Challenges in simulating 'fat & soda' taxes based on demand elasticity estimates

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Outline

1. Background

2. The challenges
   - Capturing substitutions
   - Capturing 'actual' price changes
   - Nonlinear elasticities

3. Some remarks for discussion

Aim of this presentation

- A flexible 'filler' before the coffee break (be short!)
- Raise some points for discussion with experts of demand analysis

Background: Simulating demand response to soda taxes

Ex-ante evaluations of the potential effects of (soda) taxes often rely on demand estimates:

- Estimate a demand model (typically a system AIDS, QAIDS, EASI...)
- Impose an (average) price change for taxed drinks based on the tax rate
- Predict consumption (purchase) response using estimated elasticities

Some examples:

- Caro et al. (Food Policy, 2017, Chile) $\rightarrow$ Effective
- Tiffin et al. (Health Economics, 2014, UK) $\rightarrow$ Effective
- Harding and Lovenheim (Journal of Health Economics, 2017, US) $\rightarrow$ Effective
- Vecino-Ortiz and Arroyo-Ariza (Plos One, 2018, Colombia) $\rightarrow$ Effective

However, most ex-post evaluations found smaller effects than expected, especially for small taxes

Some challenges in demand estimation

Why are demand-based simulations inconsistent with ex-post evaluations?
Some hypotheses...

- Ability to capture the substitution patterns
  - Level of product aggregation and range of substitute products
  - Heterogeneity in substitutions
  - Changes in substitute prices
- Unit values vs. prices (overestimation of elasticities)
- Non-linear elasticities (and price changes outside the data support)
- Asymmetric response to price increases and decreases (loss aversion)
- Accounting for habit formation (not discussed here... and little discussion in general?)

Estimation of (cross-)price elasticities

The estimation of cross-price elasticities from demand model is sensitive to the researcher choices

- The basket of goods (or the "choice set" for DCMs), and conditional demand systems tend to return higher price elasticities
- The level of product disaggregation, higher disaggregation (e.g. UPC level) leads to higher price elasticities
- As substitutions are heterogeneous across consumers, "average" elasticities may be misleading (here DCMs win)

Table IV. Predicted price elasticities for 2008 in high-income countries ($n = 2515$, 37 studies)

	Price change						
Consumption change	Fruit & veg	Meat	Fish	Dairy	Cereals	Fats & oils	Sweets
Fruit & veg	**-0.53*****	0.002	0.010	-0.030***	0.048*	-0.033	0.060***
Meat	-0.009	**0.60*****	0.016	-0.018	0.045*	-0.003	0.049**
Fish	-0.015*	0.042*	**0.61*****	-0.032**	0.075*	0.012	0.046
Dairy	-0.03**	0.001	0.004	**-0.60*****	0.100***	0.023	0.057**
Cereals	-0.02**	0.000	0.013	0.039**	**-0.43*****	-0.013	0.048**
Fats & oils	-0.017	-0.046	-0.037	-0.007	0.054	**-0.42*****	0.043
Sweets	-0.007	0.000	0.020	0.004	0.057**	0.003	**-0.56*****
n	630	525	260	366	332	123	279

Figure: Meta-analysis by Cornelsen et al. (Health Economics, 2014)

The challenge of measuring prices

- Household budget surveys and homescan data collect the prices of purchased products.
- This implies that these are not the actual shelf prices driving the consumer choice, but they embed a consumer choice dimension.
- This unit value problem is well known and can be addressed, but (a) it is not yet clear how well; (b) it is often ignored
- The problem is more serious with aggregate categories
- Elasticities from unit values are inflated

	1st quartile		3rd quartile		Interquartile range		
	Unit value	Price	Unit value	Price	Unit value	Price	Tax
Coca-cola can	0.53	0.55	0.68	0.63	0.15	0.09	0.03
Soft drinks	0.77	0.89	1.58	1.49	0.81	0.60	0.10

Figure: Our processing on Nielsen consumer panel, 2019-20

Nonlinear elasticities (and predictions outside the data support)

- Do consumers react equally to price increases and price decreases?
- Is the (average) response in purchases to a 10% price increase twice of response to a 5% price increase?
- Is the simulated price change within the range of price changes observed in the data-set?
- Elasticities estimated prior to a tax are based on changes in individual product prices, but the tax is applied at the product category level (see aggregation)
- Does the Lucas critique apply? Signalling effects?

Allowing for loss aversion

Difference in quantity consumed in response to the simulated fiscal intervention.

	Without Reference Price			With Reference Price	
	Quantity	Tax	Subsidy	Quantity	Tax
Sugar free soft drinks	1.76	0.07 (0.013)	0.12 (0.020)	1.75	0.08 (0.017)
SSBs sugar < 5g	1.47	0.18 (0.011)	−0.07 (0.013)	1.46	0.22 (0.013)
SSBs sugar $5-8$g	0.21	−0.02 (0.003)	0.01 (0.004)	0.22	−0.03 (0.003)
SSBs sugar > 8g	1.66	−0.43 (0.008)	0.01 (0.011)	1.64	−0.46 (0.008)
Water	0.86	−0.16 (0.016)	1.52 (0.077)	0.85	−0.14 (0.019)
Beer and cider	1.20	−0.03 (0.010)	0.14 (0.033)	1.22	−0.02 (0.012)
Taxed SSBs	1.87	−0.45 (0.009)	0.02 (0.011)	1.86	−0.49 (0.009)
Non-taxed drinks (exc. Beer)	4.10	0.09 (0.023)	1.57 (0.080)	4.06	0.16 (0.028)

Notes: Standard error in parentheses. Quantity = baseline quantity in liters/week. The tax and subsidy columns report estimated cha quantities consumed (in liters/week) under the tax and subsidy scenarios. The simulated tax follows the UK sugar tax scheme, i.e. 18 drinks with 5-8g sugar/100ml and 24p/litre for drinks with more than 8g sugar/100ml; the simulated subsidy envisages a 15p/liter dis drinks and water

Figure: Simulating tax effects with and without loss aversion; Biondi et al., JEBO (2020)

Some points for discussion

- Many issues, but several of them may be irrelevant (comparison between ex-ante simulation and quasi-experimental?)
- One point is clear: with significant own-price elasticities and low substitution elasticities, tax are always predicted to have an impact
- Are non-price effects of taxation under-investigated?