Bag leakage: The effect of disposable carryout bag regulations on unregulated bags

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Is this question economically important?

Yes this question is important because the United Nations Environmental Program estimates that 10 to 20 million tonnes of plastic enters the world's oceans each year, costing $13 billion in environmental damage to marine ecosystems, including losses incurred by fisheries and tourism.

However, there is no regulation for all the plastic bags. The government only regulated one kind of bags which is disposable carryout bags

The results show that a 40 million pound reduction of plastic per year from the elimination of plastic carryout bags is offset by an additional 12 million pounds of plastic from increased purchases of trash bags. In particular, sales of small, medium, and tall trash bags increase by 120%, 64%, and 6%, respectively. This means that 28.5 percent of the plastic reduction from DCB (disposable carryout bags) policies is lost due to consumption shifting towards unregulated trash bags.

The results also provide a lower bound for the reuse of plastic carryout bags, with 12–22% of plastic carryout bags reused as trash bags pre-regulation

Is this question interesting to you? Why or why not

Plastic bags have become a threat to the life of animals living on earth as well as in water
Chemicals released by waste plastic bags enter the soil and make it unable to reproduce plants.

Is this question interesting to you? Why or why not?

Yes, We know that Maryland and the DMV areas are trying to implement charging DCB.

Currently, Maryland and Virginia implementing Partial charge or ban on Bags.

We also have Washington D.C implementing charge on some plastic bags

What strategies do the authors use to estimate causal effects?

The author uses the strategies of event study analysis and a difference in differences (DD) quasi-experimental design

California provides an exceptional quasi-experiment for analyzing the effects of DCB policies. From 2007 through 2015, 139 Californian cities and counties implemented DCB policies, affecting over one third of California's population. The Author focus his analysis on food stores.

California disposable carryout bag (DCB) policies over time

(a) 2011

(b) 2013

(c) 2015

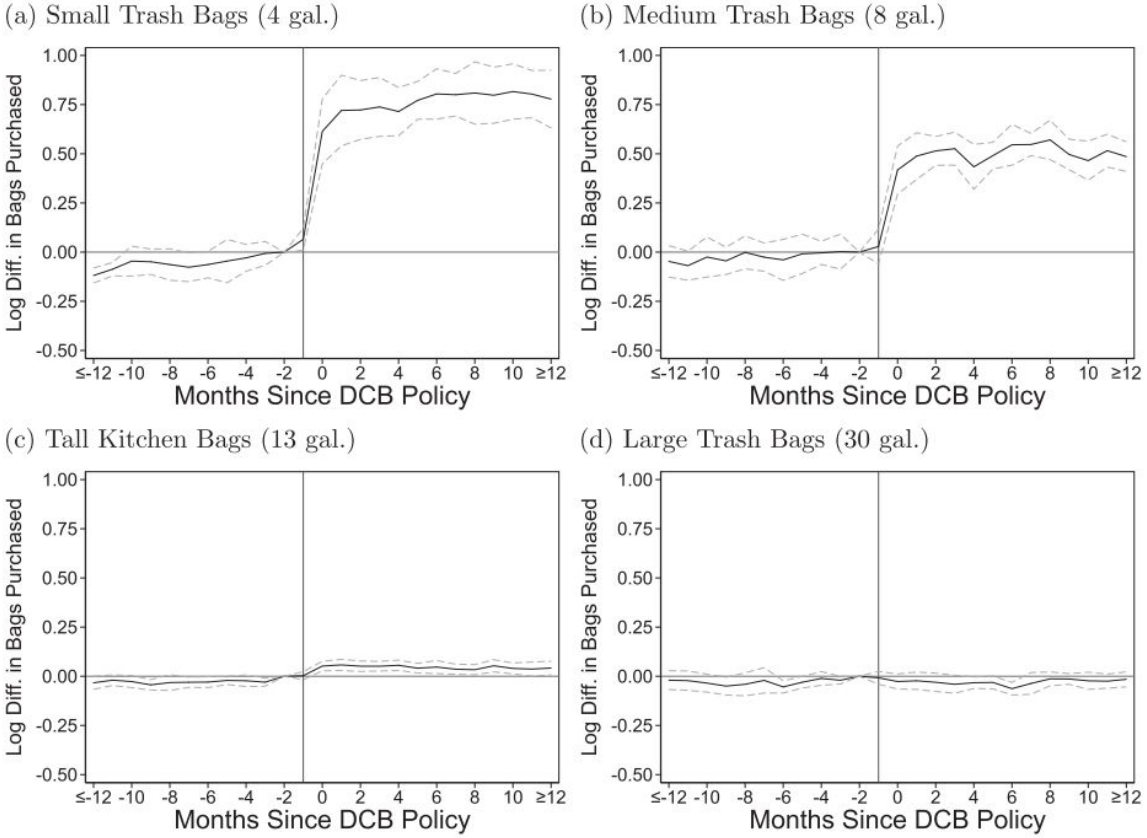
What is treatment?

The author aggregate the raw retail scanner data to the store by month by product group level and employ the following event study regression model:

$$Y^B_{sjm} = \sum_{l=-12}^{12} \beta_l D_{l,jm} + \theta_{sj} + \delta_m + \epsilon_{sjm}$$

where Y^B_{sjm} is the outcome variable for store s in jurisdiction j and month-of-sample m with respect to bag product group B, θ_{sj} is a vector of store fixed effects, and δ_m is a vector of month of sample fixed effects. $D_{l,jm}$ is a dummy variable equaling one

What are the outcome variable(s)?



What are the outcome variable(s)?

Y^{B}_{sjm}, is the logged number of product group B bags sold in store s and month of sample m, which means the $\beta\hat{}$l point estimates measure the log difference in bag sales between treated and yet to be treated stores l months from DCB policy implementation

$\beta\hat{}_0$ = 0.627 and $\beta\hat{}_1$ = 0.734. These estimates mean that the average monthly sales of small trash bags at treated stores are 87% and 108% higher during the first and second months of a DCB policy

What arguments do the authors make to support the interpretation of their results as causal effects?

Sales of small trash bags at treated stores remain 120% higher than at the yet to be treated stores. All of the post-policy $\hat{\beta}_1$ coefficients are significantly greater than zero at the 1% significance level.

Panel (b) for medium trash bags follow a similar pattern as those in panel (a) for small trash bags. Average monthly sales of medium trash bags are 54% higher during the first month of a policy, 65% higher in the second month, and remain 64% higher 12 months or more after a policy. In panel (c), I also find a small increase in the sale of tall kitchen bags that corresponds to the implementation of DCB policies. panel (d) I find no statistically significant change in large trash bag sales due to DCB policy implementation.

Data used to estimate research design

Adoption of disposable carryout bag regulations

Sample: stores in jurisdictions that meet the following criteria:

(1) located in California, <= 50 miles from the coast

(2) an entire jurisdiction or can be uniquely identified based on zip code

Retail scanner database (trash bag sales)

From participating stores in California between January 2009 and December 2015

Food stores, mass merchandising stores, and drug stores

Data used to estimate research design

Observational data (the number and types of carryout bags used at checkout)

Direct observation

One month before (December 2013) and four months after (January–April 2014) the policy change

Bi-weekly visits to a set of 7 stores:

3: mid-sample period, 2: entire sample period, 2: no

Bag product group by weight (environmental impacts of the various types of bags)

Material, weight, and volume capacity

four categories of garbage bags and six categories of common carryout bags

Main regression equation(s)

the causal effect of DCB policies on bag purchases using an event study design

$$Y^B_{sjm} = \sum_{l=-12}^{12} \beta_l D_{l,jm} + \theta_{sj} + \delta_m + \epsilon_{sjm}$$

Y^B_{sjm} the number of product group B bags sold in store s in jurisdiction j and month-of-sample m (both in levels and in logs)

θ_{sj} a vector of store fixed effects

δ_m a vector of month-of-sample fixed effects

$D_{l,jm}$ Dummy variable, =1 if jurisdiction j in month m implemented a DCB policy l months ago

l = 0 denoting the month of implementation

Main regression equation(s)

the effects of DCB policies on the use of various carryout bags

$$Y^{C}_{tsjdm} = \sum_{l=-1}^{3} \beta_l D_{l,jm} + \beta_x X_{tsjdm} + \theta_{sj} + \delta_{dm} + \epsilon_{tsjdm}$$

Y^{C}_{tsjdm} the number of carryout type C bags used for transaction t in store s in jurisdiction j on date d in month m

$D_{l,jm}$ the set of monthly event study dummies

X_{tsjdm} control variables

θ_{sj} store fixed effects

δ_{dm} date fixed effects

Econometric results: coefficients

Table 5
Effect of DCB policies on annual bag usage, weight, and capacity, in California.

	(1) Δ Bags/Store-Month[a]	(2) Δ Bags/Txn[a]	(3) Δ Bags/Year[b] (million)	(4) Δ Lbs/Year[c] (million)	(5) Δ Gal/Year[c] (million)
Trash Bags					
Small trash bag	1,727.554 (197.619)		323	3.3	1,291
Medium trash bag	1,032.274 (215.011)		193	3.6	1,542
Tall kitchen bag	699.095 (242.766)		131	4.6	1,697
Carryout Bags					
Plastic carryout bag		−3.689 (0.215)	−5238	−40.3	−20,952
Net Plastic Δ			−4591	−28.8	−16,422
Leakage Rate			12.4%	28.5%	21.6%

Econometric results: interpreting coefficients

- Trash bags:
  - **Small trash bags**: After a local jurisdiction in California adopts a DCB policy, there is an expected monthly sales increase of 1,727.554 small trash bags per store for the next 12 months, compared to the 12 months prior to DCB policy enactment
  - **Medium trash bags**: After a local jurisdiction in California adopts a DCB policy, there is an expected monthly sales increase of 1,032.274 medium trash bags per store for the next 12 months, compared to the 12 months prior to DCB policy enactment
  - **Tall kitchen bags**: After a local jurisdiction in California adopts a DCB policy, there is an expected monthly sales increase of 699.095 tall kitchen bags per store for the next 12 months compared to the 12 months prior to DCB policy enactment
- **Plastic carryout bags**: After a local jurisdiction in California adopts a DCB policy, there is an expected decrease of 3.689 plastic carryout bags per store transaction for the next 12 months, compared to the 12 months prior to DCB policy enactment

Econometric results: sign, size, significance

- Trash bags:
  - Sign: positive for all three
  - Significance: statistically significant (low SE for all three)
  - Size: substantial size (translates to increases in plastic consumption from additional purchases of 3.3 million pounds for small bags, 3.6 million pounds for medium bags, and 4.6 million pounds for tall kitchen bags)
- Plastic carryout bags:
  - Sign: negative
  - Significance: statistically significant (very low SE)
  - Size: very substantial size (translates to a 40.3 million pound reduction in plastic consumption from decreased use of plastic carryout bags)

Econometric results: questions to consider

- How convincing are these results?
  - The paper's results are convincing as it pertains to estimating the overall causal impact of California DCB policies enacted between 2011 and 2016
  - … But it is hard to apply these results to other States and other time periods (i.e., external validity)
- Do these results seem economically important?
  - Yes, because leakage is considerable and should be factored in when discussing the success of DCB policy (i.e., there is a difference between eliminating 40 versus 29 million pounds of plastic)

Internal, construct, and external validity

- Internal validity = strong
  - Through employing event study analysis and a difference in differences (DD) quasi-experimental design, the author leverages panel data to provide credible estimates
  - By not including jurisdictions within 50 miles of the coast, the author improves her internal validity (because these areas observe the direct impact of plastic pollution on marine ecosystems, the parallel trends assumption for counterfactuals seems unlikely to hold)
- Construct validity = strong
  - There is no reason to doubt that DCB policies were equally enforced across all jurisdictions
- External validity = questionable
  - Residents of other States might be systematically different than Californians in a way that would cause them to react differently to DCB policies (e.g., maybe Californians are more likely than most Americans to reuse plastic carryout bags)
  - Time period likely matters too (e.g., Californians reusing plastic carryout bags could depend on the status of environmentalism movements, which do not exhibit linear trends in their registration and funding)

Our opinion

- Overall, we think that this was a very interesting study that should be considered when evaluating the success of DCB policies
  - There is a big difference between eliminating 40 versus 29 million pounds of plastic
- However, we are skeptical that government intervention is necessary to incentivize the production of thin grocery bags intended to be used as small trash bags
  - This seems like a profitable idea that private markets could implement without government assistance
- We are also skeptical about the author's idea that bag taxes could be a more effective tool than bans
  - While this might be true in the context of leakage costs, we feel like the 5 cents tax is rarely enforced in self check-out areas, which would make the policy less effective than a ban

Works Cited

Taylor, R. L. (2019). Bag leakage: The effect of disposable carryout bag regulations. *Journal of Environmental Economics and Management*, 254-271.