

2021

**Attracting FDI strategies of developing country
considering environmental damage
- NEV(New Energy Vehicle)**

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1. MOTIVATION

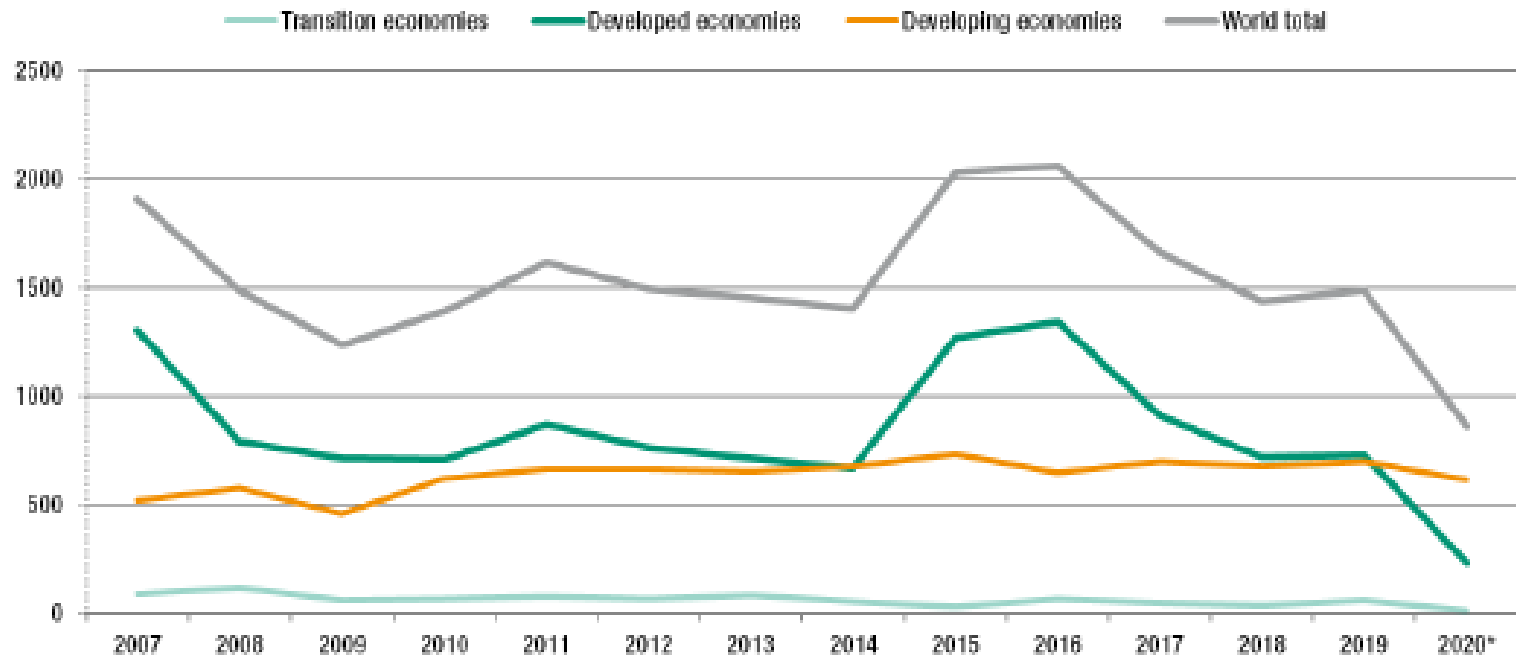
- ✓ The developing country faces a dilemma between **attracting foreign investment** and **accelerating pollution haven**.
 - There is trade-off between the attractiveness of **foreign direct investment (FDI)** and **the increase in environmental damage**.
 - Without strict environmental regulation, it is relatively easy to attract FDI but multiply environmental damage in the developing country.
 - Before setting their policies, developing countries should consider the environmental effects of FDI.

1. MOTIVATION

✓ (case) China

- Global foreign direct investment (FDI) collapsed in 2020, falling by 42% to an estimated \$859 billion, from \$1.5 trillion in 2019. **(UNCTAD, 2021)**

Figure1. FDI inflows: global and by group of economies, 2007-2020



Source: UNCTAD. (Billions of US dollars)

* Preliminary estimates.

Source: UNCTAD (2021)

1. MOTIVATION

✓ (case) China

- Global foreign direct investment (FDI) collapsed in 2020, falling by 42% to an estimated \$859 billion, from \$1.5 trillion in 2019. (UNCTAD, 2021)
 - It is more than 30% less than 2009 (\$1,236 trillion) when companies put off large investments due to the global financial crisis.
 - The decline was concentrated in developed countries. A sharp decrease was recorded in the United States and Europe.
- Despite the conflict between the U.S. and China, **China became the largest recipient, attracting an estimated \$163 billion in inflows in the last year, 2020.** (UNCTAD, 2021)
 - While FDI in developed countries has decreased significantly due to the COVID-19 pandemic, China where the early phase of the pandemic have increased FDI inflows.

1. MOTIVATION

✓ (case) China

- However, **the concerns over the environmental damage** in China are growing, as the FDI attractions has increased.
- In China, according to **the GCC (Green Car Credit)**, as part of NEV(New Energy Vehicle) policy, all automakers are required to pay additional fee to produce more than a certain percentage of pollution-produced vehicles. This is one of the policies to increase the production of pollution-free vehicles that do not (or less) emit emissions such as electric vehicles.
- Under the policy, **companies producing ICE (Internal Combustion Engine) vehicles exceeding the standard must pay fines to the government** (or purchase greenhouse gas emission rights from other companies).
 - In April 2021, FAW-Volkswagen (Volkswagen of Germany and FAW of China's joint venture) agreed to purchase the green car credits from Tesla to comply with environmental regulations in China.
 - **What will happen to FDI in China due to the new environmental regulations by the Chinese government such as the GCC?**

2. PURPOSE OF STUDY

- ✓ The aim of this paper is that analyzing **the optimal FDI attracting strategies of developing country focusing on their environmental damage**. In addition, the paper shows that **the optimal location decisions of each firms under the different environmental regulations**.
- ✓ Set up a **two-country theoretical model**
 - **In the first stage**, the South government decides **the level of import tariff and environmental policies** (pollution emission tax, the GCC standard).
 - **In the second stage**, the North firm decides where to locate
 - **FDI (Domestic Cournot)** : produce their products in the South
 - **Stay at home (International Cournot)** : produce their goods in their own country and trade it with import tariff.

3. DIFFERENTIATED APPROACH

✓ The preceding researches:

- **Abe and Zhao (2005)** have examined the welfare effects of environmental policies for the case where the choice of investment type between an international joint venture and FDI as well as firm location is endogenously determined.
- **Kayalica and Lahiri (2005)** analyze the effects of FDI on the environmental policies of a host country competing with another country for a third country market.
- **Celik and Orbay (2011)** analyze the effects of both trade and environmental policies on the location choice of the developed country.

✓ The differentiated approach:

- Considering both **trade policy** and **environmental pollution policy**
 - **Import tariff** and **pollution tax**
- Adjust and apply **new realistic environmental regulation policy**
 - **pollution emission tax** and **the GCC standard**

4. THE BASIC MODEL

- ✓ The production under **Domestic Cournot (DC)**
 - **The profit function** of the firm N and the firm S:

$$\checkmark \quad \pi_N = \{ p(X) - c_N \} x_N - e_S (\beta x_N)$$

$$\checkmark \quad \pi_S = \{ p(X) - c_S \} x_S - e_S (\beta x_S)$$

$p(X)$: the inverse demand function

$$p(X) = \alpha - X \quad \alpha \in \mathfrak{R}_+ \quad X = x_N + x_S$$

π_N, π_S : the profit function of the firm N, firm S

x_N, x_S : the output of the firm N, firm S

c_N, c_S : the constant marginal production costs for the firm N, firm S ($c_N < c_S$)

e_N, e_S : the pollution tax imposed by the government N and S each
(e_N is exogenously given)

— → the additional costs to produce more than allowed GCC level

$x_i = \beta x_i$: the level of the GCC permits in the country i (permitted production amount)

4. THE BASIC MODEL

✓ The production under **Domestic Cournot (DC)**

- **The profit function** of the firm N and the firm S:

✓ $\pi_N = \{ p(X) - c_N \} x_N - e_S (\beta x_N)$

✓ $\pi_S = \{ p(X) - c_S \} x_S - e_S (\beta x_S)$

- The market stage equilibrium **outputs and profits** for any given level of e_S , β

✓ $x_N^{DC} = \frac{1}{3}(\alpha + c_S - 2c_N - \beta e_S)$

✓ $x_S^{DC} = \frac{1}{3}(\alpha + c_N - 2c_S - \beta e_S)$

✓ $\pi_N^{DC} = \frac{1}{9}(\alpha + c_S - 2c_N - \beta e_S)^2$

✓ $\pi_S^{DC} = \frac{1}{9}(\alpha + c_N - 2c_S - \beta e_S)^2$

4. THE BASIC MODEL

✓ The optimal policies of the developing country under **Domestic Cournot (DC)**

- **The social welfare function** of the South under DC:

$$\mathbf{v} \quad SW_S^{DC}(e_S, \beta) = \frac{1}{2} \{x_N^{DC} + x_S^{DC}\}^2 + \pi_S^{DC} + (e_S - d_L)(\beta x_N^{DC}) + (e_S - d_H)(\beta x_S^{DC})$$

- The optimal **pollution tax level** to maximizes the SW of the South under DC

$$\mathbf{v} \quad e_S^{DC} = \frac{1}{2\beta} \{c_S - c_N + \beta(d_H + d_L)\} = \frac{(d_H + d_L)\{(\alpha - 2c_S + c_N)d_H + (\alpha + c_S - 2c_N)d_L\}}{(2\alpha - 5c_S + 3c_N)d_H + (2\alpha + c_S - 3c_N)d_L}$$

- The optimal level of the GCC permits (permitted production ratio) in the South

$$\mathbf{v} \quad \beta = \frac{1}{(d_H + d_L)^2} \{(2\alpha - 5c_S + 3c_N)d_H + (2\alpha + c_S - 3c_N)d_L\}$$

4. THE BASIC MODEL

✓ The production under **International Cournot (IC)**

- **The profit function** of the firm N and the firm S:

✓ $\pi_N = \{p(X) - c_N - t_S\} x_N - e_N(\delta x_N)$

✓ $\pi_S = \{p(X) - c_S\} x_S - e_S(\beta x_S)$

- The Cournot-Nash equilibrium **outputs and profits** for any given level of e_S , g_S

✓ $x_N^{IC} = \frac{1}{3}(\alpha - 2c_N + c_S - 2\delta e_N + \beta e_S - 2t_S)$

✓ $x_S^{IC} = \frac{1}{3}(\alpha - 2c_S + c_N + \delta e_N - 2\beta e_S + t_S)$

✓ $\pi_N^{IC} = \frac{1}{9}(\alpha - 2c_N + c_S + 2\delta e_N + \beta e_S - 2t_S)^2$

✓ $\pi_S^{IC} = \frac{1}{9}(\alpha - 2c_S + c_N + \delta e_N - 2\beta e_S + t_S)^2$

4. THE BASIC MODEL

✓ The optimal policies of the developing country under **International Cournot (IC)**

- **The social welfare function** of the South under IC:

$$\text{v } SW_S^{IC}(e_S, \beta) = \frac{1}{2} \{x_N^{IC} + x_S^{IC}\}^2 + \pi_S^{IC} + (e_S - d_H)(\beta x_S^{IC}) + t_S x_N^{IC}$$

- The optimal **pollution tax level** to maximizes the SW under IC

$$\text{v } e_S^{IC} = \frac{1}{\beta} (t - \alpha + c_S + 2\beta d_H) = d_H$$

- The optimal level of the GCC permits (permitted production ratio) in the South

$$\text{v } \beta^{IC} = \frac{1}{4d_H} (3\alpha - 4c_S + c_N + \delta e_N - t) = \frac{1}{3d_H} (2\alpha - 3c_S + c_N + \delta e_N)$$

- The optimal level of the import tariff under IC

$$\text{v } t_S^{IC} = \frac{1}{3} (\alpha - c_N - \delta e_N)$$

5. RESULTS OF STUDY

✓ The optimal policies of the developing country under **Domestic Cournot (DC)**

❖ **Idea 1.** The optimal **pollution tax level** to maximizes the SW of the South under DC is that

$$e_S^{DC} = \frac{1}{2\beta} \{c_S - c_N + \beta(d_H + d_L)\} = \frac{(d_H + d_L)\{(\alpha - 2c_S + c_N)d_H + (\alpha + c_S - 2c_N)d_L\}}{(2\alpha - 5c_S + 3c_N)d_H + (2\alpha + c_S - 3c_N)d_L}$$

❖ The optimal pollution tax level increases if the sum of environmental damage is high. That is, the South government imposes strict pollution tax level if the industry causes serious environmental damage.

$$(d_H + d_L) \uparrow \Rightarrow e_S^{DC} \uparrow$$

❖ **Idea 2.** The equilibrium profits of two firms under DC is that

$$\pi_N^{DC}(x_N^{DC}, x_S^{DC}) = \frac{(c_S - c_N)^2 d_H^2}{(d_H + d_L)^2} \quad \pi_S^{DC}(x_N^{DC}, x_S^{DC}) = \frac{(c_S - c_N)^2 d_L^2}{(d_H + d_L)^2}$$

❖ The equilibrium profits under DC will be increases if the technology gap between two firms increase.

5. RESULTS OF STUDY

✓ The optimal policies of the developing country under **Domestic Cournot (DC)**

❖ **Idea 3.** The social welfare of the South under DC is that

$$SW_S^{DC} = \frac{(c_S - c_N)}{2(d_H + d_L)^2} \{ (2\alpha - 3c_S + c_N)d_H^2 + 4(c_S - c_N)d_H d_L + (c_S + c_N - 2\alpha)d_L^2 \}$$

- ❖ Since it is assumed that the North firm has a better technology than the South firm, $c_N < c_S$
- ❖ The SW under DC will be increases if the technology gap between two firms increase. That is, the South government has incentive to attract FDI if there is huge gap between the South and the North.

5. RESULTS OF STUDY

✓ The optimal policies of the developing country under **International Cournot (IC)**

❖ **Idea 4.** The South does not prefer to engage FDI if $d_H = d_L$ and $c_N = c_S$

$$SW_S^{DC} - SW_S^{IC} < 0$$

❖ When (1) the marginal cost of the South firm converges to the marginal cost of the North firm and (2) the environmental damage of the South firm converges to the one of the North firm, the South does not prefer to engage FDI.

❖ **Idea 5.** The firm N prefer to engage FDI $\pi_N^{DC} > \pi_N^{IC}$ if

$$\frac{(c_S - c_N)^2 d_H^2}{(d_H + d_L)^2} - \frac{1}{9} (\alpha + c_H - \delta e_N)^2 > 0$$

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