample alcohol consumption)
- time effects that vary by alcohol type (gin, vodka, whisky etc)
- We include a control function based on:
  - tax rates ▸ detail, exchange rates and producer prices ▸ detail, retail wages index ▸ detail
  - to focus on price variation driven by cost shifters

Price elasticities

We estimate the distribution of own and cross price elasticities

▸ Coefficient estimates

Key takeaways:

- own-price elasticities vary over products ▸ Figure
- cross-price elasticities vary over products and individuals ▸ Figure
  - mean for heaviest drinkers is over 4.5 times lightest drinkers
  - heaviest drinkers more likely to respond to price increase by switching to alternative products (rather than out of the market)
  - as a consequence the overall price elasticity of demand for ethanol for heavy drinkers is much lower than for light drinkers; -0.95 for the top quintile compared with -2.07 for the bottom

Externality function

- We assume the externality function, $\phi(.)$, takes the form:

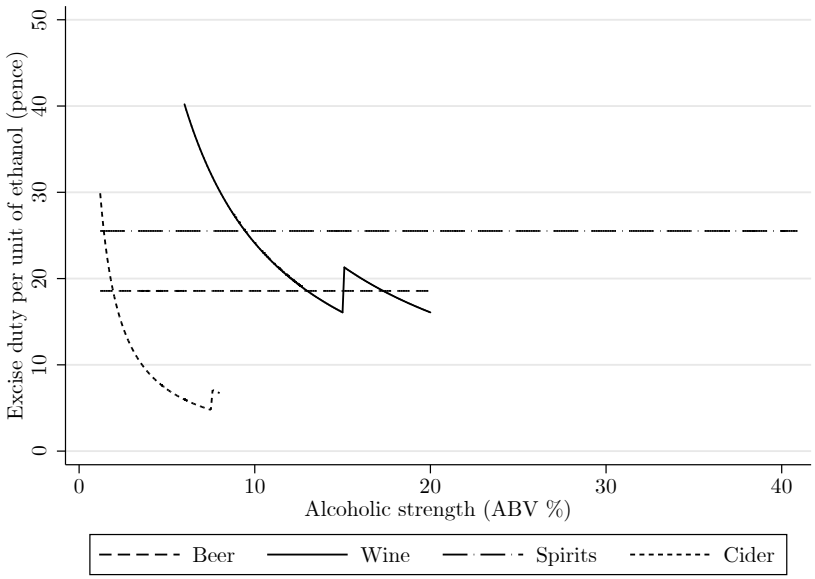
$$\phi(Z_{it}) = \phi_0 Z_{it} + \phi_1 Z_{it}^2$$

  where $Z_{it} = \sum_j z_j q_{ijt}$ denotes derived ethanol demand

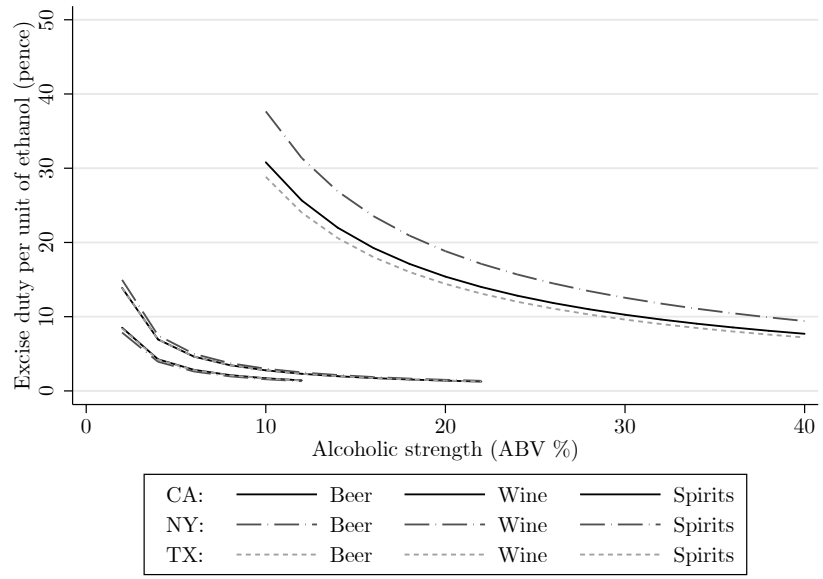
- We calibrate function to match UK government estimate of aggregate external costs (£7.25 billion in 2011)
- There is considerable evidence that externalities are convex, but not on the degree of convexity – we show how our results vary with the convexity of function
  - we measure this as proportion of externalities accounted for by heaviest 19% of drinkers (who together account for 60% of ethanol purchases)
  - benchmark is 60% of external costs generated by heaviest drinkers – corresponds to a linear externality function
  - increase to 95% to increase convexity

Existing Alcohol Taxes

(a) UK system



(b) US system



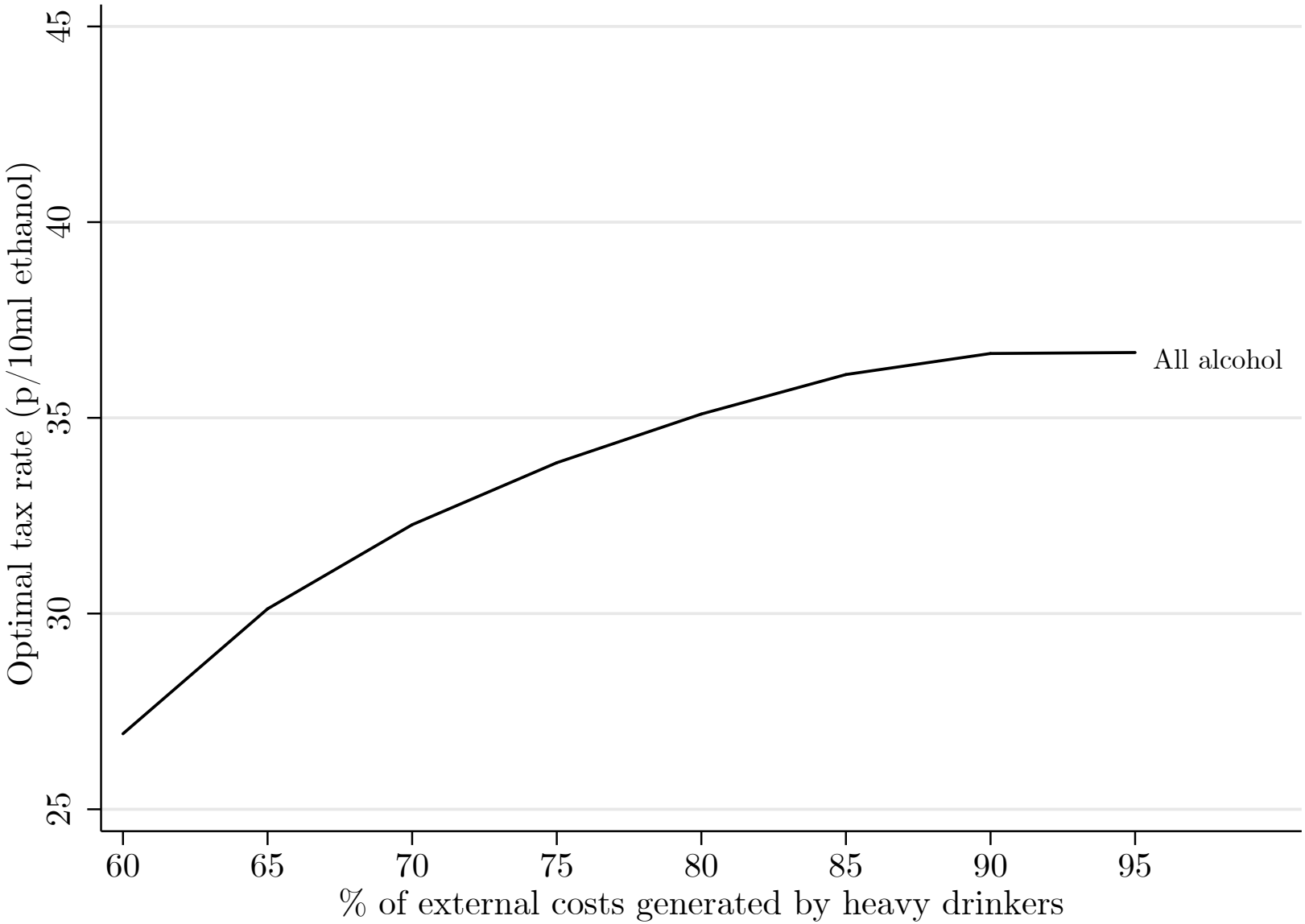
We focus on two tax regimes

1. **Single ethanol tax rate**: one per-ethanol-unit tax rate for all products, common across consumers.

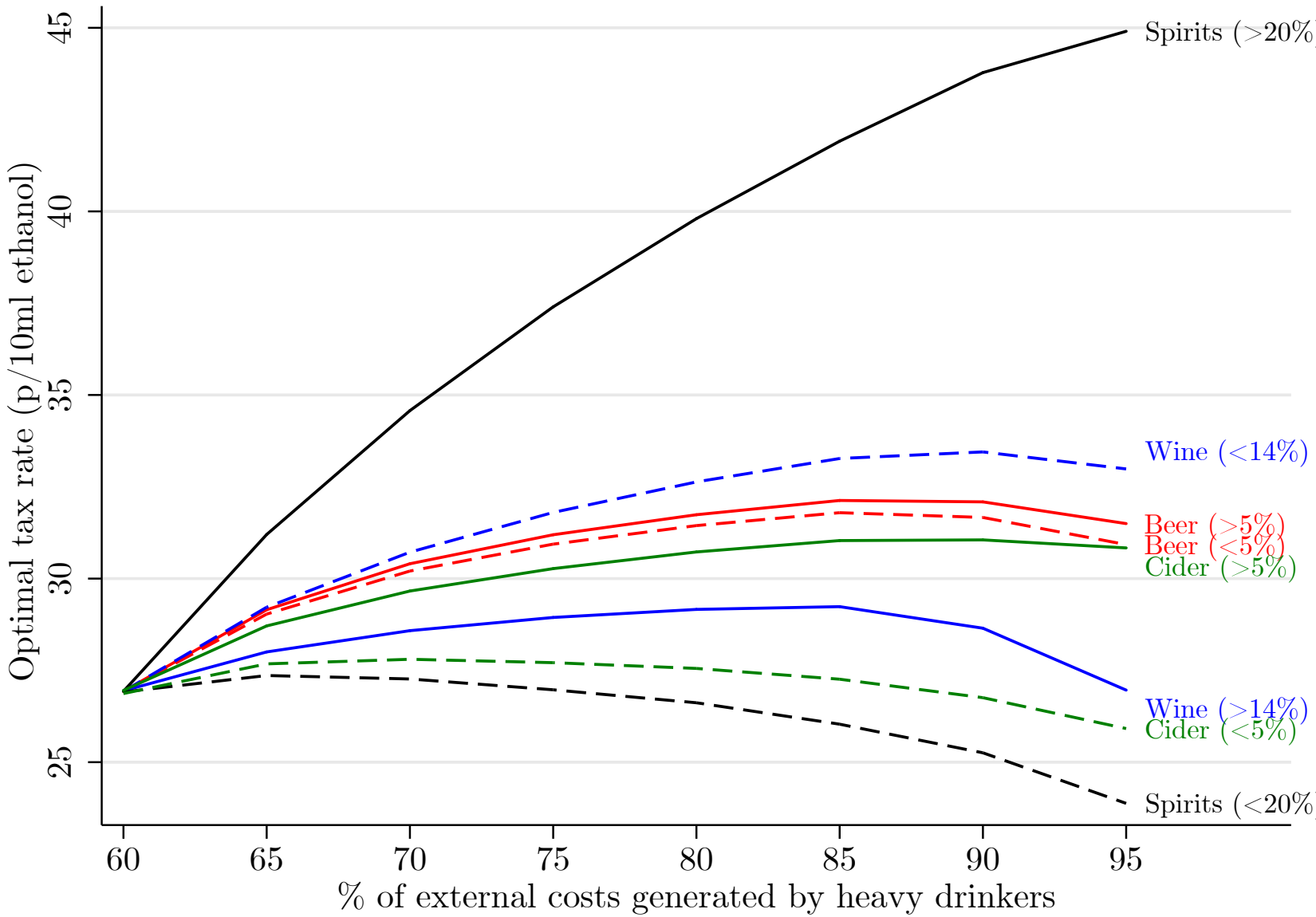
2. **Product level tax rates**: per-ethanol-unit rates allowed to vary across products, common across consumers:

   - rates are allowed to be differentiated across 8 alcohol types, strong and weak beer, wine, spirits and cider

Optimal single rate



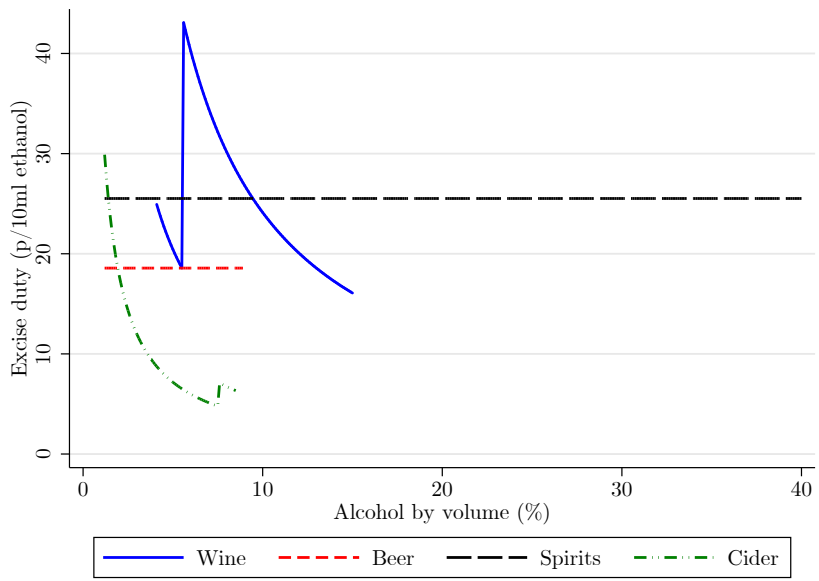
Optimal multi rate



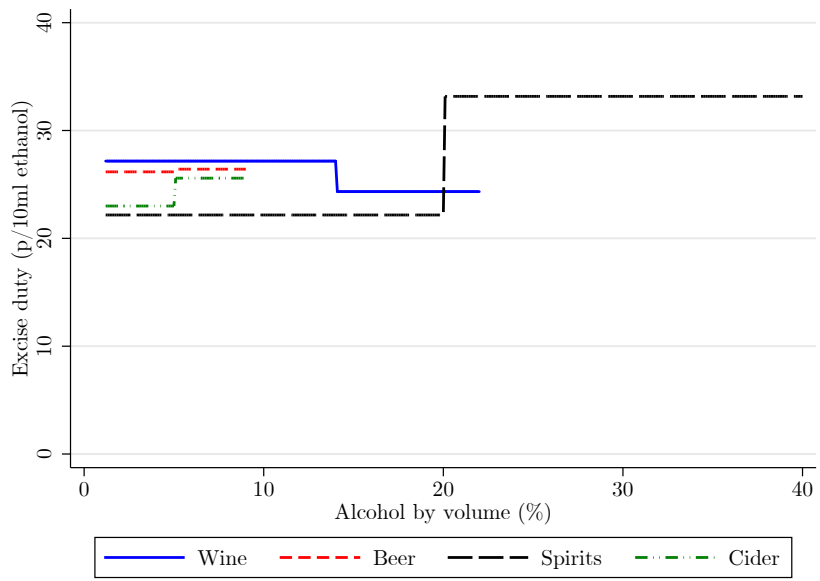
Comparison of the current UK system with the optimal multi rate system

at 80% of the external costs generated by heavy drinkers

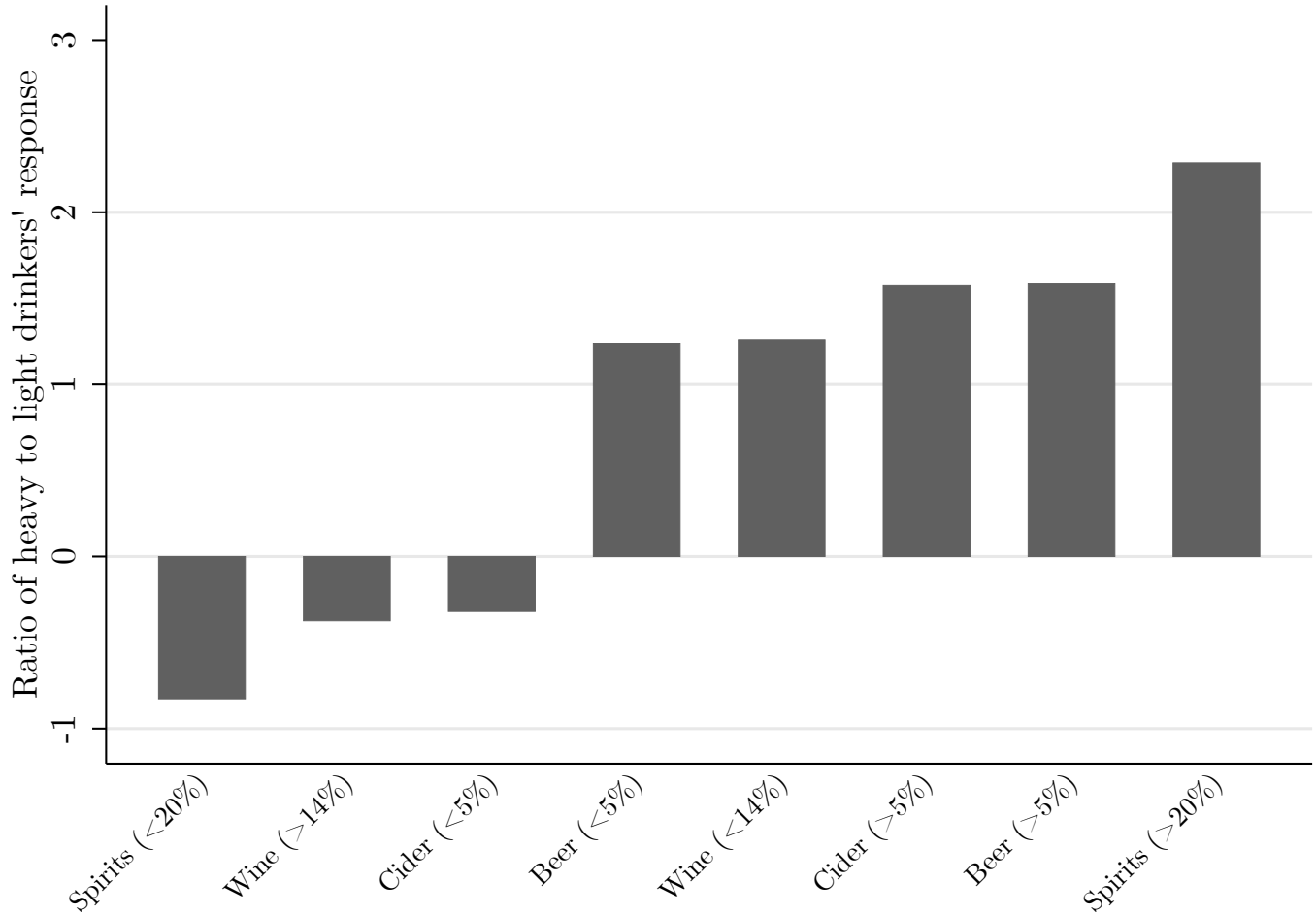
(a) Current UK system



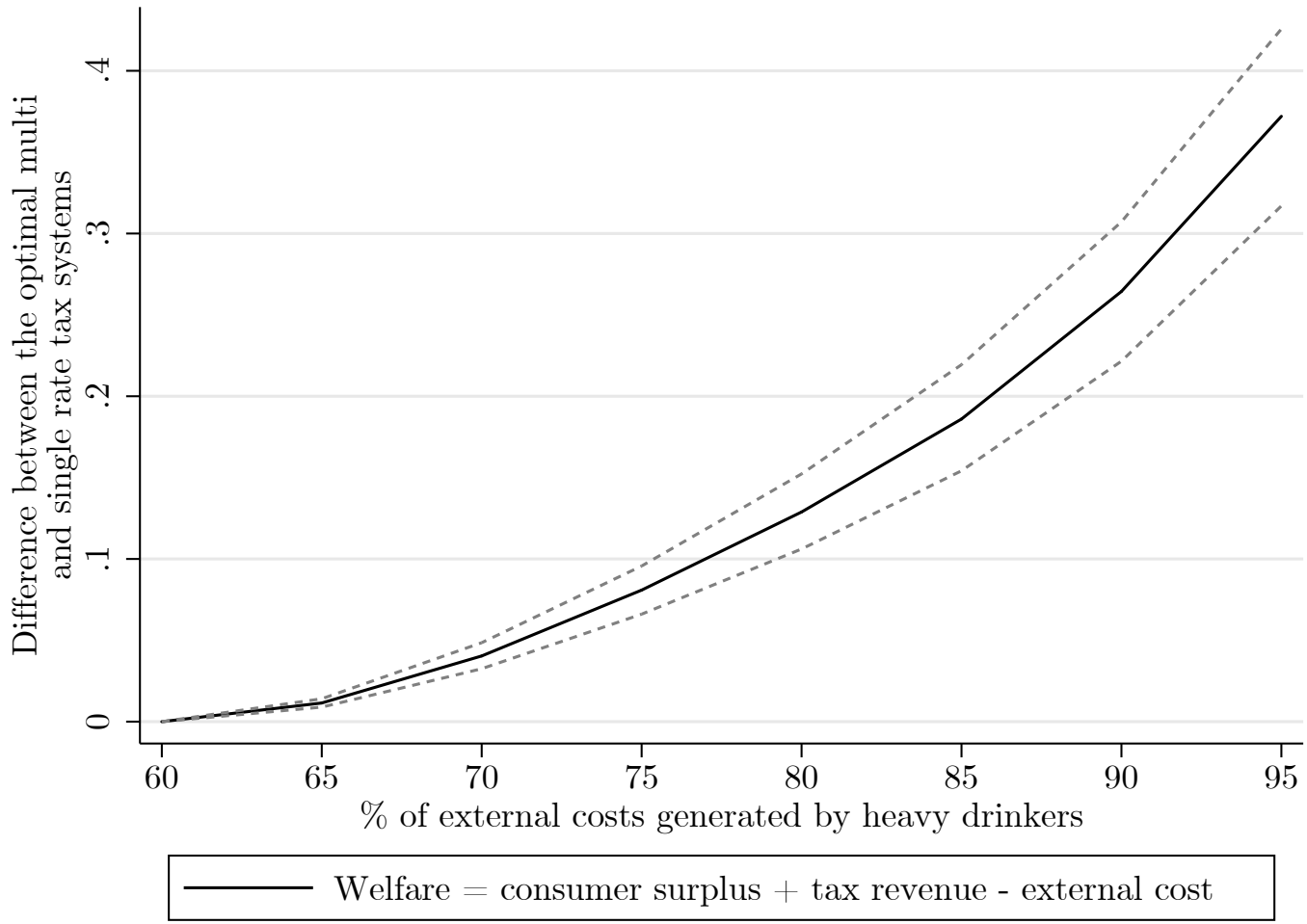
(b) Optimal UK system



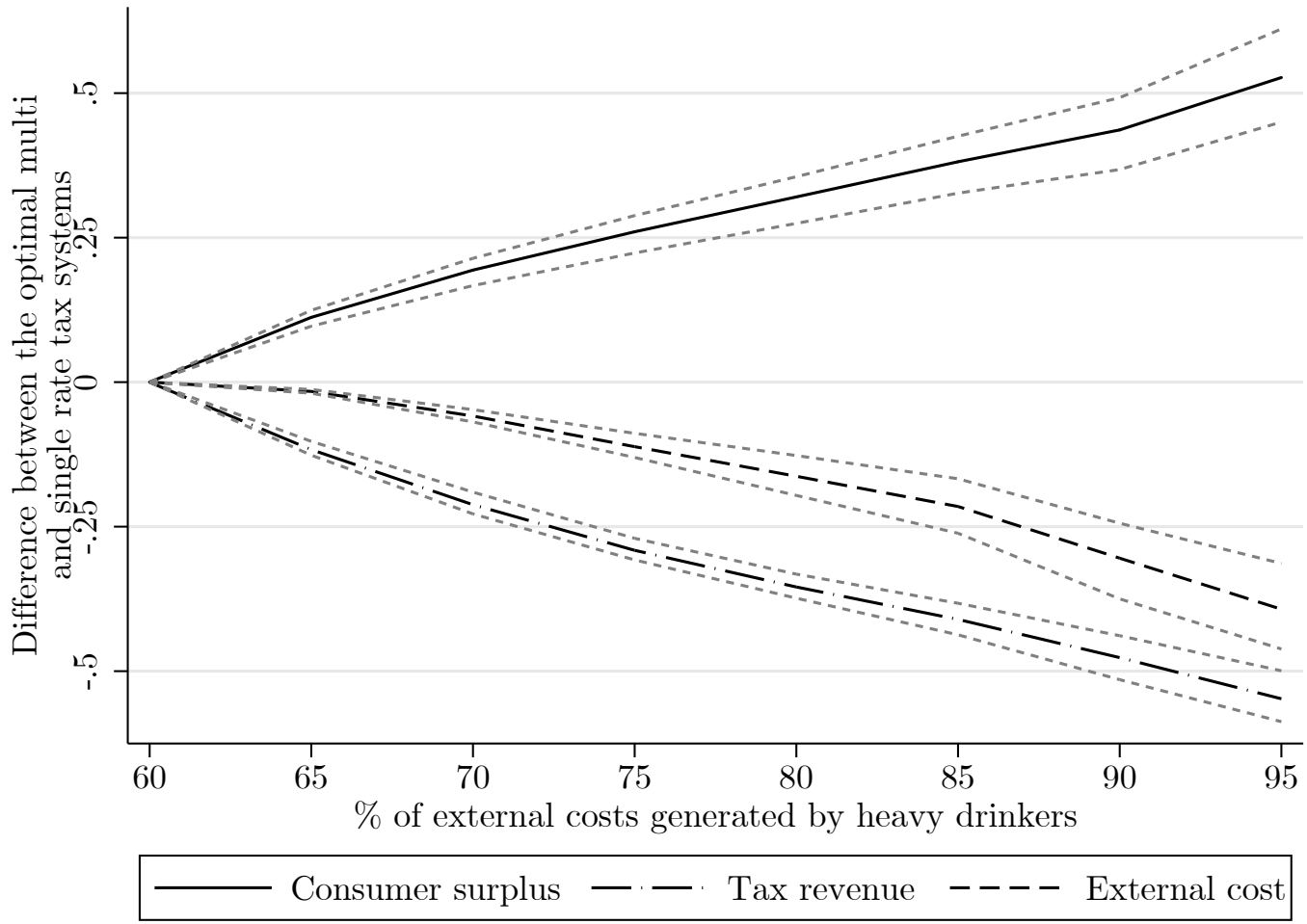
Response of heavy and light drinkers to increases in the price of different alcohol types



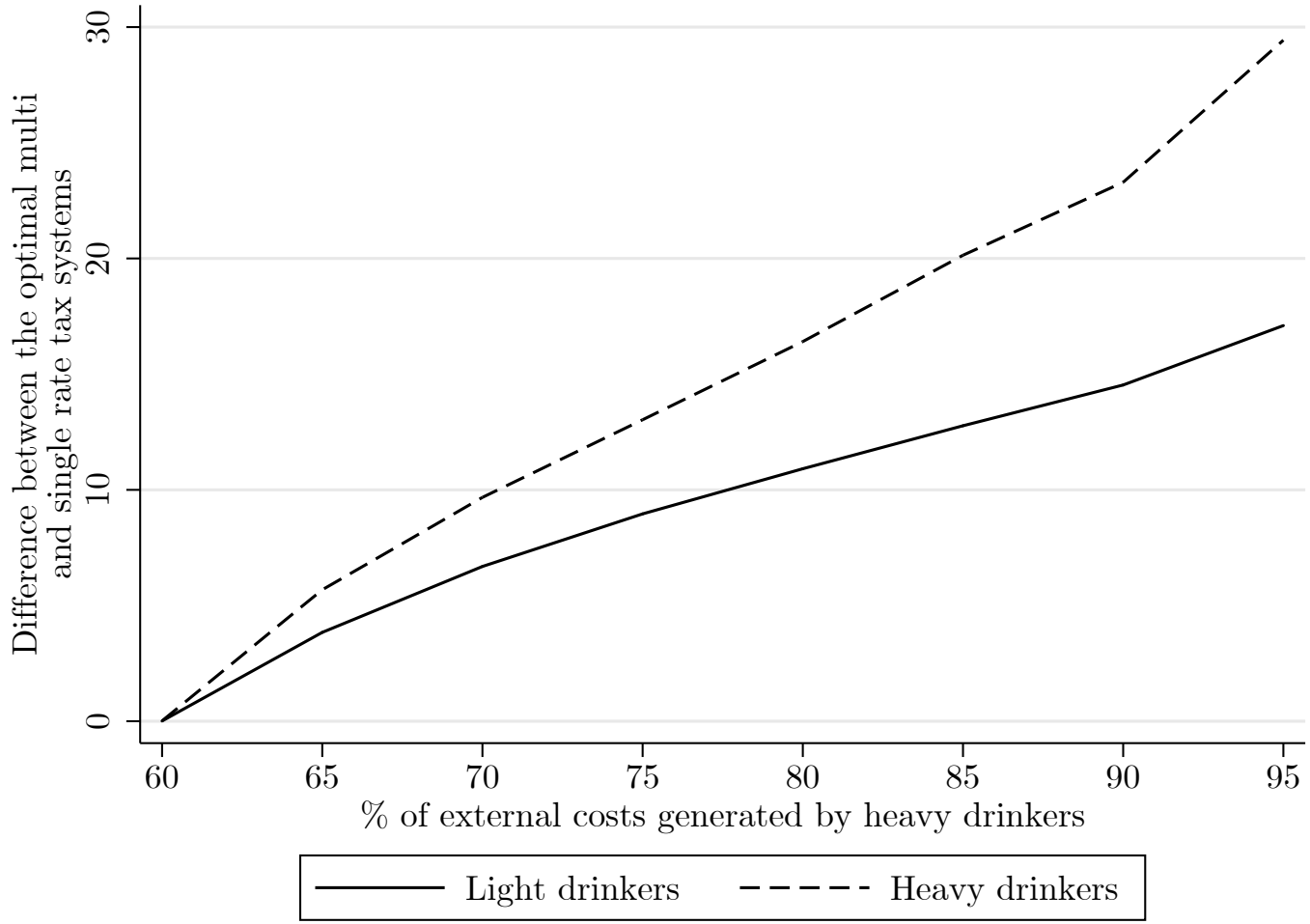
Comparison of optimal single and multi rate tax systems - total welfare



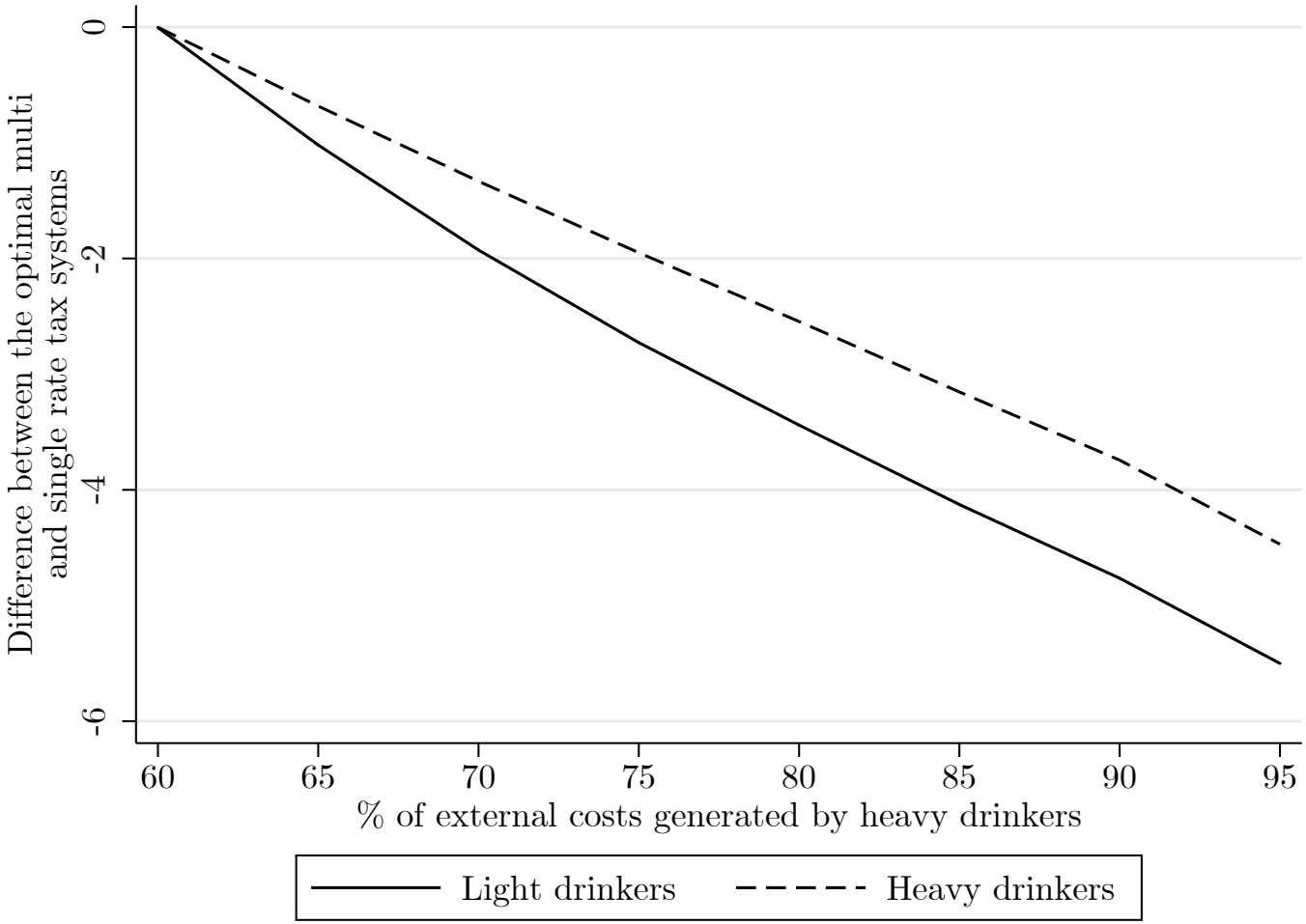
Comparison of optimal single and multi rate tax systems - consumer surplus, tax revenue, externality



Comparison of optimal single and multi rate tax systems for heavy and light drinkers - consumer surplus



Comparison of optimal single and multi rate tax systems for heavy and light drinkers - average tax rate faced



Summary and conclusions

We consider corrective tax design to correct consumption externalities in markets in which:

- marginal externalities vary across consumers
- there are many differentiated products
- there is potential correlation between marginal externalities and shape of demand, allowing the possibility to better target externality generating consumption

These ideas have empirical relevance in the UK alcohol market:

- an optimal system that varies rates across alcohol types would improve welfare relative to a single rate, if the externality function is convex

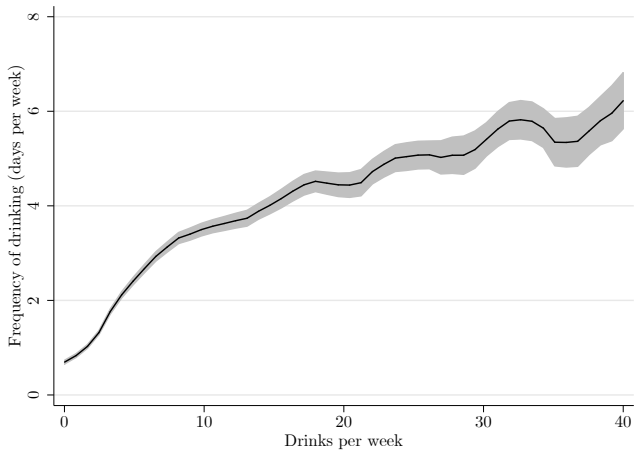
Thanks!


NO TAXATION WITHOUT INEBRIATION
BURP
THAT DOESN'T MAKE ANY SENSE.
NEITHER DO ANY OF THE OTHER ARGUMENTS AGAINST RAISING THE ~~BEER~~ TAX.
cider

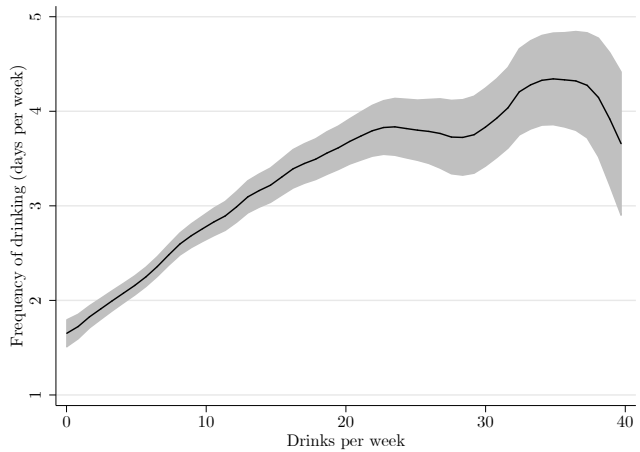
EXTRA SLIDES

Ethanol consumption, binge and frequency of drinking

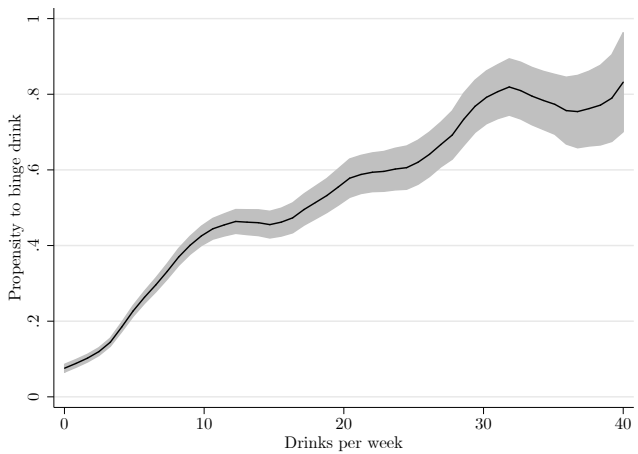
(a) UK: frequency of drinking



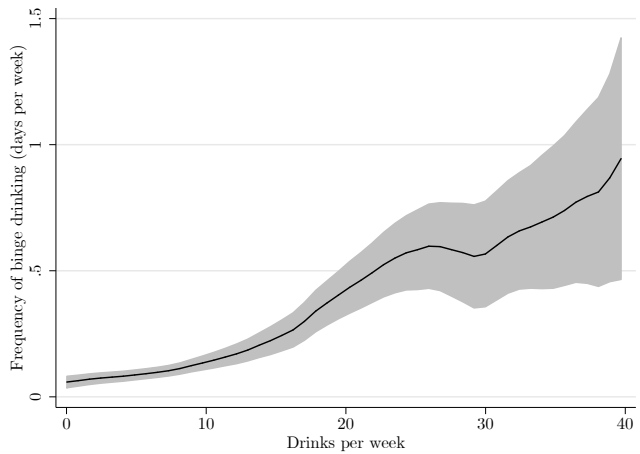
(b) US: frequency of drinking



(c) UK: binge drinking



(d) US: binge drinking



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Supply side considerations

The planner does not take account of the existence of positive mark-ups arising from imperfect competition:

- the UK supermarket segment is competitive

We assume complete pass-through of tax to consumer prices:

- can interpret the optimal tax rates as the change in consumer prices (per unit of ethanol) required
  - if pass-through is known, tax rates can be adjusted to ensure post-tax equilibrium prices are the optimal ones
- theoretical results showing relationship between degree of log-convexity of demand and pass-through
  - we find no relationship between the second derivatives of log demands and optimal tax rates

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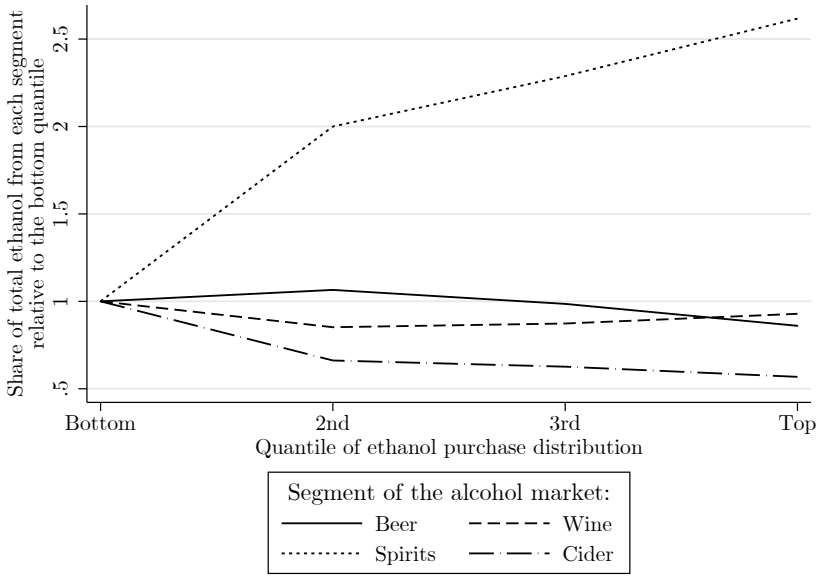
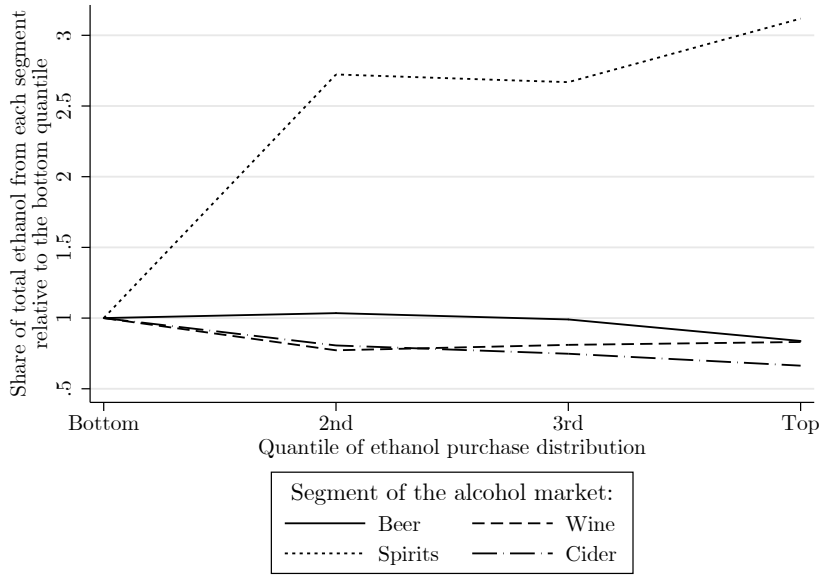
On- and off-trade alcohol purchases

(a) On and off-trade



(b) Off-trade only



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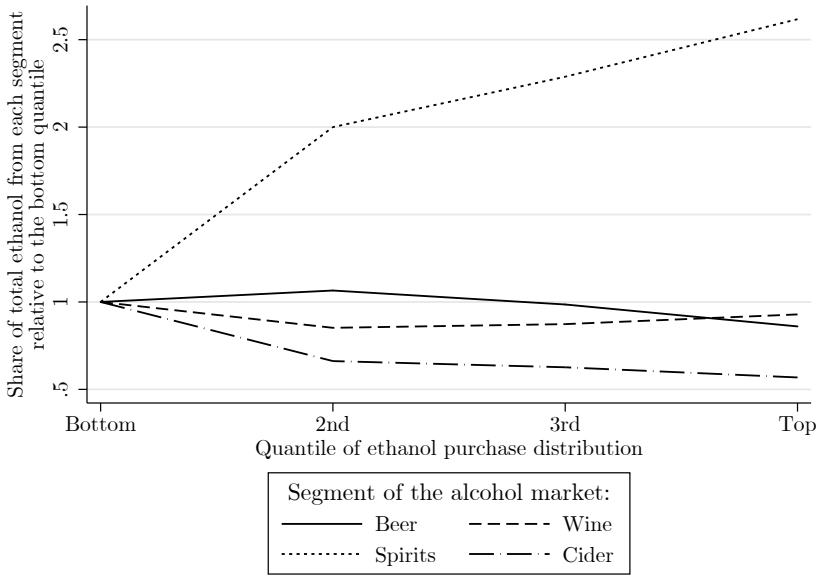
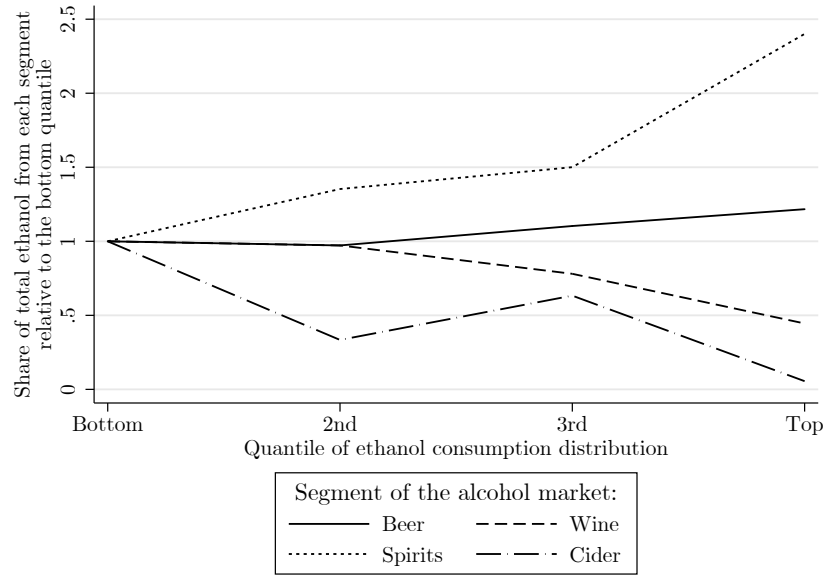
Variation in alcohol types bought across the total ethanol distribution

(a) UK



(b) US



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Data

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	LCFS	Kantar Worldpanel	
	All households	All households	Alcohol purchasers only
Number of households	5,691	18,713	11,634
Mean age of household's adult members	50.79	50.90	51.87
	[50.36, 51.22]	[50.68, 51.11]	[51.60, 52.14]
Number of household members	2.36	2.58	2.62
	[2.33, 2.39]	[2.56, 2.60]	[2.59, 2.64]
SES: Highly skilled	0.19	0.20	0.22
	[0.18, 0.20]	[0.20, 0.21]	[0.21, 0.23]
SES: Semi-skilled	0.53	0.57	0.58
	[0.51, 0.55]	[0.56, 0.58]	[0.57, 0.59]
SES: Unskilled	0.28	0.23	0.20
	[0.27, 0.29]	[0.22, 0.24]	[0.19, 0.20]
Region: North	0.34	0.35	0.35
	[0.33, 0.36]	[0.34, 0.35]	[0.34, 0.36]
Region: Central	0.34	0.33	0.33
	[0.33, 0.35]	[0.32, 0.33]	[0.32, 0.34]
Region: South	0.32	0.33	0.32
	[0.30, 0.33]	[0.32, 0.33]	[0.31, 0.33]

Instruments - tax changes in 2011

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Segment	Applies to products:	Rate changes (month)
Beer	1.8-2.8% ABV	+1.25 (March); -9.28 (Oct)
	2.8-7.5% ABV	+1.25 (March)
	>7.5% ABV	+1.25 (March); +4.64 (Oct)
Wine	5.5-15% ABV (still)	+16.23 (March)
	15-22% ABV (still)	+21.64 (March)
	5.5-8.5% ABV (sparkling)	+15.72 (March)
	8.5-15% ABV (sparkling)	+20.79 (March)
Spirits	0-100% ABV	+1.72 (March)
Cider	1.2-7.5% ABV	-0.14 (March)
	7.5-8.5% ABV	-0.17 (March)

Instruments - exchange rates and producer prices

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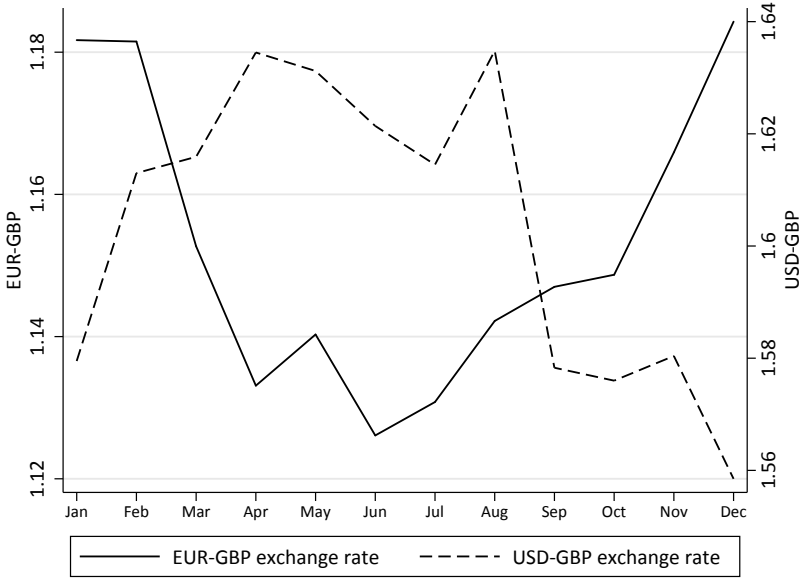
(a) Exchange rates



(b) Factory gate prices for beer and cider

Instruments - local economic conditions (wages)

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Retailer coverage in different regions

	Tesco	Sainsbury's	Asda	Morrisons	Discounter	Upmarket	Other
North East	19.3	10.0	27.6	18.7	5.9	2.6	16.0
North West	27.1	9.8	25.3	14.6	6.0	2.2	15.0
Yorkshire and Humber	23.3	9.9	21.3	23.3	4.8	2.5	14.9
East Midlands	29.9	13.2	17.8	15.8	5.4	2.6	15.3
West Midlands	26.0	15.6	19.6	14.8	6.2	2.8	14.9
East of England	39.3	16.5	13.6	9.6	4.2	4.4	12.4
London	31.7	26.2	11.9	7.2	3.3	6.4	13.2
South East	36.0	22.1	14.1	7.5	3.8	5.6	11.0
South West	34.5	17.4	14.9	11.4	6.0	4.2	11.5
Wales	34.0	6.8	22.1	12.1	7.7	2.3	14.9
Scotland	30.8	7.4	22.5	15.8	6.5	2.8	14.1

Dynamics in demand

Reduced form tests for evidence of:

- habit formation:
  - estimate probability of purchasing ethanol, and quantity purchased, as a function of quantity of ethanol previously purchased
  - once we condition on household fixed effects there is only a very weak relationship between past and current purchases
- stocking up:
  - estimate probability purchasing ethanol, and quantity purchased, as a function of constructed inventory variable (following Hendel and Nevo (2006))
  - find a very weak positive relationship between inventory variable and current purchase

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Coeffient estimates I

Household group:	< 7	7-14	14-21	21-35	> 35
Panel A: Preferences for observable product characteristics					
Means					
Price	-0.327	-0.258	-0.254	-0.273	-0.283
	(0.039)	(0.028)	(0.025)	(0.023)	(0.024)
Beer*Total ethanol content	0.271	0.268	0.229	0.232	0.238
	(0.022)	(0.016)	(0.014)	(0.014)	(0.014)
Wine*Total ethanol content	0.030	0.036	0.047	0.064	0.107
	(0.025)	(0.017)	(0.015)	(0.014)	(0.013)
Spirits*Total ethanol content	0.336	0.144	0.089	0.049	0.064
	(0.061)	(0.057)	(0.041)	(0.047)	(0.039)
Cider*Total ethanol content	0.224	0.181	0.183	0.208	0.187
	(0.029)	(0.022)	(0.020)	(0.022)	(0.020)
Beer*Total ethanol content^2	-0.339	-0.337	-0.221	-0.201	-0.191
	(0.030)	(0.021)	(0.017)	(0.017)	(0.018)
Wine*Total ethanol content^2	0.056	0.070	0.107	0.121	0.057
	(0.046)	(0.027)	(0.021)	(0.020)	(0.017)
Spirits*Total ethanol content^2	-0.415	-0.108	0.008	0.091	0.095
	(0.085)	(0.080)	(0.056)	(0.063)	(0.051)
Cider*Total ethanol content^2	-0.486	-0.269	-0.263	-0.267	-0.169
	(0.076)	(0.052)	(0.046)	(0.057)	(0.040)

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Coeffient estimates II

Household group:	< 7	7-14	14-21	21-35	> 35
Panel A: Preferences for observable product characteristics					
Variances					
Price	0.043	0.047	0.068	0.061	0.053
	(0.009)	(0.006)	(0.007)	(0.006)	(0.004)
Total ethanol content	0.010	0.006	0.009	0.012	0.009
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Strength	0.312	0.490	0.387	0.332	0.374
	(0.037)	(0.041)	(0.030)	(0.022)	(0.030)
Covariances					
Price*Total ethanol content	-0.018	-0.014	-0.023	-0.026	-0.021
	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)
Price*Alcohol strength	-0.013	-0.058	-0.050	0.020	0.012
	(0.011)	(0.009)	(0.010)	(0.006)	(0.005)
Total ethanol content*Alcohol strength	-0.016	-0.005	-0.003	-0.018	-0.005
	(0.005)	(0.003)	(0.003)	(0.003)	(0.002)

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Coeffient estimates III

Household group:	< 7	7-14	14-21	21-35	> 35
Panel B: Preferences for unobserved product characteristics					
Mean product effects for each segment					
Beer	-1.338	-1.144	-0.969	-0.849	-0.830
	(0.037)	(0.030)	(0.030)	(0.028)	(0.031)
Wine	-6.467	-5.496	-5.067	-4.167	-4.290
	(0.134)	(0.112)	(0.113)	(0.101)	(0.116)
Spirits	-6.279	-4.472	-3.751	-2.872	-3.297
	(0.305)	(0.297)	(0.232)	(0.286)	(0.240)
Cider and FABs	-8.143	-5.648	-4.042	-1.958	-2.697
	(0.693)	(0.675)	(0.524)	(0.657)	(0.542)
Variances					
Beer	2.303	2.109	2.895	2.292	1.805
	(0.199)	(0.209)	(0.234)	(0.188)	(0.144)
Wine	1.817	1.505	2.341	2.494	1.525
	(0.172)	(0.128)	(0.199)	(0.181)	(0.119)
Spirits	1.016	0.431	2.121	1.007	2.191
	(0.264)	(0.087)	(0.294)	(0.119)	(0.209)
Cider and FABs	1.766	3.688	3.301	2.582	3.069
	(0.226)	(0.322)	(0.323)	(0.242)	(0.274)
Product effects			Yes		
Type-time effects			Yes		
Control function			Yes		
Number of households			2250		
Number of purchase occasions			56250		

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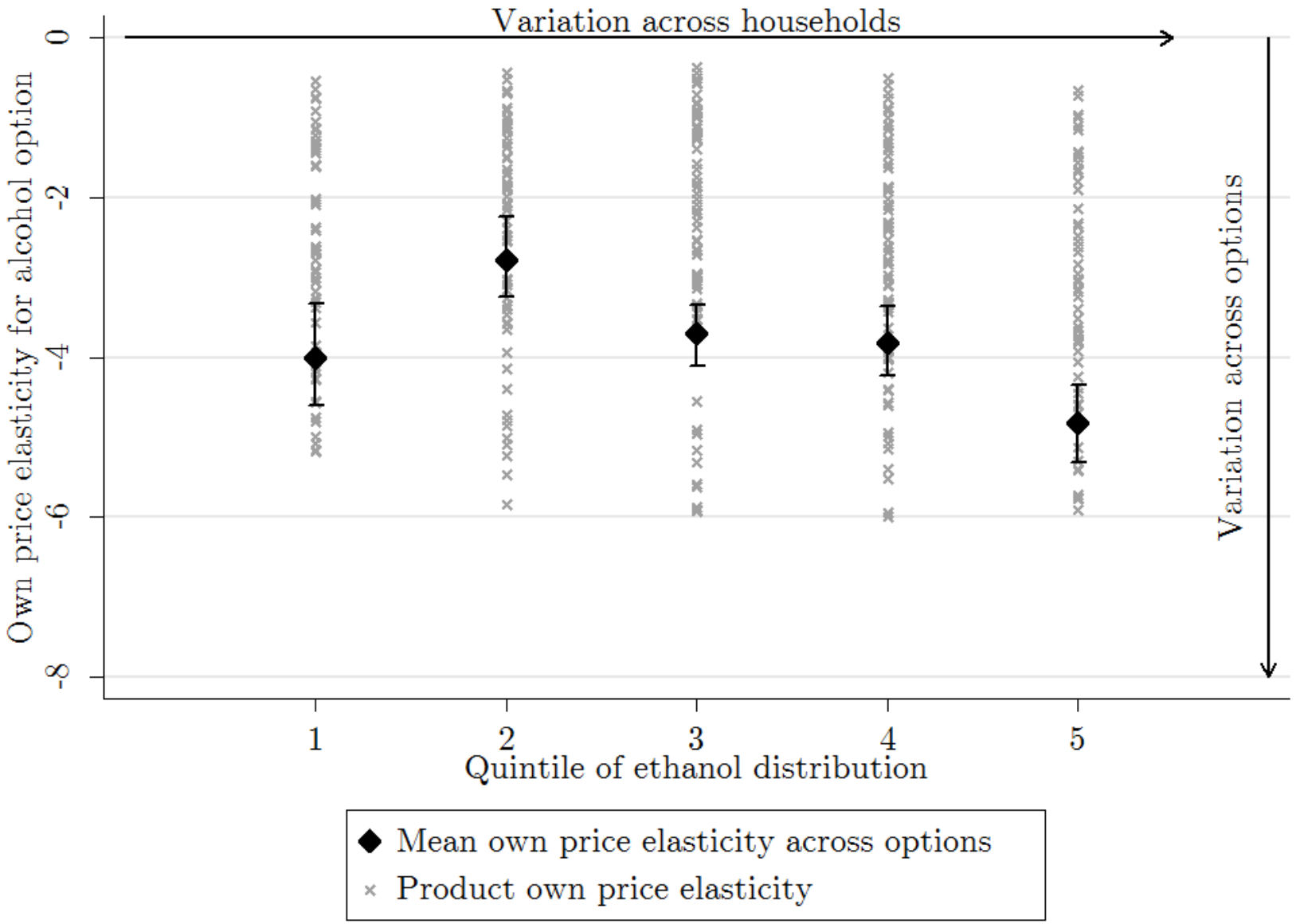
Product own price elasticities



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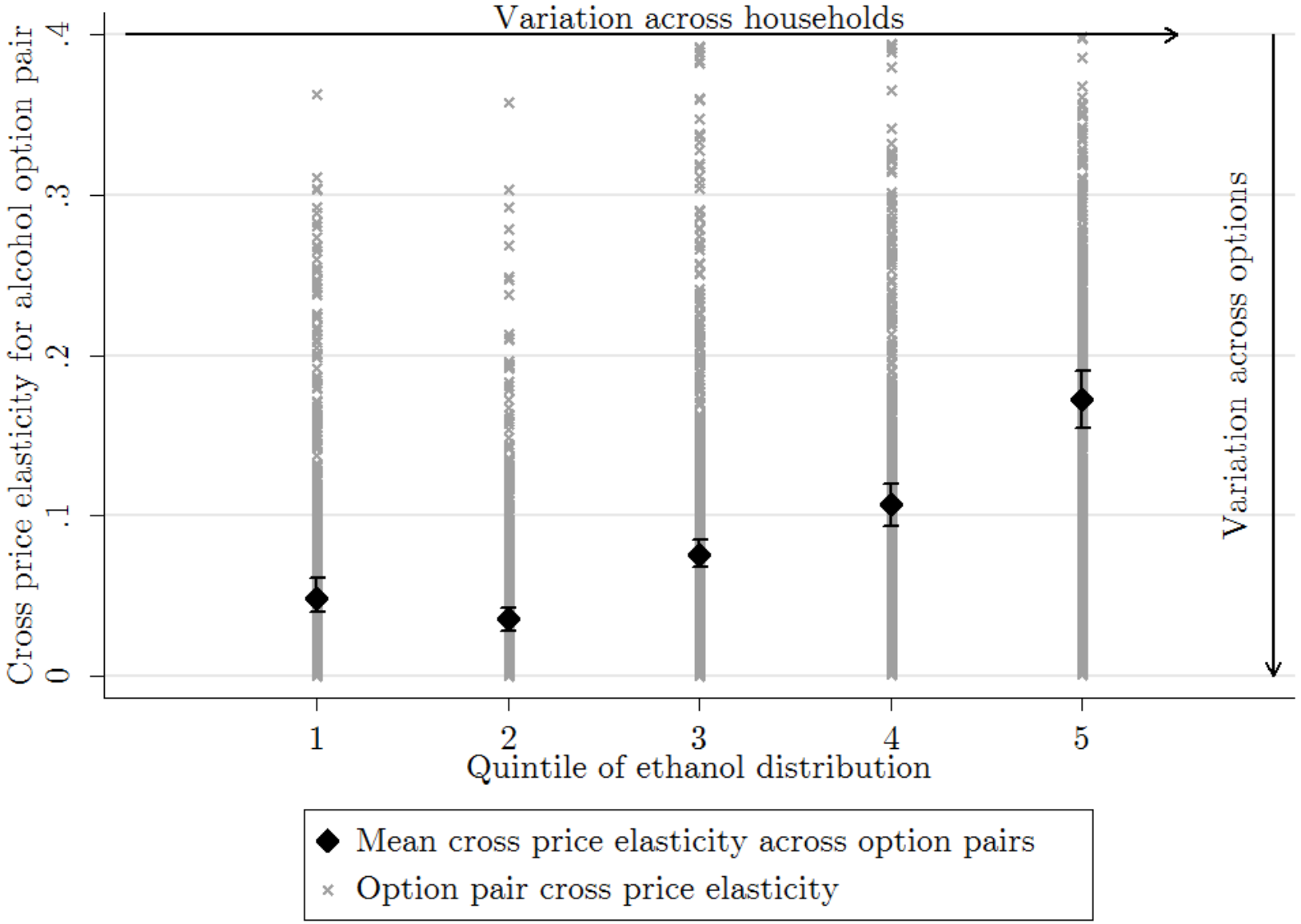
Product cross price elasticities



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