Trade Liberalization and the Environment: Theory and Evidence from Mexico

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Objective

- Has trade liberalization in NAFTA countries altered environmental polices in investment receiving nations like Mexico. ?
- Has trade liberalization in Mexico spurred investments that are environment-friendly?
- Do investments by Mexican affiliates of multinationals and also by Mexican firms have favorable environmental consequences?

Theory

• The Porter effect is a theory of how tighter environmental regulation can be a source of competitiveness for firms with cleaner technology.

• We embed the Porter effect within the general equilibrium model with one clean good and one polluting good developed in Copeland and Taylor (2003, Ch. 2).

THEORY: The economy produces

- a clean good Y, and
- a pollution-producing good X.
- F is potential output, that is the maximum output of X with zero abatement.
- $X=(1-\theta)F$, where θ is the proportion of F used for abatement.
- F is produced using capital and labor with CRS.
- Z is output of pollution, given by $(1-\theta)^{1/\alpha} F$, where $0<\alpha<1$.
- Abatement costs τ per unit of emission.

Theory

Net output X is produced in two stages:

- First stage: the cost minimizing technique of producing a unit of F is determined using labor and capital
- Second stage: Z is optimally abated.
- Effectively, F and Z are inputs into the CRS production of X:

$x = z^{\alpha}.F^{(1-\alpha)}$.

- Thus, α is the share of abatement costs (τz) in the value of net output (px).

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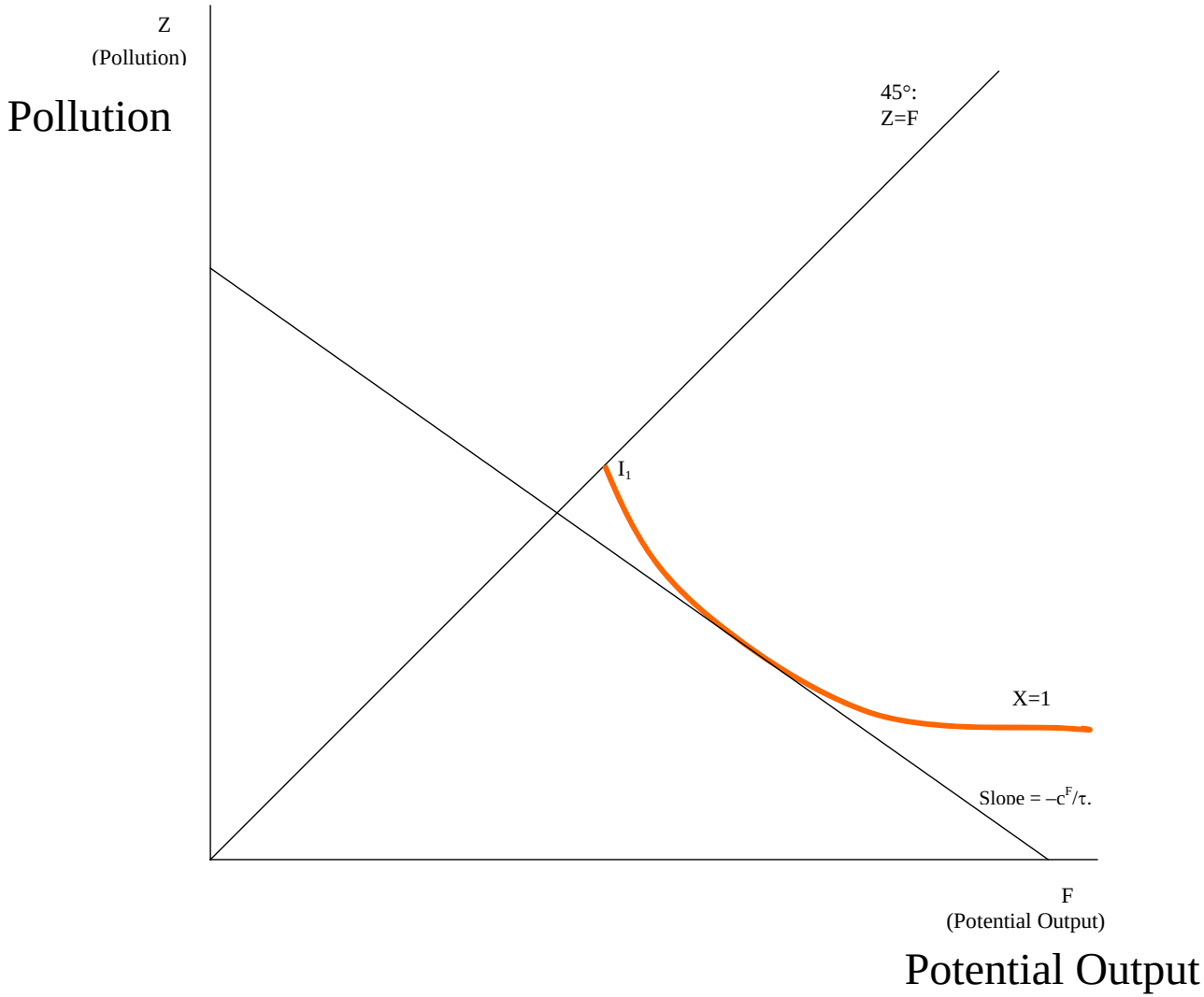
Figure 1: Copeland and Taylor GE model



Porter Effect

- Porter and van der Linde's (1995) product offsets and process offsets are sources for new environment-friendly technologies.
  - Product offsets: Environmental regulation produces less pollution and also higher quality products at lower product cost (e.g. through higher resale, lower product disposal).
  - Process offsets: Environmental regulation reduces pollution and enables higher resource productivity (e.g. through high process yield, less down time, materials savings, lower energy consumption, conversion of waste into usable forms).
  - These offsets result in competitive advantage due to early mover advantage.
    - Eg. US chemical firm moves into Mexican market with cleaner technology in response to the Mexican government's newly imposed tougher environmental regulation. The firm has early mover advantage -- it is ahead of its competitors in the new regulatory regime.

Figure 2: Environment-Friendly Technology

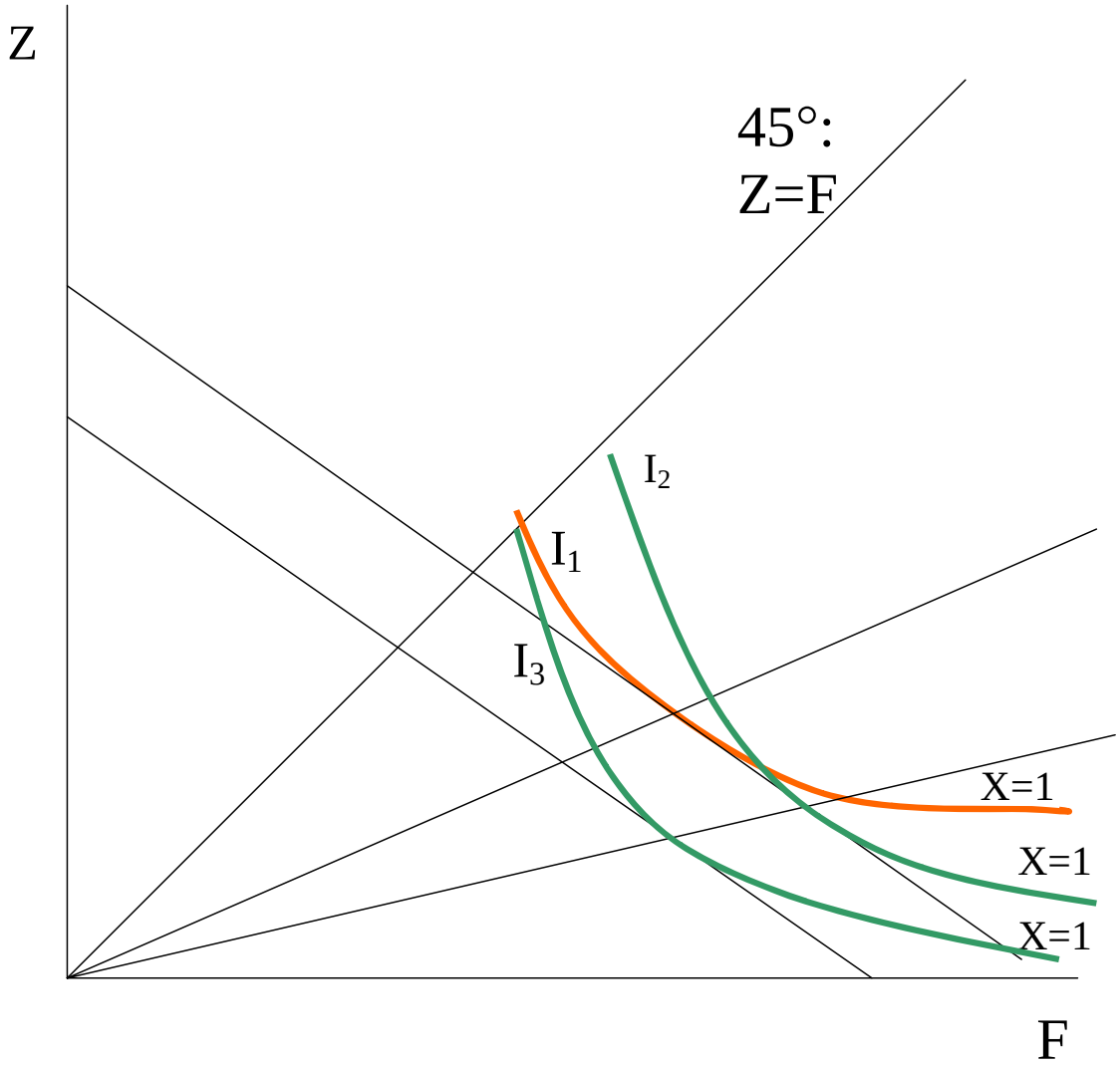


Figure 2

- Figure 2 shows unit isoquants with more environment-friendly technology. The technology I2 sacrifices productivity gains on F for greater productivity on the abatement of Z. The technology I3 is more efficient in both, producing F as well as abating Z.
  - Liberalization policies that encourage FDI (rather than direct innovation) can drive similar results. FDI brings in cleaner technology because, in the presence of a permanent emission charge, source-country firms see a competitive advantage in producing using I_2-technology in an industry in which the majority of firms are using the less efficient I_1-technology.

- The isoquant I3, shows innovation increasing productivity even in the first stage so that less F and less Z can produce a unit of x compared to I2. However, all the figures are based on the I2 technology, where the offsets occur primarily in the second stage.

Figure 3

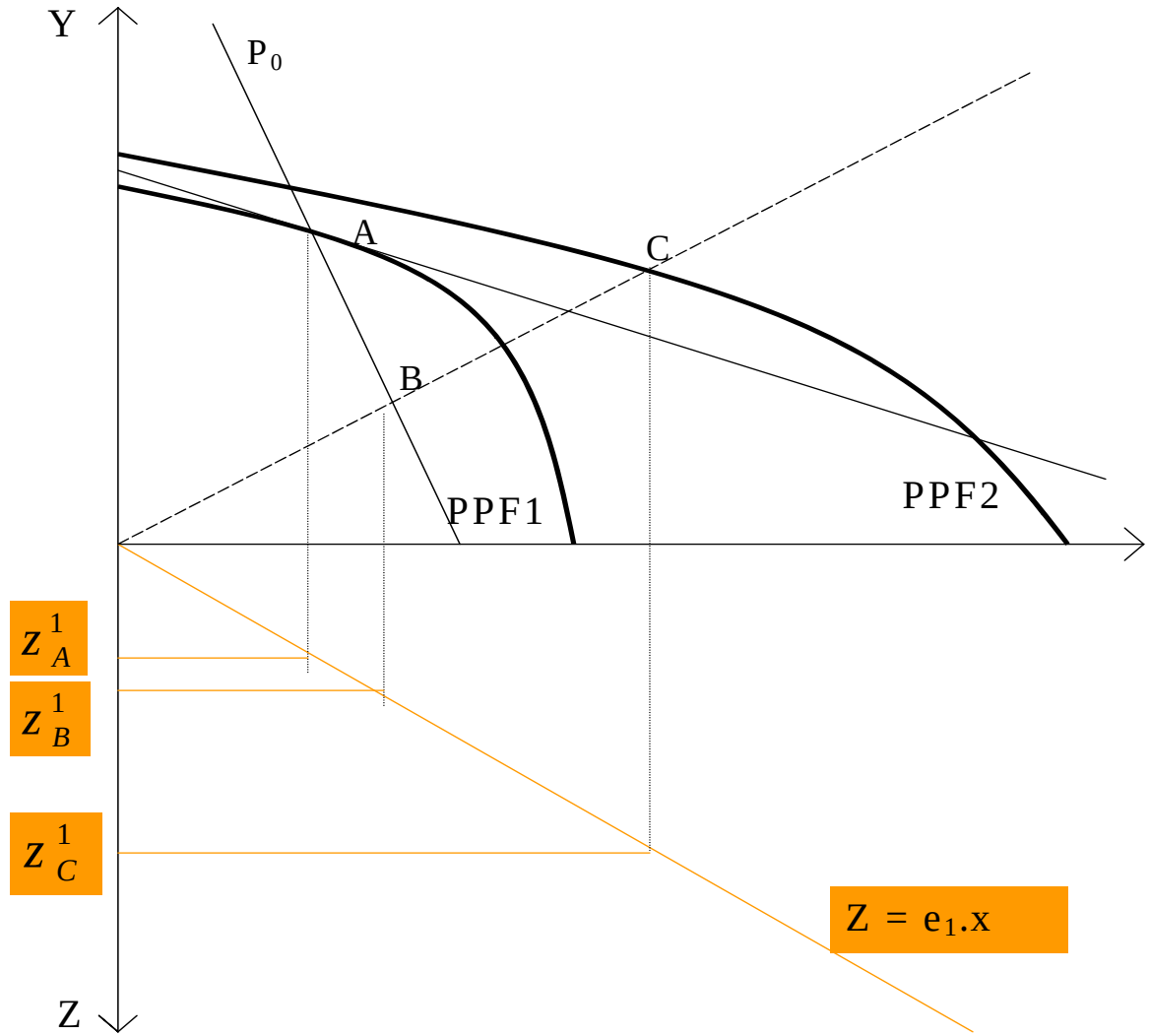


Figure 3: Biased expansion of X

- Figure 3 shows the impact of an inflow of capital that is biased towards good X. Production possibility frontier PPF_1 arises from production technology I1 in figure 2 and PPF_2 arises from an inflow of capital that uses the same technology. The outward shift in the PPF is biased towards the dirty good X.
- P^0 is the world price of X (P^y =1, y is the clean good). The emission intensity of x with this technology is e_1 so that the output of pollution $Z = e_1.x$.
- Figure 3 isolates the pure composition effect of the inflow of capital from the scale effect.
  - Keeping the world price unchanged at P^0 and scaling down production from C to the isocost P^0 yields the point B.
  - The movement from A to B is the pure composition effect while the movement from B to C is the pure scale effect as output expands along the ray OC.
  - The bottom part of the figure shows that composition effect of producing more X than Y increases pollution.
  - q indicates the producer price $p(1-\alpha)$. The line P^0 measures initial output at base period world price, which indicates the initial scale of the economy

Figure 4

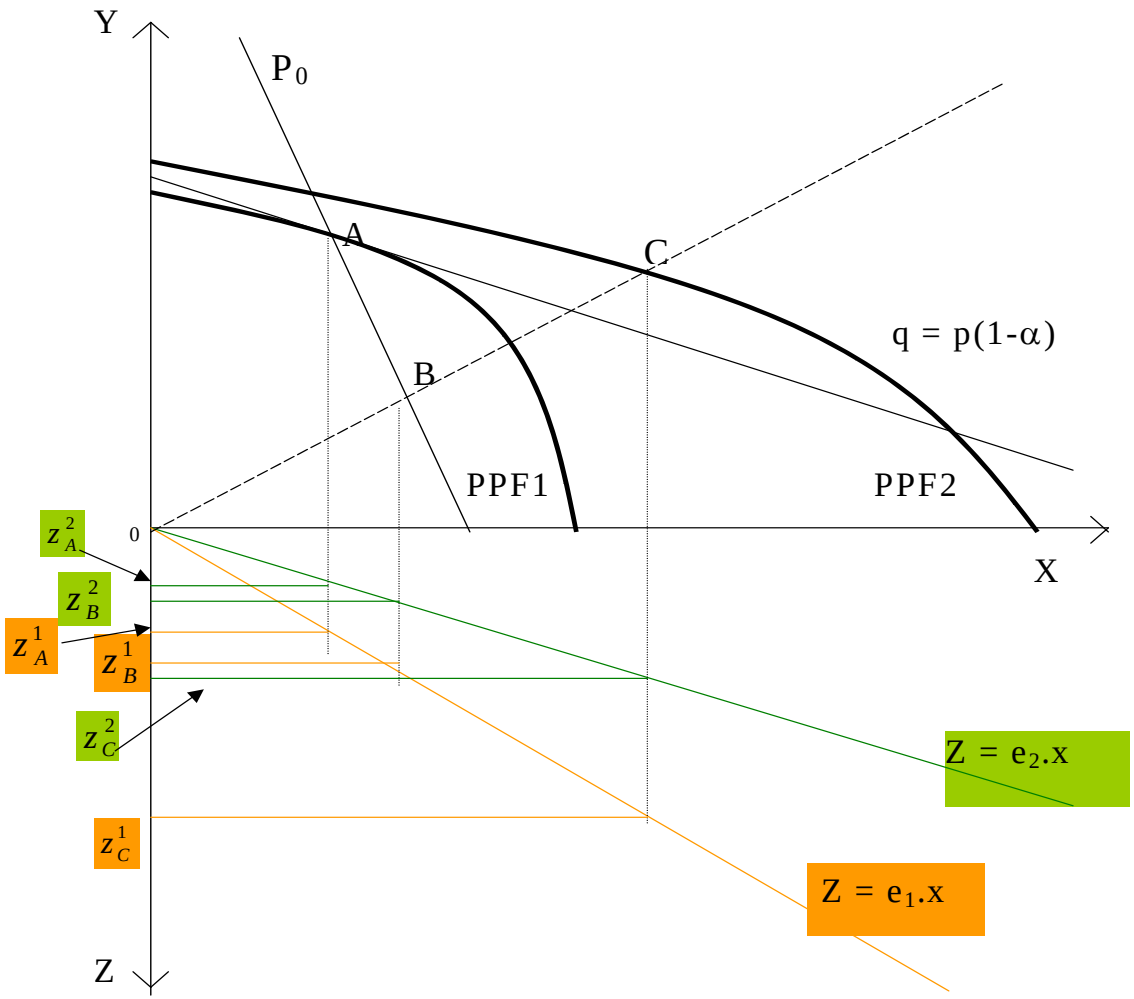


Figure 4: New vs. Indigenous technology

- Figure 4 compares the composition and scale effects with the new versus the indigenous technology.
- The only difference here is the line $Z = e_2 x$ which indicates that the cleaner foreign technology has lower emissions intensity e_2.
- The composition and scale effects are smaller than with the old technology, therefore the total pollution is lower.
- The difference is entirely due to the technique effect. This is the Porter hypothesis in the context of trade liberalization.

Hypotheses

- The Porter Effect 2: Environmental-friendly investments are strongly associated with environmental performance of firms.
  - firm performance may be measured by the percentage reduction of environmental contaminants, or by whether the firm earns ISO recognition, or whether the firm earns PROFEPA's recognition for sizable improvement in environmental performance

Hypotheses

- The Porter Effect 1: Firms with long-term interests will make environmental-friendly investments
  - long term interests may be identified by origin of capital, size of the firm, economic sector of firms, geographical location, etc.
  - In order to test these hypotheses, data should be broad in the cross-section (many firms) as well as in the time series.

Map of Mexico