An Economic View of Corporate Social Impact

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Increasing focus on companies' social impact

- 1/3 of U.S. professionally managed assets ($17 trillion) consider environmental, social, and governance issues (SIF Foundation 2020)
  - More than doubled since 2015

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- Arguments that firms should maximize something other than profits
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  - British Academy (2018): "Corporate purposes should include public purposes that relate to the firm's wider contribution to public interests and societal goals"

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  - British Academy (2018): "Corporate purposes should include public purposes that relate to the firm's wider contribution to public interests and societal goals"
- Question: how do we measure corporate social impact?

This paper

1. Conceptual framework: corporate social impact $\coloneqq$ social welfare loss from a firm's exit in equilibrium
2. Quantify social impact in the U.S. for 75 large companies in 12 industries

Agenda

1. Background
2. Model
3. Data
4. Descriptive results
5. Product market estimation
6. Labor market estimation
7. Corporate social impact estimates

Background

Background: existing rating systems

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IMPACT-WEIGHTED FINANCIAL ACCOUNTS:

The Missing Piece for an Impact Economy

Example: Just Capital

Workers

RANKING
WEIGHT: 35%

How a company invests in its employees.

Customers

RANKING
WEIGHT: 24%

How a company treats its customers.

Communities

RANKING
WEIGHT: 18%

How a company supports its communities.

Environment

RANKING
WEIGHT: 11%

How a company reduces its environmental impact.

Shareholders

RANKING
WEIGHT: 11%

How a company delivers value to its shareholders.

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Poll Americans to Identify the Issues That Matter Most.

Evaluate Companies on the Issues People Care About.

Rank America's Largest Publicly Traded Corporations.

Just Capital customers issues

How we measure Customers issues

A company's Customer score is determined by factors ranging from data privacy to the creation of quality, beneficial products. The way a company treats its customers makes up 24% of its score in the Rankings.

Makes products that do not harm

Offers products or services that are not harmful to health, the environment, or society.

Ranking weight: 4.7% Learn more >

Makes safe and reliable products

Creates products that are reliable, safe, and durable.

Ranking weight: 4.5% Learn more >

Protects customer privacy

Prioritizes customer privacy and stores customer data securely.

Ranking weight: 3.3% Learn more >

Makes fairly priced products

Provides products and services of good value and does not price them unfairly.

Ranking weight: 3.1% Learn more >

Treats customers fairly and inclusively

Just Capital environment issues

How we measure Environment issues

Environmental issues make up 11% of a company's overall score in the Rankings, with practices like waste reduction and efficient energy usage forming the basis for how we evaluate companies.

Minimizes pollution

Mitigates health impacts caused by pollution and cleans up any environmental damage it causes.

Ranking weight: 4.6% Learn more ›

Protects the environment

Follows all environmental laws and regulations and establishes policies and systems that protect the environment.

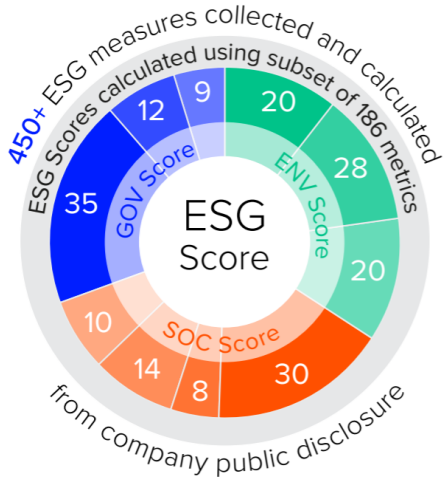
Ranking weight: 3.8% Learn more ›

Uses resources efficiently

Maximizes use of renewable energy, recycles, and prioritizes resource efficiency.

Ranking weight: 2.8% Learn more ›

Example: Refinativ



Environmental
- Resource use
- Emissions
- Innovation

Social
- Workforce
- Human rights
- Community
- Product responsibility

Governance
- Management
- Shareholders
- CSR strategy

Category definitions are available in Appendix F.

Concerns

- How to weight and combine different measures?
- Substantial disagreement across rating systems (Chatterji et al. 2015; Berg, Koelbel, and Rigobon 2022; Christensen, Serafeim, and Sikochi 2022)

Initial insight

Economics offers a useful toolkit for *clarifying* concepts and *quantifying* social impact in dollars

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How a company invests in its employees.

Worker surplus

Customers

RANKING
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How a company treats its customers.

Consumer surplus

Communities

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WEIGHT: 18%

How a company supports its communities.

Environment

RANKING
WEIGHT: 11%

How a company reduces its environmental impact.

Externalities

Shareholders

RANKING
WEIGHT: 11%

How a company delivers value to its shareholders.

Producer surplus

Enterprise impact vs. investment impact

- Brest and Born (2013), others: firm *f*'s social impact $\neq$ social impact of investing in *f*
- Example (Green and Roth 2020): in equilibrium, investment in *f* displaces other profit-motivated investors, who instead invest in other firms with low social impact
- Reasons why a firm's social impact matters:
  - Firms want to assess their performance (product/investment decisions, incentive pay, etc.)
  - Investors, workers, and consumers may want to *associate* themselves with high-impact firms (Bonnefon et al. 2022)
  - A firm's social impact is one input to optimal impact investing strategies in many models
    - Chowdhry, Davies, and Waters (2019), Green and Roth (2020), Oehmke and Opp (2020), Roth (2021)

Model

Model sketch

- Many product markets: autos, airline travel, cigarettes, ..., and numeraire details
- Many local labor markets and employers

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- People choose products and employer to maximize utility
  - Cigarettes & soda: maximize *perceived* utility, misoptimize due to “internalities”
- Externalities distributed equally across people
- Profits distributed unequally across people
- Social welfare: Pareto-weighted sum of individual utility

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Two notions of corporate social impact:

1. *Individual impact*: welfare loss from f's exit, while competing firms remain in market
2. *Share of industry impact*: f's Shapley value for the social welfare loss if *all* firms exit

Example limitations

Welfarist moral philosophy:

- May not capture full importance of diversity and inclusion
- May not be as well-suited as a process approach to value *practices* such as political lobbying and governance structures

Assumptions for empirical implementation

1. Social marginal welfare weights $\propto$ 1/income (Saez 2002; Chetty 2006; Saez and Piketty 2013; Allcott, Lockwood, and Taubinsky 2019)
2. Quasilinear, additively separable utility
3. Intermediate goods produced in perfectly competitive markets with no externalities
4. Each firm a "small" part of the labor market, so exit does not affect other firms' wage offers
5. Each firm makes one representative product at baseline price $p_f = \$1$, with exogenous characteristics and cost function

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Example limitations:

- Ignore pollution and worker surplus at suppliers
- Ignores interactions between product and labor markets (e.g., GM labor demand $\uparrow$ when Ford exits)
- Ignore how competitors might adjust product lines and production functions
  - Social impact depends on time horizon

Necessary ingredients

1. Model of counterfactual prices and quantities
2. Data to quantify key parameters

Data

Survey overview

- Key question: how hard is it for a firm's consumers and workers to find substitutes?

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- 11 differentiated product markets
  - Autos, airlines, CPG (cereal, cigarettes, carbonated soft drinks, beer, yogurt, toothpaste), grocery retail, chain restaurants, and smartphones

Product market questions (autos example)

- **Consumption**: Do you currently own or lease a vehicle?
  - *Yes | No*
- **Most recent brand**: What brand is your vehicle?
  - *Acura | Chevrolet | Ford | ...*
- **Customer satisfaction**: Overall, how satisfied are you with [Chevrolet]?
  - *0 (not at all satisfied) | ... | 10 (extremely satisfied)*
- **Firm price response**: Imagine that the price of all [Chevrolet] vehicles and all other vehicles made by [General Motors] were **25%** higher. Would you still have chosen a [Chevrolet], or some other vehicle made by [General Motors], even at the higher price?
  - *Yes | No*
- **Aggregate price response**: Now imagine that the price of all vehicles doubled. Would you still have a vehicle?
  - *Yes | No*

Labor market questions

- Employment status, employer size, industry, occupation, annual salary, and worker satisfaction

- **Worker price response**: Imagine your primary employer faced major new competition and had to permanently cut everyone's salary by **10%**. Would you keep working there, even at the lower salary?
  - *Yes | No (I'd get a new job or stop working)*

Descriptive statistics

- 3,544 valid responses
- Results weighted for national representativeness on income, education, gender, age, and race/ethnicity

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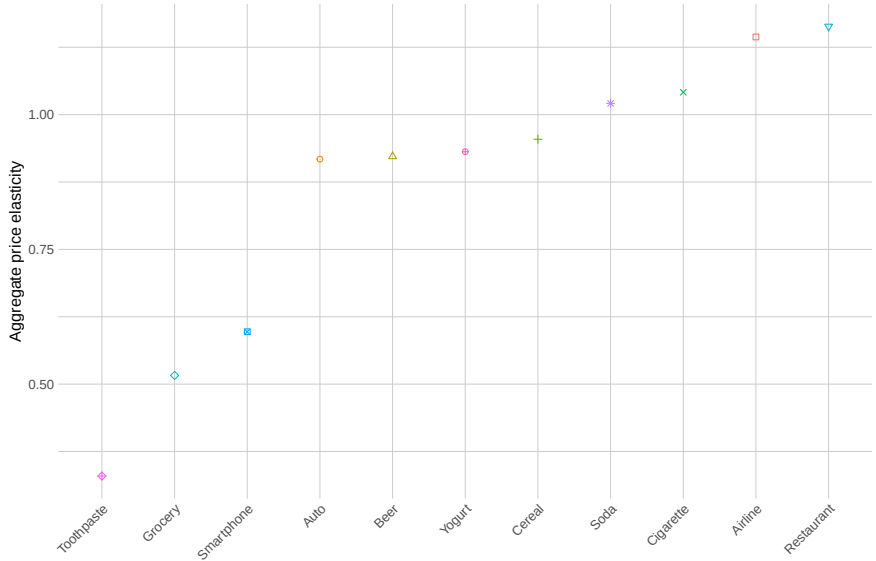
	Mean	Std. dev.	Minimum	Maximum
Customer satisfaction	8.51	1.72	1	10
Price response	0.63	0.48	0	1
Aggregate price response	0.57	0.39	0	1
Worker satisfaction	7.37	2.33	1	10
Worker price response	0.55	0.50	0	1

Descriptive results

Aggregate price elasticity by industry



Price elasticity and customer income by firm

Limitation and validation

- Key limitation: self-reports instead of market behavior

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Validation:

- Firms' average customer income and market shares line up well with other sources figures
- Price response correlated with customer satisfaction figures
- Worker price response correlated with worker satisfaction figure
- Elasticities mostly comparable to other estimates using market data
  - Auto model-level elasticity (3.76) $\approx$ range in Berry, Levinsohn, and Pakes (1995)
  - Auto aggregate elasticity (0.91) $\approx$ 1.0 suggested in BLP (2004)
  - Soda aggregate elasticity (1.02) $\approx$ range in Allcott, Lockwood, and Taubinsky (2019) review
  - Cigarette aggregate elasticity (1.04) $>$ early estimates in Gallet and List (2003), but recent estimates are closer (Cotti et al. 2020; Allcott and Rafkin 2021)
  - Labor supply arc elasticity (4.6) $>$ range in Manning (2011), but tight labor market in 2021

Product market estimation

Product market estimation: sketch

Differentiated product markets: details

- Standard approach following (e.g.) Berry, Levinsohn, and Pakes (1995, 2004)
- Logit model with
  - Firm-specific shifters for high-income consumers
  - Firm-specific random coefficients (controls firms' demand elasticity)
  - Inside good random coefficient (controls aggregate demand elasticity)
- Assume firms set prices to maximize profits in static Nash equilibrium
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Oil market: details

- Assume undifferentiated product, price-taking firms
- Simulate global supply and demand, assign 20% of welfare effects to U.S.

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- Profits distributed to income percentiles based on C-corp ownership from DNA
  - Welfare-weighted profits = 0.12 $\times$ unweighted profits

Externality and internality assumptions

Externality and internality assumptions

Airlines, autos, oil:

- Climate change externalities at $51 social cost of carbon (U.S. gov't 2021)
- Airlines: CO2 emissions from firm *f*'s average flight
- Autos: lifetime CO2 emissions from firm *f*'s average vehicle sold

Beer:

- Externality = $33.60/liter of pure alcohol (Herrnstadt, Parry, and Siikamaki 2015)

Cigarettes:

- Externality = $0.64 per pack (Sloan et al. 2004; DeCicca, Kenkel, and Lovenheim 2021)
- Internality = $(1 - \beta) \times$ (mortality effect $\times$ VSL year) = (1-0.67) $\times$ $44.40 $\approx$ $14.65 per pack (Gruber and Koszegi 2001; Chaloupka, Levy, and White 2019)

Soda (Allcott, Lockwood, and Taubinsky 2019):

- Externality = 0.85 cents per ounce
- Internality = 0.93 cents per ounce

Industry average externality and internality per dollar of sales

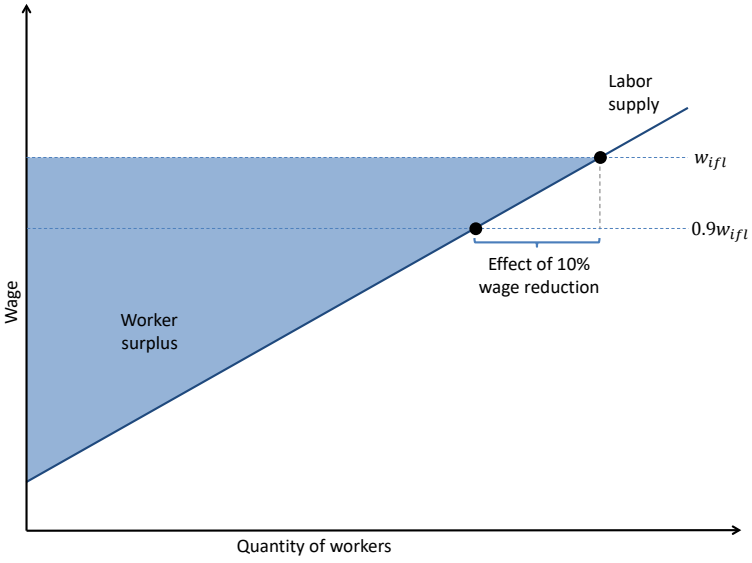
	(1)	(2)
Industry	Externality (/$ sales)	Internality (/$ sales)
Airline	$0.07	–
Auto	$0.03	–
Beer	$0.61	–
Cigarette	$0.12	$2.77
Oil	$0.34	–
Soda	$0.19	$0.21

Example limitations

- Functional form assumptions
  - Constant marginal cost
  - Inframarginal consumer surplus (Hausman 1996)
    - Survey data: similar demand function figure
- Externality and internality magnitudes

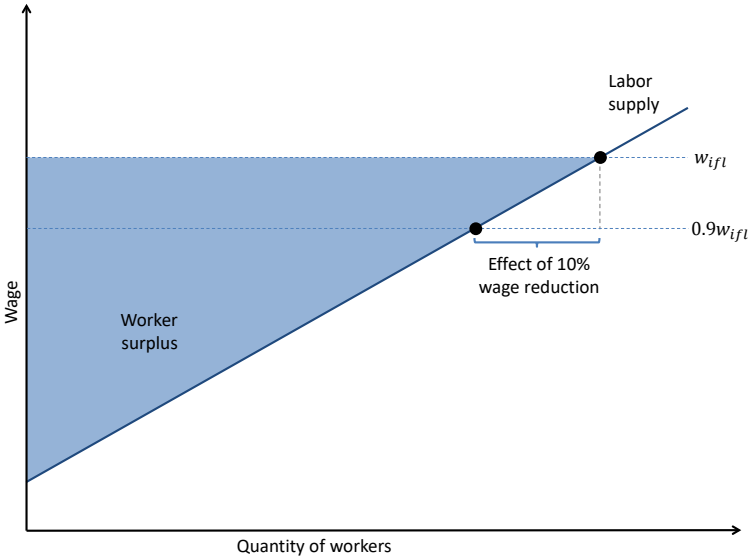
Labor market estimation

Labor market estimation: sketch



- Survey responses + linear labor supply $\Longrightarrow$ worker surplus triangle

Labor market estimation: sketch



- Survey responses + linear labor supply $\Longrightarrow$ worker surplus triangle
- Heterogeneity on earnings, education, occupation, employer local size, local labor market size
  - Project onto firm f's workers using ACS and InfoUSA data

details

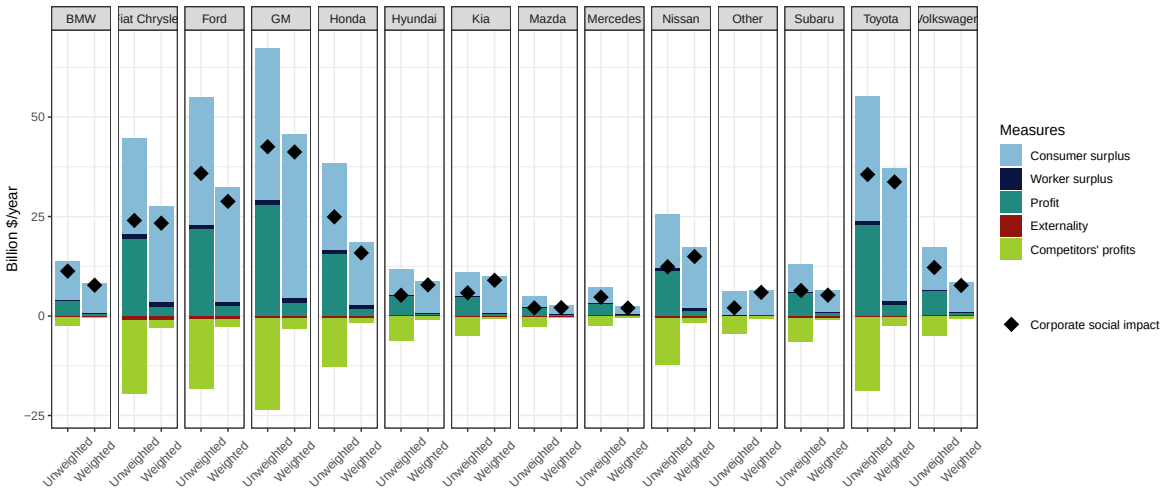
Predictors of labor supply response after 10 percent salary decrease

	(1)	(2)	(3)
Constant	0.613***	0.597***	0.448***
	(0.023)	(0.033)	(0.079)
Annual earnings ($10,000)	−0.019***	−0.018***	−0.020***
	(0.003)	(0.003)	(0.003)
College degree	−0.064**	−0.064**	−0.078**
	(0.030)	(0.032)	(0.032)
Occupation: service		0.067	0.077
		(0.050)	(0.050)
Occupation: sales and office		0.028	0.030
		(0.035)	(0.035)
Occupation: natural resources, construction, maintenance		−0.071	−0.036
		(0.051)	(0.053)
Occupation: production, transportation, material moving		0.014	0.017
		(0.053)	(0.054)
ln(firm's total employees in county)			0.025***
			(0.006)
ln(labor market size)			0.007
			(0.008)
Observations	1,302	1,302	1,302
R^2	0.048	0.052	0.064

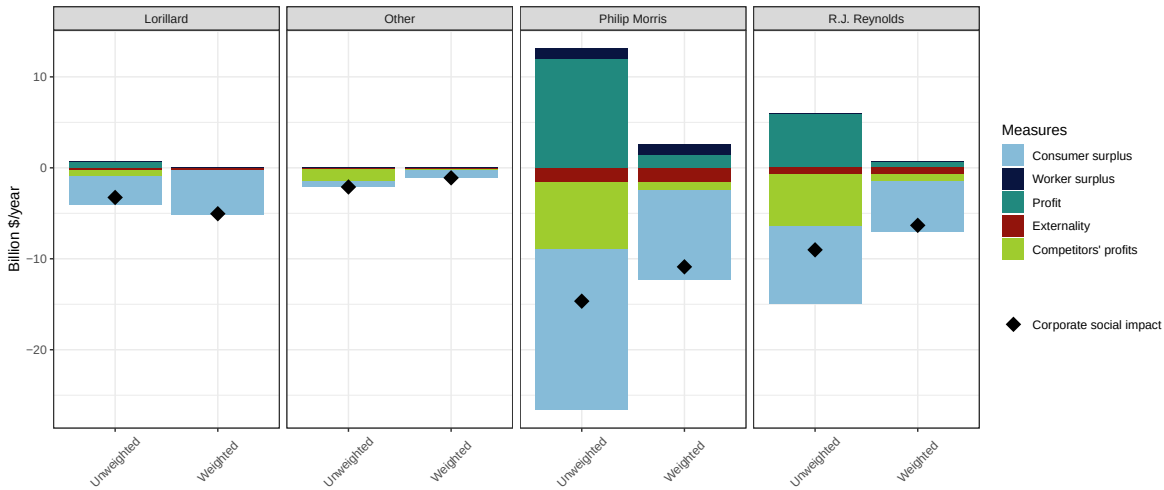
Corporate social impact estimates

Examples: autos and cigarettes

Auto industry: components of (individual) corporate social impact

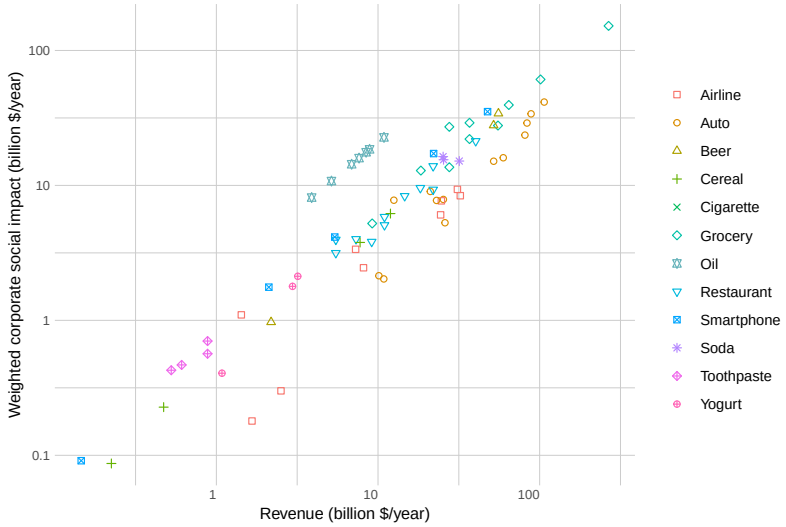


Cigarette industry: components of (individual) corporate social impact



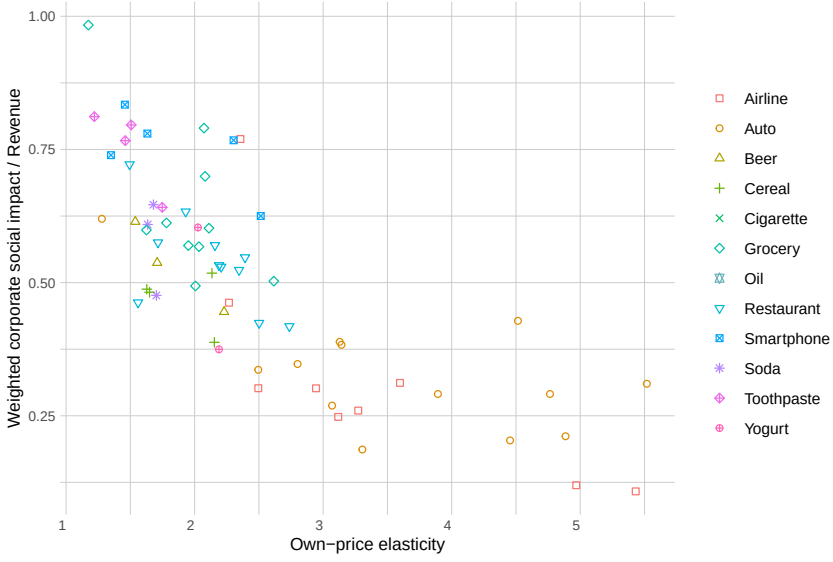
Key drivers of corporate social impact

Size is a good proxy for impact (excluding cigarettes)



Unweighted

Demand elasticity drives impact/revenue (excluding cigarettes)



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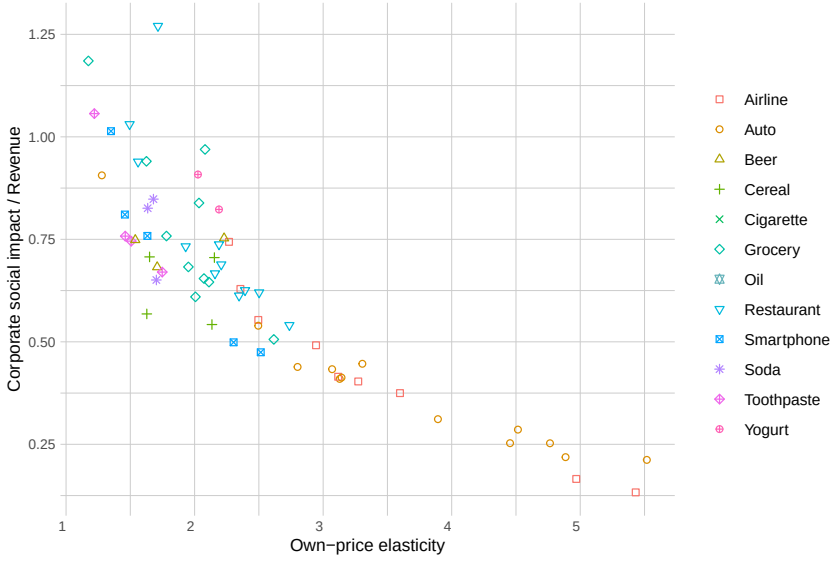
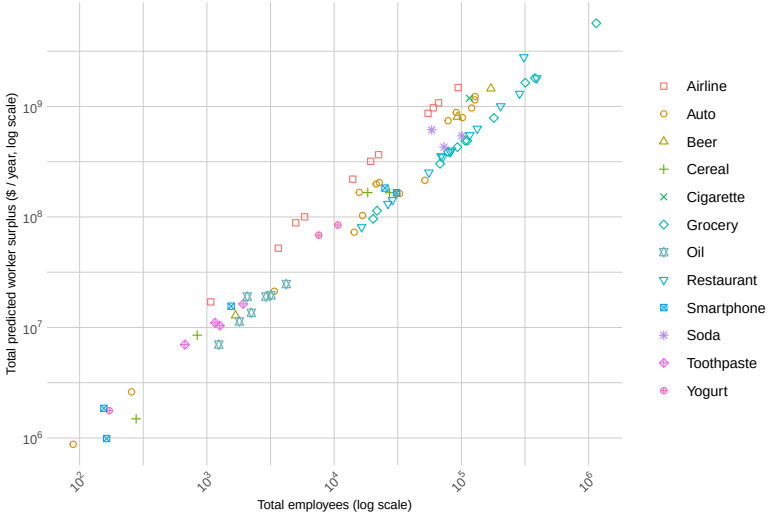
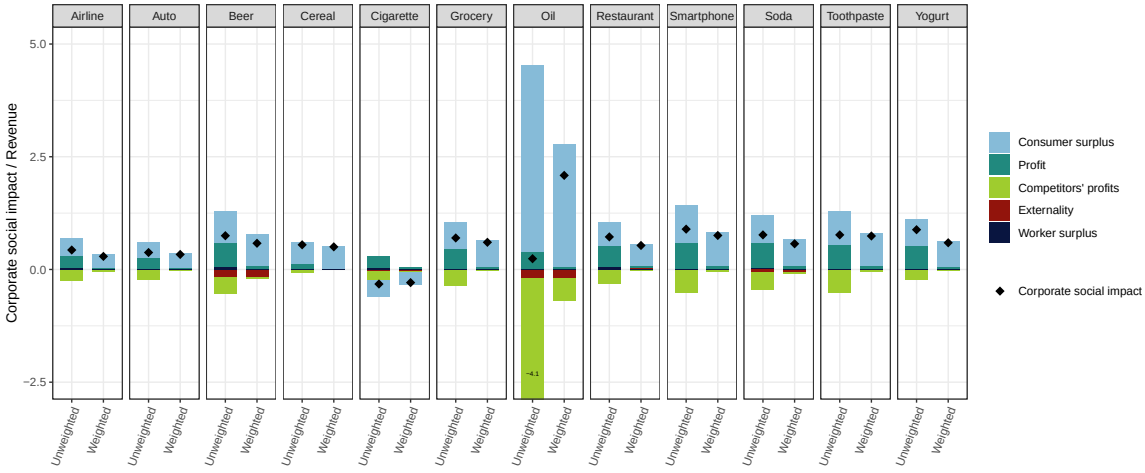


Our observables predict little variation in worker surplus/worker

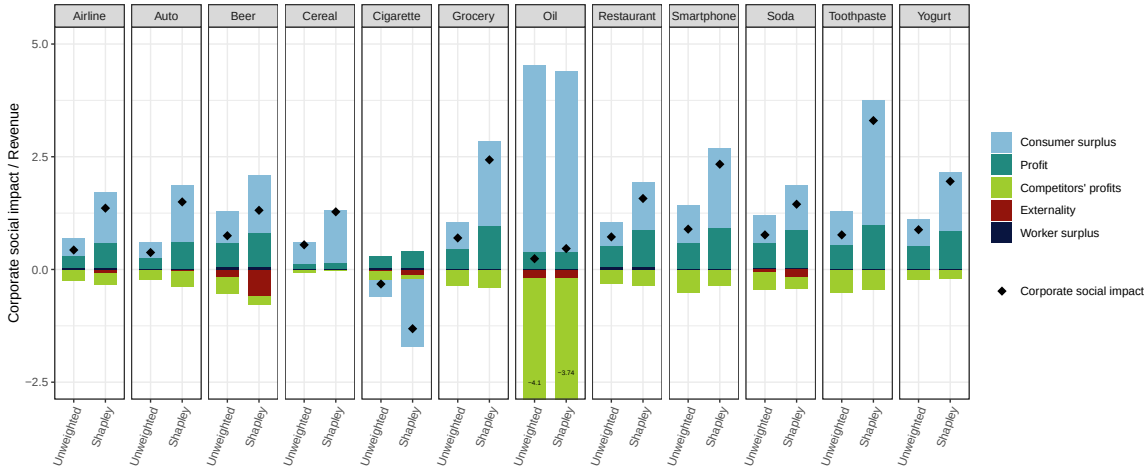


Average impact by industry

Weighted vs. unweighted social impact



Unweighted individual impact vs. Shapley share of industry impact



Highest- and lowest-impact firms

Top 10 firms

Weighted Corporate Social Impact (billion $/year)

Top 10 firms

Weighted Corporate Social Impact (billion $/year)

Rank	Firm	Industry	Impact
1	Walmart	Grocery	152.06
2	Kroger	Grocery	60.98
3	GM	Auto	41.47
4	Costco	Grocery	39.44
5	Apple	Smartphone	35.2
6	Molson Coors	Beer	34.15
7	Toyota	Auto	33.92
8	Ahold	Grocery	29.09
9	Ford	Auto	28.99
10	Anheuser-Busch	Beer	27.89

Top 10 firms

Weighted Corporate Social Impact / Revenue

Top 10 firms

Weighted Corporate Social Impact / Revenue

Rank	Firm	Industry	Impact/revenue
1	Conoco	Oil	2.09
2	Eni	Oil	2.09
3	Total	Oil	2.09
4	Shell	Oil	2.09
5	Chevron	Oil	2.09
6	BP	Oil	2.09
7	Exxon	Oil	2.08
8	ALDI	Grocery	0.98
9	Google	Smartphone	0.83
10	Glaxo	Toothpaste	0.81

Bottom 10 firms

Weighted Corporate Social Impact (billion $/year)

Bottom 10 firms

Weighted Corporate Social Impact (billion $/year)

Rank	Firm	Industry	Impact
66	Glaxo	Toothpaste	0.43
67	Chobani	Yogurt	0.41
68	Spirit	Airline	0.3
69	Post	Cereal	0.23
70	Frontier	Airline	0.18
71	Lenovo	Smartphone	0.09
72	Quaker	Cereal	0.09
73	Lorillard	Cigarette	-5.05
74	R.J. Reynolds	Cigarette	-6.32
75	Philip Morris	Cigarette	-10.64

Bottom 10 firms

Weighted Corporate Social Impact / Revenue

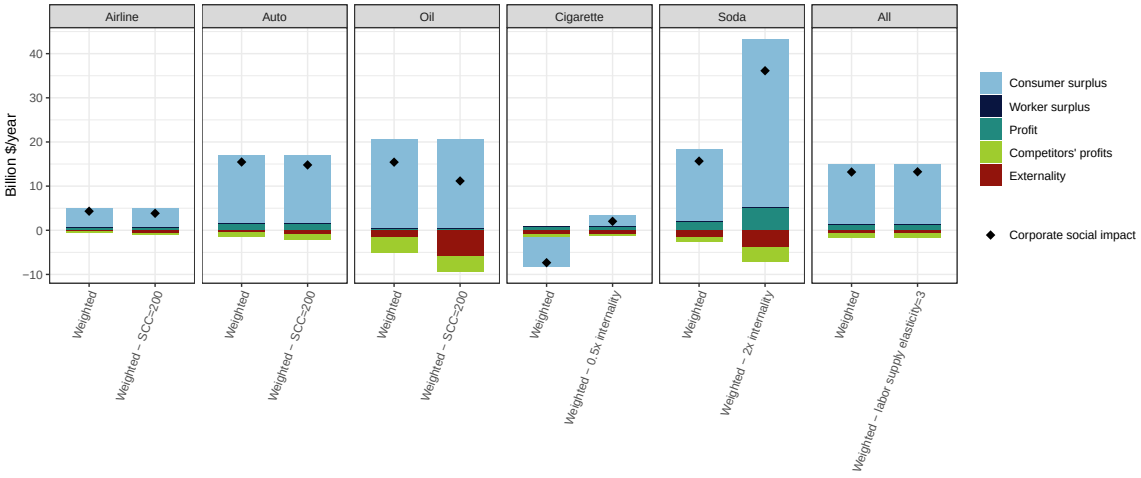
Bottom 10 firms

Weighted Corporate Social Impact / Revenue

Rank	Firm	Industry	Impact/revenue
66	American	Airline	0.26
67	Southwest	Airline	0.25
68	Mazda	Auto	0.21
69	Subaru	Auto	0.2
70	Mercedes	Auto	0.19
71	Spirit	Airline	0.12
72	Frontier	Airline	0.11
73	Philip Morris	Cigarette	-0.23
74	R.J. Reynolds	Cigarette	-0.26
75	Lorillard	Cigarette	-1.71

Robustness

Robustness to alternative assumptions



Comparison to existing metrics

Existing metrics unrelated to our economics-based metric

Conclusion

Recap of limitations

Utilitarian moral philosophy:

- May not capture full importance of diversity and inclusion
- May not be as well-suited as a process approach to value *practices* such as political lobbying and governance structures

Static partial equilibrium assumptions:

- Ignore pollution and worker surplus at suppliers
- Ignore fixed costs (privileges capital-intensive industries)
- Ignore how competitors might adjust product lines and production functions
  - Social impact depends on time horizon

Empirical implementation:

- Survey responses instead of market behavior
- Functional form assumptions (marginal cost, inframarginal consumer surplus)
- Externality and internality magnitudes

Conclusion: key results about corporate social impact

1. Consumer surplus is by far the most important component of social impact
   - Dwarfs profits, worker surplus, and externalities
2. Existing metrics not very correlated with our economics-based metric

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$\Longrightarrow$ Keys to social impact:

- Don't make deeply harmful products
- Serve low-income people
- Make differentiated products that more people want to buy

Appendix

Model: setup

People

- Product markets m have products $j \in \mathcal{J}_m$ at prices p_j and choice occasions $t \in \mathcal{T}_m$ back
- Firms $f \in \mathcal{F}_m$ make products $\mathcal{J}_f$
- Local labor markets l, firms offer wages $w_{fl}(\theta)$
- $\boldsymbol{p}$, $\boldsymbol{w}(\theta)$: price and wage vectors

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- People $i \in \{1, ..., N\}$ with income-earning ability θ_i choose:
  - one product per market and choice occasion; quantity of numeraire n
  - where to work

People

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- Local labor markets l, firms offer wages $w_{fl}(\theta)$
- $\boldsymbol{p}$, $\boldsymbol{w}(\theta)$: price and wage vectors

- People $i \in \{1, ..., N\}$ with income-earning ability θ_i choose:
  - one product per market and choice occasion; quantity of numeraire n
  - where to work

- y_{ijt}, y_{ifl}: choice indicators for buying j in t, working at f in l. $\boldsymbol{y} = \{y_{ift}, y_{ifl}\}$
- u_{ift}, u_{ifl}: utility from buying from f in t, working at f in l
- Φ: negative externality
- Income: $z_i = \pi_i + \sum_{fl} w_{ifl}(\theta_i) y_{ifl}$; π_i: person i's share of profits
- Budget constraint: $n + \sum_m \sum_{t \in \mathcal{T}_m} \sum_{j \in \mathcal{J}_m} p_j y_{ijt} \leq z_i$
- Additively separable utility:

$$U_i = U_i \left(\sum_m \sum_{t \in \mathcal{T}_m} \sum_{j \in \mathcal{J}_m} u_{ijt} y_{ijt} + n + \sum_{fl} u_{ifl} y_{ifl} - \Phi \right)$$

Choice and internalities

- Utility after substituting budget constraint:

$$U_i\left(\boldsymbol{y};\boldsymbol{p},\boldsymbol{w}(\theta_i)\right) = U_i\left(\sum_m \sum_{t\in\mathcal{T}_m} \sum_{j\in\mathcal{J}_m} (u_{ijt} - p_j)y_{ijt} + \pi_i + \sum_{fl}(u_{ifl} + w_{ifl}(\theta_i))y_{ifl} - \Phi\right)$$

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- Standard case: consumers maximize utility (ignoring effect on profit and externality)

$$\boldsymbol{y}^*=\arg\max U_i\left(\boldsymbol{y};\boldsymbol{p},\boldsymbol{w}(\theta_i)\right)$$

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- In two product markets, we relax this assumption:
  - Cigarettes (Gruber and Koszegi 2001)
  - Sugary drinks (Allcott, Lockwood, and Taubinsky 2019)
- Firm f's products impose negative "internality" γ_f
- Choice y^*_{ift} maximizes *perceived* utility $\tilde{U}_i$, which instead depends on $\tilde{u}_{ift} := u_{ift} + \gamma_f$

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$$\boldsymbol{y}^*=\arg\max \tilde{U}_i\left(\boldsymbol{y};\boldsymbol{p},\boldsymbol{w}(\theta_i)\right)$$

- Indirect utility: $V_i\left(\boldsymbol{p},\boldsymbol{w}(\theta_i)\right)=U_i\left(\boldsymbol{y}^*;\boldsymbol{p},\boldsymbol{w}(\theta_i)\right)$
- Aggregate demand: $q_j(\boldsymbol{p})=\sum_{t\in\mathcal{T}_m}\sum_i y^*_{ijt}$

Profit

- $C_f(q_f)$: firm f's total production cost
- Profit

$$\Pi_f(\boldsymbol{p}) = \sum_{j \in \mathcal{J}_f} [p_j q_j(\boldsymbol{p}) - C_j(q_j)]$$

- Total profit:

$$\sum_f \Pi_f(\boldsymbol{p}) = \sum_i \pi_i$$

Externalities

- Firm f's representative product imposes linear negative externality ϕ_f
- Per-person externality:

$$\Phi = \frac{1}{N} \sum_m \sum_{j \in \mathcal{J}_m} q_j(\boldsymbol{p}) \phi_j$$

Social welfare

- $g(z)$: social marginal welfare weight, varies only by income (Saez and Stantcheva 2016)
- Social welfare is the weighted sum of indirect utility

$$W(\boldsymbol{p}, \boldsymbol{w}) = \sum_i \omega_i V_i \left(\boldsymbol{p}, \boldsymbol{w}(\theta_i)\right)$$

- U quasilinear $\implies$ W in units of \$

Model: corporate social impact

Corporate social impact

- $\{\boldsymbol{p}^{\mathcal{X}}, \boldsymbol{w}^{\mathcal{X}}\}$: equilibrium prices and wages with set of firms $\mathcal{X}$ in the market back
- Welfare loss from firm f's exit conditional on initial firms $\mathcal{X}_0$:

$$\Delta W_f(\mathcal{X}) \coloneqq W\left(\boldsymbol{p}^{\mathcal{X}_0}, \boldsymbol{w}^{\mathcal{X}_0}\right) - W\left(\boldsymbol{p}^{\mathcal{X}_0 \setminus f}, \boldsymbol{w}^{\mathcal{X}_0 \setminus f}\right)$$

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- **Individual impact**: welfare loss if all other firms remain in the market:

$$\Delta W_f^{Individual} = \Delta W_f(\mathcal{F})$$

Firm vs. industry impact

- A firm's CSI could be small even if it's industry's impact is large
- Example: cigarette market with two undifferentiated firms
  - Individual firm exit may not capture moral intuitions

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- Implement using Shapley values

Share of industry impact

- $\mathcal{R}$: set of all orderings of firms in market m
  - Two-firm example: $\mathcal{R} = \{(1,2),(2,1)\}$
- $\mathcal{P}_f^R$: $f \cup$ set of firms that precede f in order R
  - Two-firm example: $\mathcal{P}_1^{(1,2)} = \{1\}$, $\mathcal{P}_1^{(2,1)} = \{2,1\}$

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- **Share of industry impact**: Shapley value for the social welfare loss if all firms exit:
  - $\mathcal{R}_m$: set of all orderings of firms, $\mathcal{P}_f^R$: f & all firms that precede f in R

$$\Delta W_f^{Shapley} = \frac{1}{F_m!} \sum_{R_m} \Delta W_f \left(\mathcal{P}_f^R\right)$$

- Interpretation: average welfare gain from adding f over all permutations of other firms
  - Two firm example (undifferentiated products, total market value = 100): $\Delta W_1^{Shapley} = \frac{1}{2}(100 + 0)$

back

Social welfare

- $g(z)$: social marginal welfare weight, varies only by income (Saez and Stantcheva 2016)
- $a(z)$: after-tax income
- Distributional preferences parameterized by ρ:

$$g_i = \kappa a(z_i)^{-\rho}$$

- Set $\kappa = N / \left[\sum_i a(z_i)^{-\rho}\right]$, so that $\bar{g}(z) = 1$

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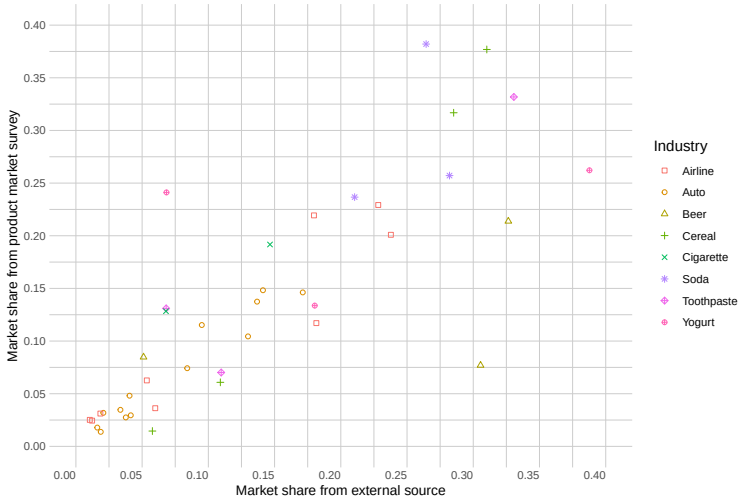
We consider two cases:

- $\rho = 0$. $g(z) = 1, \forall z$
  - $W =$ total surplus
- $\rho = 1$. $g(z) \propto 1/a(z)$ (log utility), as in Saez (2002)
  - $W =$ "weighted surplus"

Survey validation

Survey vs. external market shares



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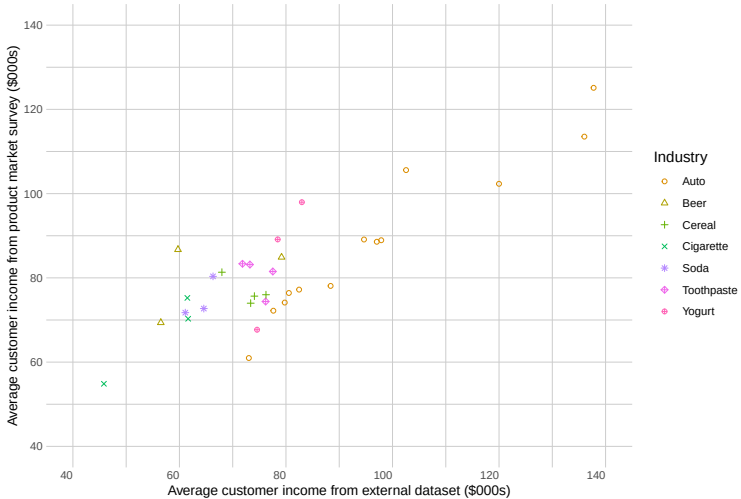
Survey vs. external customer income



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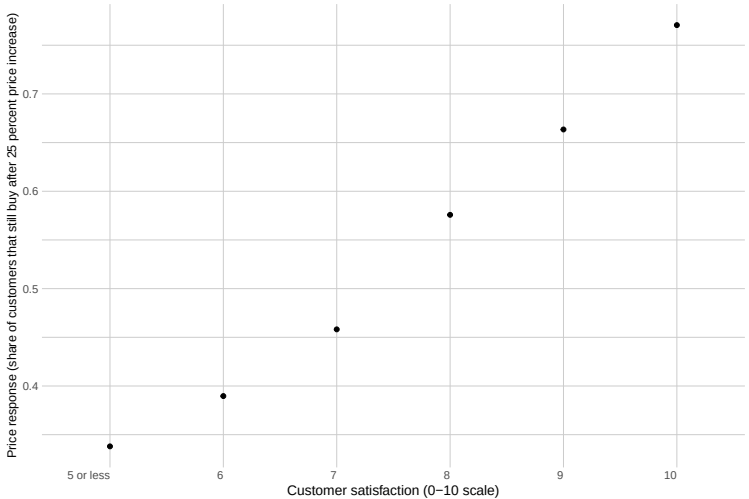
Customer satisfaction vs. price response



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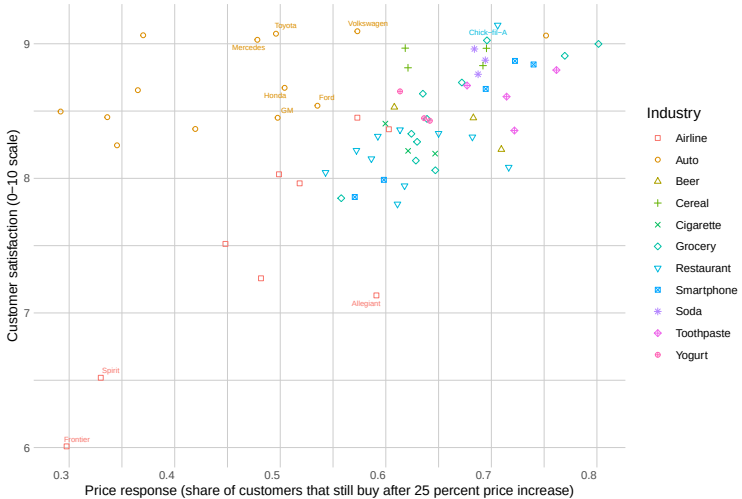
Customer satisfaction and price response by firm



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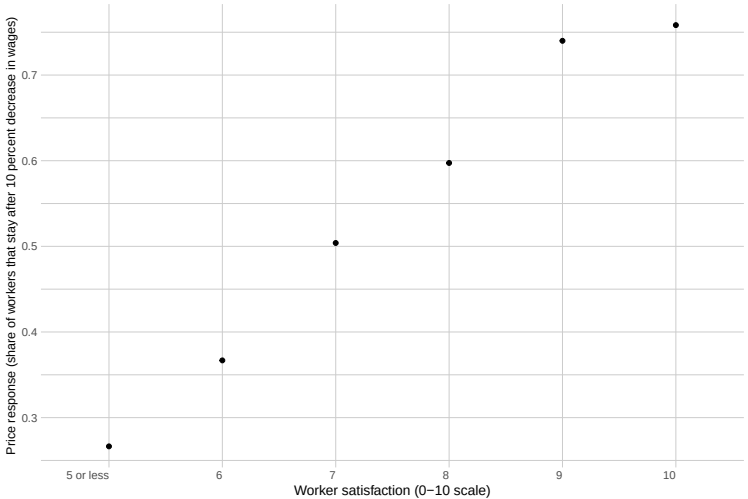
Worker satisfaction vs. worker price response



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Differentiated product markets: supply and demand system

Product market demand system

- Standard logit with
  - Above-$60k income $\times$ firm fixed effect ζ_{zf} (controls differences by income)
  - Firm-specific random coefficients ν_{if} (controls firm own-price elasticity)
  - Inside good random coefficient ν_{in} (controls aggregate elasticity)

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- Perceived net utility from consuming firm f on choice occasion t:

$$\tilde{u}_{ift} = \Bigg(\underbrace{\xi_f}_{\substack{\text{unobserved} \\ \text{characteristic}}} + \underbrace{\gamma_f}_{\text{internality}} + \underbrace{A_i \zeta_f}_{\substack{\text{income-firm} \\ \text{effect}}} + \underbrace{\sigma_f \nu_{if}}_{\text{firm RC}} + \underbrace{\sigma_n \nu_{in}}_{\text{inside good RC}} + \underbrace{\epsilon_{ift}}_{\substack{\text{extreme value} \\ \text{utility shock}}} \Bigg) / \eta$$

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- Normally distributed random coefficients: $\nu_{if}, \nu_{in} \sim N(0, 1)$
- Logit assumption: $\epsilon_{ift} \sim$ type 1 extreme value
- Fix $\sigma_f = 0$ for one firm back

Product market choice probabilities

- Income z representative utility as function of price p_f and random coefficients $\boldsymbol{\nu}_i$

$$V_{zf}(p_f, \boldsymbol{\nu}_i) = -\eta p_f + \xi_f + \gamma_f + A_i \zeta_f + \sigma_f \nu_{if} + \sigma_n \nu_{in}$$

- $j = 0$: outside good. $V_{z0} = 0$

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- Income z choice probability over distribution of ν:

$$P_{zf}(\boldsymbol{p}) = \mathbb{E}_{\nu}\left[\frac{e^{V_{zf}(p_f, \nu_i)}}{1 + \sum_{k \in \mathcal{F}_m} e^{V_{zk}(p_k, \nu_i)}}\right]$$

- Approximate $\mathbb{E}_{\nu}$ with simulation draws
- μ_z: share of population in income group z
- $P_f(\boldsymbol{p}) = \sum_z \mu_z P_{zf}(\boldsymbol{p})$: firm f simulated choice probability
- $q_f(\boldsymbol{p}) = N T_m P_f(\boldsymbol{p})$: firm f simulated quantity

Counterfactual without firm f

- Recall $\boldsymbol{p}^{\mathcal{X}}$: equilibrium prices with firms $\mathcal{X}$
- Income z average perceived consumer surplus per choice occasion in market m (Small and Rosen 1981):

$$\widetilde{CS}_{zm}(\boldsymbol{p}) := \mathbb{E}_{\boldsymbol{\nu}} \left[\frac{1}{\eta} \ln \left(1 + \sum_{f \in \mathcal{F}_m} e^{V_{zf}(p_f, \boldsymbol{\nu}_i)} \right) \right] + K$$

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- Effect of firm f on weighted consumer surplus:

$$\Delta CS_f(\mathcal{X}_0) = N \sum_z \mu_z g(z) \cdot T_m \left[\widetilde{CS}_{zm}(\boldsymbol{p}^{\mathcal{X}_0}) - \widetilde{CS}_{zm}(\boldsymbol{p}^{\mathcal{X}_0 \setminus f}) - \sum_f \gamma_f \left(P_{zf}(\boldsymbol{p}^{\mathcal{X}_0}) - P_{zf}(\boldsymbol{p}^{\mathcal{X}_0 \setminus f}) \right) \right].$$

Differentiated product markets: estimation strategy and counterfactuals

Identification overview

Mostly follows BLP (1995, 2004)

1. Survey microdata is informative about income-firm effects ζ_{zf} and price responses η, σ_f, σ_n
2. Aggregate market shares are informative about firm-level mean utilities $\delta_f := \xi_f + \gamma_f$
3. Assume constant marginal cost, infer from profit maximization assumption

Micro moments from survey data

- $\boldsymbol{p}^0 = \mathbf{1}$: baseline prices, $\boldsymbol{p}'_f$: prices after firm f 25% price increase
- F_{if}: $\mathbf{1}$(respondent i bought from firm f)
- A_i: $\mathbf{1}$(i is above \$60k income)
- B_i: $\mathbf{1}$(i is below \$60k income)
- ω_i: sample weight; χ_{im}: $\mathbf{1}$(i consumes in market m)
- $P_{zf}(\boldsymbol{p})$: firm f simulated choice probability for income z

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- Average consumption by income primarily identifies income-firm effects ζ_{zf}

$$g_f^{inc} = \left(\frac{\mu_A P_{Af}(\boldsymbol{p}^0) - \mu_B P_{Bf}(\boldsymbol{p}^0)}{1 - P_0(\boldsymbol{p}^0)} \right) - \left(\frac{\sum_i \omega_i \chi_{im} A_i F_{if} - \sum_i \omega_i \chi_{im} B_i F_{if}}{\sum_i \omega_i \chi_{im}} \right)$$

Micro moments from survey data

- $\boldsymbol{p}^0$: baseline prices, $\boldsymbol{p}'_f$: prices after firm f 25% price increase
- F_{if}: $\mathbf{1}$(respondent i bought from firm f)
- H_{if}: $\mathbf{1}$(respondent i bought from firm f and would still buy at $\boldsymbol{p}'_f$)
- O_i: $\mathbf{1}$(respondent i bought an inside good and would still buy if all prices doubled)
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- $P_f(\boldsymbol{p}) = \sum_z \mu_z P_{zf}(\boldsymbol{p})$: firm f simulated choice probability

- Firm price response primarily identifies η and firm RC standard deviations σ_f:

$$g_f^{sub} = \frac{P_f(\boldsymbol{p}'_f)}{P_f(\boldsymbol{p}^0)} - \frac{\sum_i \omega_i \chi_{im} H_{if}}{\sum_i \omega_i \chi_{im} F_{if}}$$

- Aggregate price response primarily identifies inside good std. dev. σ_n:

$$g^{out} = \frac{1 - P_0(\boldsymbol{p}')}{1 - P_0(\boldsymbol{p}^0)} - \frac{\sum_i \omega_i \chi_{im} O_i}{\sum_i \omega_i \chi_{im}}$$

- Method of simulated moments: set $\{g_f^{inc}, g_f^{sub}, g^{out}\} = 0$
- BLP contraction mapping: unobserved characteristics $\delta_f := (\xi_f + \gamma_f)$ match market shares

Marginal cost and counterfactual prices

- Firm f's first-order condition:

$$p_f - C_f' = \frac{q_f}{-\partial q_f(\boldsymbol{p})/\partial p_f}$$

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- Infer C_f' from demand system

- Simulate counterfactual prices $\boldsymbol{p}^{\mathcal{X}}$ by iterating FOCs to a fixed point (Morrow and Skerlos 2011; Conlon and Gortmaker 2020)

Oil market

Oil market: overview

Three differences relative to differentiated product markets:

- Undifferentiated product
- Firms have upward-sloping marginal cost
- Assume firms are price-takers

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Data:

- Construct global marginal cost curves by firm from Rystad Energy
- Gasoline consumption by income from National Household Travel Survey

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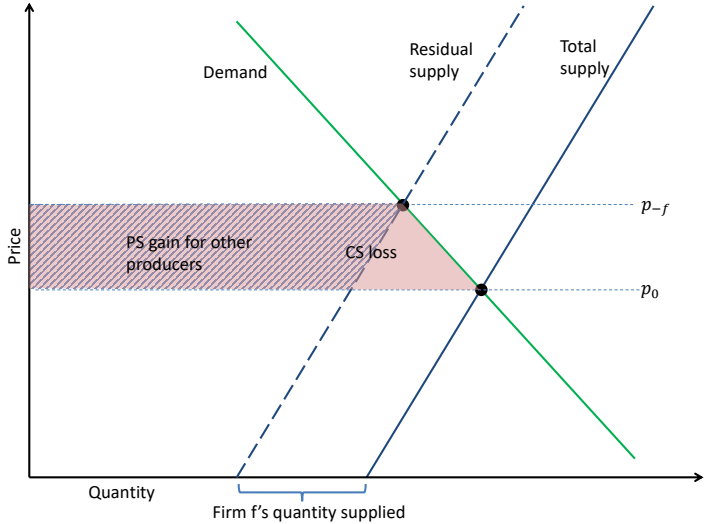
- Import global demand and supply elasticities from Caldera et al. (2019) back

Graphical illustration: oil market



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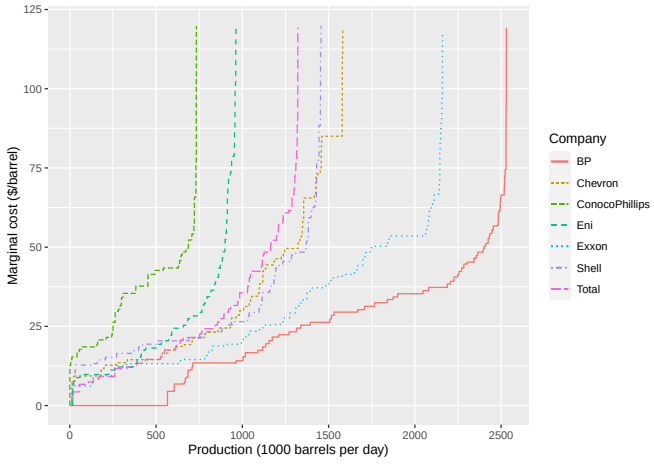
Marginal cost curves by firm



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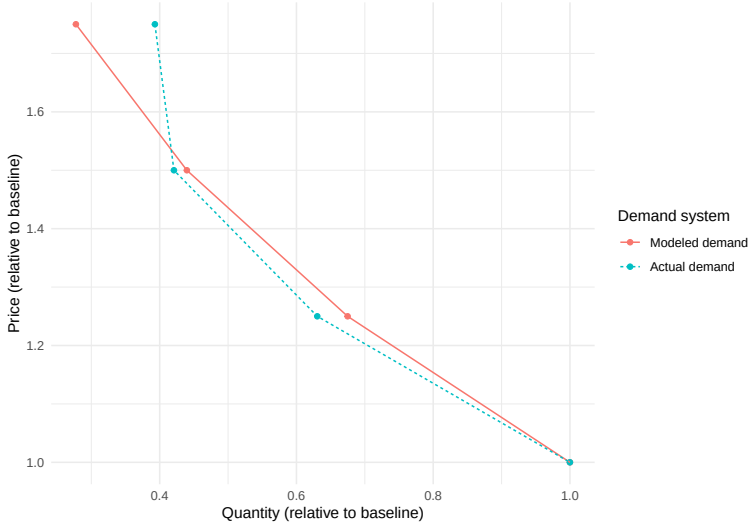
Modeled demand function vs. survey data



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Labor market details

Labor market equilibrium

- Differentiated firms model back
- Assume firms are “small,” so exit doesn’t affect other firms’ wages
- $\Longrightarrow$ can estimate worker surplus considering only firm f’s current workers
  - No need to model changes in firm f’s workers’ outside options or surplus for workers at other firms

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- Worker i's surplus at fl instead of outside option:

$$\frac{(u_{ifl} + w_{ifl}) - (u_{i0} + w_{i0})}{w_{ifl}} = \frac{\epsilon_{ifl}}{\alpha \boldsymbol{x}_{ifl}},$$

with $\epsilon_{ifl} \sim U(0,1)$ and ϵ independent of $\boldsymbol{x}$.

- Expected (over ϵ) worker surplus is

$$\mathbb{E}_\epsilon [WS_{ifl}] = \int_0^1 \frac{w_{ifl}\epsilon}{\alpha \boldsymbol{x}_{ifl}} d\epsilon = \frac{w_{ifl}}{2\alpha \boldsymbol{x}_{ifl}}$$

- Firm f's worker surplus is

$$\Delta WS_f = \sum_{l \in \mathcal{L}_f} \sum_{i \in fl} \frac{w_{ifl}}{2\alpha \boldsymbol{x}_{ifl}}$$

Estimation strategy

- Survey samples not large enough to get firm-specific estimates back
- Predict worker surplus using f's distribution of location and worker characteristics
- $\boldsymbol{x}_{ifl}$:
  - annual eanings
  - **1**(college)
  - occupation
  - ln(f's total employment in county l)
  - labor market size: ln(jobs in i's occupation in l)

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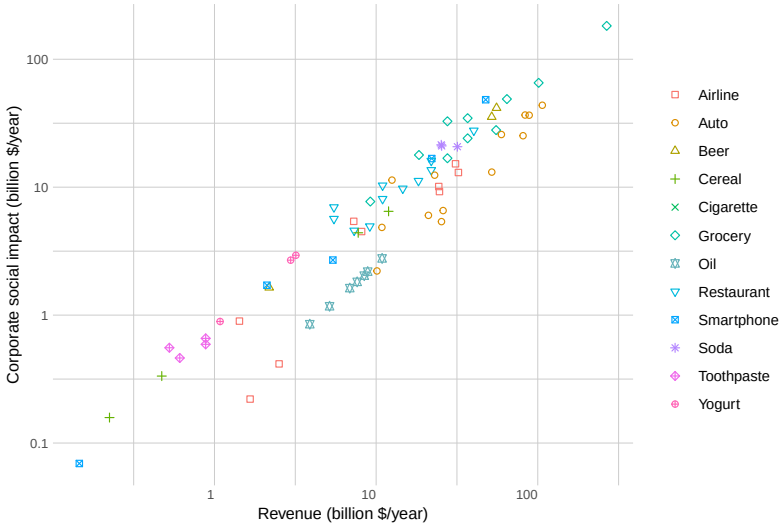
- L_{ifl}: 1(respondent i would leave after 10% salary cut)

$$L_i = \mathbf{1}\left[u_{ifl} + 0.9w_{ifl} \leq u_{i0} + w_{i0}\right] = \mathbf{1}\left[\epsilon_{ifl} \leq (0.1\boldsymbol{\alpha})\boldsymbol{x}_{ifl}\right]$$

Corporate social impact results

Size is a good proxy for impact (excluding cigarettes)



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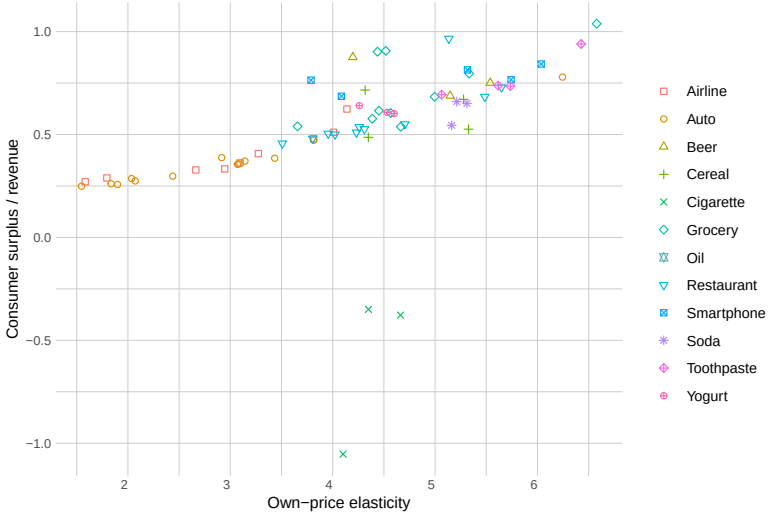
Survey own-price elasticity $\Longrightarrow$ consumer surplus



Survey own-price elasticity $\Longrightarrow$ markup