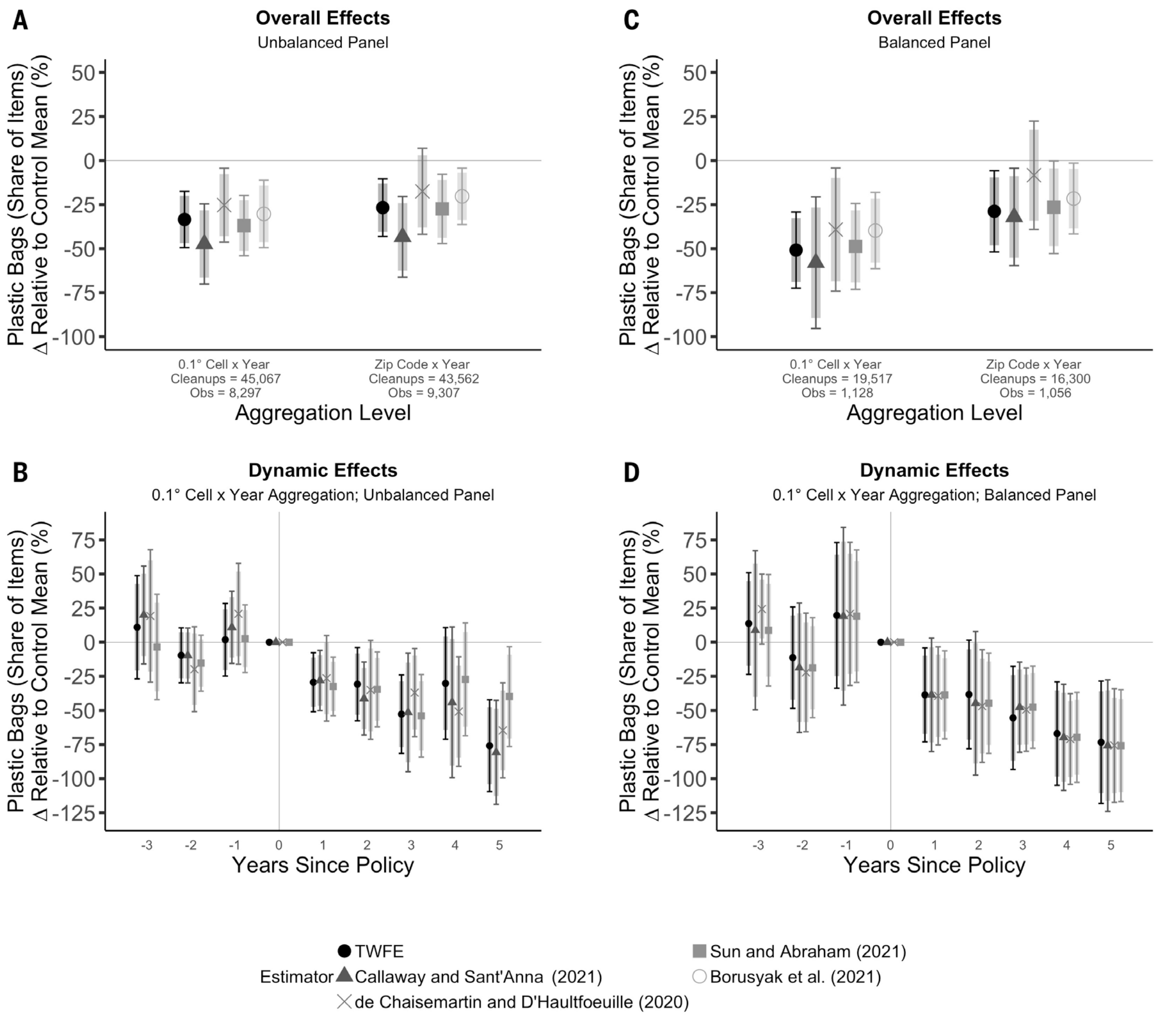

Fig. 2. The effects of bag policies on plastic litter. Coefficient plots for regressions using five estimators [TWFE and (*31*–*34*)]. The outcome variables are plastic bags' share of total items collected during shoreline cleanups as documented in the TIDES data. Results are divided by the control mean (4.5%). We use 2016–2023 (inclusive) cleanup data and examine the effects of 182 bag policies implemented beginning in 2017. Obs, observations. (**A**) Overall (after versus before) effects for the entire (unbalanced) sample, according to eq. S1, for various spatiotemporal aggregations. (**B**) Dynamic effects for the 0.1° grid cell by year aggregation level, according to eq. S2. We do not show results using (*34*) on the same plot, as suggested by (*46*) (fig. S7). Year 1 is the first full year for which a policy is in effect. (**C** and **D**) Results in (A) and (B), respectively, but for a balanced panel subset. In all panels, in the event of multiple policies in a unit, the effective date of the first policy is used (see fig. S12 for robustness to alternative approaches). Zip codes with repealed policies and all their neighbors, including those two or three zip codes away, as well as all neighbors of treated zip codes, are excluded from the main analysis. Thick lines show a 90% confidence interval, and thin lines show a 95% confidence interval. Standard errors are clustered by zip code.

policy changes—may lead to lower item counts or bags being removed at different rates than other litter. As a robustness check, we run our regression controlling for the number of cleanups (fig. S12). We also conduct an analysis comparing the time passed since the last cleanup in the same 0.1° grid cell and differences in cleanup characteristics. We find that with every additional day between successive cleanups, the change in share of items that are plastic bags is very small compared with the mean (table S4).

Spillover analysis

Next, we examine whether there are spatial spillovers or transboundary movements of plastic litter associated with plastic bag policies. These spillovers could be negative or positive. If people living in treated areas try to avoid the ban by increasing shopping and littering in untreated neighboring areas, then we would be overestimating the policy's true effect. Alternatively, there could be beneficial spillovers if stores in treated areas serve people from untreated areas or if stores near treated areas implement their own bag policies. In these cases, we would be underestimating the policy's true effect. Testing for spillovers, we do not find statistically significant effects in neighboring zip codes. Imprecisely, we find potential beneficial spillovers on the zip codes immediately neighboring treated areas but possible negative spillovers two zip codes away from the treated area (i.e., neighbors of neighbors) (Fig. 3B). Out of an abundance of caution, in our main specification (Fig. 2), we drop the neighbors, neighbors of neighbors, and neighbors of neighbors of neighbors (i.e., three zip codes away) of zip codes with bag policies (see Fig. 3A for an illustration of zip code treatment categories in North and South Carolina).

Heterogeneity by policy type, scope, and location

We test the effectiveness of various types of policies in reducing plastic litter. We first explore the differences between complete bans, partial bans, and fees (taxes). While we find relative decreases in plastic litter for both bans and fees, we find the magnitude of the decrease to be