Online Appendices

Appendix A: Proof of Lemma 1

This appendix presents the proof of Lemma 1.

(i) We apply the following equalities:

$$w^\sigma \phi \Phi_2(\phi) + \Phi_1(\phi) = w(1-\phi^2)\theta\mu_1\mathcal{A}_1,$$
$$\phi\Phi_1(\phi) + w^\sigma \Phi_2(\phi) = w^\sigma(1-\phi^2)\mu_2(1-\theta)\mathcal{A}_2,$$

which are derived from (6) and (8). If both $\Phi_1(\phi)$ and $\Phi_2(\phi)$ are negative for a specific $\phi \in [0,1]$, the above equalities imply that both $\mathcal{A}_1$ and $\mathcal{A}_2$ are negative, which is impossible according to (3) and the fact that $\phi \in [0,1]$, regardless of whether $w \geq 1$ or $w < 1$.

(ii) According to (7), (9), and (10), we know that $\Phi_1(\phi) - \Phi_2(\phi)$ is strictly convex, and

$$\Phi_1(0) - \Phi_2(0) = w\theta\mu_1 - (1-\theta)\mu_2 < 0.$$

Therefore, $\Phi_1(\phi) - \Phi_2(\phi)$ has at most one root in $[0,1]$. In other words, $\Phi_1(\phi)$ and $\Phi_2(\phi)$ cross at most once in $\phi \in [0,1]$.

(iii) If $w \geq 1$, we show that $\Phi_2 > 0$ and $\Phi_1(\phi)$ turns from positive to negative when ϕ increases in $[0,1]$. In fact, we have

$$0 < \Phi_1(0) = w\theta\mu_1 < \mu_2(1-\theta) = \Phi_2(0), \tag{A.1}$$

$$\begin{aligned} \Phi_1(1) &= -(w^\sigma - 1)[w\theta\mu_1 + (1-\theta)\mu_2] \leq 0 \\ &\leq (1-w^{-\sigma})[w\theta\mu_1 + (1-\theta)\mu_2] = \Phi_2(1). \end{aligned} \tag{A.2}$$

The above relationships imply two facts. (a) There is a threshold value $\tilde{\phi}_1 \in (0,1]$ such that $\Phi_1(\phi) \gtreqless 0$ if $\phi \lesseqgtr \tilde{\phi}_1$. (b) According to (ii), the inequalities of (A.1) and (A.2) tell us that $\Phi_1(\phi) < \Phi_2(\phi)$ holds for all $\phi \in [0,1)$. Thus, $\Phi_2(\phi) > 0$ holds when $\phi \in [0, \tilde{\phi}_1]$. On the other hand, the result of (i) implies that $\Phi_2(\phi) > 0$ holds when $\phi \in (\tilde{\phi}_1, 1)$.

(iv) We have

$$\Phi_2(0) = \mu_2(1-\theta) > 0 > (1-w^{-\sigma})[w\theta\mu_1 + (1-\theta)\mu_2] = \Phi_2(1).$$

Since $\Phi_2(\phi)$ is a convex function, it has a unique root $\tilde{\phi}_2$ such that $\Phi_2(\phi) \gtreqless 0$ if $\phi \lesseqgtr \tilde{\phi}_2$.

(v) If $w < 1$, we have

$$\Phi_1(0) = w\theta\mu_1 > 0,$$
$$\Phi_1(1) = (1-w^\sigma)[w\theta\mu_1 + (1-\theta)\mu_2] > 0.$$

On the other hand, since $\Phi_1(\phi)$ is a quadratic convex function, we have

$$\begin{aligned} \min_{\phi \in [0,1]} \Phi_1(\phi) &= \Phi_1\Big(\frac{w^\sigma[w\theta\mu_1 + (1-\theta)\mu_2]}{2(1-\theta)\mu_2}\Big) \\ &= \frac{w^{2\sigma}}{4(1-\theta)\mu_2}\Big\{4w(w^{-2\sigma}-1)(1-\theta)\theta\mu_1\mu_2 - [w\theta\mu_1 - (1-\theta)\mu_2]^2\Big\}. \end{aligned} \tag{A.3}$$

If σ is large such that (11) holds, (A.3) and $\Phi_1(\phi)$ are always positive in $[0, 1]$. Meanwhile, if σ is small such that the inequality of (11) is reversed, (A.3) is negative. In the latter case, there is an interval $(\tilde{\phi}_{1a}, \tilde{\phi}_{1b})$ in which $\Phi_1(\phi)$ is negative. According to (i), we know that $(\tilde{\phi}_{1a}, \tilde{\phi}_{1b}) \subset (0, \tilde{\phi}_2)$. □

Appendix B: Trade pattern and trade costs in different cases

This appendix enhances Section 2.3 by analyzing how trade pattern and firm behavior are related to trade costs. We have three cases: the developed country, the developing country with a large σ, and the developing country with a small σ. In our numerical examples, we plot the curves for both interior and corner equilibria, although our focus is the interior equilibrium part only.

B.1: The developed-country case ($w \geq 1$)

If country 1 is a developed country (i.e., $w \geq 1$), Lemma 1 tells us that $\Phi_1(\tilde{\phi}_1) = 0$ and $\Phi_2(\phi) > 0$ for $\phi \in [0, 1)$. Full agglomeration takes place in country 2 when $\phi \geq \tilde{\phi}_1$.

Since Φ_i is convex and $\Phi_i(0) > 0$ $(i = 1, 2)$, we have

$$\Phi_1'(\phi) < 0, \quad \Phi_2(\phi) > 0, \quad \forall \phi \in [0, \tilde{\phi}_1]. \tag{B.1}$$

Rewrite (13) as

$$\mathrm{EX}_1(\phi) = \frac{w^{1-\sigma}\mu_2}{w^{1-\sigma} + \frac{n_2}{\phi n_1}}(1-\theta)L, \tag{B.2}$$

which shows that $\mathrm{EX}_1(\phi)$ is negatively related to $n_2/(\phi n_1)$. Meanwhile,

$$\frac{d}{d\phi}\ln\left(\frac{n_2}{\phi n_1}\right) = \frac{\Phi_2'(\phi)}{\Phi_2(\phi)} - \frac{1}{\phi} - \frac{\Phi_1'(\phi)}{\Phi_1(\phi)} \tag{B.3}$$

holds. Thus $\mathrm{EX}_1(\phi)$ of (B.2) decreases with ϕ iff (B.3) is positive.

Since $\Phi_1(\phi)$ is positively infinitesimal when ϕ approaches $\tilde{\phi}_1$ from the left (i.e., $\phi \uparrow \tilde{\phi}_1$) based on (B.1), we know that (B.3) is positive when $\phi \uparrow \tilde{\phi}_1$. Accordingly, $\mathrm{EX}_1(\phi)$ decreases when ϕ approaches $\tilde{\phi}_1$ from the left.

Similarly, we have

$$\mathrm{EX}_2(\phi) = \tau q_{21} \cdot n_2 = \frac{w\mu_1}{\frac{w^{1-\sigma}}{\frac{\phi n_2}{n_1}} + 1}\theta L, \tag{B.4}$$

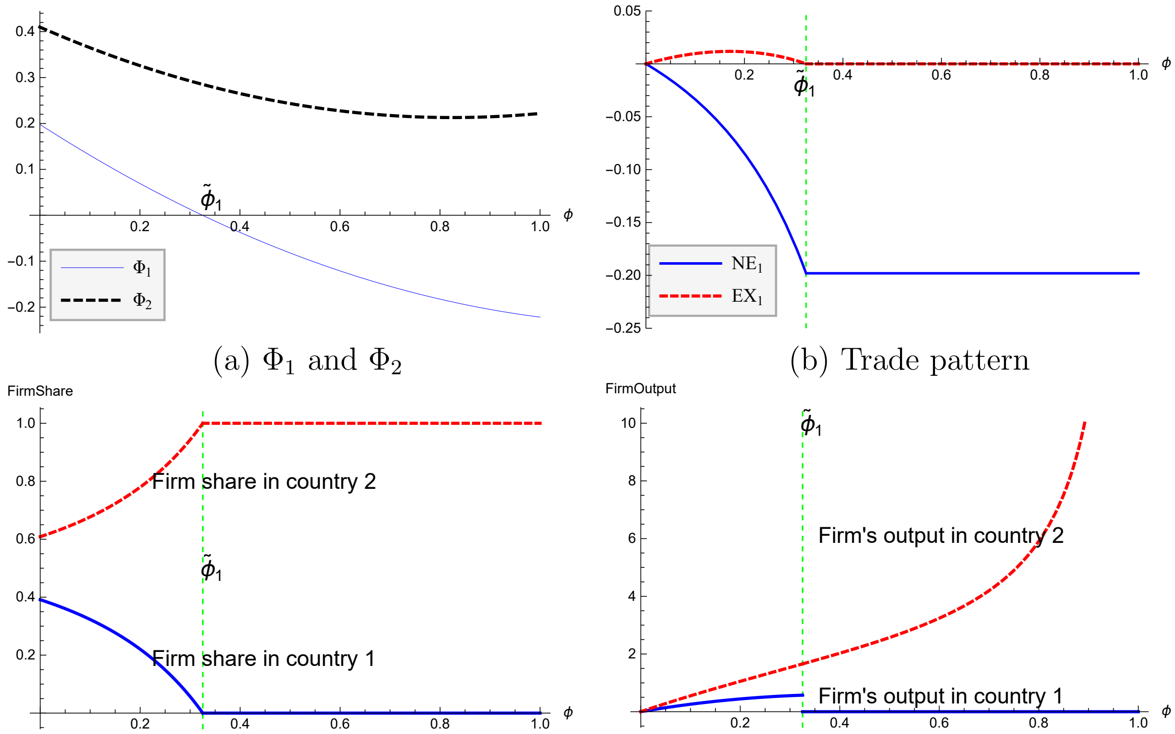
$$\frac{d}{d\phi}\ln\left(\frac{\phi n_2}{n_1}\right) = \frac{1}{\phi} + \frac{\Phi_2'(\phi)}{\Phi_2(\phi)} - \frac{\Phi_1'(\phi)}{\Phi_1(\phi)}. \tag{B.5}$$

When $\phi \uparrow \tilde{\phi}_1$, expression (B.5) is positive, so EX_2 of (B.4) increases with ϕ. Note that $\mathrm{NE}_1 = \mathrm{EX}_1 - \mathrm{EX}_2$; we know that NE_1 decreases with ϕ when $\phi \uparrow \tilde{\phi}_1$. When ϕ reaches $\tilde{\phi}_1$, all firms are located in country 2, so the exports of country 1 become zero. Country 1 is a net importer since the opening of trade.

Figure B.1 provides a numerical simulation to exhibit the non-monotonic relationship between exports and trade costs, as well as the firm behavior therein. The parameters are specified as

$$w = 1.1, \theta = 0.3, \mu_1 = 0.6, \mu_2 = 0.4, L = 1, \sigma = 4, F = 1, \tag{B.6}$$

which satisfy (10). In this example, $\tilde{\phi}_1 \approx 0.325$ is plotted in Figure B.1 (a). The interior equilibrium exists iff $\phi \in [0, \tilde{\phi}_1)$, while the corner equilibrium takes place iff $\phi \in [\tilde{\phi}_1, 1]$.



(a) Φ_1 and Φ_2 (b) Trade pattern

(c) Firm shares (d) Each firm's output for export

FIGURE B.1 Trade pattern, firm behavior, and trade costs if $w \geq 1$
Notes: The interior equilibrium occurs if $\phi \in [0, \tilde{\phi}_1)$, and the corner equilibrium occurs otherwise.

Figure B.1 (b) plots the curves of NE_1 and EX_1. Curve EX_1 has an inverted U shape in the interior equilibrium part. When ϕ is small, the local supply is required to meet the demand in each country. The net exports are zero in both countries, and the larger individual demand in country 1 is attractive to firms. Meanwhile, curve EX_1 in the corner equilibrium for a large ϕ (i.e., $\phi \in [\tilde{\phi}_1, 1]$) remains zero from (21), and NE_1 is a negative constant.

In Figures B.1(c) and (d), we explain the change in trade pattern by firm's behavior. The firm share in country 1 decreases when ϕ increases from 0 to $\tilde{\phi}_1$ due to the higher labor cost in country 1 ($w \geq 1$). In contrast, each firm's output for export in both countries goes up with ϕ. The value in country 1 is always lower than that in country 2, and the gap keeps widening. The trend of firm shares and each firm's output for export bring about a monotonic change in net exports and a bell-shaped change in exports in country 1. In addition, when ϕ exceeds the critical value $\tilde{\phi}_1$, country 1 loses all firms, which fully agglomerate in country 2 (i.e., corner equilibrium).

B.2: The developing-country case ($w < 1$) with large σ

If country 1 is a developing country (i.e., $w < 1$), all firms agglomerate in country 1 when $\phi \geq \tilde{\phi}_2$. When σ is large satisfying (11), we have

$$\Phi_2'(\tilde{\phi}_2) < 0, \quad \Phi_1(\phi) > 0, \quad \forall \phi \in [0, \tilde{\phi}_2]. \tag{B.7}$$

Now $\mathrm{EX}_1(\phi)$ of (13) increases with $\phi n_1/n_2$ because it can be written as

$$\mathrm{EX}_1(\phi) = \frac{w^{1-\sigma}\mu_2}{w^{1-\sigma} + \frac{1}{\frac{\phi n_1}{n_2}}}(1-\theta)L.$$

Meanwhile, based on (B.7), the following term

$$\frac{d}{d\phi}\ln\left(\frac{\phi n_1}{n_2}\right) = \frac{1}{\phi} + \frac{\Phi_1'(\phi)}{\Phi_1(\phi)} - \frac{\Phi_2'(\phi)}{\Phi_2(\phi)}$$

is positive when $\phi \uparrow \tilde{\phi}_2$. Therefore, $\mathrm{EX}_1(\phi)$ increases when ϕ is around $\tilde{\phi}_2$. Similarly, we know that $\mathrm{NE}_1(\phi)$ increases with ϕ again when ϕ is close to $\tilde{\phi}_2$.

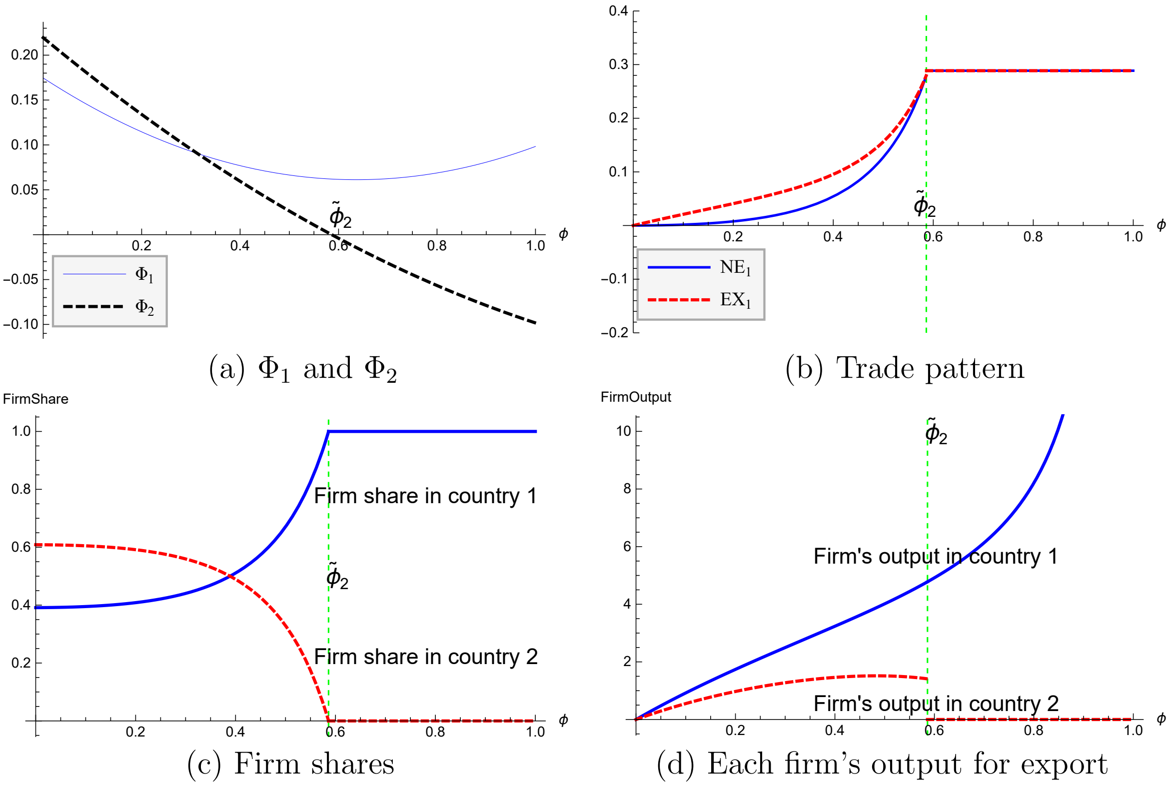
Figure B.2 provides a numerical example for this second case. The parameters are specified as

$$w = 0.97, \theta = 0.3, \mu_1 = 0.6, \mu_2 = 0.4, L = 1, \sigma = 8, F = 1,$$

satisfying (10) and (11). In this example, we have a positive $d\mathrm{NE}_1/\mathrm{d}\phi$ at $\phi = 0$, and $\tilde{\phi}_2 \approx 0.586$. Figure B.2(b) plots EX_1 and NE_1 for both interior and corner equilibria. It clearly shows the monotone relationships of EX_1 and NE_1 with trade costs in the interior equilibrium. The derivatives of EX_1 and NE_1 at $\phi = 0$ and $\phi \uparrow \tilde{\phi}_2$ are positive. In addition, EX_1 and NE_1 in the corner equilibrium are positively constant after reaching $\tilde{\phi}_2$. Therefore, being opposite to the example in Figure B.1, country 1 is always a net exporter for all $\phi > 0$.

Figure B.2 shows that population size is not the only determinant of trade pattern and a small country is not definitely a net importer. This result is distinct from the previous literature because two more factors are introduced here. On the one hand, the consumers in two countries have different demand parameters μ_1 and μ_2. On the other hand, labor wages in two countries are different.

More specifically, as shown in Figure B.2(c) and (d), the lower wage rate in country 1 attracts more firms when trade freeness increases, and thus its firm share expands. In addition, each firms' output for export in country 1 also rises when trade freeness goes up. Both of these factors contribute to the increasing exports and net exports in country 1 when $\phi \in (0, \tilde{\phi}_2)$. If ϕ reaches $\tilde{\phi}_2$, all firms agglomerate in country 1 (i.e., corner equilibrium).



(a) Φ_1 and Φ_2 (b) Trade pattern (c) Firm shares (d) Each firm's output for export

FIGURE B.2 Trade pattern, firm behavior, and trade costs if $w < 1$ and σ is large
Notes: The interior equilibrium occurs if $\phi \in [0, \tilde{\phi}_2)$, and the corner equilibrium occurs otherwise.

B.3: The developing-country case with small σ

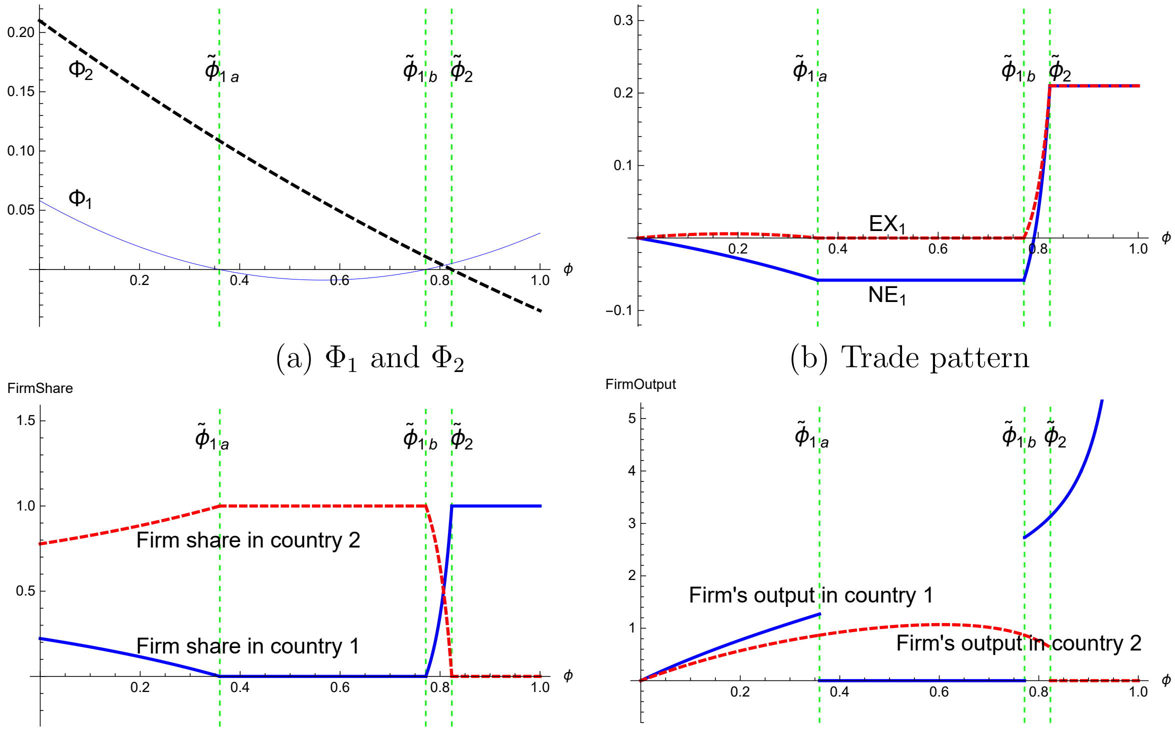
Although condition (11) for the case of Section B.2 does not lose too much generality, we also discuss what happens in the exceptional case. Specifically, $\Phi_1(\phi)$ may be negative if $w < 1$ and σ is small such that (11) is violated.

Figure B.3 shows the trade pattern and firm behavior in the developing country at small σ, violating (11) with parameters (B.8). Let $(\tilde{\phi}_{1a}, \tilde{\phi}_{1b})$ be the interval in which $\Phi_1(\phi) < 0$ holds, which is observed in Figure B.3(a).

$$w = 0.97, \theta = 0.3, \mu_1 = 0.2, \mu_2 = 0.3, L = 1, \sigma = 4, \text{and } F = 1. \tag{B.8}$$

Since Φ_1 and Φ_2 cannot be negative simultaneously, we know that $[\tilde{\phi}_{1a}, \tilde{\phi}_{1b}] \subset (0, \tilde{\phi}_2)$. This means that when $\phi \in [0, \tilde{\phi}_{1a}) \cup (\tilde{\phi}_{1b}, \tilde{\phi}_2)$, there is an interior equilibrium; when $\phi \in [\tilde{\phi}_{1a}, \tilde{\phi}_{1b}] \cup [\tilde{\phi}_2, 1]$, a corner equilibrium appears. Figure B.3(b) confirms that NE_1 drops as ϕ increases from 0, as given by (24). In this example, country 1 is a net importer when ϕ is small and then becomes a net exporter when ϕ is large. Thus, the trade pattern varies with trade cost. This result is consistent with Zeng and Uchikawa (2014, Figure 2 on p.229), which uses a model of multiple countries.

The variation of firm shares is given in Figure B.3(c). The lower labor cost in country 1 is attractive to firms. However, a small σ implies a strong agglomeration force in the larger market (country 2), which pushes firms out of country 1. Therefore, we have full



(a) Φ_1 and Φ_2 (b) Trade pattern

(c) Firm shares (d) Each firm's output for export

FIGURE B.3 Trade pattern, firm behavior, and trade costs if $w < 1$ and σ is small
Notes: The interior equilibrium occurs if $\phi \in [0, \tilde{\phi}_{1a}) \cup (\tilde{\phi}_{1b}, \tilde{\phi}_2)$, and the corner equilibrium occurs otherwise.

agglomeration in country 2 if $\phi \in [\tilde{\phi}_{1a}, \tilde{\phi}_{1b}]$. Overall, the interaction of these two forces results in a non-monotonic change in the firm share in country 1: it decreases (eventually to zero) when ϕ is small but increases (eventually to one) later when ϕ is large.

Appendix C: The HME and trade costs in different cases

This part analyzes the relationship between the HME and trade costs in Section 2.4. We have two cases: the developed country and the developing country. Again, our focus is the interior equilibrium part only.

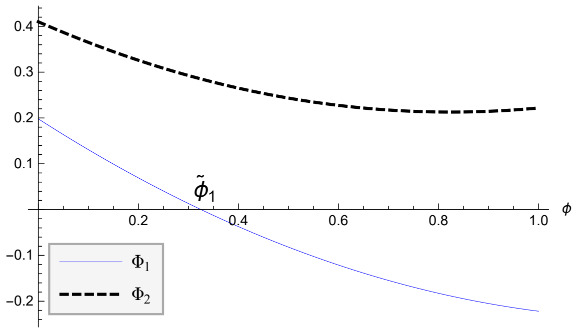
C.1: The developed-country case with $w \geq 1$

If country 1 is a developed country (i.e., $w \geq 1$), the result regarding the strong SME is simple:

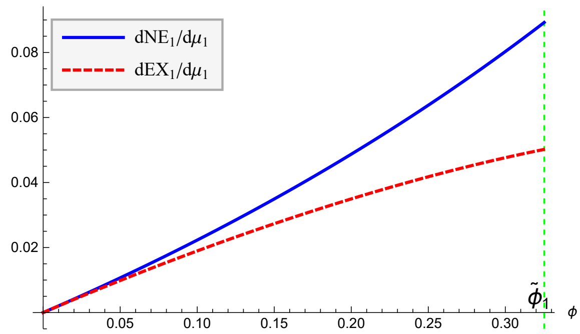
$$\frac{d^2 \text{NE}_1}{d\mu_1 d\phi} \begin{cases} > 0 & \text{if } \phi \in [0, \tilde{\phi}_1) \\ = 0 & \text{if } \phi \in [\tilde{\phi}_1, 1] \end{cases},$$

where the inequality comes from (4) and (31).

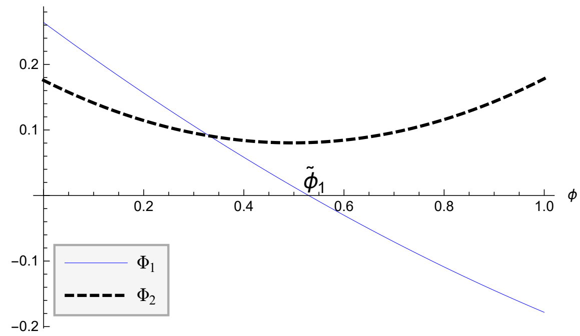
We have no definite results for the weak SME. In fact, in most cases (e.g., $(1-2w^\sigma\phi)\Phi_2$ is positive or weakly negative), (27) is positive when $\phi \uparrow \tilde{\phi}_1$. This result is confirmed by our numerical simulation in Figure C.1(a) and (b), using parameters (B.6). As shown in Figure C.1(b), both $d\mathrm{EX}_1/d\mu_1$ and $d\mathrm{NE}_1/d\mu_1$ increase monotonously as ϕ rises. The weak SME is observed in this example.



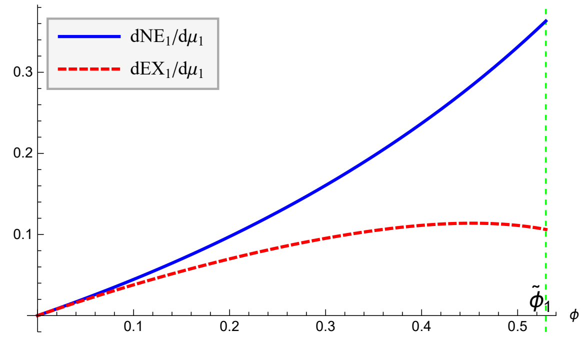
(a) Φ_1 and Φ_2 under (11)



(b) SME under (11)



(c) Φ_1 and Φ_2 violating (11)



(d) SME violating (11)

FIGURE C.1 The HME and trade costs if $w \geq 1$
Notes: The curve trend in the interior equilibrium (i.e., $\phi \in [0, \tilde{\phi}_1)$) is our focus.

However, (27) may become negative when $(1-2w^\sigma\phi)\Phi_2$ is strongly negative. This is confirmed by another numerical example plotted in Figure C.1(c) and (d), in which we change θ from 0.3 to 0.6 in (B.6). In this case, $d\mathrm{EX}_1/\mathrm{d}\mu_1$ rises first and then falls as ϕ is close to $\tilde{\phi}_1$. We do not observe the weak SME.

In summary, we have the strong SME but no definite result for the weak one in the developed country.

C.2: The developing-country case with $w < 1$

We have the following results

$$\Phi_1(\tilde{\phi}_2) > 0, \quad \Phi_2(\tilde{\phi}_2) = 0, \quad \Phi_2'(\tilde{\phi}_2) < 0, \tag{C.1}$$

from Lemma 1 and the convexity of $\Phi_2(\phi)$. When $\phi \uparrow \tilde{\phi}_2$, we have

$$
\begin{aligned}
&\frac{d}{d\phi}\Big(\frac{n_2}{\phi n_1}\Big) < 0 \quad \text{from (B.3)},\\
&\frac{d}{d\mu_1}\ln\Big(\frac{n_2}{\phi n_1}\Big) = -\frac{1}{\Phi_2}\cdot w^{1-\sigma}\theta\phi\mathcal{A}_1 - \frac{1}{\Phi_1}\cdot\frac{d\Phi_1}{d\mu_1} < 0 \quad \text{from (4)},\\
&\frac{d^2}{d\phi d\mu_1}\ln\Big(\frac{n_2}{\phi n_1}\Big) = \frac{1}{\Phi_2^2}\Big[\frac{d^2\Phi_2}{d\phi d\mu_1}\Phi_2 + w^{1-\sigma}\theta\phi\mathcal{A}_1\frac{d\Phi_2}{d\phi}\Big]\\
&\qquad\qquad - \frac{1}{\Phi_1^2}\Big(\frac{d^2\Phi_2}{d\phi d\mu_1}\Phi_1 - \frac{d\Phi_1}{d\phi}\frac{d\Phi_1}{d\mu_1}\Big) < 0 \quad \text{from (4) and (C.1)}.
\end{aligned}
$$

The above inequalities give

$$
\frac{d}{d\phi}\Big(\frac{n_2}{\phi n_1}\Big) < 0, \quad \frac{d}{d\mu_1}\Big(\frac{n_2}{\phi n_1}\Big) < 0, \quad \frac{d^2}{d\phi d\mu_1}\Big(\frac{n_2}{\phi n_1}\Big) < 0,
$$

which lead to

$$
\frac{d^2\mathrm{EX}_1}{d\mu_1 d\phi} > 0, \text{ if } \phi \uparrow \tilde{\phi}_2 \tag{C.2}
$$

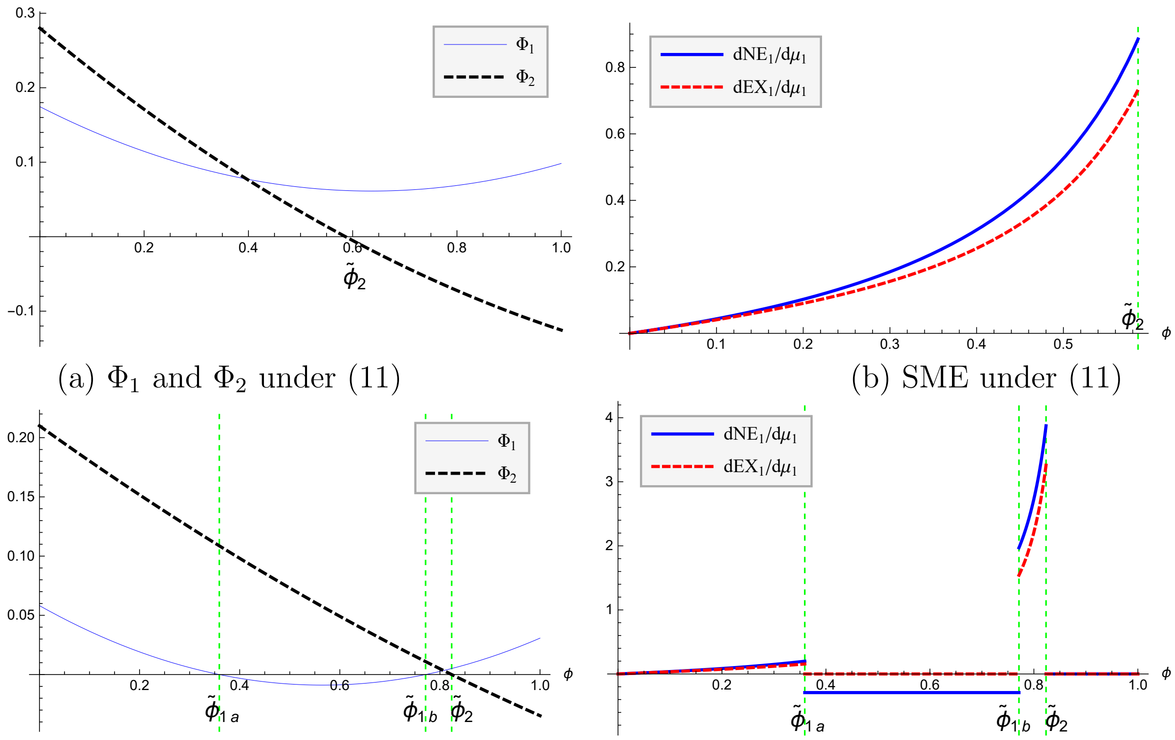
from (26). Furthermore, we get

$$
\frac{d^2\mathrm{NE}_1}{d\mu_1 d\phi} = \frac{d^2\mathrm{EX}_1}{d\mu_1 d\phi} + \frac{2Lw\theta\phi}{(1-\phi^2)^2} > 0, \text{ if } \phi \uparrow \tilde{\phi}_2
$$

from (30).

Accordingly, both $d\mathrm{EX}_1/d\mu_1$ and $d\mathrm{NE}_1/d\mu_1$ increase with ϕ when ϕ approaches $\tilde{\phi}_2$ from the left. Figure C.2(a) and (b) plot a numerical example using the following parameters: $w = 0.9, \theta = 0.3, \mu_1 = 0.6, \mu_2 = 0.4, L = 1$, and $\sigma = 4$, which satisfy (11). Curves $d\mathrm{EX}_1/d\mu_1$ and $d\mathrm{NE}_1/d\mu_1$ in Figure C.2(b) monotonously go up as ϕ rises.

When σ is small such that the inequality of (11) is reversed, interior equilibrium occurs when $\phi \in [0, \tilde{\phi_{1a}}) \cup (\tilde{\phi_{1b}}, \tilde{\phi}_2)$. This is confirmed by the numerical example plotted in Figure C.2(c) and (d) with parameters (B.8). Although $d\mathrm{EX}_1/d\mu_1$ and $d\mathrm{NE}_1/d\mu_1$ are discontinous, these curves still monotonically increase with ϕ in each interval, which is consistent with Figure C.2(b).



(a) Φ_1 and Φ_2 under (11)

(b) SME under (11)

(c) Φ_1 and Φ_2 violating (11)

(d) SME violating (11)

FIGURE C.2 The HME and trade costs if $w < 1$
Notes: The curve trend in the interior equilibrium (i.e., $\phi \in [0, \tilde{\phi}_2)$ in (a) and (b), $\phi \in [0, \tilde{\phi}_{1a}) \cup (\tilde{\phi}_{1b}, \tilde{\phi}_2)$ in (c) and (d)) is our focus.

Appendix D: Air purifier trade of sample countries

This part is a detailed description of the environmental product trade in Section 3.1.1. We map the temporal trends in exports and imports of air purifiers as representative environmental products in our 46 countries. In Figure D.1, we find several noteworthy features.

First, the export shares of these 46 countries are quite different. They can be divided into four groups. (i) The first group includes Germany, the United States, and South Africa. Each country occupies a huge market share in the international market, once close to 25%. Their trends are different: Germany's market share continued to rise, while that of the United States stabilized, and that of South Africa dropped sharply. (ii) The second group includes Belgium, Canada, China, France, Japan, Mexico, and the United Kingdom, each with a share of 5% to 10%. (iii) The third group includes countries with a share between 0.1% and 5%. (iv) The fourth group includes countries having a share generally less than 0.1%.

Second, many of the countries with overall growth in exports suffer from air pollution, either light or heavy, such as China, India, the Republic of Korea, Malaysia, Mexico, Thailand, and Romania (although Germany does not).

Third, the trade status of some countries changes significantly. In particular, China, the Republic of Korea, Malaysia, and Mexico have shifted from net importers to net exporters.

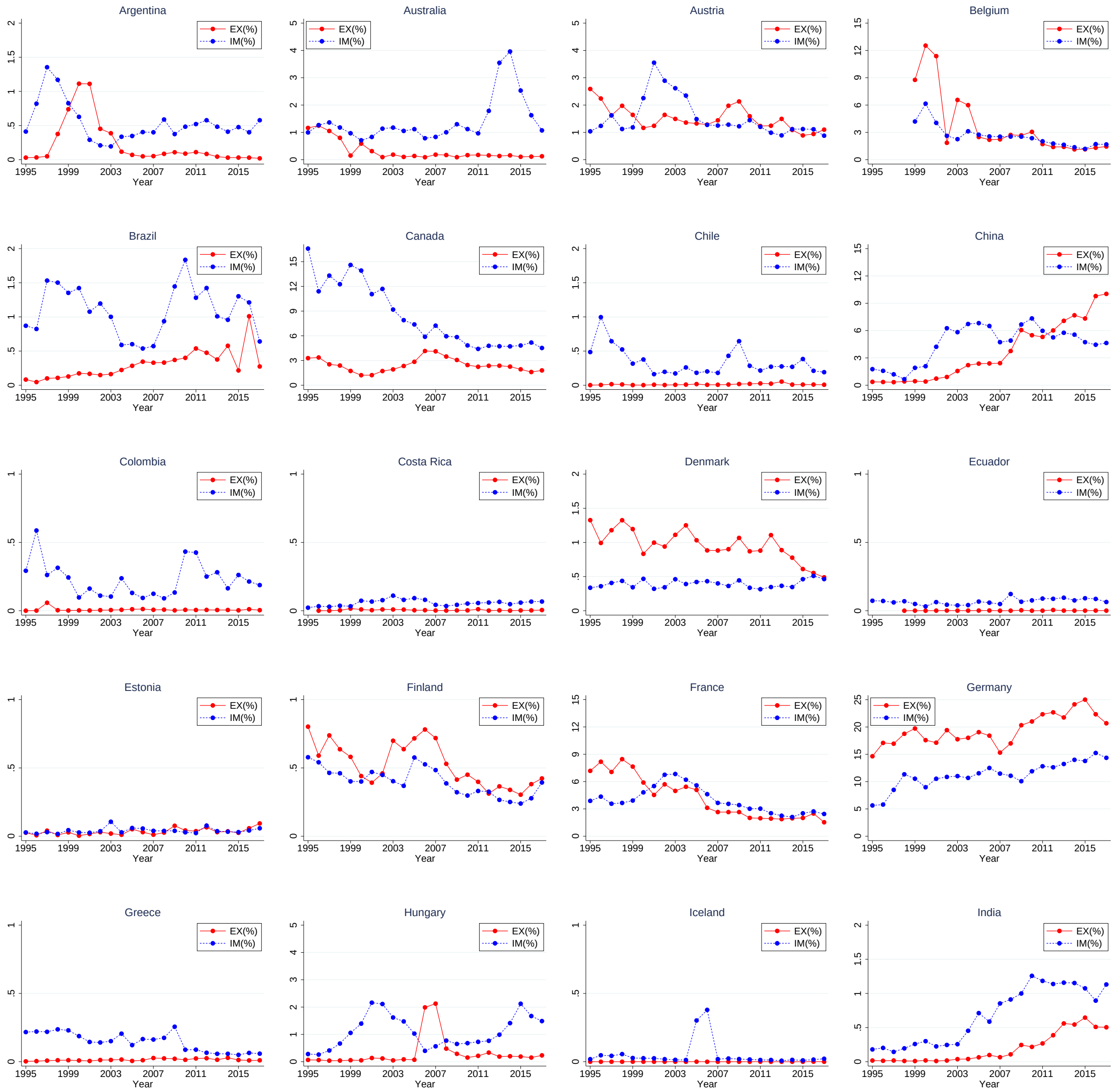


FIGURE D.1 The temporal changes of trade share of air purifiers in each sample country

Notes: The legend "EX(%)" in each subgraph represents the percentage of the observed country's export of air purifiers in the world's total export of air purifiers. Similarly, "IM(%)" represents the percentage of the observed country's imports. The original export and import data of air purifiers come from the United Nation Comtrade Database.

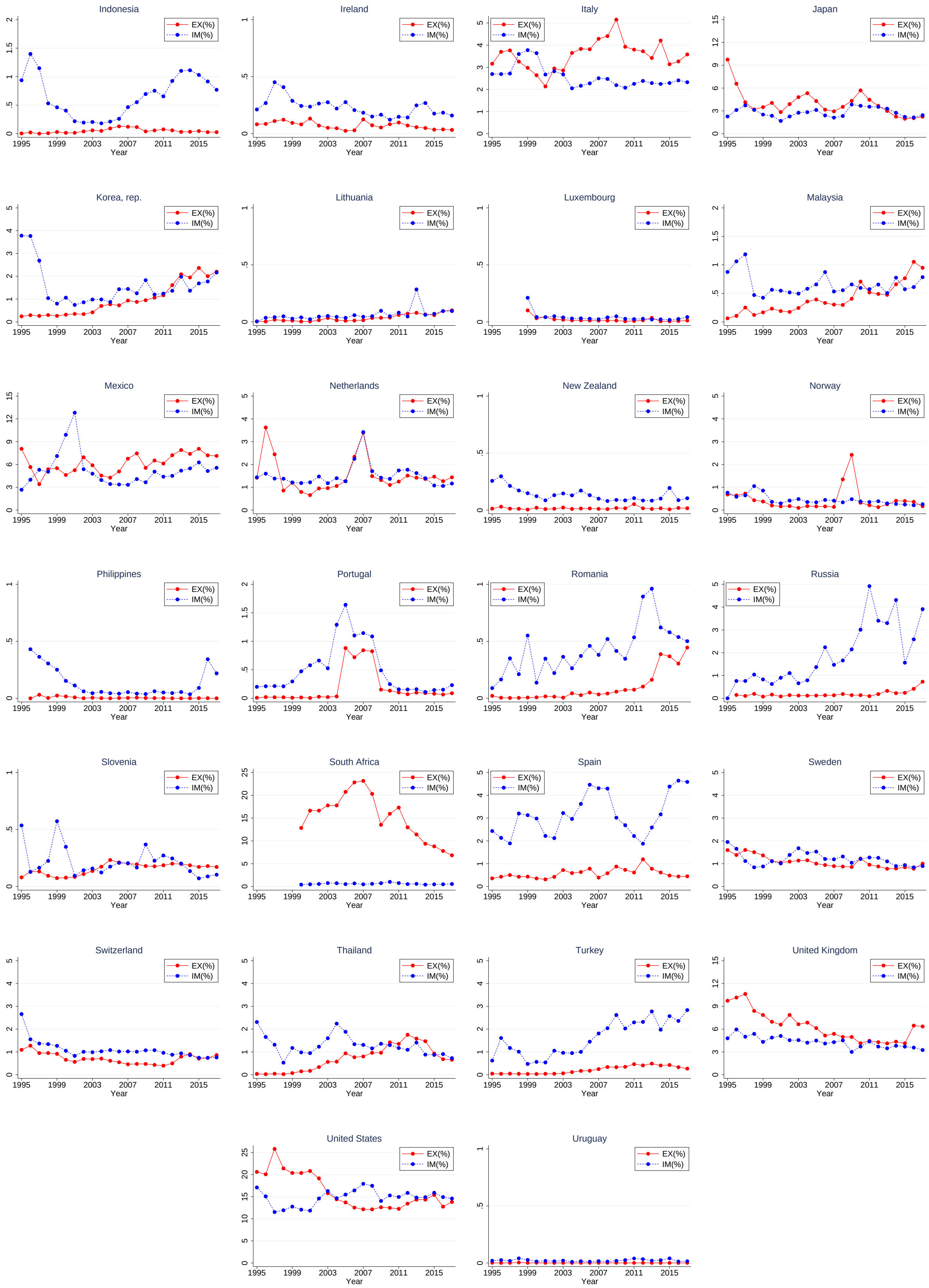
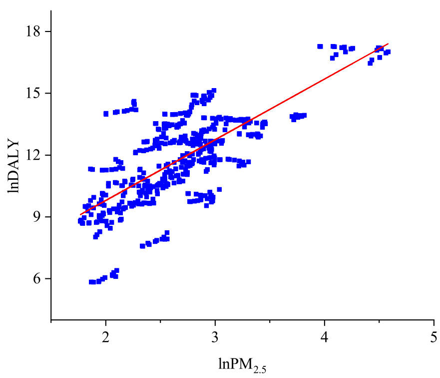


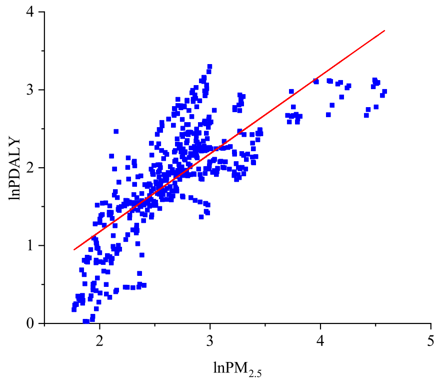
FIGURE D.1 The temporal changes of trade share of air purifiers in each sample country (continued 1)

Appendix E: Air pollution and environment-related risks

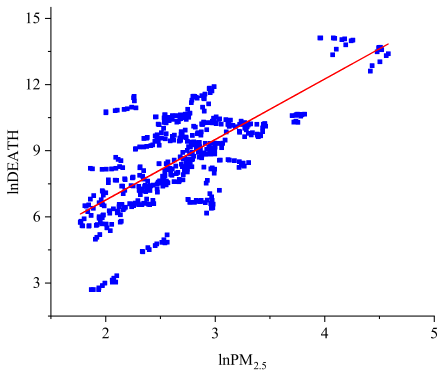
This part is a supplement to Section 3.1.2 on the environmental demand shifter. We adopt four indicators of environment-related risks caused by ambient particulate matter directly. In Figure E.1, we visually show the correlation between $PM_{2.5}$ concentration and environmental health risks. These scatter plots indicate that $\ln PM_{2.5}$ has a positive correlation with lnDALY, lnPDALY, lnDEATH, and lnPDEATH. Furthermore, air pollution may be highly correlated with environment-related health risks. Therefore, this result provides evidence for the rationality of using $PM_{2.5}$ as the environmental demand shifter.



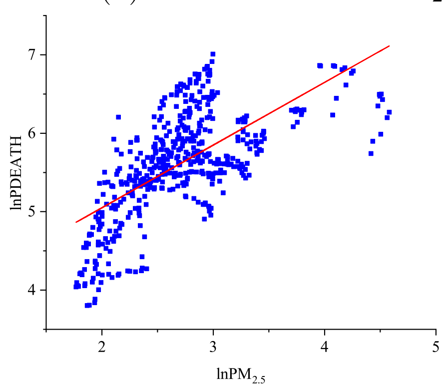
(a) lnDALY and $\ln PM_{2.5}$



(b) lnPDALY and $\ln PM_{2.5}$



(c) lnDEATH and $\ln PM_{2.5}$



(d) lnPDEATH and $\ln PM_{2.5}$

FIGURE E.1 $PM_{2.5}$ concentration and environment-related risks

Notes: The solid lines in the subfigures are fitted trend lines. $\ln PM_{2.5}$ is the logarithm of the annual $PM_{2.5}$ concentration. lnDALY and lnPDALY refer to the logarithm of total Disability-Adjusted Life Years (DALYs) and the logarithm of DALYs per thousands inhabitants in a country, respectively. lnDEATH and lnPDEATH represent the logarithm of total premature deaths and the logarithm of premature deaths per million inhabitants. These environmental risks are caused by ambient particulate matter. All above data are from the OECD Statistics.

Appendix F: Descriptive statistics and variable definitions

This appendix is a detailed description of the data in Section 3.1. Table F.1 shows descriptive statistics (observations, mean, standard error) and definitions of the variables related to the trade of environmental products, the environmental demand shifters, control variables, and other factors. $\ln WPM_{2.5}$, PPMT, lnWPMPOP, $\ln WPM_{2.5}fos$, and $\ln WNH_3$ all exclude the value of the observed country and represent the corresponding values of the rest of the world.

TABLE F.1 Descriptive statistics and variable definitions

Variable	Obs.	Mean	S.E.	Definition
The trade of environmental products				
lnExvalue	501	16.872	0.147	Logarithm of air purifier export value (US $) in a country
lnImvalue	501	18.134	0.081	Logarithm of air purifier import value (US $) in a country
Nettrade	501	-1.262	0.092	Net export value, equals lnExvalue - lnImvalue
The environmental demand shifter				
$\ln PM_{2.5}$	506	2.712	0.024	Logarithm of annual $PM_{2.5}$ ($\mu g/m^3$) in a country
Control variables				
$\ln WPM_{2.5}$	506	3.837	0.004	Logarithm of annual $PM_{2.5}$ ($\mu g/m^3$) in the rest of the world
lnPCGDP	506	9.748	0.050	Logarithm of per capita GDP (current US $) in a country
lnAVH	503	7.496	0.006	Logarithm of annual hours worked by employees
TFP	506	0.742	0.009	TFP level at current PPPs (USA = 1)
lnWPCGDP	506	9.100	0.012	Logarithm of per capita GDP (current US $) in the rest of the world
Other variables				
lnREX	499	5.393	0.091	Logarithm of the proportion of air purifier exports to total merchandise exports in a country
lnRIM	501	6.553	0.031	Logarithm of the proportion of air purifier imports to total merchandise imports in a country
lnRNE	499	-1.163	0.083	Logarithm of the proportion of a country's air purifier net exports to total merchandise net exports in a country
PPMT	506	75.091	1.605	The proportion of population in a country exposed to excessive $PM_{2.5}$ that exceed the World Health Organization Target $10\mu g/m^3$
WPPMT	506	92.550	0.180	The proportion of people in the rest of the world exposed to excessive $PM_{2.5}$ that exceeds $10\mu g/m^3$
lnPMPOP	492	16.362	0.110	Logarithm of the population in a country exposed to excessive $PM_{2.5}$ that exceeds $10\mu g/m^3$
lnWPMPOP	506	22.575	0.004	Logarithm of the total population in the rest of the world exposed to excessive $PM_{2.5}$ that exceeds $10\mu g/m^3$
$\ln PM_{2.5}fos$	828	3.585	0.062	Logarithm of annual $PM_{2.5}$ emissions (Gg) from fossil fuels in a country
$\ln WPM_{2.5}fos$	828	9.468	0.005	Logarithm of annual $PM_{2.5}$ emissions (Gg) from fossil fuels in the rest of the world
$\ln NH_3$	828	5.454	0.056	Logarithm of annual NH_3 emissions (Gg) in a country
$\ln WNH_3$	828	10.812	0.004	Logarithm of annual NH_3 emissions (Gg) in the rest of the world
lnTariff	505	1.461	0.025	Logarithm of the average of most favored nation rates in a country

Appendix G: A Discussion on Google Trends

In Sections 4.2.3 and 4.2.4, we use the Google Trends index with specific keywords to assess media coverage and decompose the air purifier trade value, respectively. To show the robustness of our findings, we engage in a series of supplementary discussions.

G.1: Additional testing of media coverage

In Section 4.2.3, we use the data corresponding to the Google Trends index (observed values for countries other than China) and the Baidu Index (observed values for China) using the keyword "$PM_{2.5}$" to characterize media coverage. To investigate the influence of Chinese samples on empirical robustness, we employ two alternative testing methods: (i) all observations, including those from China, originated from the Google Trends index; (ii) exclusion of Chinese samples.

Columns (i) to (iii) of Table G.1 present the results of all observations from the Google Trends index, while Columns (iv) to (vi) display results excluding the Chinese samples. Both sets of results are consistent with those in Table 5. In other words, whether the Chinese observations are derived from the Baidu Index, Google Trends, or are excluded altogether, there is no significant interference with empirical robustness.

TABLE G.1 The Google Trends index regarding "$PM_{2.5}$"

	Google Trends: $PM_{2.5}$			Exclude China's observations		
	lnExvalue (i)	lnImvalue (ii)	Nettrade (iii)	lnExvalue (iv)	lnImvalue (v)	Nettrade (vi)
lnGT-$PM_{2.5}$	1.363*	-0.702	2.065**	2.224**	-0.622	2.845*
	(0.714)	(0.468)	(0.908)	(0.973)	(0.791)	(1.602)
lnWGT-$PM_{2.5}$	1.052*	0.071	0.982*	1.248**	0.196	1.052**
	(0.564)	(0.298)	(0.491)	(0.557)	(0.426)	(0.417)
Control var.	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	413	413	413	404	404	404
Adjusted R^2	0.966	0.964	0.900	0.965	0.963	0.899

Notes: lnGT-$PM_{2.5}$ and lnWGT-$PM_{2.5}$ represent the logarithm of Google Trends index regarding the keyword "$PM_{2.5}$" for a country and the rest of the world. Standard errors in parentheses are clustered at the country level. *, **, and *** represent a significance level of 10%, 5%, and 1%, respectively.

G.2: Additional test of the decomposition of air purifiers trade

In Section 4.2.4, we use the Google Trends index with various keywords to decompose the trade values of household and industrial air purifiers. As a supplementary demonstration, we subsequently exclude Chinese samples and retest the data, as presented in Table G.2. The results across all columns are consistent with those in Table 6.

TABLE G.2 Decomposed by the Google Trends: exclude China's observations

	Household air purifier trade			Industrial air purifier trade		
	lnExvalue-H (i)	lnImvalue-H (ii)	Nettrade-H (iii)	lnExvalue-I (iv)	lnImvalue-I (v)	Nettrade-I (vi)
$\ln PM_{2.5}$	2.992*	1.900	1.092	-1.949	-1.605	-0.345
	(1.730)	(1.396)	(1.117)	(1.598)	(1.399)	(0.333)
$\ln WPM_{2.5}$	-1.587	24.247	-25.834***	-13.503	-10.965	-2.539
	(17.938)	(17.795)	(7.892)	(15.023)	(15.291)	(2.793)
Control var.	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	404	404	404	404	404	404
Adjusted R^2	0.912	0.824	0.902	0.669	0.658	0.533

Notes: lnExvalue-H, lnImvalue-H, and Nettrade-H represent the logarithm of export value, import value, and net trade value, respectively, for household air purifiers. Similarly, lnExvalue-I, lnImvalue-I, and Nettrade-I represent the logarithm of those indicators for industrial air purifiers. Standard errors in parentheses are clustered at the country level. *, **, and *** represent a significance level of 10%, 5%, and 1%, respectively.

Appendix H: Placebo tests for other goods

This is a supplemental explanation for Section 4.3.1. We select two types of placebo goods for testing: the first is household appliances, and the second is emerging electronic products.

In Columns (i) to (xv) of Table H.1, the coefficients of these household appliances indicate that $PM_{2.5}$ does not significantly contribute to the growth of export value and net export value for air conditioners, washing machines, televisions, including window or wall conditioners and color televisions.

Furthermore, in all columns of Table H.2, no significant evidence is found to support that $PM_{2.5}$ drives the export and net export growth of emerging electronics, including tablets, robot vacuum cleaners and its parts, smartwatches & wireless headphones, capacitive screens for smartphones, digital music players.

TABLE H.1 Placebo test I for the HME: Household appliances

	Air conditioners			Washing machines			Televisions		
	lnExvalue (i)	lnImvalue (ii)	Nettrade (iii)	lnExvalue (iv)	lnImvalue (v)	Nettrade (vi)	lnExvalue (vii)	lnImvalue (viii)	Nettrade (ix)
$\ln PM_{2.5}$	-1.125	0.351	-1.541	1.891	1.664*	0.183	-2.512	0.334	-2.787
	(1.239)	(0.514)	(1.368)	(1.643)	(0.880)	(1.982)	(1.783)	(0.672)	(1.866)
$\ln WPM_{2.5}$	-8.229**	-11.574*	3.110	-6.581	0.447	-7.005	-3.952	-20.532***	16.803
	(3.199)	(6.639)	(6.123)	(5.502)	(11.670)	(11.469)	(7.224)	(7.151)	(12.957)
Control var.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	497	499	497	491	499	491	498	499	498
Adjust R^2	0.951	0.966	0.879	0.895	0.927	0.830	0.905	0.951	0.824

	Window or wall air conditioners			Color televisions		
	lnExvalue (x)	lnImvalue (xi)	Nettrade (xii)	lnExvalue (xiii)	lnImvalue (xiv)	Nettrade (xv)
$\ln PM_{2.5}$	-2.475	0.012	-2.626	-1.203	0.105	-1.268
	(2.015)	(1.001)	(2.472)	(1.890)	(1.095)	(2.227)
$\ln WPM_{2.5}$	-7.090	-21.898**	14.377	-2.852	-24.661*	21.937
	(6.489)	(10.616)	(11.808)	(12.990)	(14.113)	(24.550)
Control var.	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	481	499	481	495	497	495
Adjust R^2	0.858	0.909	0.780	0.874	0.859	0.831

Notes: The HS code of air conditioners is "8415—Air conditioning equipment, machinery," that of washing machines is "8450—Household or laundry-type washing machines, including machines which both wash and dry," and that of televisions is "8528—Television receivers, video monitors, projectors." In addition, the HS code of window or wall air conditioners is "841510—Air conditioning machines; comprising a motor-driven fan and elements for changing the temperature and humidity, of a kind designed to be fixed to a window, wall, ceiling or floor, self-contained or split-system." The HS code of color televisions is "852810/852812/852872—Other color reception apparatus for television, whether/not incorporating radio-broadcast receivers/sound/video recording/reproducing apparatus." The HS codes and trade data come from the UN Comtrade Database. Clustered standard errors at the country level are reported in parentheses. *, **, and *** represent a 10%, 5%, and 1% significance level, respectively.

TABLE H.2 Placebo test II for the HME: Emerging electronics

	Tablets			Robot vacuum cleaners			Parts of robot vacuum cleaner		
	lnExvalue (i)	lnImvalue (ii)	Nettrade (iii)	lnExvalue (iv)	lnImvalue (v)	Nettrade (vi)	lnExvalue (vii)	lnImvalue (viii)	Nettrade (ix)
$\ln PM_{2.5}$	1.910	0.462	1.474	-1.414	-1.156	-0.607	1.827	2.348	0.010
	(2.284)	(0.562)	(2.318)	(2.155)	(1.094)	(2.397)	(1.671)	(1.478)	(2.092)
$\ln WPM_{2.5}$	-5.291	-8.170	3.039	4.167	-1.239	4.211	28.524**	2.043	27.211***
	(12.127)	(5.238)	(14.757)	(10.758)	(9.372)	(13.510)	(10.906)	(8.584)	(9.107)
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjust R^2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control var.	456	457	456	347	358	346	348	358	347
Year fixed eff.	0.879	0.962	0.77	0.931	0.950	0.877	0.928	0.952	0.825
	Smartwatches & wireless headphones			Capacitive screens for smartphone			Digital music players		
	lnExvalue (x)	lnImvalue (xi)	Nettrade (xii)	lnExvalue (xiii)	lnImvalue (xiv)	Nettrade (xv)	lnExvalue (xvi)	lnImvalue (xvii)	Nettrade (xviii)
$\ln PM_{2.5}$	0.457	0.063	0.415	0.403	1.992**	-1.788	-4.536	1.622	-5.890
	(0.905)	(0.542)	(0.946)	(1.005)	(0.891)	(1.371)	(3.978)	(2.040)	(5.094)
$\ln WPM_{2.5}$	-9.726*	-9.234***	-0.457	1.051	0.622	0.106	-8.584	-38.618	28.167
	(4.998)	(1.843)	(5.472)	(4.403)	(6.207)	(6.987)	(17.584)	(37.606)	(48.954)
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjust R^2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control var.	358	359	358	358	359	358	428	458	428
Year fixed eff.	0.980	0.986	0.946	0.972	0.967	0.901	0.807	0.867	0.700

Notes: The HS code of tablets is “847130—Data processing machines; portable, digital and automatic, weighing not more than 10kg,” that of robot vacuum cleaners is “850819—Vacuum cleaners with self-contained electric motor,” that of parts of robot vacuum cleaner is “850870—Vacuum cleaners, other than with a self-contained electric motor,” that of smartwatches & wireless headphones is “851762—Communication apparatus; machines for the reception, conversion and transmission or regeneration of voice, images or other data,” that of capacitive screens for smartphone is “851770—Telephone sets and other apparatus for the transmission or reception of voice, images or other data,” and that of digital music players is “852713—Radio broadcast receivers; apparatus combined with sound recording or reproducing apparatus, not needing external power.” The HS codes and trade data come from the UN Comtrade Database. Clustered standard errors at the country level are reported in parentheses. *, **, and *** represent a 10%, 5%, and 1% significance level, respectively.

Appendix I: 2SLS regression for IV

This part presents the regression results of the Two-Stage Least Squares (2SLS) method, corresponding to Section 4.3.2. IVD and IVPD are the instrumental variables for $PM_{2.5}$, calculated from (37) and (38), respectively, both of which represent predicted environmental health risks (PEHR). They are logarithmically processed in the 2SLS regression, denoted as lnIVD and lnIVPD. Column (i) is estimated from the first-stage model (39), while Columns (ii) to (iv) contain the results of second-stage model (40).

Columns (ii) to (iv) suggest that air purifier exports still rise significantly with $PM_{2.5}$, and the increase in exports is larger than that in imports. In other words, the HME in environmental sector is confirmed to be robust.

TABLE I.1 Two-stage least square (2SLS) regression

	First stage	Second stage		
	$\text{lnPM}_{2.5}$ (i)	lnExvalue (ii)	lnImvalue (iii)	Nettrade (iv)
Panel A: IVD as instrumental variable				
lnIVD	0.144*** (0.031)			
$\text{lnPM}_{2.5}$		26.480* (15.193)	-1.172 (3.152)	27.652* (15.215)
Observations	499	499	499	499
Panel B: IVPD as instrumental variable				
lnIVPD	0.119*** (0.027)			
$\text{lnPM}_{2.5}$		29.784** (14.625)	-0.329 (2.875)	30.113** (14.645)
Observations	499	499	499	499
$\text{lnWPM}_{2.5}$	Yes	Yes	Yes	Yes
Control var.	Yes	Yes	Yes	Yes
Year fixed eff.	Yes	Yes	Yes	Yes
Country fixed eff.	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the country level are reported in parentheses. *, **, and *** represent a 10%, 5%, and 1% significance level, respectively.

Appendix J: Generality analysis for environment-related goods

This part is a supplement to Section 4.5, showing the regression results of the whole and sub-environmental industries in detail. Table J.1 suggests that in the whole environmental industry and Sub1 to Sub5, with rising $PM_{2.5}$, the increase in exports is significantly greater than that in imports. Likewise, Table J.2 also show similar results in Sub6 to Sub9. In addition, the net exports also increase significantly with $PM_{2.5}$ (Sub1 to Sub3, Sub5 to Sub9), which also provides auxiliary evidence. Once again, the (strong) HME is ubiquitous in the most environmental sub-industry and the benchmark findings in Section 4.1 are general.

TABLE J.1 General analysis for the HME in the whole and some sub-environmental industries

	The whole			Sub1: Air pollution control			Sub2: Environmental equipment		
	lnExvalue	lnImvalue	Nettrade	lnExvalue	lnImvalue	Nettrade	lnExvalue	lnImvalue	Nettrade
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
$lnPM_{2.5}$	1.544***	0.304	1.185**	2.443***	0.604	1.784**	2.111***	0.916***	1.226*
	(0.492)	(0.278)	(0.491)	(0.708)	(0.483)	(0.775)	(0.605)	(0.227)	(0.633)
$lnWPM_{2.5}$	-3.921	-7.724***	3.249	-6.493	-8.061***	1.346	-8.134***	-1.067	-7.139***
	(3.759)	(2.111)	(2.819)	(7.163)	(2.743)	(6.576)	(2.631)	(1.601)	(2.010)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control var.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	110012	115636	109123	5722	5974	5720	16470	16907	16466
Adjusted R^2	0.721	0.750	0.310	0.811	0.859	0.441	0.805	0.864	0.491
	Sub3: Environ. preferable products			Sub4: Heat and energy manag.			Sub5: Noise abatement		
	lnExvalue	lnImvalue	Nettrade	lnExvalue	lnImvalue	Nettrade	lnExvalue	lnImvalue	Nettrade
	(x)	(xi)	(xii)	(xiii)	(xiv)	(xv)	(xvi)	(xvii)	(xviii)
$lnPM_{2.5}$	2.149**	0.158	-0.111	1.336**	0.735*	0.641	1.727**	0.031	1.634**
	(0.989)	(1.651)	(1.784)	(0.611)	(0.425)	(0.837)	(0.797)	(0.676)	(0.730)
$lnWPM_{2.5}$	-9.483	-30.480***	27.892***	-4.291	-7.692***	3.586	-0.920	-2.847	1.941
	(8.386)	(6.978)	(5.732)	(5.282)	(2.067)	(5.527)	(3.430)	(4.888)	(3.348)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control var.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1708	1913	1677	12306	12858	12268	1475	1497	1475
Adjusted R^2	0.662	0.630	0.304	0.725	0.791	0.351	0.904	0.942	0.615

Notes: The definitions of the whole environmental industry and sub-industries are in line with Figure 3, which comes from the OECD classification standard. All results are controlled for the year fixed effect and country fixed effect and are clustered at the country level. In addition, compared with above the estimates, product fixed effect are additionally considered. *, **, and *** indicate a significance level of 10%, 5%, and 1%, respectively.

TABLE J.2 Generality analysis for the HME in remaining sub-environmental industries

	Sub6: Renewable energy plant			Sub7: Solid and waste manag.			Sub8: Soil and water remediation		
	lnExvalue (i)	lnImvalue (ii)	Nettrade (iii)	lnExvalue (iv)	lnImvalue (v)	Nettrade (vi)	lnExvalue (vii)	lnImvalue (viii)	Nettrade (ix)
$lnPM_{2.5}$	1.570***	-0.125	1.582**	1.571**	-0.449	2.063**	2.452**	0.020	2.553**
	(0.527)	(0.527)	(0.636)	(0.693)	(0.519)	(0.828)	(1.101)	(0.499)	(1.225)
$lnWPM_{2.5}$	-6.741	-6.020***	-0.442	-3.776	-11.954***	7.920	-2.165	-4.379	2.204
	(4.477)	(2.199)	(5.050)	(5.146)	(2.283)	(4.915)	(5.580)	(3.689)	(3.923)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control var.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24125	25342	23972	11981	12463	11978	1931	1992	1931
Adjusted R^2	0.731	0.735	0.308	0.783	0.818	0.474	0.749	0.783	0.434
	Sub9: Waste water manag.			Sub10: Cleaner tech. and products			Sub11: Natural resources protection		
	lnExvalue (x)	lnImvalue (xi)	Nettrade (xii)	lnExvalue (xiii)	lnImvalue (xiv)	Nettrade (xv)	lnExvalue (xvi)	lnImvalue (xvii)	Nettrade (xviii)
$lnPM_{2.5}$	1.398***	0.672***	0.769*	0.857	0.322	0.325	1.701	-0.670	2.290
	(0.464)	(0.209)	(0.430)	(0.722)	(0.483)	(0.739)	(1.691)	(0.740)	(2.077)
$lnWPM_{2.5}$	-5.097	-5.825**	0.764	4.950*	-12.604***	15.738***	-1.366	-11.710**	10.333*
	(4.447)	(2.609)	(2.178)	(2.480)	(4.156)	(4.303)	(4.903)	(5.227)	(5.861)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control var.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14731	14928	14731	18139	20265	17481	1424	1497	1424
Adjusted R^2	0.810	0.862	0.424	0.566	0.566	0.244	0.633	0.721	0.469

Notes: The definitions of the whole environmental industry and its sub-industries align with Figure 3, which is based on the OECD classification standard. Furthermore, in addition to the estimates provided above, the product fixed effect is additionally considered. *, **, and *** indicate a significance level of 10%, 5%, and 1%, respectively.