



The Importance of Producer Price Markups for Carbon Tax Evaluations: Evidence from Taiwan

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Motivation

Carbon Tax/Carbon Trade

- One of policies to combat climate change

Competitive Market Setting for CGE

- Many CGE models choose **competitive market** for the investigation of carbon pricing

In reality, not all industries are competitive

- Industries make profits
- Firms could be able to set prices **higher** than **marginal costs**

Motivation

Importance of Price Setting Ability

$$Profit = P_{Y,t}(\mathbf{j})Y_t(\mathbf{j}) - Cost_t(\mathbf{j})$$

- Competitive market: firms are price takers and cannot affect prices
- The market determine the prices

First order conditions:

$$P_{Y,t}(\mathbf{j}) = MC_t(\mathbf{j})$$

Motivation

Importance of Price Setting Ability

$$Profit = P_{Y,t}(j)Y_t(j) - Cost_t(j)$$

- Price markups over marginal costs:

First order conditions:

$$P_{Y,t}(j) + \frac{\Delta P_{Y,t}(j)}{\Delta Y_t(j)} Y_t(j) = MC_t(j)$$

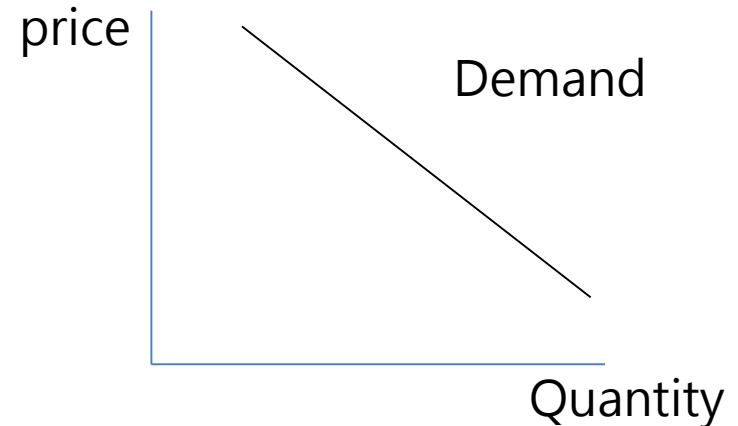
$$\left(1 + \frac{Y_t(j)\Delta P_{Y,t}(j)}{P_{Y,t}(j)\Delta Y_t(j)} \right) P_{Y,t}(j) = MC_t(j)$$

$$(1 - \epsilon_Y(j)) P_{Y,t}(j) = MC_t(j)$$

Because $\epsilon_Y(j) = -\frac{Y_t(j)\Delta P_{Y,t}(j)}{P_{Y,t}(j)\Delta Y_t(j)} > 0$

$$P_{Y,t}(j) > MC_t(j)$$

Price is higher than marginal cost



Motivation

Difference

- Competitive

$$P_{Y,t}^c(j) = MC_t(j)$$

- Price markups

$$P_{Y,t}^m(j) = \frac{MC_t(j)}{(1 - \varepsilon_Y(j))}$$

$$\varepsilon_Y(j) > 0$$

If the carbon tax has the same effects on marginal costs

$$P_{Y,t}^m(j) > P_{Y,t}^c(j)$$

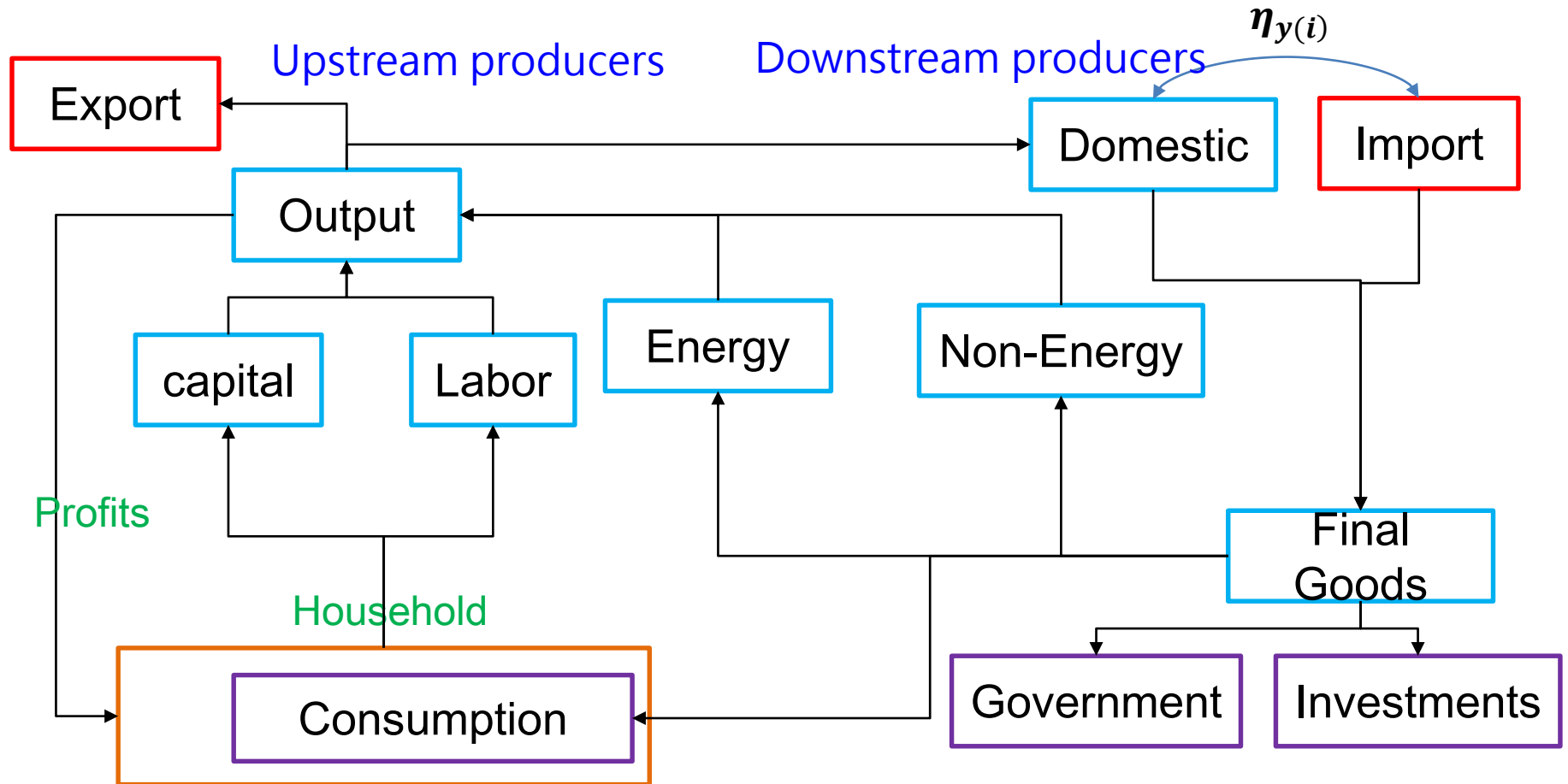
Purpose

- Compare the impacts of **firm pricing strategy** on policy evaluation (carbon tax, in this paper)

Model

Intuitions

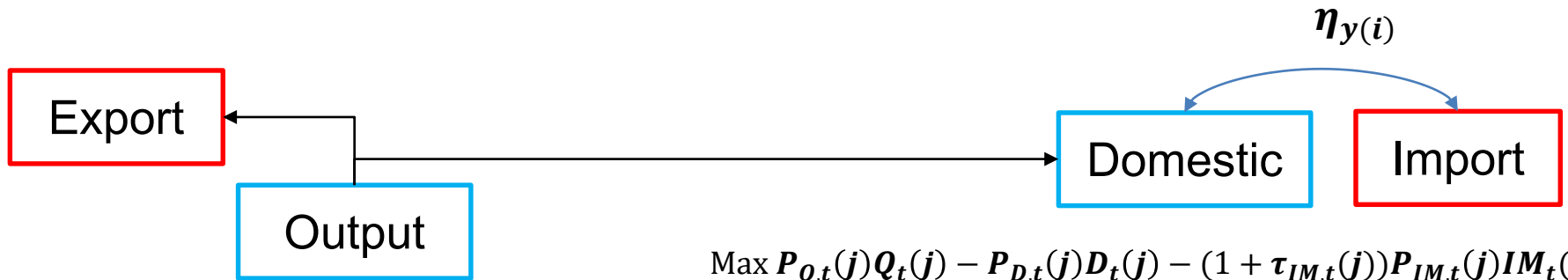
- Elasticity $\eta_{y(i)}$ higher \rightarrow substitute easily \rightarrow Monopolistic power is low \rightarrow Low price markups over marginal costs



Model

Price Markups

- $\eta_{y(i)}$ controls elasticity and price markups



$$\text{Max } P_{Q,t}(j)Q_t(j) - P_{D,t}(j)D_t(j) - (1 + \tau_{IM,t}(j))P_{IM,t}(j)IM_t(j)$$

$$Q_t(j) = \left((a_{D(j)})^{\frac{1}{\eta_{q(j)}}} (D_t(j))^{\frac{\eta_{q(j)}-1}{\eta_{q(j)}}} + (a_{IM(j)})^{\frac{1}{\eta_{q(j)}}} (IM_t(j))^{\frac{\eta_{q(j)}-1}{\eta_{q(j)}}} \right)^{\frac{\eta_{q(j)}}{\eta_{q(j)}-1}}$$



$$P_{Q,t}(i) = \left(a_{IM(j)} \left((1 + \tau_{IM,t}(j))P_{IM,t}(j) \right)^{1-\eta_{y(i)}} + a_{D(j)} \left(P_{D,t}(j) \right)^{1-\eta_{y(i)}} \right)^{\frac{1}{1-\eta_{y(i)}}}$$



$$IM_t(j) = a_{IM(j)} \left(\frac{P_{IM,t}(j)}{P_{Q,t}(i)} \right)^{-\eta_{y(i)}} Q_t(j)$$

$$D_t(j) = a_{D(j)} \left(\frac{P_{D,t}(j)}{P_{Q,t}(i)} \right)^{-\eta_{y(i)}} Q_t(j)$$

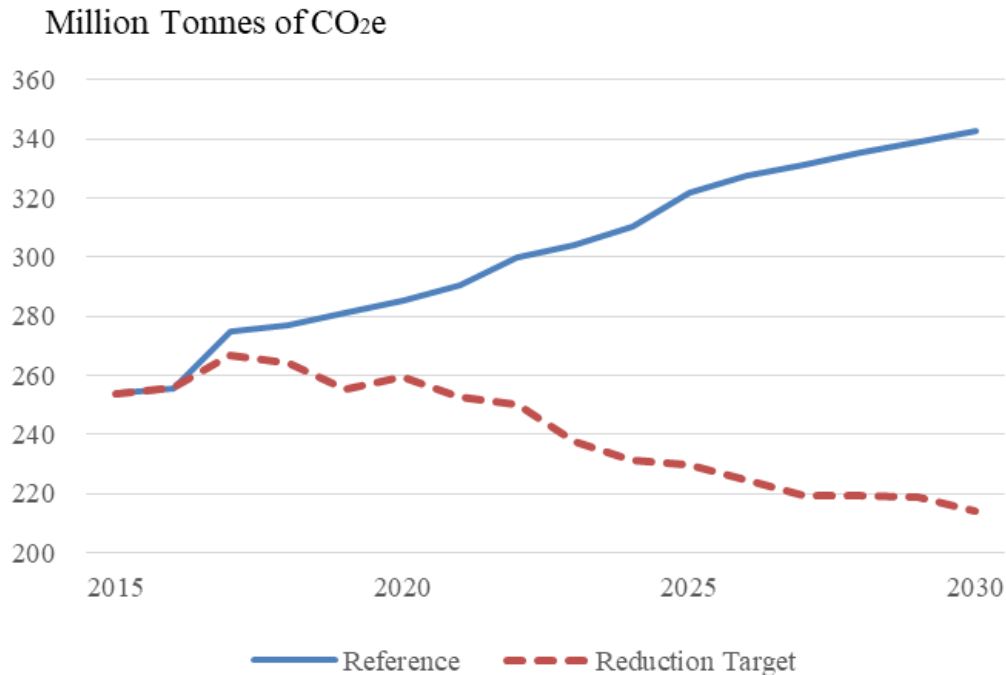
$$\begin{aligned} \frac{1}{\varepsilon_Y(j)} &= -\frac{P_{Y,t}(j)}{Y_t(j)} \frac{\Delta D_t(j)}{\Delta P_{D,t}(j)} - \frac{P_{Y,t}(j)}{Y_t(j)} \frac{\Delta EX_t(j)}{\Delta P_{Y,t}(j)} \\ &= -\frac{D_t(j)}{Y_t(j)} \left(-\eta_{y(i)} + \frac{P_{D,t}(j)D_t(j)}{P_{Q,t}(j)Q_t(j)} \eta_{y(i)} \right) - \frac{P_{Y,t}(j)}{Y_t(j)} \frac{\Delta EX_t(j)}{\Delta P_{Y,t}(j)} \end{aligned}$$

Results

Carbon Emission Goal

- **Carbon tax** is launched to achieve the emission target

CO2 Emissions: Reference and Target Path

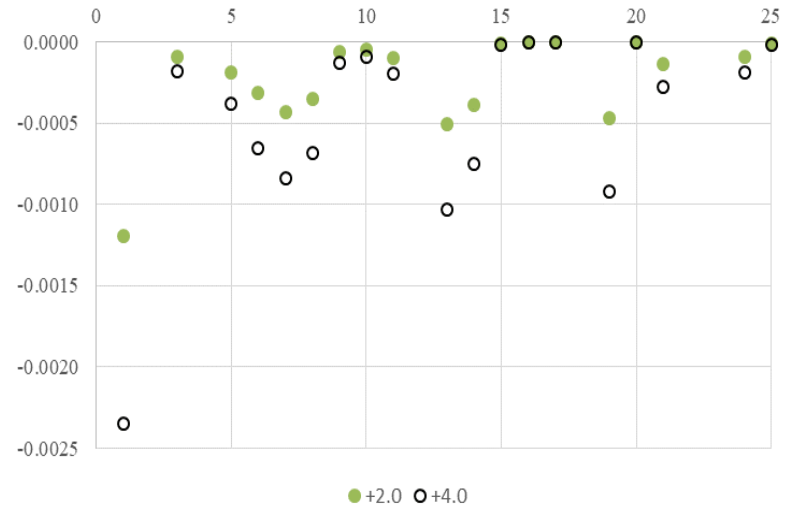
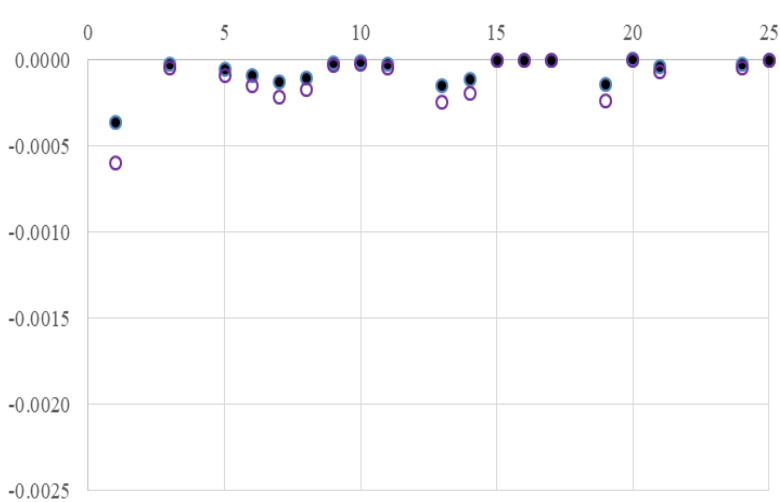


Results

Price markups over marginal costs

- Four elasticity values: **benchmark**(+0), +0.5, +1.0, +2.0, +4.0
- **High** elasticity → **low** price markups

Price Markup Relative to +0.0



● +0.5 ○ +1.0

high price markups

low price markups

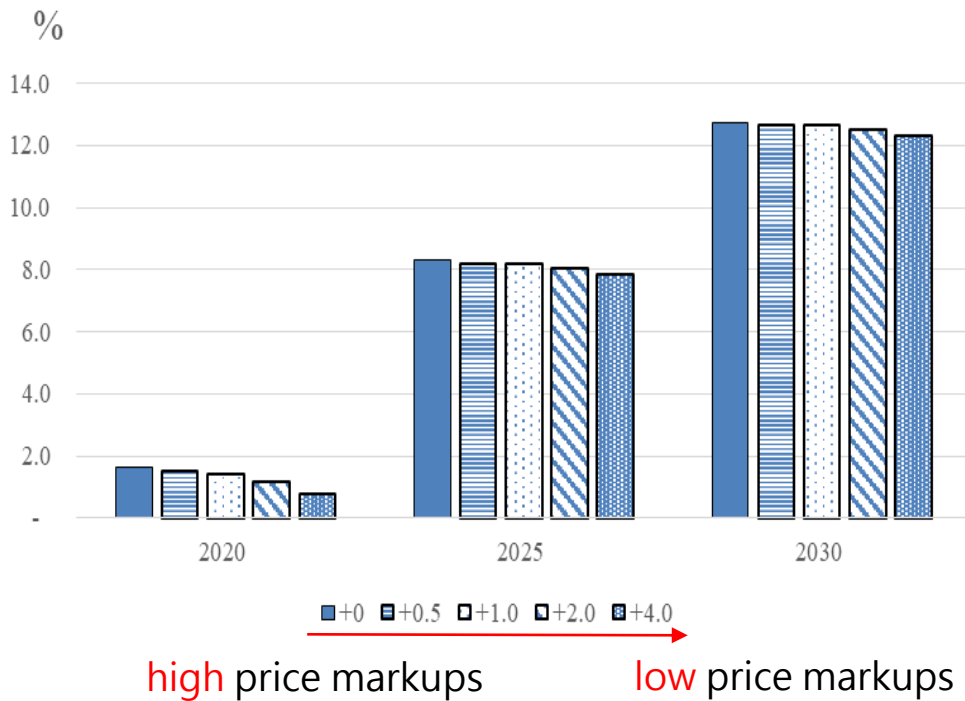


Results

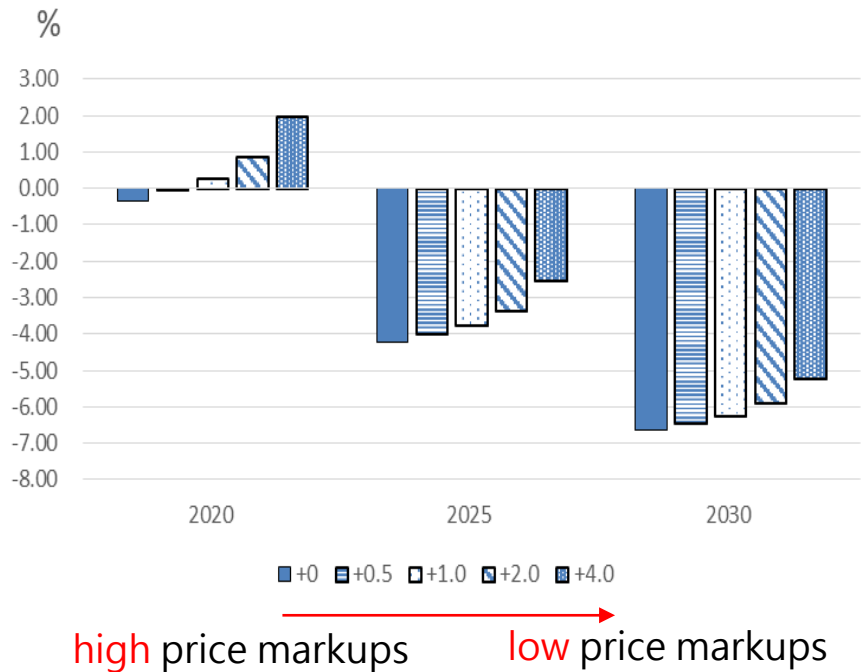
Consumer Price Index (CPI)

- High elasticity, low markups on CPI
- Less impacts on GDP

CPI



GDP

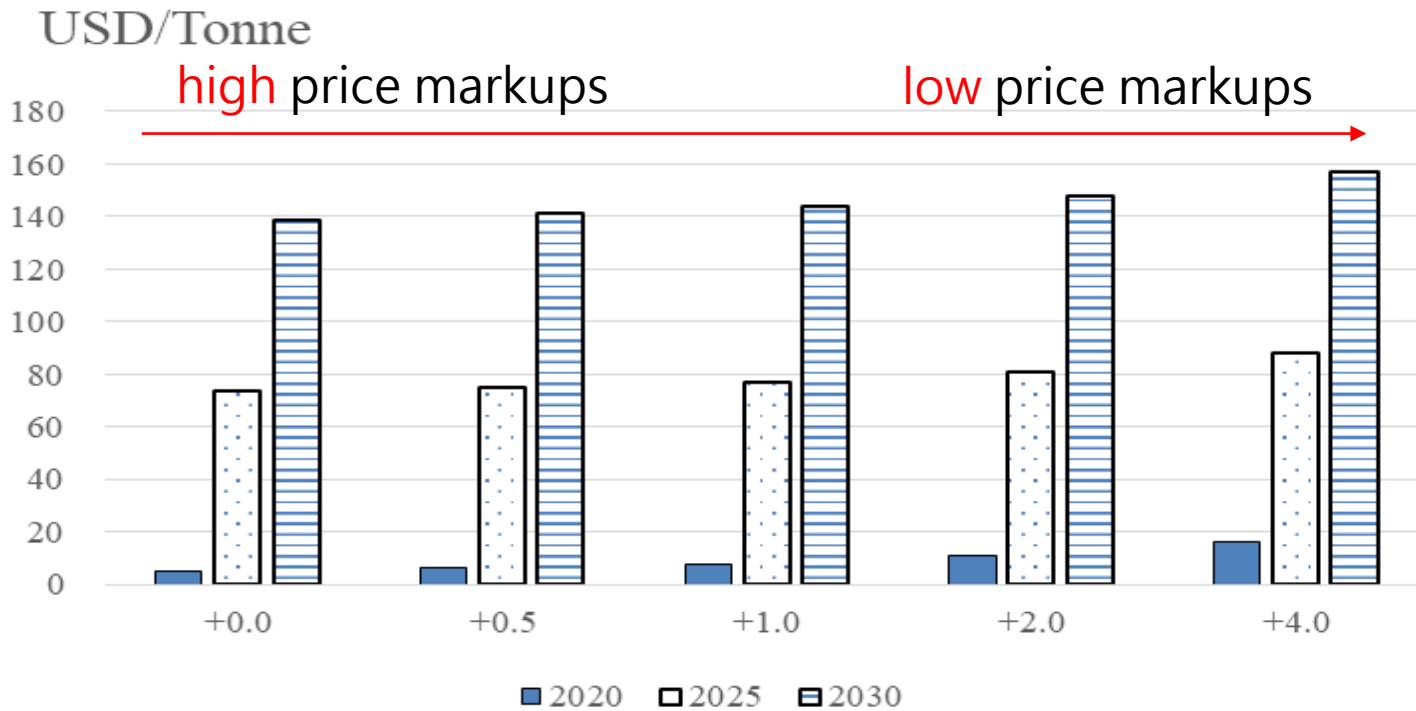


Results

Carbon Price

- High elasticity → Less impacts on GDP
- Higher carbon prices to reach the target

Carbon Price relative to the Referene Scenario



Conclusions

The Carbon Tax Evaluations are related to the Specifications on Market Structure

- **High Price** Markups → **Enlarge** the impacts of carbon tax burdens → **large** GDP losses

Competitive Market Structure might mitigate the economic losses

- **Reforms** in the Japanese electricity market since 1995 in order to enhance competitiveness
- **Reforms** in the Taiwanese **electricity market**.



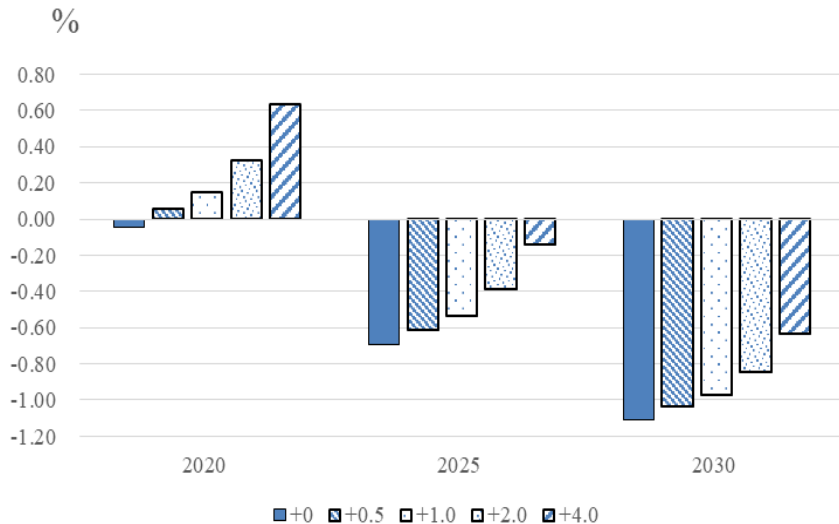
Appendix

Results

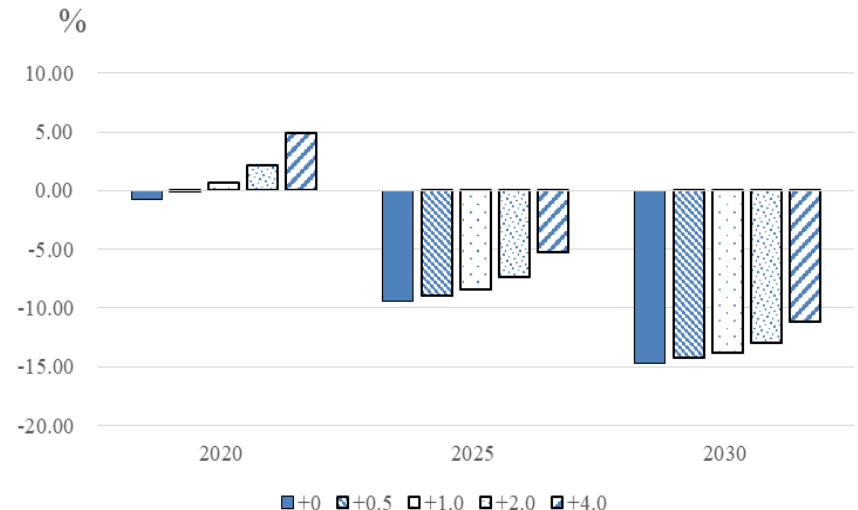
Effects on Demand Side

- High Elasticity → Low impacts on demand side

Consumption



Investment

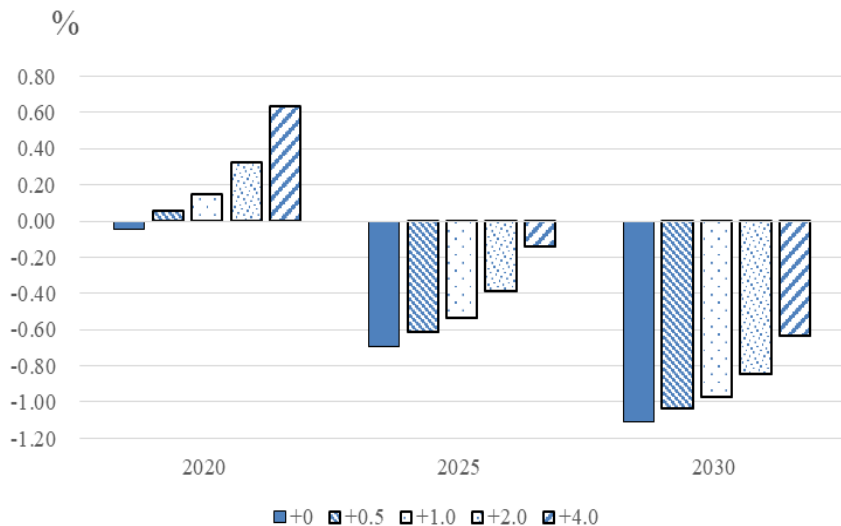


Results

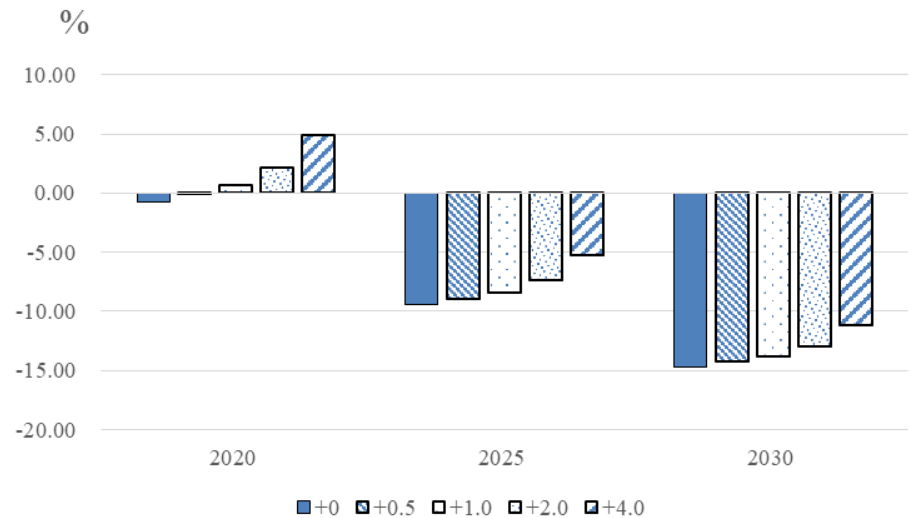
Effects on Demand Side

- High Elasticity → Low impacts on demand side

Export



Import



Results

Domestic v.s. Foreign Markets

- Share of domestic goods market **increases** after the launch of carbon tax.
- **High** elasticity → **Low** price markups → **Lower** domestic share

$$D_t^s = \frac{\sum_{j=1}^{26} D_t(j)}{\sum_{j=1}^{26} Y_t(j)}$$

