Micro to Macro: Optimal Trade Policy with Firm Heterogeneity

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Outline

Motivation

- Know that exporters are larger and more productive than non-exporters
- How should trade policy be shaped by this observation?
    - Micro questions
        - should some exporters be subsidized?
        - should all foreign exporters be taxed?
    - Macro question
        - what is overall optimal level of tax and subsidy?

This paper

- Optimal trade policy under general framework of Melitz (2003)
  - **heterogeneous** fixed cost and variable cost among firms and countries unlike what we saw in Melitz
- 2 different tax schemes in general
  - firms face discriminatory tax
  - firms face uniform tax

Result

- Micro
  - More profitable foreign exporters should be taxed more
  - Domestic exporters should be taxed uniformly
- Macro
  - terms-of-trade pins down the overall level of trade tax
    - optimal trade restrictions increase with deterioration of terms-of-trade

Literature

- Firm heterogeneity in Optimal Trade policy
  - Demidova and Rodriguez-Clare(2009), Felbermayr, Jung and Larch (2013), Haaland and Venebles (2014): used Melitz (2003) to explore the implications of firm heterogeneity for optimal trade policy but with restricted setup
    - only CES utility function
    - constant fixed costs of exporting across firms
    - Pareto distribution
    - uniform trade tax
- Methodology
  - Primal approach and general Lagrange multiplier methods, as in Costinot, Lorenzoni, Werning (2014) and Costinot, Donaldson, Vogel, Werning (2015)

Technology

- Two countries $i = H, F$
  - $L_i =$ labor endowment
  - $w_i =$ wage
- fixed entry cost $f_i^e > 0$ to draw productivity $\varphi \in \phi$
  - N_i = measure of entrants
  - G_i = distribution of φ
- Technology of a firm with draw φ

$$l_{ij}(q, \varphi) = a_{ij}(\varphi)q + f_{ij}(\varphi), \text{ if } q > 0$$
$$l_{ij}(q, \varphi) = 0 \text{ if } q = 0$$

Preferences

- Representative agent with two-level utlity function:

$$U_i = U_i(Q_{H_i}, Q_{F_i})$$

$$Q_{ji} = [\int_{\phi} N_j(q_{ji}(\varphi))^{1/\mu_i} dG_j(\varphi)]^{\mu_i}$$

with $\mu_i \equiv \sigma_i/(\sigma_j - 1)$ and elasiticity of substitution for country j goods $\sigma_j > 1$

- Melitz (2003): special case $\mu_i = \mu_F = \mu$ and

$$U_i(Q_{Hi}, QFi) = [Q_{Hi}^{1/\mu} + Q_{Fi}^{q/\mu}]^{\mu}$$

Market structure

- All markets are monopolistically competitive with free entry
- All labor markets are perfectly competitive

Policy

- ad-valorem consumption and production taxes
- $t_{ij}(\varphi), s_{ij}(\varphi)$: tax and subsidy charged and paid by country i on the consumption and production of firm with φ in country j
  - for $i \neq j, t_{ij}(\varphi) > 0$ a tariff, an import subsidy otherwise
  - for $i \neq j, s_{ij}(\varphi) > 0$ an export subsidy, an export tax otherwise

Decentralized Equilibrium with Taxes

- In a decentralized equilibrium
  - consumers choose consumption to maximzize their utility st their budget constraints
  - firms choose their ouptut to maximize their profits taking their demand curves as given
  - firms enter up to the point at which expected profits are zero
  - markets clear
  - government's budget is balanced in each country
- Notation:

$$\tilde{p}_{ij}(\varphi) \equiv \mu_i w_i a_{ij}(\varphi)/(1 + s_{ij}(\varphi))$$
$$\tilde{q}_{ij}(\varphi) \equiv [(1 + t_{ij}(\varphi))\tilde{p}_{ij}(\varphi)/P_{ij}]^{-\sigma_i} Q_{ij}$$

Equilibrium Conditions

$$q_{ij}(\varphi) = \begin{cases} \tilde{q}_{ij}(\varphi), \text{if} \mu_i a_{ij}(\varphi)\tilde{q}_{ij}(\varphi) \geq l_{ij}(\tilde{q}_{ij}(\varphi), \varphi) \\ 0, \text{otherwise} \end{cases} \quad (1)$$

$$p_{ij}(\varphi) = \begin{cases} \tilde{q}_{ij}(\varphi), \text{if} \mu_i a_{ij}(\varphi) q_{ij}(\varphi) \geq l_{ij}(q_{ij}(\varphi), \varphi) \\ \infty, \text{otherwise} \end{cases} \quad (2)$$

$$Q_{Hj}, Q_{Fj} \in \arg \max_{\tilde{Q}_{Hj}, \tilde{Q}_{Fj}} U_j(\tilde{Q}_{Hj}, \tilde{Q}_{Fj}) \mid \sum_{i=H,F} P_{ij}\tilde{Q}_{ij} = w_j L_j + T_j \quad (3)$$

$$P_{ij}^{1-\sigma_j} = \int_{\phi} N_i[(1 + t_{ij}(\varphi))p_{ij}(\varphi)]^{1-\sigma_i} dG_i(\varphi) \quad (4)$$

$$f_i^e = \sum_{j=H,F} \int_{\Phi} [\mu_i a_{ij}(\varphi) q_{ij}(\varphi) - l_{ij}(q_{ij}(\varphi), \varphi)] dG_i(\varphi) \quad (5)$$

Equilibrium Conditions cont.

$$L_i = N_i[\sum_{j=H,F} \int_{\Phi} l_{ij}(q_{ij}(\varphi), \varphi) dG_i(\varphi) + f_i^e] \quad (6)$$

$$T_i = \sum_{j=H,F} [\int_{\Phi} N_j(t_{ji}(\varphi)p_{ji}(\varphi)q_{ji}(\varphi)dG_j(\varphi) - \int_{\Phi} N_j(s_{ji}(\varphi)p_{ij}(\varphi)q_{ij}(\varphi)dG_i(\quad (7)$$

Home Government's Problem

The H government's problem is

$$\max_{T_H,\{t_{jH},s_{Hj}\}_{j=H,F},\{q_{ij},Q_{ij},p_{ij},P_{ij},w_i,N_i\}_{i,j=H,F}} U_H(Q_{HH},Q_{FH})$$

subject to equilibrium conditions $(1)-(7)$

- Assume that only H governemnt is strategic, whereas F government is passive, with all taxes = 0
- Solve the H government's problem using the primal approach:
  - relaxed planning problem in which domestic consumption, output, and the measure of entrants can be chosen directly
  - show that the optimal allocation can be implemented throughlinear taxes and characterize the structure of these taxes

Home's Planning Problem

- A problem of central planner who directly controls the quantities demanded by home consumers q_{HH}, q_{FH}, q_{HF} and measure of home entrants N_H st

$$\int_{\Phi} N_i(q_{ij}(\varphi))^{1/\mu} dG_i(\varphi) \geq Q_{ij}^{1/\mu_i}, \text{ for} i = H \text{ or} j = H \tag{8}$$

- Solve Home's planning problem using a micro-to-macro strategy:
  - take macro quantities Q_{HH}, Q_{HF} and Q_{FH} as given and solve cost minimization problem to find q_{HH}, q_{HF}, and q_{FH} as well as the measure of the entrants, N_H
  - solve macro quantities

1st Micro Problem

- 1st micro problem: finding q_{HH}, q_{HF}, N_H to minimize the cost to produce Q_{HH}, Q_{HF}:

$$q^*_{Hj}(\varphi) = \begin{cases} (\mu_H a_{Hj}(\varphi)/\lambda_{Hj})^{-\sigma_H}, \text{if} \varphi \in \Phi_{Hj}, \\ 0, \text{otherwise} \end{cases}$$

with $\Phi_{Hj} \equiv \{\varphi : (\mu_H - 1) a_{Hj}(\varphi)(\mu_H a_{Hj}(\varphi)/\lambda_{Hj})^{-\sigma_H} \geq f_{Hj}(\varphi)\}$ the set of domestically produced varieties sold in country j

2nd Micro Problem

- 2nd micro problem: finding q_{FH} conditional on Q_{HF} subject to Foreign's eqiulibrium conditions:

$$q^*_{FH}(\varphi \mid Q_{HF}) = \begin{cases} (\mu_F \chi_{FH} a_{FH}(\varphi))^{-\sigma_F}, \text{if} \varphi \in \Phi^u_{FH} \\ f_{FH}(\varphi)/((\mu_F - 1)a_{FH}(\varphi)), \text{if} \varphi \in \Phi^c_{FH} \\ 0, \text{otherwise} \end{cases}$$

with 2 sets of varieties defined by

$$\Phi^u_{FH} \equiv \{\varphi : \theta_{FH}(\varphi) \in [(\max\{1, (\lambda_L - \lambda_E)/(\lambda_L + (\mu_F - 1)\lambda_E)\})^{1/\sigma_F} \tag{9}$$

$$\Phi^c_{FH} \equiv \{\varphi : \theta_{FH}(\varphi) \in [\lambda_L/(\lambda_L + (\mu_F - 1)\lambda_E), 1]\} \tag{10}$$

where $\theta_{FH}(\varphi)$ can be thought as a "profitability" of foreign varieties in Home's market

Macro Problem

- Home's palnner maximize $U_H(Q_{HH}, Q_{FH})$ st resource constraint (8) and the foreign equilibrium conditions
- Solution:

$$MRT_H^* P^* / MRS_H^* = 1/\nu^*,$$

with $MRS_H \equiv \partial U_{HH} / \partial Q_{HH} / (\partial U_H / \partial Q_{FH})$ and $MRT_H^* \equiv (\partial L_H / \partial Q_{HH}) / (\partial L_H / \partial Q_{HF})$

Summary

- The first main message of your talk in one or two lines.
- The second main message of your talk in one or two lines.
- Perhaps a third message, but not more than that.

- Outlook
  - Something you haven’t solved.
  - Something else you haven’t solved.