# Mémoire M2

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# Intuition

This section seeks to offer preliminary insights into how greenhouse gas (GHG) emissions respond to the implementation of two agricultural public policies: the introduction of tariffs and the provision of subsidies.

To do so, we consider a two-countries market, with a importing country $H$, and exporting country $F$.

We denotes the supply and the demand functions for both country $i \in \{H, F\}$:

$$S_i = S_i^0 \left(1 + \eta_i \left(P_i - P_i^0\right)/P_i^0\right)$$
$$D_i = D_i^0 \left(1 + \epsilon_i \left(P_i - P_i^0\right)/P_i^0\right),$$

with $S_i$ and $D_i$, the quantities produced and demanded by country $i$, $P_i$ the price, in country $i$, $\eta_i$ and $\epsilon_i$ are the supply and demand elasticity in country $i$. $X^0$ denotes the initial value of $X$.

Those two countries form the entirety of the economy, hence, the sum of their productions is equal to the sum of their consumptions: $D_H - S_H = S_F - D_F$.

For simplification, we introduce the following aggregate elasticities:

- total demand elasticity $\epsilon = \frac{\partial D}{\partial P_F}\frac{P_F^0}{D^0} = \left(\epsilon_H \frac{D_H^0}{P_H^0} + \epsilon_F \frac{D_F^0}{P_F^0}\right)\frac{P_F^0}{D^0} < 0$,
- total supply elasticity $\eta = \frac{\partial S}{\partial P_F}\frac{P_F^0}{S^0} = \left(\eta_H \frac{S_H^0}{P_H^0} + \eta_F \frac{S_F^0}{P_F^0}\right)\frac{P_F^0}{S^0} > 0$,
- home import demand elasticity $\mu_H = \frac{\partial (D_H - S_H)}{\partial P_H}\frac{P_H^0}{M_H^0} = \frac{\epsilon_H D_H^0 - \eta_H S_H^0}{M_H^0} < 0$,
- foreign export supply elasticity $\chi_F = \frac{\partial (S_F - D_F)}{\partial P_F}\frac{P_F^0}{X_F^0} = \frac{\eta_F S_F^0 - \epsilon_F D_F^0}{X_F^0} > 0$.

## 2.1 Introduction of a tariff in home country

We consider the first policy, where country $H$ introduce a tariff $t$, it implies the following relations between prices: $P_H = P_F + t$.

With, the tariff, the price in the exporting country becomes

$$\frac{P_F}{P_F^0} = -\frac{\mu_H(1 - t/P_H^0) - \chi_F}{\eta - \epsilon}\frac{X_F^0}{D^0},$$

and varies negatively with $t$:

$$\frac{\partial P_F}{\partial t} = \frac{\mu_H}{\eta - \epsilon}\frac{X_F^0}{D^0}\frac{P_F^0}{P_H^0} < 0.$$

Total production from both countries

See Appendix A for proofs.

# Appendix A

# Intuition

First let's expresse $P_F$ as a function of $t$ and the elatsicities.

Starting from $D_H - S_H = S_F - D_F$ and the supply and demand definitions, we have:

$$D_H^0 \left(1 + \epsilon_H \frac{P_H - P_H^0}{P_H^0}\right) - S_H^0 \left(1 + \eta_H \frac{P_H - P_H^0}{P_H^0}\right) = S_F^0 \left(1 + \eta_F \frac{P_F - P_F^0}{P_F^0}\right) - D_F^0 \left(1 + \epsilon_F \frac{P_F - P_F^0}{P_F^0}\right).$$

We then factorize by $P_i - P_i^0/P_i^0$, for $i = H, F$

$$\frac{P_H - P_H^0}{P_H^0}[D_H^0 \epsilon_H - S_H^0 \eta_H] + D_H^0 - S_H^0 = \frac{P_F - P_F^0}{P_F^0}[S_F^0 \eta_F - D_F^0 \epsilon_F] + S_F^0 - D_F^0.$$

Noting that $D_H^0 - S_H^0 = S_F^0 - D_F^0$, it leads to:

$$\frac{P_H - P_H^0}{P_H^0}[D_H^0 \epsilon_H - S_H^0 \eta_H] = \frac{P_F - P_F^0}{P_F^0}[S_F^0 \eta_F - D_F^0 \epsilon_F].$$

Using the agrregated elasticities defined in the the chapter 2.1, we have

$$\frac{P_F}{P_F^0} = -\frac{\mu_H(1 - t/P_H^0) - \chi_F}{\eta - \epsilon} \frac{X_F^0}{D^0}.$$