

Supplemental Appendix to
“Plastic Dumping Grounds: The International Incidence of
Environmental Regulation”

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APPENDIX S1. RELATIVE TO ABSOLUTE CHANGES IN PLASTIC WASTE IMPORTS

In Section 2.2, we quantify changes in plastic waste trade across country groups using the difference-in-differences specification in Equation (2.1). The corresponding regression results are reported in Table S6.1. These estimates are relative to the log change in trade of non-plastic products within each country group. To recover absolute changes in plastic waste trade flows, we impose a balance-of-trade (BoT) condition. This allows us to solve for the implied log change in non-plastic trade flows, denoted α_c to recover the missing intercept in the DiD specification. Below we derive this adjustment step by step.

Assumption 1 (Balanced Trade).

For each country k , changes in total imports equal changes in total exports:

$$\sum_{o \neq k} \sum_h \Delta x_{okht} - \sum_{d \neq k} \sum_h \Delta x_{kdht} = 0.$$

Assumption 1 would follow from the standard assumption of balanced trade in goods, that is particularly suited to waste trade when it is exported to reduce processing costs by filling empty ships traveling to cheaper processing countries. More generally, when there are trade imbalances, Assumption 1 is the usual assumption of balanced trade in changes in quantitative models of gains from trade.

The balanced trade assumption pins down the missing intercept α_k for each country. Imposing $\sum_{o \neq k} \sum_h \Delta x_{okht} = \sum_{d \neq k} \sum_h \Delta x_{kdht}$ on the relative estimates and solving yields

$$\exp \alpha_k = \left[\sum_h \left(\sum_{o \neq k} x_{okh,t=0} - \sum_{d \neq k} x_{kdh,t=0} \right) \right] / \left[\sum_h \left(\sum_{o \neq k} x_{okh,t=0} \exp \beta_{ok,t=T}^h - \sum_{d \neq k} x_{kdh,t=0} \exp \beta_{kd,t=T}^h \right) \right],$$

after which the absolute change in exports is $\Delta x_{okht} = x_{okh,t=0}(\exp(\alpha_k + \beta_{ok,t=T}^h) - 1)$.

APPENDIX S2. COMPARISON OF PRODUCT QUALITY ACROSS COUNTRIES

In subsection 3.2, we discuss that one potential explanation for the displacement of domestic plastic waste by imported plastic waste is that Turkish firms shifted toward higher-quality imported plastic waste as it became cheaper following the ONS policy.

Using bilateral trade data on values and quantities from UN Comtrade, we estimate a product-level quality measure following the methodology outlined by Khandelwal et al. (2013). In particular, we estimate the following regression:

$$(S2.1) \quad \ln q_{podt} + \sigma \ln uv_{podt} = \alpha_{pt} + \alpha_{dt} + \epsilon_{podt}$$

where q_{podt} is the quantity of exports of HS 6-digit product p by country o to country d in year t , and uv_{podt} is its unit value. We set the elasticity of substitution $\sigma = 5$. The estimated quality is $\hat{\epsilon}_{podt}/(\sigma - 1)$. The estimation sample includes all 2-digit HS codes containing at least one waste product and covers the pre-ONS period from 2012 to 2016.

Averaged over the 2012–2016 period, the estimated quality distribution of waste products exported by countries on which China relied heavily before the ONS policy—*Top Exporters*—first-order stochastically dominates that of products exported by Turkiye, both across all waste products and restricting to plastic waste. Table S2.1 reports the corresponding mean differences by country group. We regress the average estimated quality for waste products over the 2012-2016 period on dummy variables indicating the type of exporting countries, namely *China*, *Turkiye*, and *Top Exporters*, with the rest of the world serving as the base category. In both columns, the estimated average product quality for *Top Exporters* is higher than the one for *Turkiye*. In particular, for plastic waste products, the estimated difference is about 35% and is statistically significant at the 1% level. If Turkish firms export higher-quality plastic waste than they sell domestically, the quality gap between imported and domestically available plastic waste in Turkiye is likely even larger, in favor of imports.

TABLE S2.1. Estimated Product Quality by Country Group

Dependent Variable:	(1)	(2)
Estimated product quality	All waste products	Plastic waste products
<i>China</i>	0.119a (0.030)	0.404a (0.037)
<i>Turkiye</i>	0.186a (0.030)	0.203a (0.037)
<i>TopExporters</i>	0.397a (0.058)	0.500a (0.082)
R^2	0.012	0.026
# observations	45365	7854

Note: This table reports estimates from regressing the average product quality for waste products, recovered from Equation (S2.1), on dummy variables indicating country groups (China, Turkiye and Top Exporters), with the rest of the world as the omitted category. Column (1) uses all waste products; Column (2) restricts to plastic waste. The sample covers the period 2012-2016. Robust standard errors are clustered at the origin-country level.

APPENDIX S3. THEORETICAL FRAMEWORK

S3.1. Welfare.

Aggregate consumption Q_k is a CES composite of sectoral consumption Q_k^j ,

$$Q_k \equiv \left(\sum_{j \in \{u, s, n\}} \eta_j Q_k^j \frac{\sigma-1}{\sigma} \right)^{\frac{\sigma}{\sigma-1}}, \quad Q_k^j \equiv \left(\sum_o \sum_{f \in \mathcal{F}_o^j} q_{fok}^j \frac{\sigma_j-1}{\sigma_j} \right)^{\frac{\sigma_j}{\sigma_j-1}},$$

where the elasticity of substitution across sectors is $\sigma > 1$. Within each sector j , consumption Q_k^j is a CES aggregate of differentiated varieties q_{fok}^j , where q_{fok}^j denotes consumption in country k of the variety produced by firm $f \in \mathcal{F}_o^j$ in origin country o . The elasticity of substitution within sector j is $\sigma_j > \sigma > 1$, and $\eta_j > 0$ denotes sectoral preference weights (normalised as $\eta_u \equiv 1$).

The environmental components are given by

$$B_k \equiv \sum_{f \in \mathcal{F}_k^s} b_{fk}^s, \quad X_k \equiv \sum_{f \in \mathcal{F}_k^u} \sum_o \sum_{g \in \mathcal{F}_o^s} x_{f(k)g(o)}^u, \quad V_k \equiv \sum_{j \in \{u, s, n\}} \sum_{f \in \mathcal{F}_k^j} v_{fk}^j,$$

where, b_{fk}^s denotes waste disposed by firm f in country k , x_{fk}^u denotes the plastic waste recycled and re-used by firm f in country k , and v_{fk}^j denotes virgin plastic input use by firm f in sector j in country k .

S3.2. Sectors and Firms. Production. A firm $f \in \mathcal{F}_k^j$ produces output y_{fk}^j with Hicks-neutral productivity ϕ_{fk}^j according to

$$y_{fk}^j = \phi_{fk}^j F_j \left(l_{fk}^j, v_{fk}^j, \mathbf{1}\{j = u\} x_{fk}^j \right),$$

where l_{fk}^j , v_{fk}^j , and x_{fk}^j denote labor, virgin plastic, and recycled plastic inputs, respectively, and $\mathbf{1}\{j = u\}$ is an indicator equal to one for *Using* firms and zero otherwise.

Let $x_{f(k)g(o)}^u$ denote purchases by *Using* firm f in country k from *Supplying* firm g located in country o . Domestic and foreign recyclable inputs are combined into the firm's recycled-input composite:

$$x_{fk}^u = G_u \left(\{x_{f(k)g(k)}^u\}_{g \in \mathcal{F}_k^s}, \chi_{fk}^u \{x_{f(k)g(o)}^u\}_{o \neq k, g \in \mathcal{F}_o^s} \right),$$

where $\chi_{fk}^u \geq 0$ is a firm-specific parameter governing the efficiency with which imported recycled inputs are used.

Waste Generation. Production generates waste as a by-product. A firm f in sector j produces $\theta_k^j y_{fk}^j / \phi_{fk}^j$ units of total waste, where $\theta_k^j > 0$ is a sector-specific technological parameter and y_{fk}^j / ϕ_{fk}^j is the effective units of output produced by the firm. Defining in terms of effective units ensures that ϕ_{fk}^j is Hicks-neutral (because otherwise it would denote firm differences in output versus by-product productivity).

Recycling and Disposal. A firm chooses how much of its waste to sell as recyclables, denoted r_{fk}^s , with the remainder disposed of domestically, b_{fk}^s .¹ These choices are subject to the material balance constraint that total waste produced must equal the sum of recyclable and disposed waste:

$$(S3.1) \quad r_{fk}^s + b_{fk}^s = \zeta_{fk}^s \theta_k^s y_{fk}^s / \phi_{fk}^s.$$

Recyclable plastic waste is sold to *Using* firms across destinations. For example, a medical syringe producer can sell its plastic waste to a traffic-cone producer that uses it as an input in production. Let $r_{f(k)g(d)}^s$ denote this shipment of recyclable plastic from *Supplying* firm f in country k to *Using* firm g in country d . Total recyclable units sold by firm f is given by

$$r_{fk}^s = \sum_d \sum_{g \in \mathcal{F}_d^u} r_{f(k)g(d)}^s.$$

Under iceberg trade costs $\tau_{kd} \geq 1$, the quantity of recyclable input received by firm g in country d is

$$x_{g(d)f(k)}^u = \frac{r_{f(k)g(d)}^s}{\tau_{kd}}.$$

Only *Using* firms demand recyclable plastic as an input, while only *Supplying* firms generate plastic waste. Firms in the *Neither* sector neither use nor generate plastic

¹For simplicity all non-plastic waste, $\tilde{b}_{fk}^j = (1 - \zeta_{fk}^j) \theta_k^j y_{fk}^j / \phi_{fk}^j$, is disposed of at zero cost rather than recycled; relaxing this adds notation without changing the main results.

waste and are affected by any changes in plastic waste prices only through general equilibrium channels.

Firm's profit maximization.

Firms are assumed to be monopolistically competitive in each market, and their maximized profit function is

$$\pi_{fk}^j(\mathbf{p}_k) \equiv \max_{\{q_{fkd}^j\}_d, l_{fk}^j, v_{fk}^j, x_{fk}^j, r_{fk}^j, b_{fk}^j} \pi_{fk}^j(\mathbf{p}_k),$$

where r_{fk}^j and b_{fk}^j are only relevant for *Supplying* firms ($f \in \mathcal{F}_k^s$), and x_{fk}^j only for *Using* firms ($f \in \mathcal{F}_k^u$).²

Hotelling elasticities are defined in the standard way. For any activity $i \in \{l, v, x, q, r, b\}$ and any price component $p_{i'} \in \mathbf{p}$, the Hotelling elasticity is

$$\varepsilon_{ii',fk}^j \equiv \pi^* \pi_{ii'}^* / \pi_i^* \pi_{i'}^*$$

for $\pi_{ii'}^* \equiv \partial^2 \pi_{fk}^j / \partial p_i \partial p_{i'}$ and $\pi_{i'}^* \equiv \partial \pi_{fk}^j / \partial p_{i'}$, and the share of activity i' in profits is

$$s_{i'fk}^j \equiv |p_{i'} \pi_{i'}^*| / \pi^*.$$

We assume constant Hotelling elasticities across firms within each product-country market, $\varepsilon_{ii',fk}^j = \varepsilon_{ii',k}^j$ for all firms f in (j, k) and $p_i, p_{i'} \in \mathbf{p}$, and examine the case when the law of conservation of material constraints bind weakly (because firms typically do not sell all their waste).

S3.3. Market Clearing. The model is closed with standard market-clearing conditions linking firm-level outcomes to national income.

Assumption 2 (Market Clearing).

- (a) *National Income Identity.* Income in country k equals revenues from domestic firms' final-goods sales plus net exports of virgin resources NX_k^v and recyclable waste NX_k^r .³ Since all income is spent on final consumption,

$$(S3.2) \quad E_k = I_k = \sum_j \sum_{f \in \mathcal{F}_k^j} \sum_d R_{fkd}^j + NX_k^v + NX_k^r,$$

where $E_k \equiv \sum_o \sum_j \sum_{f \in \mathcal{F}_o^j} R_{fok}^j$ is total expenditure on final goods, domestic and imported.⁴

²Iceberg costs τ_{kd} apply only to recycled plastic waste; adding them to virgin plastic and final goods would not change the qualitative results.

³ NX_k^r and NX_k^v are net exports (exports minus imports) of recycled and virgin plastic, respectively.

⁴This implies net exports across final goods, virgin plastic, and recycled waste sum to zero, $0 = NX_k^{\text{final}} + NX_k^v + NX_k^r$.

(b) *Labor Market Clearing.*

$$(S3.3) \quad L_k = \sum_j \sum_{f \in \mathcal{F}_k^j} l_{fk}^j; \quad L_k^r = \sum_{f \in \mathcal{F}_k^s} A_k(\zeta_{fk}^s) r_{fk}^s + D_k b_{fk}^s,$$

where l_{fk}^j is production labor and the second term is waste-management labor (generating recyclables, $A_k(\zeta_{fk}^s) r_{fk}^s$, and disposing of by-products, $D_k b_{fk}^s$). The wage adjusts to clear each labor market.

(c) *Virgin Resource Pricing.* The world price of the virgin resource, p_v , is taken as given and unaffected by the ban over the medium run.

Segmented labor markets for production workers and waste workers allows their wages to differ, as is typically the case in most countries. Since virgin plastic is derived from oil and gas, condition (c) amounts to taking the oil price as given for Turkiye, a net energy importer, in the welfare analysis.

S3.4. Sufficient Statistics. We show that empirically-relevant firm outcomes are summarized by sufficient statistics based on firms' exposure to imported recyclable plastic inputs and their waste intensity. Let $\tilde{c}_{fk}^j \equiv c_{fk}^j(\mathbf{p}_k) + \mathbf{1}\{j = s\} \Omega_{fk}^s$ be firm f 's effective unit cost, where Ω_{fk}^s is the net waste-management cost per unit of output for *Supplying* firms. Optimal pricing $p_{fkd}^j = \frac{\sigma_j}{\sigma_j - 1} \tilde{c}_{fk}^j$ implies the usual CES responses for prices, quantities, and revenues:

$$d \ln p_{fkd}^j = d \ln \tilde{c}_{fk}^j, \quad d \ln q_{fkd}^j = -\sigma_j d \ln p_{fkd}^j + \eta_d^j, \quad d \ln R_{fkd}^j = (1 - \sigma_j) d \ln p_{fkd}^j + \eta_d^j,$$

where $\eta_d^j \equiv \sigma_j d \ln P_d^j + d \ln Q_d^j$ is a common destination shifter.

Let $m_{fk}^j \in \{l, v, x_D, x_M\}$ index labor, virgin plastic, and domestic and imported recycled plastic, with domestic and imported recycled inputs relevant only for the using sector ($x_{D, fk}^j = x_{M, fk}^j = 0$ for $j \neq u$).⁵ By Shephard's lemma, input demands satisfy $d \ln m_{fk}^j = d \ln Q_{fk}^j - \sum_{\tilde{m}} \epsilon_{m\tilde{m}}^j s_{\tilde{m}fk}^j d \ln p_k^{\tilde{m}}$, where $s_{\tilde{m}fk}^j$ is the cost share of input \tilde{m} and $\epsilon_{m\tilde{m}}^j$ the corresponding input-demand elasticity. Writing $s_{m0k}^j \equiv s_{mfk}^j / (1 - s_{x_Mfk}^j)$ for the normalized share of input $m \in \{l, v, x_D\}$ within spending on inputs other than imported recycled plastic, unit costs change by

$$d \ln c_{fk}^j = \sum_{m \in \{l, v, x_D\}} s_{m0k}^j (1 - s_{x_Mfk}^j) d \ln p_k^m + \mathbf{1}\{j = u\} s_{x_Mfk}^u d \ln \left(\frac{\rho_k^M}{\chi_{fk}^u} \right).$$

We implicitly assume the composition of all inputs other than imported recycled plastic is common across firms within a sector-country, so s_{m0k}^j does not vary across

⁵Here $x_{D, fk}^u$ and $x_{M, fk}^u$ are the domestic and imported recycled inputs of *Using* firm f .

firms and cross-firm variation in cost shares operates solely through the imported-recycled share $s_{x_Mfk}^u$.

S3.4.1. *Using Sector.* For using firms, collecting the common terms $A_k^u \equiv \sum_m s_{m0k}^u d \ln p_k^m$ and $B_k^u \equiv d \ln \rho_k^M - A_k^u$ gives $d \ln c_{fk}^u = A_k^u + s_{x_Mfk}^u B_k^u$, both common across firms within (u, k) . Hence cross-firm differences collapse to

$$\Delta_{ff'} d \ln c_{fk}^u = B_k^u \Delta_{ff'} s_{x_Mfk}^u.$$

Because every cost share is proportional to $(1 - s_{x_Mfk}^u)$, the same logic carries through the input-demand responses: conditional on common sectoral elasticities and input prices, cross-firm differences in both unit-cost and input-demand responses are fully summarized by $s_{x_Mfk}^u$, the imported-recycled-plastic share in total costs. In the data we observe recycled inputs by origin, so the empirical counterpart is $S_{fk}^u \equiv \sum_{o \neq k} s_{ofk}^u$, which corresponds directly to $s_{x_Mfk}^u$. When the shock operates through the price of imported recycled plastic, S_{fk}^u is therefore a sufficient statistic for the heterogeneous responses of using firms.

S3.4.2. *Supplying Firms.* An analogous argument applies to the *Supplying* sector, with one difference: the relevant source of heterogeneity is not efficiency in processing imported inputs but the share of plastic waste in total waste generated, ζ_{fk}^s .

Under CES demand with elasticity $\sigma_s > 1$ in the final-good market and $\varepsilon_r > 1$ in the recycled-input market, optimal prices are constant markups over marginal cost,

$$p_{fkd}^s = \frac{\sigma_s}{\sigma_s - 1} \cdot \frac{\tilde{c}_k^s + w_k^r D_k \zeta_{fk}^s \theta_k^s}{\phi_{fk}^s}, \quad \rho_{fkd}^s = \tau_{kd} \frac{\varepsilon_r}{\varepsilon_r - 1} w_k^r (A_k(\zeta_{fk}^s) - D_k),$$

where the final-good price reflects both production and disposal costs and the recyclable price reflects the net marginal cost of drawing recyclables from by-products. Totally differentiating and taking cross-firm differences within a country removes all common (aggregate) shocks, leaving firm-specific exposure to disposal costs as the sole source of variation, summarized by

$$\Upsilon_k^s(\zeta_{fk}^s) \equiv \frac{w_k^r D_k \zeta_{fk}^s \theta_k^s}{\tilde{c}_k^s + w_k^r D_k \zeta_{fk}^s \theta_k^s}.$$

Carrying this through the CES demand system, the cross-firm differences in price, output, employment, and final-good revenue responses all take the form

$$\Delta_{ff'} d \ln Z_{fk}^s = \kappa_Z \Delta_{ff'} \Upsilon_k^s(\zeta_{fk}^s) \left(d \ln w_k^r - d \ln \tilde{c}_k^s \right), \quad Z \in \{p^s, Q^s, l^s, R^s\},$$

with κ_Z a constant $(1, -\sigma_s, -\sigma_s, 1 - \sigma_s)$ respectively). Recyclable-input prices, by contrast, depend only on common destination-level shifters and the term $A_o(\zeta_{go}^s) - D_o$, so their cross-firm differences vanish, $\Delta_{gg'} d \ln R_{go}^{r,s} = 0$. Total firm revenue is the share-weighted sum of final-good and recyclable-input revenue, so its cross-firm difference inherits the same Υ_k^s structure. Differences across supplying firms in revenue and quantity responses are therefore governed by a single source of heterogeneity, the firm-specific plastic-waste share ζ_{fk}^s : through $\Upsilon_k^s(\zeta_{fk}^s)$, a higher plastic-waste share raises the sensitivity of final-good revenues and quantities to waste-management costs.

APPENDIX S4. ECONOMIC IMPACTS

S4.1. From Relative to Absolute Effects. Table 2 shows the relative effects of the ONS-policy on varying outcomes. In these results, industry-time fixed effects subsume the average response of *Neither* firms, which we denote by β_n^Y . The estimated coefficients β_j^Y capture effects relative to this baseline, and the implied absolute percentage change in outcome Y_{fk}^j for sector j is

$$(S4.1) \quad \frac{\Delta Y_{fk}^j}{Y_{fk}^j} = \exp(\beta_j^Y S_{fk}^j + \beta_n^Y) - 1.$$

when the dependent variable is expressed in logarithmic form. To recover the general equilibrium effects, we must determine the baseline impact β_n^Y . The model structure provides this through market-clearing conditions. In particular, market clearing for production labor in Assumption 2(b) requires that total employment changes across all firms sum to zero:

$$\sum_j \sum_f \Delta l_{fk}^j = 0.$$

Substituting the model-implied expression for employment changes,

$$\frac{\Delta l_{fk}^j}{l_{fk}^j} = \exp(\beta_j^l S_{fk}^j + \beta_n^l) - 1,$$

into Equation (S4.1) allows us to solve for β_n^l .

The relative changes (β_j^l) are reported in Table 2, and the initial employment in each sector is summarized in Table S4.1. These pin down the absolute employment response of non-exposed firms and, empirically, we find that the employment change among non-exposed firms is tiny ($\beta_n^l = -0.00076$). Consequently, the general equilibrium effect on employment turns out to be negligible, and the relative changes in

employment estimated in the difference-in-differences specification can be interpreted as the absolute change due to the policy.

To extend this logic to changes in outcomes other than employment reported in Tables 2 and S4.4, we impose regularity conditions that are standard in production theory below. Assumption 3 formalizes that labor has a positive marginal product and that material inputs are used productively in equilibrium. Because *Neither* firms are not directly exposed to recyclable plastics (as their $\chi_{fk}^n = 0$, $\zeta_{fk}^n = 0$), their outcomes can change due to the ONS policy only through general equilibrium channels such as wages or other input prices. Empirically, however, we observe economically negligible employment changes among *Neither* firms, implying that these indirect general equilibrium price effects are likewise minimal in practice. Under Assumption 3, the economic environment facing *Neither* firms is effectively unchanged, so their output, revenues, input use, and waste generation also remain approximately constant. This is not a mechanical implication of monotonicity alone, but rather reflects the combination of no direct policy exposure and negligible equilibrium price movements. It follows that the relative difference-in-differences estimates can be interpreted as close approximations to absolute percentage changes for exposed firms.

Assumption 3 (Monotonicity in Production).

- (i) *Output and revenues are strictly increasing in labor inputs.*
- (ii) *Virgin inputs, other material inputs, and by-products are strictly increasing in output.*

TABLE S4.1. Initial Sector-Level Aggregates (Pre-ONS)

Sector	Sales	Employment	Net Imports	Virgin Imports
<i>n</i>	127.3 billion	1,130,300	23.5 billion	0.78 billion
<i>s</i>	172.5 billion	852,057	57.6 billion	1.36 billion
<i>u</i>	1.70 billion	13,136	0.40 billion	0.05 billion

Note: This table reports aggregate annual values by sector for 2016, the pre-policy base year. Sector *n* denotes the *Neither* sector, *s* the *Supplying* sector, and *u* the *Using* sector. Sales and net imports of intermediates are expressed in 2016 USD. Virgin imports are defined as imports of crude petroleum, coal, palm oil, natural gas, and plastic in its primary form, also expressed in 2016 USD. Employment is measured in number of workers. The sample includes all manufacturing firms with more than 20 employees, as well as a representative sample of smaller firms.

S4.2. Demand Elasticity. Profit maximization implies that the log changes in output prices can also be re-written as $\ln P_{fkk}^j = \alpha_k^j + \beta^P S_{fk}^j$, as shown earlier in the

TABLE S4.2. National Income Accounting for Turkiye (Pre-ONS)

Component	Billion USD
Total firm revenues	301.5
<i>Neither</i> sector	127.3
<i>Supplying</i> sector	172.5
<i>Using</i> sector	1.7
Net exports of virgin plastic	-2.19
Net exports of recycled plastic waste	-0.01
Implied aggregate expenditure E_k	299.3

Note: Aggregate expenditure E_k is derived from the national income identity in Equation (S3.2) under the balanced trade condition in Assumption 1. Annual pre-ONS averages in 2016 USD.

derivations of firm's unit cost changes. From the CES structure, revenues of domestic firms are $\ln R_{fkk}^j = \ln \left(I_k \left(Q_k^j / Q_k \right)^{\frac{\sigma-1}{\sigma}} \eta_j Q_k^j \frac{1-\sigma_j}{\sigma_j} \right)^{\sigma_j} + (1 - \sigma_j) \ln P_{fkk}^j$ where the first term is a sectoral demand shifter from general equilibrium adjustments and the second term is the change in demand from own price effects. Optimal final price of domestic firms is $P_{fkk}^j = \frac{\sigma_j}{\sigma_j-1} c_{fk}^j$ for $j = n, u$ varieties. These CES relationships give the system of demand equations (4.8) and (4.9) that are estimated in Table S4.3. Exposure to banned plastic waste imports significantly lowers output prices for *Using* firms (Column 1), with no effect for *Supplying* firms; the first stage is strong and precisely estimated (Column 2); and the IV second stage (Column 3) gives $\beta^D = -(\sigma_u - 1) \approx -8.6$. Defining β_n^P as the price impact of *Neither* firms (that is subsumed in the industry-time fixed effects), $\Delta P_{f\iota} / P_{f\iota} = \exp(\beta^P S_f^u + \beta_n^P) - 1$, and the CES structure implies $\beta_n^P = 0$ when $\Delta l_{fk}^n \approx 0$, so $\Delta P_{f\iota} / P_{f\iota} = \exp(\beta^P S_f^u) - 1$.

S4.3. Consumption Gains. Under CES preferences, changes in aggregate consumption are expenditure-share-weighted changes in sectoral consumption, $\Delta Q_k / Q_k = \sum_j (E_k^j / E_k) (\Delta Q_k^j / Q_k^j)$. ONS generates no meaningful response in the *Supplying* or *Neither* sectors: Column (2) of Table 2 shows no relative revenue response for *Supplying* firms, and Column (1) of Table S4.4 shows no relative export response across exposed sectors. Combined with the relative-to-absolute mapping in Appendix S4.1, this implies $\Delta Q_k^j = 0$ for $j \in \{s, n\}$, so all consumption-side gains operate through the *Using* varieties.

We recover the income change from the national income identity, $\Delta I_k = \sum_{f \in \mathcal{F}_k^u} \Delta R_{fkk}^u + \Delta NX_k^r$. Domestic *Using*-firm revenues rise by \$195.8 million, while net exports of recycled plastic waste fall by \$92.2 million (Equation 2.1, Table S6.1), giving

TABLE S4.3. Demand Elasticity Estimation for Using Firms

	ln(P_{fit})	FS ln(P_{fit})	IV ln(R_{fit})
$Post_t \times S_f^u$	-0.246a (0.0307)	-0.243a (0.0265)	
$Post_t \times S_f^s$	-0.0300 (0.0335)		
ln($Price_{fpt}$)			-8.596a (2.304)
$Post_t \times Employment_{f,t=0}$	0.00554 (0.00525)	0.00981 (0.00632)	0.119c (0.0655)
N	407168	407168	407168
Fixed Effects:			
Firm \times Product	Yes	Yes	Yes
Industry \times Year	Yes	Yes	Yes
KP Stat			84.20

Note: Robust standard errors clustered at the firm-product level in parentheses. Significance: a $p < 0.01$, b $p < 0.05$, c $p < 0.10$.

TABLE S4.4. Trade-Relevant Margins of the ONS Policy

	Exports (1)	Imports excl. Virgin and Plastic Waste (2)
$Post_t \times S_f^u$	10.16 (9.273)	7.829 (11.29)
$Post_t \times S_f^s$	0.152 (0.149)	-0.0477 (0.133)
$Post_t \times Employment_{f,t=0}$	0.0310 (0.0202)	0.0154 (0.0158)
N	76465	76465
R^2	0.820	0.853
Fixed Effects:		
Sector \times Year	Yes	Yes
Firm	Yes	Yes

Note: This table presents trade-related margins as dependent variables in Equation (4.4). Outcomes are firm exports (Column 1) and firm imports of non-plastic/non-virgin products (Column 2), in logarithms, estimated by OLS. Significance: a $p < 0.01$, b $p < 0.05$, c $p < 0.10$.

$\Delta I_k = 195.8 - 92.2 = \103.6 million. Since $\Delta R_{fkk}^j = 0$ for $j \in \{s, n\}$,⁶ sectoral expenditure adjusts only in the *Using* sector, $\Delta E_k = \Delta E_k^u = \Delta I_k$.

The remaining unknown is sectoral expenditure E_k^u , which we bound using home bias: expenditure on domestic varieties weakly exceeds expenditure on imports, so $E_k^j \leq 2 \sum_{f \in \mathcal{F}_k^j} R_{fkk}^j$, giving $E_k^u \leq \$3.4$ billion for the *Using* sector. This makes the break-even condition least demanding.

S4.3.1. *Model-Implied Compensating Variation.* Under CES demand, log-differentiating the domestic expenditure share $R_{fkk}^j/E_k^j = (p_{fkk}^j/P_k^j)^{1-\sigma_j}$ maps observed firm-level

⁶Because our firm-level data do not separately report domestic sales, we estimate the same specification on total and export revenues (Column (1) of Table 2 and Column (1) of Table S4.4). We find no significant export changes, and attribute the *Using*-sector response to domestic sales.

revenue and price responses into the sectoral price index,

$$\frac{\Delta P_k^j}{P_k^j} = \frac{\Delta p_{fkk}^j}{p_{fkk}^j} + \frac{1}{\sigma_j - 1} \left(\frac{\Delta R_{fkk}^j}{R_{fkk}^j} - \frac{\Delta E_k^j}{E_k^j} \right),$$

and the compensating variation of the *Using*-sector price change is $CV_k = -E_k^u(\Delta P_k^u/P_k^u)$, which is positive for price declines.⁷ The firm-level revenue and price responses are recovered from Equation 4.4 (Table 2, Column 2) and Equation 4.9 (Table S4.3, Column 1): the average exposed *Using* firm sees an 11.5% revenue increase and a 0.2% price decline following ONS, with no significant response in the *Supplying* or *Neither* sectors.⁸ Substituting the empirical moments and $\sigma_u = 9.6$,

$$CV_k = \frac{1}{8.6} \times 103.6 \text{ million USD} - E_k^u(-0.002 + 0.115),$$

where the coefficient on E_k^u is strictly positive, so CV_k is decreasing in the *Using* expenditure; home-bias therefore gives an upper bound of $CV_k \leq \$12.05$ million.

Substituting into aggregate welfare (expressed in nominal units), $P_k \Delta W_k = \Delta I_k - CV_k - D_k^{VSL}$ with $\Delta I_k = \$103.6$ million and $CV_k \leq \$12.05$ million gives $P_k \Delta W_k \leq 115.65 - D_k^{VSL}$. Across the four mortality-cost specifications,

$$P_k \Delta W_k \leq \begin{cases} 115.65 - 557.78 = -442.13 & \text{(a) Disposal only} \\ 115.65 - 570.63 = -454.98 & \text{(b) + recycling + Using firms} \\ 115.65 - 611.23 = -495.58 & \text{(c) + PM2.5 from recycling (low) + Using firms} \\ 115.65 - 654.86 = -539.21 & \text{(d) + PM2.5 from recycling (high) + Using firms.} \end{cases}$$

Welfare is strictly negative under all specifications, with losses of \$442.13–\$539.21 million. Equivalently, the shadow price of PM10 that would make ONS welfare-neutral—equating damages to the maximum model-implied gain of $\Delta I_k + CV_k = \$115.65$ million—is

$$p_k^{PM10, \text{break-even}} = \frac{115.65 \text{ million USD}}{\Delta PM10_k} = \begin{cases} 115.65/4,368,259 = \$26.48 & \text{(a)} \\ 115.65/4,468,784 = \$25.88 & \text{(b)} \\ 115.65/4,786,718 = \$24.16 & \text{(c)} \\ 115.65/5,128,411 = \$22.55 & \text{(d),} \end{cases}$$

For ONS to have been welfare-improving, the social cost of PM10 in *Turkiye* would need to be below \$22.55–\$26.48 per kilogram.

⁷There are no changes in the *Supplying* and *Neither* sectors, so they do not appear in CV_k .

⁸From $\exp(\beta^R \bar{S}_f^u) - 1$ and $\exp(\beta^P \bar{S}_f^u) - 1$ with $\bar{S}_f^u = 0.009$, $\beta^R = 12.11$, $\beta^P = -0.243$.

APPENDIX S5. ENVIRONMENTAL IMPACTS

S5.1. Data Sources. This section details the data sources and methodology utilized to determine the environmental impacts of the ONS policy.

The environmental impact calculations in Table 3 draw on three sets of inputs described below. PM10 emission intensities, used in Panel B scenarios (b)–(d), come from Li et al. (2024) for plastic recycling and from Kim et al. (2023) for production of *Using* firms with plastic recyclables. CO₂e emission factors for waste burning and virgin plastic production, used in Appendix S5.3, come from Climate Trace and Li et al. (2024) respectively. The broader toxicity and ecotoxicity indicators reported in Appendix Table S5.3 draw on the same study.

Environmental Impact Intensities: Impact intensities are midpoint indicators from the life-cycle assessment (LCA) of global plastic waste by Li et al. (2024), which applies the ReCiPe 2016 (H) v1.13 method across polymers (HDPE, LDPE, PET, PP, PS, PVC), treatment pathways (recycling, incineration with and without energy recovery, landfill, open dumping, open burning), and countries, per functional unit of 1 kg treated or substituted (e.g. climate change in kg CO₂-eq, marine ecotoxicity in kg 1,4-DCB-eq). We use the Turkiye-specific intensities from the study’s public data repository. Manufacturing impacts of higher plastic output are modeled using conversion-stage impact factors (for ‘box production from recyclable plastics’) from Kim et al. (2023), normalized per kilogram and in ReCiPe 2016 Midpoint (H) units, excluding virgin-material production. The pollutants reported below are standard ReCiPe midpoint indicators. **Fine particulate matter** (PM2.5) penetrates deep into the lungs and is a leading risk factor for premature mortality, with no clear safe threshold. **Human toxicity** (carcinogenic and non-carcinogenic) captures cancer risk and other health effects—neurological, developmental, respiratory, organ—from emitted metals, organic compounds, and combustion by-products. **Terrestrial ecotoxicity** measures harm to soils, plants, and soil organisms from heavy metals, persistent organic pollutants, and combustion residues. All three are screening-level: they place diverse emissions on a common scale but do not, without site-specific modeling, predict realized outcomes.

Baseline Plastic Waste Levels: The annual volume of plastic waste within Turkiye is computed by summing domestically produced waste with imported waste and subtracting exported waste. The pre-ONS levels of domestically produced waste are from the World Bank, while data for imports and exports are from UN Comtrade.

Turkiye generated 0.959 million tonnes of plastic waste annually before ONS, across all industrial, household, and other sources.

Waste Management Practices: Mismanaged-waste shares by country group are from the World Bank's What a Waste Global Database. For consistency across countries we use the World Bank mismanagement share for Turkiye in Table 1, though the main analysis is based on data from the Turkish Statistical Institute that uses a more detailed categorization for waste disposal methods.

S5.2. Government Objective Function and Optimal Fine. We extend the model by allowing the government to set an expected per-unit fine on improperly disposed plastic waste, $F_k \equiv Prob_k(\theta_k) Fee_k$ (the detection probability times the statutory fee), which enters *Supplying* firms' private disposal cost as $(w_k^r D_k + F_k) b_{fk}^s$. The government chooses F_k to maximize

$$(S5.1) \quad \mathcal{G}_k(F_k) = Q_k(F_k) - \mathcal{D}_k(F_k) + \sum_{j \in \{s, u, n\}} (\lambda_k^j - 1) \Pi_k^j(F_k) - C_k(F_k),$$

where Π_k^j is aggregate sector- j profit, $\lambda_k^j \geq 1$ is the political weight on sectoral profits, and $C_k'(F_k) \geq 0$ is the marginal cost of enforcement. Writing $\delta_k(F_k) \equiv -B_k'(F_k) > 0$ for the reduction in mismanaged by-product per unit of fine, the gross marginal social damage is

$$(S5.2) \quad MSD_k(F_k) \equiv -\frac{\mathcal{D}'_k(F_k)}{\delta_k(F_k)} = \xi_{bk} + \xi_{xk} \left(-\frac{X'_k(F_k)}{\delta_k(F_k)} \right) + \xi_{vk} \left(-\frac{V'_k(F_k)}{\delta_k(F_k)} \right),$$

which simplifies to $MSD_k = \xi_{bk}$ when the fine only affects mismanagement ($X'_k = V'_k = 0$).

Combining the first-order condition for (S5.1) with (S5.2), the implemented fine differs from the Pigouvian benchmark $F_k^{Pigouvian} = MSD_k$ by three weakly non-negative wedges: a consumption-cost wedge $-Q'_k(F_k^*)/\delta_k$, a political-economy wedge capturing excess weight on producer profits, and an enforcement-cost wedge $C'_k(F_k^*)/\delta_k$. Standard monotonicity ($B'_k < 0$, $Q'_k \leq 0$, $\Pi_k^{j'} \leq 0$, $C'_k \geq 0$) and $\lambda_k^j \geq 1$ make all three wedges non-negative, so the observed expected fine is a lower bound on gross marginal social damage,

$$(S5.3) \quad F_k^* \leq MSD_k(F_k^*),$$

and, in the empirically relevant case where the fine primarily affects improper disposal, $F_k^* \leq \xi_{bk}$.

The monotonicity conditions follow from standard consumer and producer behavior. The sign of $B'_k(F_k)$ follows from the Supplying firm's disposal choice: a higher expected fine raises the private marginal cost of improper disposal, $(w_k^r D_k + F_k)$, and weakly reduces optimal mismanagement. The sign of $Q'_k(F_k)$ is the equilibrium consumption-cost restriction: holding environmental damages fixed, stricter enforcement raises production or compliance costs and therefore weakly lowers the feasible CES consumption bundle. The profit derivatives follow from envelope arguments. For Supplying firms, the fine enters profits only through $-(w_k^r D_k + F_k)b_{fk}^s$, so

$$\Pi_k^{s'}(F_k) = - \sum_{f \in \mathcal{F}_k^s} b_{fk}^{s*} = -B_k(F_k) \leq 0.$$

For Using firms, the fine affects profits through the recycled-input price $\rho_k(F_k)$. Since $d\rho_k/dF_k \geq 0$, Hotelling's lemma gives

$$\Pi_k^w(F_k) = -X_k(F_k) \frac{d\rho_k}{dF_k} \leq 0,$$

where $X_k(F_k)$ is aggregate recycled-input demand. Firms in the Neither sector are affected only through general-equilibrium spillovers, which we assume are weakly non-positive or negligible. Enforcement costs are non-decreasing by construction.

In 2021–2022, high-profile media reports on waste mismanagement in Türkiye prompted the government to increase inspections and fines.⁹ These fines provide a revealed-preference lower bound on the planner's valuation of environmental damages: in 2024 they amounted to $F_k B_k = \$212.92$ million (in 2016 prices).

S5.3. Global Pollution. Using country-level trade, waste emissions and virgin production data, we estimate the effect of plastic waste imports on per capita waste-site COe emissions and on virgin plastic production:

$$(S5.4) \quad \begin{aligned} \ln \text{CO}_2 \text{pc}_{dt} &= \beta_x \ln x_{dt} + \Gamma_x X_{dt} + \alpha_d + \alpha_t + \varepsilon_{dt} \\ \ln m_{dt}^v &= \beta_v \ln x_{dt} + \Gamma_v X_{dt} + \alpha_d + \alpha_t + \nu_{dt}, \end{aligned}$$

where CO₂e emissions are from Climate Trace and virgin production from EXIOBASE; X_{dt} collects destination controls (per capita income, the pre-policy share in China's banned-waste imports, and initial virgin production), each interacted with a post-ONS indicator, alongside destination and year fixed effects. We instrument $\ln x_{dt}$ with two pre-determined, gravity-motivated excluded instruments: an indicator for whether destination d runs a positive trade balance against former China-supplying

⁹See <https://www.bbc.com/turkce/haberler-dunya-57142579> and Gündoğdu (2022).

origins (weighted by each origin’s pre-policy share in China’s banned-waste imports), and d ’s average proximity to those origins (the mean ratio of distance-to-China to distance-to-destination). Both capture the ease of redirecting displaced waste to d after the ban. The overidentification test (J-statistic 0.22, $p = 0.64$) does not reject instrument validity, but the KP-statistic is modest in size and we therefore report both OLS and IV estimates throughout.

TABLE S5.1. Effects on CO₂ Emissions and Virgin Plastic Production

	$\ln x_{dt}$ (1) FS	$\ln \text{CO}_2\text{pc}_{dt}^{\text{waste}}$ (2) OLS	$\ln \text{CO}_2\text{pc}_{dt}^{\text{waste}}$ (3) 2SLS	$\ln m_{dt}^v$ (4) OLS	$\ln m_{dt}^v$ (5) 2SLS
$\ln x_{dt}$		0.00704a (0.00157)	0.0347a (0.00519)	-0.0262a (0.00920)	-0.0785c (0.0409)
$\left(\sum_o \frac{x_{do} - x_{od}}{x_{do} + x_{od}} \cdot \frac{x_{oChina}}{\sum_o x_{oChina}} > 0 \right) * \mathbb{1}\{t \geq 2017\}$	1.041a (0.231)				
$\ln(\overline{\text{dist}_{oChina}} / \overline{\text{dist}_{od}}) * \mathbb{1}\{t \geq 2017\}$	0.813c (0.469)				
$\text{GDP pc}_{dt} * \mathbb{1}\{t \geq 2017\}$	-0.0107 (0.0103)	-0.000326 (0.000567)	-0.000647b (0.000313)	-0.000637 (0.00140)	-0.0000298 (0.00154)
$\frac{x_{dChina}}{\sum_d x_{dChina}} * \mathbb{1}\{t \geq 2017\}$	14.64b (5.639)	0.175 (0.238)	0.0526 (0.161)	1.541 (0.965)	1.774c (0.937)
$\ln m_{d16}^v * \mathbb{1}\{t \geq 2017\}$	-0.0660 (0.0823)	0.00262 (0.00193)	0.00327 (0.00246)	-0.0615a (0.0182)	-0.0628a (0.0171)
N	273	273	273	273	273
R^2	0.793	1.000	-1.510	0.994	-0.0211
KP-Stat			13.30		13.30
J-Stat			0.220 (0.6396)		0.219 (0.6390)
Fixed Effects:					
Country	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes

Note: Estimates of Equation (S5.4). Column (1) is the first stage, where two excluded instruments—the share-weighted trade-balance indicator and the average log-distance ratio to former China-supplying origins—predict $\ln x_{dt}$. Columns (2)–(3) report OLS and 2SLS estimates of the effect of $\ln x_{dt}$ on per capita waste-site CO₂e emissions; Columns (4)–(5) repeat this with log virgin plastic production $\ln m_{dt}^v$ as the dependent variable. Controls (interacted with the post-ONS indicator) include GDP per capita, the destination’s pre-policy share in China’s banned-waste imports, and initial virgin production. KP is the Kleibergen-Paap weak-identification F-statistic; J is Hansen’s overidentification test (p -value in parentheses). The sample covers 2015–2021, with country and year fixed effects. Standard errors clustered at the country level. Significance: a $p < 0.01$, b $p < 0.05$, c $p < 0.10$.

Column (1) of Table S5.1 reports the first stage: the interaction of the pre-ONS weighted trade imbalance with the post period strongly predicts waste imports (coefficient 1.04), consistent with empty return containers lowering the marginal cost of importing waste. The second-stage IV estimates show that a 10% rise in waste imports raises per capita CO₂e emissions from waste sites by about 0.35% (Column

3) while lowering virgin plastic production by about 0.8% (Column 5), indicating substitutability between recycled and virgin plastic.

Because virgin-production emissions are not directly observed in CO₂e, we convert predicted changes in virgin output using a factor of 2.22 tonnes CO₂e per tonne of virgin plastic (Li et al., 2024), and combine these with baseline country-level emissions, the import changes from Table 1, and the elasticities in Columns (3) and (5) of Table S5.1 to compute the implied change in global emissions, reported in Table S5.2.

TABLE S5.2. Global Pollution (CO₂e)

Pollution Sources	Δ CO ₂ e		Value	
	IV (million kg)	OLS	IV (million USD)	OLS
(a) Waste-site emissions (excl. China)	32.92	6.68	4.76	0.96
(b) Waste-site emissions (China)	-12.57	-2.55	-1.82	-0.37
(c) Virgin plastic emissions (excl. China)	-6,386.58	-2,131.57	-922.51	-307.89
(d) Virgin plastic emissions (China)	10,141.94	3,384.95	1,464.95	488.94
(e) World emissions	3,772.53	1,256.86	544.92	181.55
(f) Emissions related to Turkiye	36.83	12.27	5.32	1.77

Note: Global CO₂e consequences through two channels. Waste-site emissions combine the estimated change in plastic waste imports with baseline country-level CO₂e from waste disposal; virgin-plastic emissions combine it with the implied change in virgin production from EXIOBASE, converted at 2.22 tonnes CO₂e per tonne of virgin plastic (Li et al., 2024). Rows (a)–(d) report China and the rest of the world separately; row (e) aggregates (a)–(d) across all countries; row (f) allocates world emissions to Turkiye by population share (other allocation keys yield similar magnitudes). Carbon price \$0.144 per kg CO₂e; all values in 2016 USD.

The quantitatively dominant channel is virgin-plastic substitution, not waste disposal: since one tonne of virgin plastic generates about 2.22 tonnes of CO₂e (Li et al., 2024), even modest changes in virgin output dominate the direct emissions from increased waste imports. Diversion to the rest of the world lowers virgin production and emissions there (row (c)), while China substitutes toward virgin production after the ban (row (d)). On net (row (e)), the ONS policy raises global CO₂e emissions by 1,256.86–3,772.53 million kg, a cost of \$181.55–544.92 million—roughly the annual emissions of 0.3–1 million passenger vehicles. Allocated to Turkiye by population share (row (f)), this amounts to greenhouse gas emission costs of \$1.77–5.32 million for Turkiye.

S5.4. Other Pollutants. Using impact factors from Li et al. (2024); Kim et al. (2023), we quantify the impacts of the China ban on different environmental impact categories. Table S5.3 summarizes the consequent increases in air pollution and human toxicity arising from the channels of the rise in domestic waste mismanagement,

TABLE S5.3. Environmental Impacts (%)

Human toxicity		Air pollution & atmosphere		Ecotoxicity / resources	
Cancer risk	23	Air pollution (health)	13	<i>Ecotoxicity</i>	
Non-cancer risks	19	Smog (human health)	21	Land ecosystems	35
		Smog (ecosystems)	21	Freshwater ecosystems	23
		Ozone layer damage	27	Marine ecosystems	24
		Climate change impact	24	<i>Resources & other</i>	
		Acid rain potential	14	Nutrient pollution (freshwater)	15
				Nutrient pollution (oceans)	16
				Freshwater use	15
				Land use	16
				Mineral depletion	10
				Fossil fuel scarcity	12
				Radiation exposure	16

Notes: Environmental impact factors are from Li et al. (2024); Kim et al. (2023).

increased plastic waste recycling and increased production with recyclable plastic at home. Each of the 18 impacts shown in Table S5.3 follows the lifecycle assessments recommended by the European Union.

The results indicate moderate climate and air-quality impacts but large terrestrial ecotoxicity and human toxicity pressures, consistent with waste-handling pathways that release persistent toxic substances to land rather than only immediate air pollutant releases. The PM_{2.5} burden is comparable to a large coal plant or a city of 0.5–1 million residents; cancer-toxicity impacts are on the order of 5–10% of a large primary lead smelter’s annual output, and land-based ecotoxicity is substantially larger.

S5.5. Local Air Pollution: Other Regions. In the absence of comparable data for the rest of the world, we draw on the substitution mechanism estimated for Turkiye to other country groups. Specifically, we aggregate countries into China, Top Exporters, and the Rest of the World (RoW), and compute land-area-weighted average PM₁₀ concentrations for each group using country-level data. We then map observed changes in plastic waste imports (reported in Table 1) into implied changes in PM₁₀ using the elasticity estimated for Turkiye. The results indicate substantial heterogeneity across regions. In China, the sharp decline in plastic waste imports (-86.47%) leads to a 3.57% reduction in PM₁₀, corresponding to a decrease of approximately 13,254 tonnes. In contrast, the increase in plastic waste imports among

Top Exporters (8.83%) and the RoW (11.66%) raises PM10 by 0.36% and 0.48%, respectively, implying increases of 1,235 and 10,223 tonnes.¹⁰

APPENDIX S6. ADDITIONAL TABLES AND FIGURES

TABLE S6.1. Effect of China’s ONS Policy on Bilateral Trade in Plastic Waste

Origin o		Destination d			
		CHN	Top Exp.	RoW	TUR
CHN	S	—	-0.460 / -0.588	0.098 / -0.027	—
	D	—	0.154 / 0.050	-0.242 / -0.348 ^c	-0.591 ^a / -0.788 ^a
Top Exp.	S	-2.199 ^a / -2.376 ^a	0.440 ^a / 0.403 ^a	0.288 ^a / 0.236 ^b	3.196 ^a / 3.087 ^a
	D	-2.397 ^a / -2.620 ^a	-0.096 / -0.151	0.202 ^b / 0.151	1.678 ^a / 1.578 ^a
RoW	S	-0.849 ^a / -0.986 ^a	-0.186 ^a / -0.290 ^a	0.074 / 0.008	0.714 ^b / 0.587 ^b
	D	-0.494 ^a / -0.647 ^a	-0.308 ^a / -0.381 ^a	-0.107 / -0.175 ^b	0.689 ^a / 0.660 ^a
TUR	S	—	-0.125 / -0.235	0.986 ^c / 0.886 ^c	—
	D	—	-0.658 ^b / -0.872 ^b	-0.163 / -0.286	—

Post _{t} × Tariff _{$p,2016$} : 0.139^a / 0.137^a
Origin × Dest × Year FE: Yes / Yes Product × Origin × Dest FE: Yes / Yes
Observations: 38,976,564 R²: 0.853 / 0.853

Note: Estimates of Equation (2.1), coefficients on Post _{t} × Banned _{p} ^{HS6} × o × d × Trade _{od} ^T. Rows split each origin into Surplus (S) and Deficit (D) relationships with the destination; columns index destinations. Each cell reports column (1) / column (2), where (2) adds the full set of Post _{t} × Banned _{p} ^{HS2} interactions. Robust standard errors clustered at the origin-destination-product level (omitted here for space; full SEs in the replication file). Significance: a $p < 0.01$, b $p < 0.05$, c $p < 0.10$.

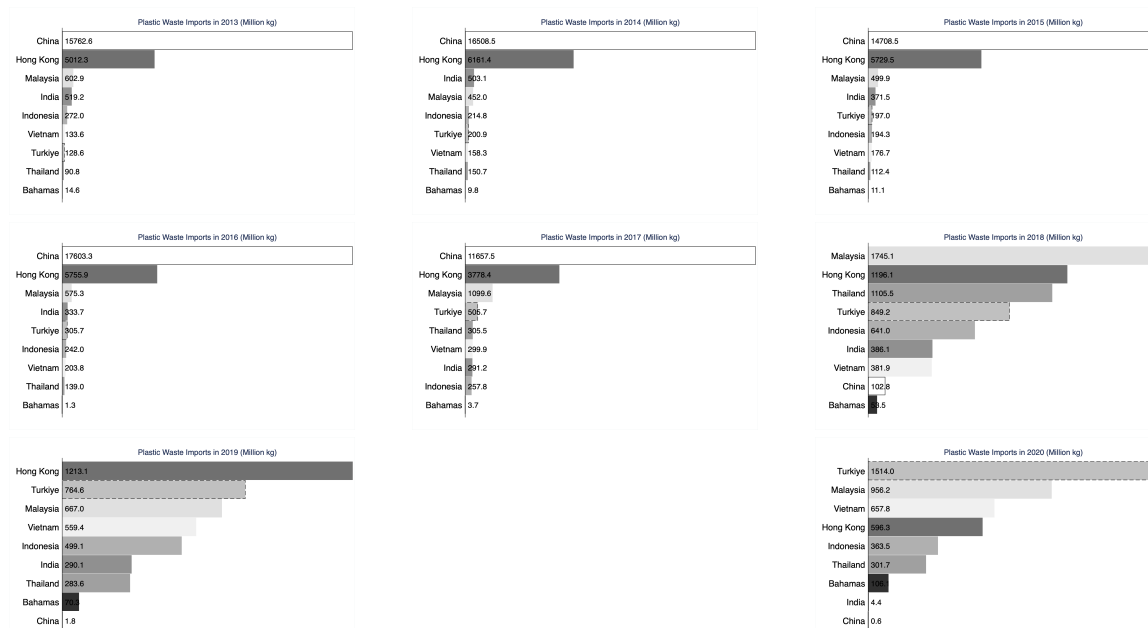
¹⁰Group-level PM10 concentrations (from WHO data) are land-area-weighted using World Bank data and mapped to import changes via the Turkiye elasticity proportionally (a 517% waste increase raises PM10 by 21.4%); percentage changes are converted to mass using land area and a 500m mixing height, then monetized at the benchmark value. This matches evidence that China’s ban improved its domestic air quality (Li and Takeuchi, 2023; Shi and Zhang, 2023; Unfried and Wang, 2022) while shifting trade internationally (Martin et al., 2021; Wen et al., 2021; Chunsuttiwat and Coxhead, 2024).

TABLE S6.2. Change in Trade in Plastic Waste

Dependent Variable: $\frac{Trade_{odpt}}{\sum_d Trade_{podt}}$	(1)	(2)
$Post_t \times Banned_{po} \times CHN_d$	-0.173a (0.014)	-0.173a (0.014)
$Post_t \times Banned_{po}$	0.0011c (0.00007)	
R^2	0.692	0.692
# observations	9689965	9689965
Fixed Effects:		
Destination \times Product \times Time	Yes	Yes
Origin \times Destination \times Time	Yes	Yes
Destination \times Origin \times Product	Yes	Yes
Origin \times Product \times Time	No	Yes

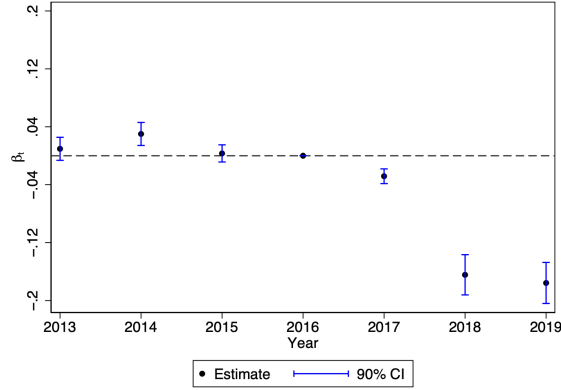
Note: This table shows the results from a difference-in-differences specification, where the dependent variable is the share of exports of product p by origin o to destination d at year t . The coefficient of interest is on the triple interaction term: $Post_t \times Banned_{po} \times CHN_d$. $Post_t$ is a dummy variable indicating 1 if year is greater than 2017, $Banned_{po}$ indicates the set of China-banned plastic waste products from initial exporter o , and CHN_d takes a value of 1 if the destination country is China. The sample covers the period 2013-2019. Statistical significance is denoted by letters: a for $p < 0.01$, b for $p < 0.05$, and c for $p < 0.10$.

FIGURE S6.1. Imports of Plastic Waste



Note: Each bar represents imports of ONS-banned plastic waste (in million kg) by country in a given year.

FIGURE S6.2. Global Trade after the Operation National Sword Policy



Note: This figure plots event-study estimates of the year-by-year coefficients β_l , together with 90% confidence intervals, from a regression of log global trade values for 6-digit HS products on interactions between year dummies D_t^l and $\text{Banned}_p^{\text{HS6}}$, an indicator for products banned by China under the ONS policy. The interaction with year 2016 is omitted as the reference year. The specification includes product and year fixed effects. The sample covers the period 2013-2019.

TABLE S6.3. Water Consumption and Plastic Waste Imports

Dependent Variable: $\Delta^{16-18} \left(\frac{\text{Water consumption}}{\text{Sales}} \right)$	(1)	(2)	(3)
S_f^u	-1.665c (0.906)		-1.665c (0.907)
S_f^s		-0.017 (0.063)	-0.017 (0.064)
Initial employment	0.053a (0.013)	0.054a (0.013)	0.053a (0.013)
N	8,215	8,215	8,215
R^2	0.032	0.032	0.032
Fixed Effects:			
Region	Yes	Yes	Yes
Sector	Yes	Yes	Yes

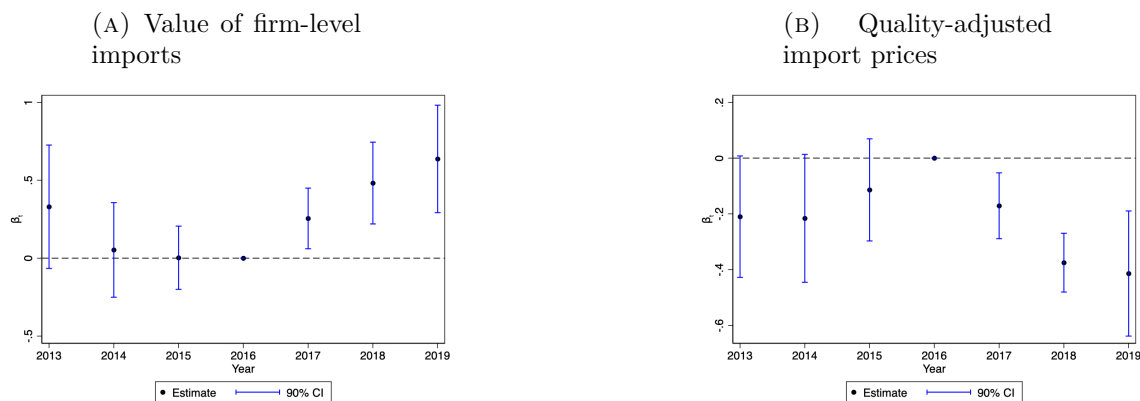
Note: The dependent variable is the change in water consumption divided by sales between 2016 (pre-ONS) and 2018 (post-ONS). Water consumption data are only available for 2016-2018. S_f^u measures the pre-ONS intensity with which, firm f relied on China-banned imports in total input costs in 2016. S_f^s captures the share of China-banned waste products in total waste generated by firm f in 2016. Standard errors are clustered at the 4-digit NACE industry level. Significance: a $p < 0.01$, b $p < 0.05$, c $p < 0.10$.

TABLE S6.4. Air Pollution and Domestic Plastic Waste Generation

Dependent Variable: ln(<i>PM</i> 10)	(1) All plastic waste	(2) Plastic waste by firms with less than 250 emp.
$Post_t \times Exposure_c^{Waste}$	0.925 ^a (0.185)	
$Post_t \times Exposure_c^{Waste, small}$		0.907 ^a (0.259)
$Post_t \times \ln(\text{Population Density})_{c,t=2015}$	-0.101 ^a (0.027)	-0.111 ^a (0.029)
$Post_t \times \ln(\text{Area})_c$	0.019 (0.012)	0.024 ^c (0.012)
$\ln(\text{Rainfall per km}^2)_{ct}$	0.026 ^b (0.012)	0.025 ^b (0.012)
R^2	0.399	0.399
# observations	288,706	288,706
Fixed Effects:		
Station \times Calendar Month	Yes	Yes
Date (Day \times Month \times Year)	Yes	Yes
NUTS2 \times Year	Yes	Yes

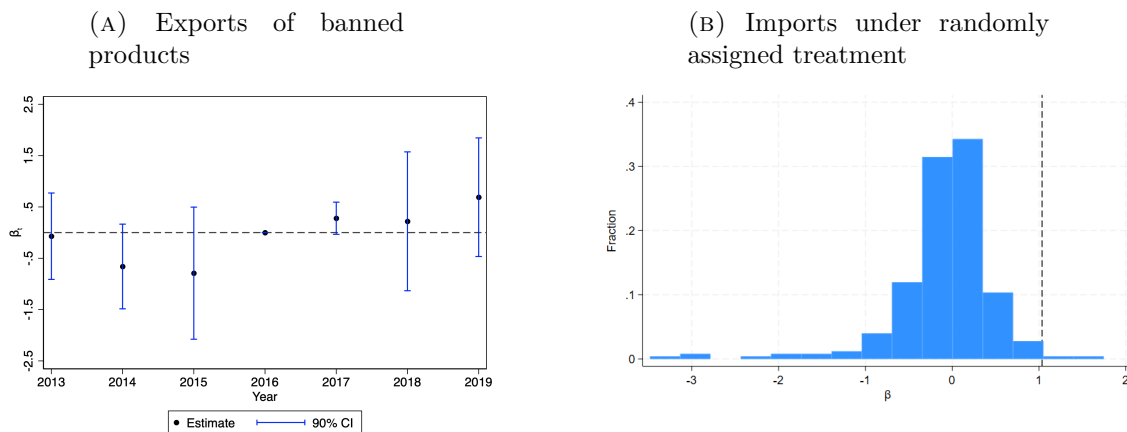
Note: This table reports estimates of the specification in (4.5). The sample is a station-day panel covering 2015-2019. The dependent variable is the log of the daily PM10 reading ($\mu\text{g}/\text{m}^3$) at station s in city c on date t . $Exposure_c^{Waste}$ is the pre-policy share of national plastic waste generated by all firms in city c ; $Exposure_c^{Waste, small}$ restricts this measure to firms with fewer than 250 employees. Observations are weighted by 2015 city population. Standard errors in parentheses are clustered twoway at the city-month and month-day levels. Significance: a $p < 0.01$, b $p < 0.05$, c $p < 0.10$.

FIGURE S6.3. Firm-level Imports and Quality-Adjusted Import Prices



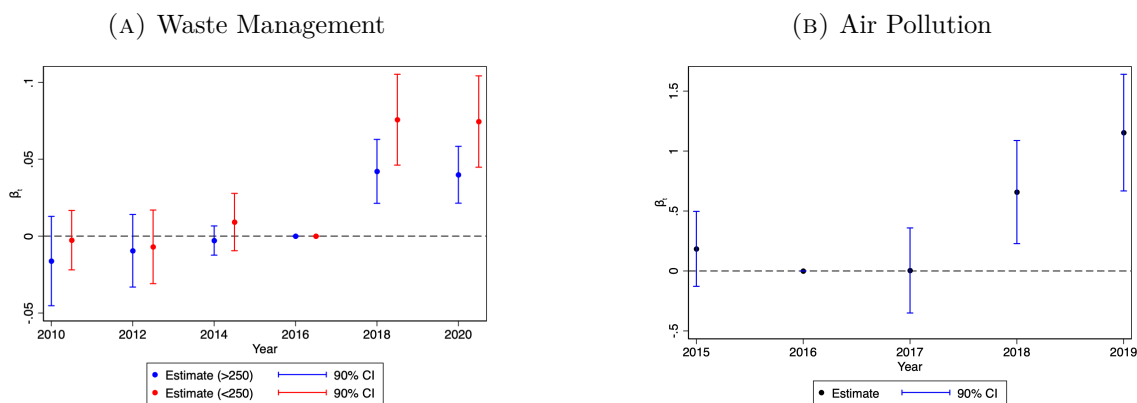
Note: Panel (A) plots estimates of β_l with 90% confidence intervals from $\ln \text{Imports}_{i,opt} = \sum_{l=2013}^{2019} \beta_l D_t^l \times \text{Banned}_p^{HS6} + \alpha_{iop} + \alpha_{ot} + e_{i,opt}$, where $\text{Imports}_{i,opt}$ is the value of imports of 8-digit HS product p by Turkish firm i from country o in year t . Panel (B) uses quality-adjusted import unit values as the dependent variable; product quality is the residual from regressing log quantity + $5 \times \log$ unit value on country-year, product-year, and firm-year fixed effects, and the quality-adjusted price is log unit value $-$ log quality. The interaction with 2016 is the reference year. The sample covers the period 2013-2019.

FIGURE S6.4. Exports and Randomly-Assigned-Treatment Placebo



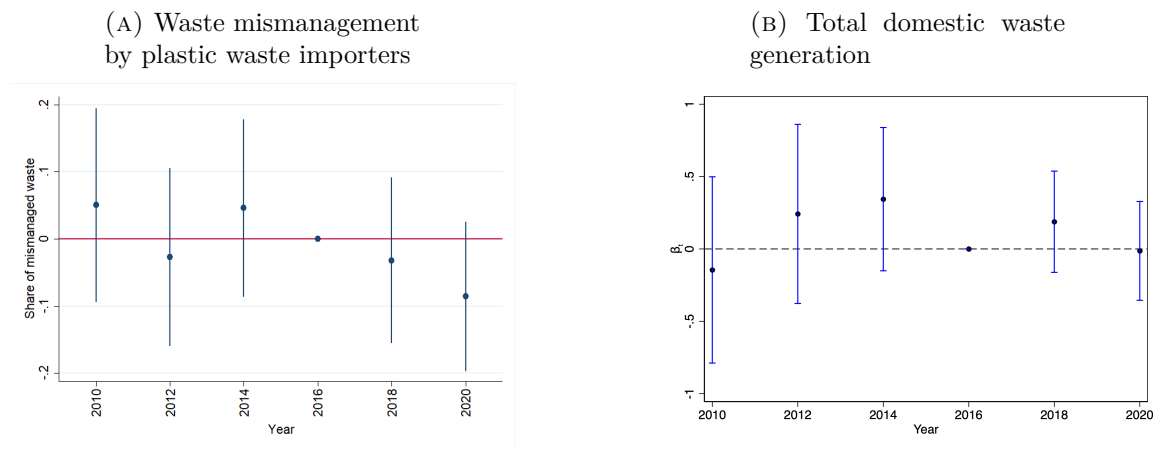
Note: Panel (A) plots estimates of β_l with 90% confidence intervals where the dependent variable is the quantity of Turkish exports of an 8-digit HS product; the interaction with 2016 is the reference year and the sample covers the period 2013–2019. Panel (B) plots the β coefficients from re-estimating the specification after randomly allocating treatment status to 8-digit HS products within their 4-digit HS codes, replicated 250 times.

FIGURE S6.5. Robustness by Firm Size: Waste Mismanagement and Local Air Pollution



Note: Both panels plot event-study estimates of β_l with 90% confidence intervals; 2016 is the reference year. Panel (A) plots the estimates from Equation (3.2) separately for firms with more than 250 employees (blue) and fewer (red); sample 2010–2020. Panel (B) estimates Equation (4.5) with $Exposure_c^{Waste}$ constructed as the 2016 share of national plastic waste generated in city c by firms with fewer than 250 employees.

FIGURE S6.6. Importer Waste Mismanagement and Waste Generation



Note: Both panels plot estimates of β_t with 90% confidence intervals; the interaction with 2016 is the reference year and the sample covers 2010–2020. Panel (A) estimates the share-mismanaged specification on importers of plastic waste (firm-product-year level), with coefficients on $D_t^l \times Banned_h$, where $Banned_h$ indicates China-banned waste products. Panel (B) reports PPML estimates with total waste produced by firm m in year t as the dependent variable (firm-year level), with coefficients on $D_t^l \times Exposure_m$, where $Exposure_m$ is the share of China-banned waste types in firm m 's total waste production.

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