# Evaluating Marginal Internalities: a new Approach

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Abstract

This paper develops a new sufficient statistic approach for estimating the marginal internality from sin good consumption. It models a biased consumer who faces uncertain health harms and receives mandatory health insurance. I show that the marginal internality can be identified by observing how sin good demand reacts to changes in health insurance coverage. The method does not require to recover the true willingness to pay for the sin good or to elicit consumers' biases using surveys. I calibrate the model to sugary drinks consumption. My results are consistent with studies that use survey-based measures of biases.

**JEL-Classification:** D11, D62, H21, H31, I12, I13, I18.
**Keywords:** marginal internality, self-control, biased beliefs

## Motivation

Sin good consumers may lack self-control or knowledge about the health harms of consumption. Hence, they impose internalities on themselves. Behavioral welfare analysis requires a measure of the the money-metric marginal internality (Allcott et al., 2019b). Previous research uses surveys to measure consumer biases. I develop a new sufficient statistic approach that does not require information about individuals' biases to measure the internality. Also, it does not require to know the true willingness to pay of consumers.

## The model

- **Period 1:**
  Individual uses income $Y_1$ to purchase sin good $X$, numeraire good $Z_1$, and pay public health insurance premium $P$. Government provides health insurance, taxes sin good at rate $\tau$ and returns tax revenues as a lump-sum transfer $\ell = \tau X$:

$$Y_1 - P + \ell = Z_1 + (p + \tau)X$$

- Probability of illness: $\pi(X)$ ($\pi'(X) > 0$), where illness $:= H^h \to H^s$, with $H^i$ = health level in state $i = s, h$
- **Period 2:**
  Individual has medical costs $M$ in sick state and insurance provides coverage $I$:

$$Y_2 = \begin{cases} Z_2^h, & \text{if healthy } (H^h), \\ Z_2^s + M - I, & \text{if sick } (H^s). \end{cases}$$

## Utility

- **Long-Term (True) Expected Utility:**

$$EU = U^1(Z_1, H^h, X) + \delta\Big\{\pi(X)U^s(Z_2^s, H^s) + [1 - \pi(X)]U^h(Z_2^h, H^h)\Big\}$$

- **Perceived Expected Utility:**

$$\widehat{EU} = U^1(Z_1, H^h, X) + \delta\beta\Big\{\widehat{\pi}(X)U^s(Z_2^s, H^s) + [1 - \widehat{\pi}(X)]U^h(Z_2^h, H^h)\Big\},$$

where we have

1. present-bias, if: $\beta < 1$
2. biased beliefs, if: $\widehat{\pi}(X) \neq \pi(X)$

## Money-metric marginal internality: Definition

The marginal internality is defined as

$$\tau^b = \delta[\beta\widehat{\pi}' - \pi']\frac{[U^s(\cdot) - U^h(\cdot)]}{U_Z^1(\cdot)}$$

## Money-metric marginal internality: Sufficient Statistic Formula

To back out the marginal internality, I derive the effect of insurance coverage $I$ on sin good demand $X$:

$$\tau^b = \underbrace{-\frac{U^s(\cdot) - U^h(\cdot)}{U_Z^s(\cdot)}}_{\substack{\text{monetary value of utility} \\ \text{loss due to sickness}}} \left[\frac{\epsilon_{X,I}}{\epsilon_{X,q}^C} + \underbrace{\frac{\delta\pi' U_Z^s(\cdot)}{U_Z^1(\cdot)}}_{\text{out-of-pocket costs}\downarrow} + \underbrace{\frac{\pi}{1+r}\frac{\epsilon_{X,Y_1}}{\epsilon_{X,q}^C}}_{\text{insurance premium}\uparrow}\right], \quad (1)$$

with

$$\begin{aligned} q &= p + \tau, \\ \epsilon_{X,I} &= \text{ semi-elasticity of sin good demand wrt insurance coverage,} \\ \epsilon_{X,q}^C &= \text{ compensated price semi-elasticity of sin good demand,} \\ \epsilon_{X,Y_1} &= \text{ income semi-elasticity of sin good demand.} \end{aligned}$$

## Intuition behind Estimation of Marginal Internality

If the consumer is rational, then a change in health insurance coverage affects sin good demand only through its effects on insurance premium and out-of-pocket costs. In this case, the terms in brackets in Equation (1) should sum up to zero. If the individual makes mistakes in sin good demand, then the insurance also affects the marginal internality. This effect is given by the terms in brackets in (1). Multiplying it with the money-metric utility loss in the sick state gives the marginal internality.

## Proposition

The money-metric marginal internality $\tau^b$ can be determined using (1) without information on present-bias $\beta$ and beliefs $\widehat{\pi}(X)$.

1. If first-period utility is of the form $U^1(Z_1, H^h, X) = U^h(Z_1, H^h) + V(X)$, then (1) can be estimated without additional assumptions about $V(X)$.
2. If health insurance is optimal, then $\tau^b$ can be estimated without any assumptions regarding first-period utility $U^1(Z_1, H^h, X)$.
3. If health insurance is optimal and second-period utility is state-independent, then $\tau^b$ can be approximated without further assumptions about $U^1(Z_1, H^h, X)$ and $U(Z_2^i, H^i)$.

## Calibration

- **Utility:**

$$U^i(Z^i, H^i) = (1 + \varphi \mathbb{1}_{i=s})\frac{Z^{i\,1-\gamma}}{1-\gamma} + \phi H^i,$$

  where $\mathbb{1}_{i=s} = \{0, 1\}$, $\gamma$ = relative risk aversion ($\gamma > 0$) and $\varphi$ = the state dependence of utility, $\phi$ = marginal utility from health.
- **Health:**
  Sick: having more than the median # chronic diseases of > 50 year olds (Finkelstein et al., 2013)
  Use data on chronic diseases from NHANES (1999-2018)
  $H^i$ = QALY mapped from subjective health, $\phi$ : derived from willingness to pay for QALY (Finkelstein et al., 2019)
- **Elasticities:**
  $\epsilon_{X,I}$=0 (Cotti et al. (2019), He et al. (2020))
  Income and price elasticities from Allcott et al. (2019a)

## Results

Additional notation: $\tau^{\xi}$ = marginal externality via health insurance, $b \equiv I/M$ = share of costs covered by insurance

Table: Results from the benchmark calibration (1 oz. $\approx$ 30 ml).

| | $\tau^b$ in ¢/oz | $\frac{\beta\widehat{\pi}'(X)}{\pi'(X)}$ | $\tau^{\xi}$ in ¢/oz | $\tau^*$ in ¢/oz | $b^*$ |
|---|---|---|---|---|---|
| **Proposition 1** *(i)* | 1.08 | 0.023 | 0.851 | 1.94 | 0.842 |
| **Proposition 1** *(ii)* | 1.1 | 0.023 | 0.851 | 1.951 | – |
| **Proposition 1** *(iii)* | 1.32 | 0.023 | 0.851 | 2.171 | – |

## Extensions

- **Private health insurance**: the sin good demand's health insurance elasticity, $\epsilon_{X,I}$, is replaced by the elasticity after crowding out of private insurance takes place (taken into account in previous calibration, results remain unchanged)
- **Multiple sin goods**: when there are multiple sin goods, the marginal internality of each good can be identified. Calibration adding diet soda affects the estimated $\tau^b$ only slightly.
- **Life expectancy effects**: life expectancy likely declines in sick state. In the case of sugary drinks, this has small effects on the numerical results.

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