# Trade Elasticities and Gains from Trade under Vertical Oligopoly

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# Outline of this talk

- Motivation
- Model:
  - Vertical oligopoly with free entry
  - Effect of trade costs on trade flows and welfare gains
- Suggestive evidence:
  - Mapping from theory to empirics
  - Preliminary estimation results
- Summary

# Motivation

- Recent years have witnessed faster growth of intermediate inputs in world trade volume:
  - Vertical specialization
  - Global value chains (GVCs)

- In analyzing fragmentation of production processes:
  - Most work $\Rightarrow$ Bilateral negotiations in buyer-seller contractual relationships (e.g., Pol Antràs' work)
  - This paper $\Rightarrow$ Market-based transactions among buyers and sellers (i.e., non-contractual relationships)

# Motivation

- Two features of market-based transactions:

  (i) Strategic interactions among large firms (Head and Spencer, 2017)
  - Only a few large firms participate in international trade
  - Markets are becoming more concentrated toward these firms over time

  (ii) Increasing interdependencies across countries (Antràs et al., 2025)
  - Trade policy shocks can lead to similar effects on countries involved in GVCs
  - Trade shocks have a complementary force on the extensive margin

- Most papers in the GVC literature consider perfectly competitive firms (e.g., Antràs and de Gortari, 2020; Johnson and Moxnes, 2023)

# Motivation

Ten most concentrated industries in China, 1998

| CIC | Industry description | HHI | Upstreamness |
|---|---|---|---|
| 4039 | Applied TV equipment and other audio-video equipment | 0.681 | 2.584 |
| 4127 | Nucleon and nuclear radiation measuring apparatus manuf. | 0.609 | 3.060 |
| 3313 | Nickel cobalt smelting | 0.573 | 4.877 |
| 4159 | Other stationary and office machine manufacturing | 0.527 | 3.060 |
| 3759 | Navigation mark and other floating equipment manuf. | 0.517 | 2.617 |
| 4124 | Meter apparatus for forming, forestry and fishing manuf. | 0.516 | 3.666 |
| 2433 | Electronic musical instrument | 0.479 | 2.781 |
| 3723 | Trolley manufacturing | 0.457 | 2.953 |
| 2413 | Teaching specimen and mode | 0.441 | 2.781 |
| 4152 | Slide projector and overhead projector manuf. | 0.396 | 3.060 |
| | | 0.519 | 3.144 |

Source: Authors' calculations

Note: HHI and upstreamness are taken from China's annual survey of industrial firms and Chor et al. (2021), respectively. The median HHI is 0.03 in this year.

# Motivation

- Research question:
  - What is the effect of trade costs on trade flows and welfare when vertically related sectors are oligopolistic?

- Main findings:
  1. The trade elasticity is greater, the more oligopolistic the vertically related sectors
  2. The welfare effect of trade liberalization is also greater, the more oligopolistic the vertically related sectors

  $\Rightarrow$ The amplified effect arises from co-movement of firms in each sector (absent in perfect competition)

# Model

- Home consumers:

$$U = U(Q) + y$$

- Inverse demand:

$$P(Q) = AQ^{-1/\sigma}, \quad \sigma > 1$$

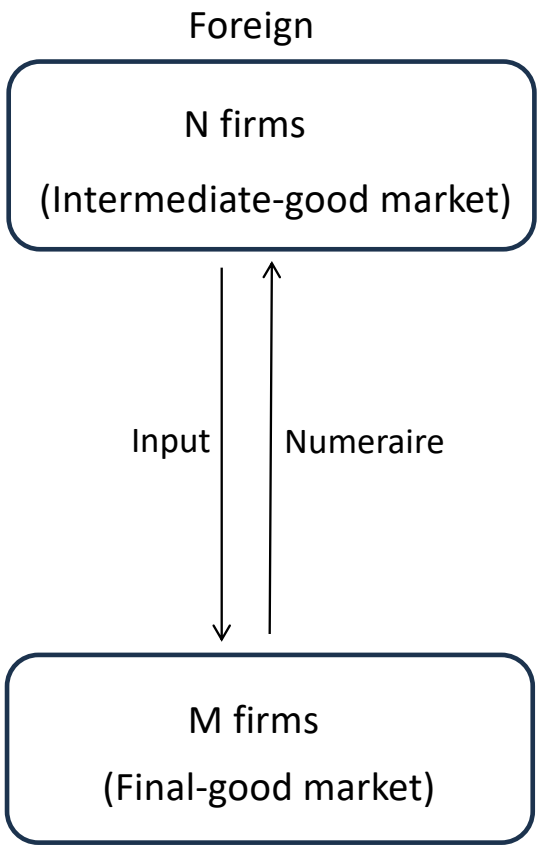
- Elasticity and curvature of demand:

$$\varepsilon \equiv -\frac{P(Q)}{QP'(Q)} = \sigma$$

$$\rho \equiv \frac{QP''(Q)}{P'(Q)} = -\left(\frac{\sigma+1}{\sigma}\right)$$

where $-2 < \rho < -1$ (c.f., Mrázová and Neary, 2017)

# Model




→ Home's ToT = $1/r$

$$\pi_{Fi} = \left(g\left(x_i + \sum_{j \neq i}^{N} x_j, M, \tau, t\right) - ct\right) x_i$$

Input price → D = S

$$r = g(X, M, \tau, t)$$

$$\pi_{Hi} = \left(P\left(q_i + \sum_{j \neq i}^{M} q_j\right) - r\tau\right) q_i$$

# Model

- Equilibrium conditions:
  - First-order condition

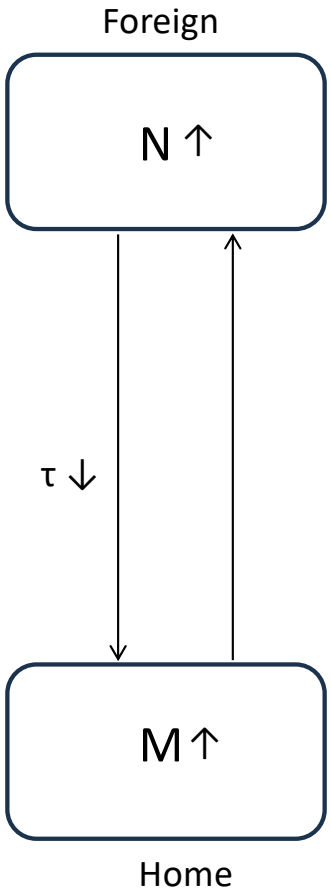
$$MP(Q) + QP'(Q) = Mr\tau \quad \Longrightarrow \quad Q$$
$$Ng(X, M, \tau, t) + Xg_X(X, M, \tau, t) = Nct \quad \Longrightarrow \quad X$$

  - Free-entry condition

$$\frac{(P - r\tau)Q}{M} = K_H \quad \Longrightarrow \quad M$$
$$\frac{(r - ct)X}{N} = K_F \quad \Longrightarrow \quad N$$

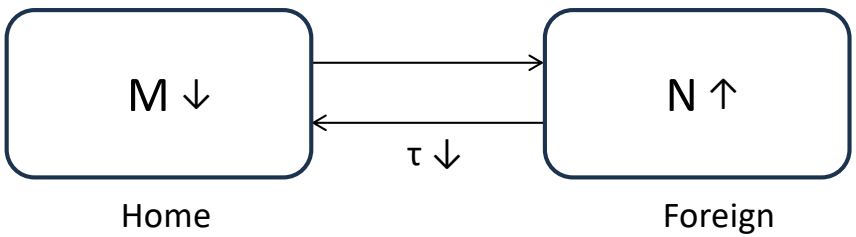
- Trade margins:
  - Extensive margin $\Rightarrow M, N$
  - Intensive margin $\Rightarrow q = \frac{Q}{M}, x = \frac{X}{N}$

# Model




- Vertical specialization ⇒ Co-movement
- Tariff reductions induce some firms to enter the Home market, as each country produces goods with complements

# Model




- Horizontal specialization ⇒ Delocation (e.g., Bagwell and Staiger, 2012)
- Tariff reductions induce some firms to exit the Home market, as each country produces goods with substitutes

# Model

## Proposition (Trade elasticities)

1. *The effect of import tariffs on aggregate imports*

$$\frac{dQ}{d\tau} = \underbrace{\frac{\partial Q}{\partial \tau}}_{<0} + \underbrace{\frac{\partial Q}{\partial M}\frac{dM}{d\tau}}_{<0} + \underbrace{\frac{\partial Q}{\partial N}\frac{dN}{d\tau}}_{<0} < 0$$

   $\Rightarrow$ *Second and third terms capture co-movement of firms*

2. *The trade elasticity with respect to import tariffs*

$$\theta \equiv -\frac{d \ln Q}{d \ln \tau} = \sigma \mu(M, N, \sigma)$$

   (i) $\mu(\infty, \infty, \sigma) = 1 \Rightarrow \theta = \sigma$ *in perfectly competitive sectors*
   (ii) $\mu(M, N, \sigma) > 1 \Rightarrow \theta > \sigma$ *in oligopolistic sectors*

3. *The trade elasticity with respect to transport costs*

$$\vartheta \equiv -\frac{d \ln X}{d \ln t} = (\sigma - 1)\eta(M, N, \sigma)$$

   $\Rightarrow \eta(.)$ *has the same property as* $\mu(.)$

# Model

## Proposition (Welfare gains)

1. *The effect of import tariffs on Home's ToT*

$$\frac{dr}{d\tau} = \underbrace{\frac{\partial r}{\partial \tau}}_{\leq 0} + \underbrace{g_X(X, M, \tau, t)\frac{\partial X}{\partial N}\frac{dN}{d\tau}}_{>0} > 0$$

   $\Rightarrow$ *Imposition of tariffs worsens Home's ToT*

2. *The effect of import tariffs on Home welfare*

$$\frac{dW}{d\tau} = \underbrace{\frac{\partial W}{\partial \tau}}_{<0} + \underbrace{(P(Q) - r)\left(\frac{\partial X}{\partial M}\frac{dM}{d\tau} + \frac{\partial X}{\partial N}\frac{dN}{d\tau}\right)}_{<0} - \underbrace{Q\frac{dr}{d\tau}}_{>0} < 0$$

   $\Rightarrow$ *Second and third terms capture co-movement of firms*

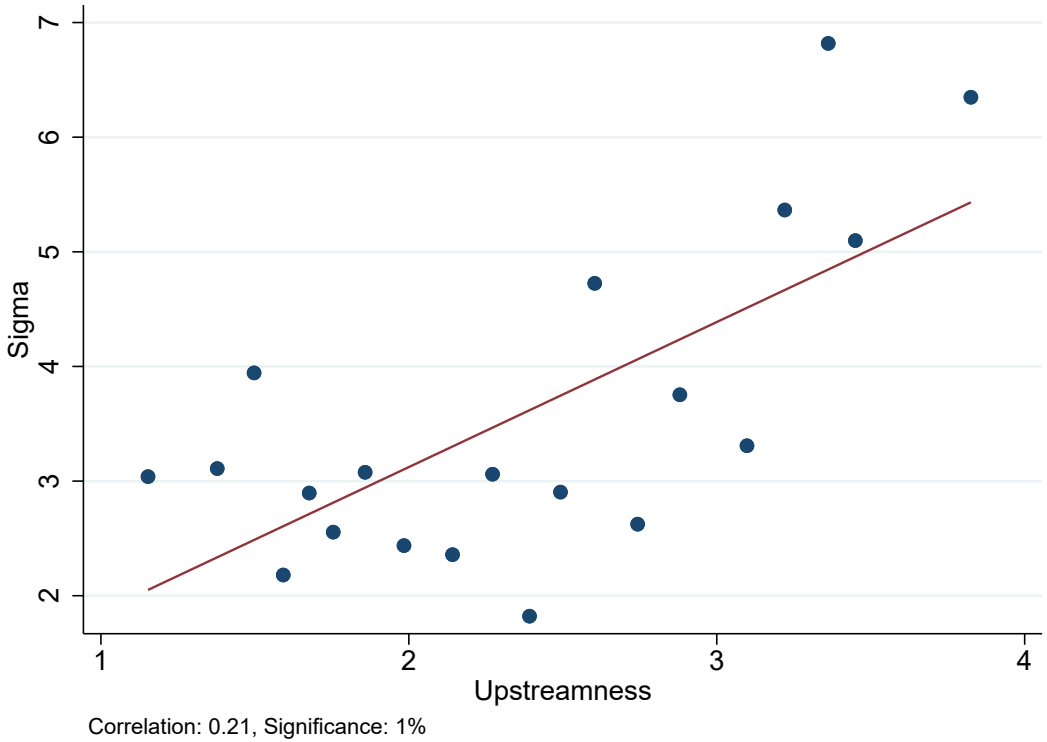
# Suggestive evidence

- Possible empirical test of our model:
  $\Rightarrow$ The trade elasticity is larger in more oligopolistic sectors

- Main empirical test of Antràs and de Gortari (2020):
  $\Rightarrow$ The trade elasticity is larger in more downstream sectors

- As downstream sectors are typically uncompetitive (Antràs and Chor, 2022), the two findings are similar, with the main difference being:
  - Our paper $\Rightarrow$ *Oligopolistic* competition
  - Antràs and de Gortari (2020) $\Rightarrow$ *Perfect* competition

# Suggestive evidence

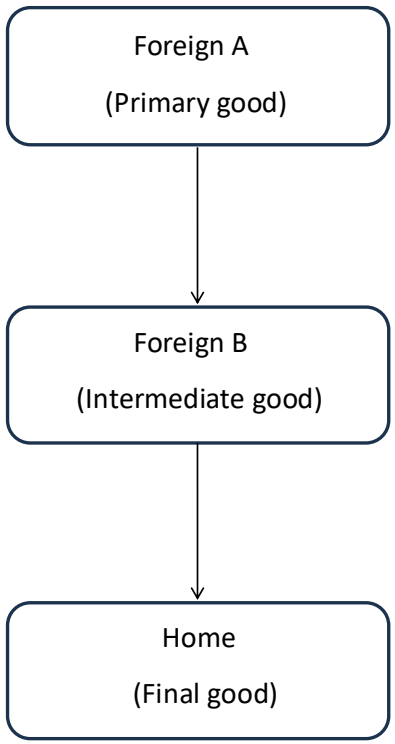



Source: Authors' calculations

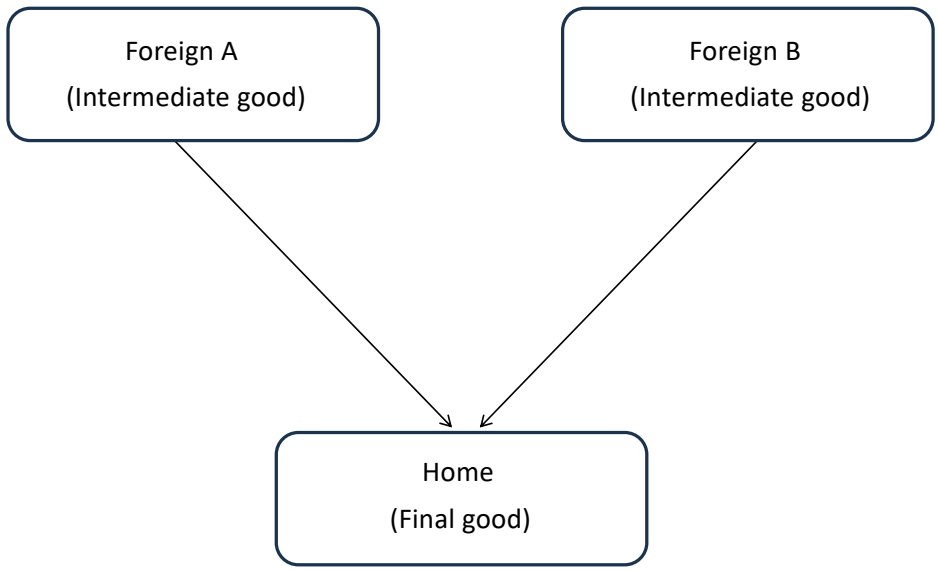
Note: The vertical and horizontal axes are measured by the import demand elasticity and upstreamness presented by Brora and Weinstein (2006) and Antràs et al. (2012), respectively

# Suggestive evidence

- Mapping from theory to empirics:




(a) Sequential production




(b) Simultaneous production

# Suggestive evidence

- Mapping from theory to empirics:
  - To avoid the compounding effect by Antràs and de Gortari (2020), we restrict our attention to (III) and (IV) in the table
  - We expect that the trade elasticity is larger for (IV) than for (III)

| | Competitive | Uncompetitive |
|---|---|---|
| Upstream | Competitive upstream goods (I) | Uncompetitive upstream goods (II) |
| Downstream | Competitive downstream goods (III) | Uncompetitive downstream goods (IV) |

# Suggestive evidence

- Imports data:
  - China Customs 2000–2007
  - Firm-product (HS 6-digit)-source country-level import transactions
  - Aggregate to HS 6-digit level imports
  - Ordinary imports only in main estimations
  - Calculate HHI and the number of importers at the HS 6-digit level

- Tariffs data:
  - UNCTAD TRAINS
  - HS 6-digit level applied tariffs, China, 2000–2007
  - Price equivalent transformation log(tariff+1)

# Suggestive evidence

Summary statistics:

| Variable | n | Mean | S.D. | Min | 0.25 | Mdn | 0.75 | Max |
|---|---|---|---|---|---|---|---|---|
| log(Imports value) | 37,508 | 6.7 | 3.19 | -6.91 | 4.64 | 6.98 | 9 | 17.83 |
| Tariffs (%) | 37,425 | 11.84 | 8.99 | 0 | 6 | 10 | 15.5 | 121.6 |
| Upstreamness | 37,375 | 2.32 | 0.91 | 1 | 1.44 | 2.36 | 3.11 | 4.65 |
| Sigma | 37,122 | 6.03 | 10.72 | 1.34 | 2.77 | 3.64 | 5.31 | 108.19 |
| HHI | 37,508 | 0.33 | 0.28 | 0 | 0.11 | 0.23 | 0.47 | 1 |
| Number of importers | 37,508 | 122.47 | 365.51 | 1 | 8 | 26 | 84 | 11695 |
| Intermediate goods dummy | 37,508 | 0.62 | 0.48 | 0 | 0 | 1 | 1 | 1 |

Note: "Competitiveness" of goods is mainly measured by Sigma (import demand elasticity) and HHI below

# Suggestive evidence

Upstreamness and Sigma:

| Dep. Var.: log(Imports) | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Samples: | Upstream & high-sigma | Upstream & low-sigma | Downstream & high-sigma | Downstream & low-sigma |
| log(Tariff+1) | 0.0863 | -0.329 | -2.588*** | -2.368*** |
| | (0.677) | (1.126) | (0.831) | (0.652) |
| Product FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| N | 11613 | 7094 | 7259 | 11400 |
| adj. R-sq | 0.868 | 0.851 | 0.850 | 0.891 |

Note: Product FE and year FE are included in all columns. Standard errors are clustered at the product level.
Significance levels: * 0.10 ** 0.05 *** 0.01.

# Suggestive evidence

Upstreamness and HHI:

| Dep. Var.: log(Imports) | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Samples: | Upstream & high-HHI | Upstream & low-HHI | Downstream & high-HHI | Downstream & low-HHI |
| log(Tariff+1) | 0.567 | -0.651 | -2.813*** | -1.915*** |
| | (0.949) | (0.461) | (0.795) | (0.467) |
| Product FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| N | 8784 | 9464 | 9624 | 8601 |
| adj. R-sq | 0.754 | 0.936 | 0.784 | 0.949 |

Note: Product FE and year FE are included in all columns. Standard errors are clustered at the product level.

Significance levels: * 0.10 ** 0.05 *** 0.01.

# Summary

- Key contributions:
  - Examine the effect of trade costs when the vertically related sectors are oligopolistic
  - Provide novel theoretical and empirical findings under vertical oligopoly
    - Better understanding of the mechanism through which trade costs can affect vertical specialization in the presence of large firms
    - Suggestive evidence on the trade elasticity consistent with the model

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