CATs and DOGs

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*** No animals were harmed in the production of this paper! ***

Motivation

How are goods traded across borders?

- Standard theory:
  - Costs of exporting borne by manufacturers
  - Int'l trade increases competition in manufacturing and lowers prices
- Role of "traders":
  - Intermediaries facilitate trade / lower trade costs:

    Rauch/Watson (JEMS, 2004), Blum/Claro/Horstman (AER:PP, 2010), Ahn/Khandelwal/Wei (JIE, 2011), Antràs/Costinot (QJE, 2011), Bernard/Grazzi/Tomasi (REStat, 2015), Akerman (CJE, 2018)
  - Manufacturing firms as "mixed" producers-traders:

    Bernard et al. (AER:PP, 2010)
  - Carry-Along Trade (CAT):

    Bernard et al. (REStud, 2018)

Carry-Along Trade (CAT)

- The evidence:

  "We document the fact that a large majority of manufacturing exporters export many products that they do not produce. In addition, a smaller set of the largest manufacturing firms produce goods where they export more than they produce. We refer to these complementary export activities together as Carry-Along Trade (CAT)."
  (Bernard et al., REStud, 2018, p. 527)

- Evidence for Belgium, Denmark, France, Italy, Sweden, and Turkey
- Key characteristics of CAT:
  - Transfer of ownership with compensation
    (▶ *NOT* transporting, re-exports, return/replacement/repair)
  - Recorded as exports, but *not* recorded as production
    (▶ *NOT* packaging; f.ex. batteries in toys)

How to think of CAT?

- Bernard et al. (2018): CAT as make-or-source decision
  - Multi-product firms decide on optimal product scope
  - Then decide whether to produce in-house or to source externally
  - CAT as a (new) sourcing technology

- Our approach: CAT as a strategic decision
  - Oligopoly (duopoly) as opposed to monopolistic competition
  - DOG (Delivery of Own Goods) as opportunity cost of CAT
  - Strategy (mode) affects both extensive and intensive margin of trade
  - Welfare and competition issues

Linkages

Demand linkages:

- Inverse demand: $p_i = a_i - bq_i - b\theta q_j, \quad \theta \in [-1, 1]$
- Products can be complements, unrelated, or substitutes

Supply linkages:

- Marginal production costs constant and product specific: c_i
- Transportation costs depend on mode of exporting:
  - DOG: $t_i^{DOG} = t$
  - CAT: $t_i^{CAT} = (1 + \xi_i)\, t, \;\; \xi_i > -1$
    - If $\xi_i < 0$, CAT creates transportation cost savings (spillovers, economies of scale, lumpiness in transportation)
    - If $\xi_i > 0$, higher transportation costs for CAT (adaptation, diseconomies of scope, or span of control issues)

Delivery of Own Goods (DOG)

- Begin w/ symmetric duopoly (asymmetry and oligopoly later)
- DOG case essentially standard duopoly Nash equilibrium
  - Profits: $\pi_i^d = (p_i - c - t)\, q_i$
  - Best response functions: $2bq_i^d = a - c - t - b\theta q_j^d$
- DOG equilibrium:
  - Outputs: $q^d = \frac{a-c-t}{b(2+\theta)}$
  - Profits: $\pi^d = \frac{(a-c-t)^2}{b(2+\theta)^2}$

Carry-Along Trade (CAT)

- CAT case essentially joint profit maximization (efficient bargaining)
  - CAT profits: $\pi_i^c = [p_i - c - t - t\xi]\, q_i + [p_j - c - t - t\xi]\, q_j$
  - Best response functions:

$$2b\left(q_i^c + \theta q_j^c\right) = a - c - t - t\xi$$
$$2b\left(\theta q_i^c + q_j^c\right) = a - c - t - t\xi$$

- CAT equilibrium:
  - Outputs: $q^c = \frac{(a-c-t-t\xi)}{2b(1+\theta)}$
  - Profits: $\pi^c = 2b\,(1+\theta)\,(q^c)^2 = \frac{(a-c-t-t\xi)^2}{2b(1+\theta)}$

Conditions for CAT

- Necessary condition for CAT: $q_j^c > 0$
  - Asymmetric case: $\frac{1}{1-\theta}\left(a_j - c_j - t\right) - \frac{\theta}{1-\theta}\left(a_i - c_i - t\right) > t\xi_i$
  - Symmetric case: $\left(a - c - t\right) > t\xi$

- Sufficient condition for CAT: $\pi_i^c > \pi_i^d + \pi_j^d$
  - Relative productivity of CAT: $z \equiv \frac{a-c-t-t\xi}{a-c-t}$
  - Relative profitability of CAT: $\Delta\Pi \equiv \frac{2b(1+\theta)}{(a-c-t)^2}\left(\pi^c - \sum \pi^d\right)$

$$\Delta\Pi\left(\theta, z\right) = z^2 - \frac{4\left(1+\theta\right)}{\left(2+\theta\right)^2} > 0$$

Equilibrium (for symmetric products)

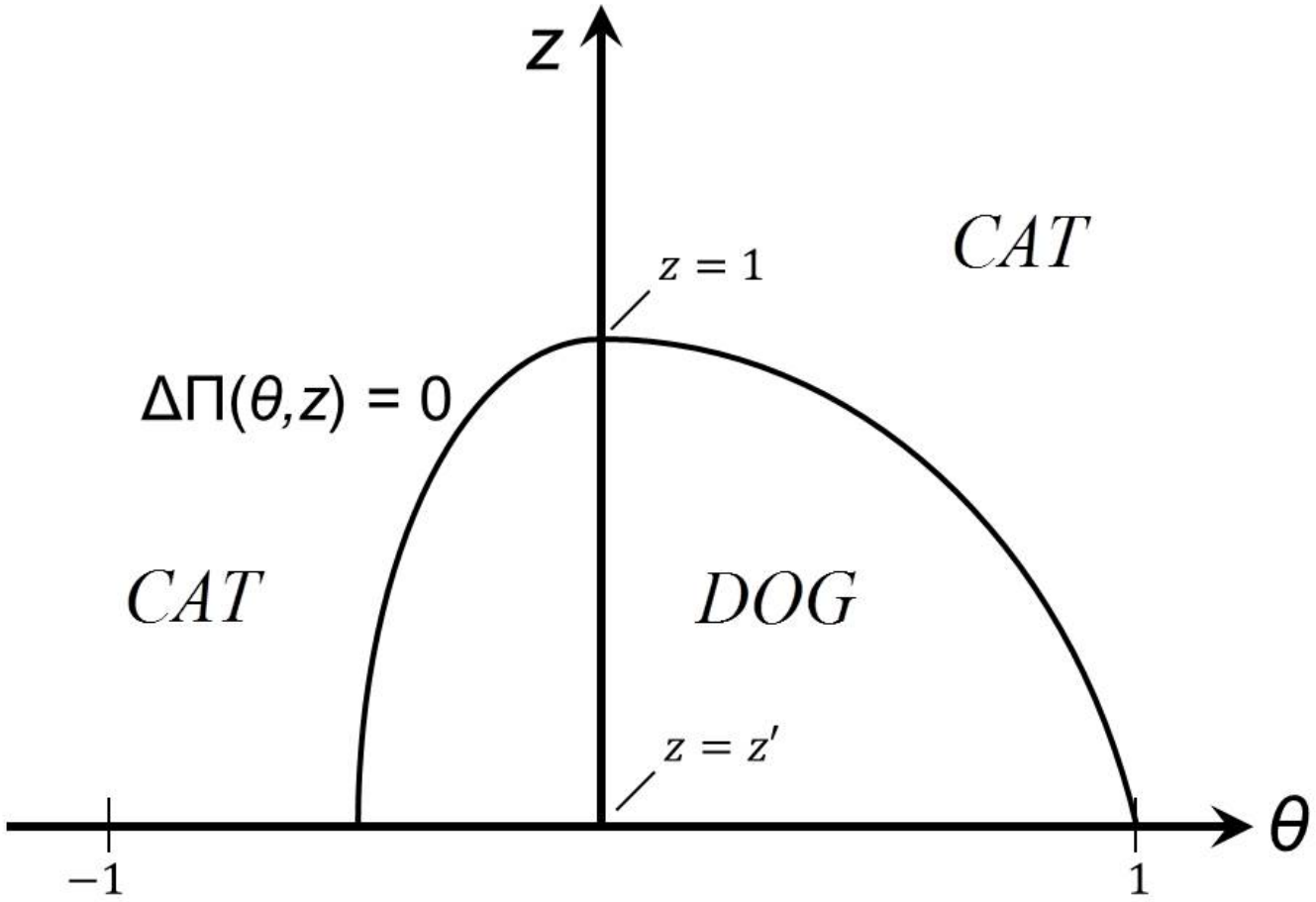

Figure: $\Delta\Pi(\theta, z) = 0$

Symmetric Equilibrium

Proposition (Demand Linkages)

(i) CAT is more profitable if demand linkages are stronger.
(ii) This effect is stronger for complements.

Proposition (Productivity Discount)

(i) If $z < 1$, the profitability of CAT is decreasing in discount.
(ii) CAT is always profitable if $z > 1$.

Corollary (Marginal Production Costs)

CAT is less profitable when marginal productions costs are higher.

Corollary (Trade Costs)

CAT is less profitable if trade costs are higher.

Asymmetric Equilibrium

Profit differentials: $\pi_i^c - \pi_j^c = -\frac{t\left(\xi_i - \xi_j\right)}{b(1+\theta)}\left(\bar{a} - \bar{c} - t - t\bar{\xi}\right)$

Proposition

The firm with the lower transportation costs performs CAT.

Proposition

If one firm is more productive than the other firm, then increasing this productivity gap makes CAT more profitable.

Trade Effects of CAT

Export quantities:

- Define $\Delta q \equiv \frac{2b(1+\theta)}{a-c-t}\left(q^c - q^d\right)$

$$\Delta q\left(\theta, z\right) = z - 2\frac{\left(1+\theta\right)}{\left(2+\theta\right)}$$

Export prices:

- Define $\Delta p \equiv \frac{2(1+\theta)}{(a-c-t)}\left(p^c - p^d\right)$

$$\Delta p\left(\theta, z\right) = -\left(1-\theta\right)\Delta q\left(\theta, z\right)$$

Quantity and Price Responses

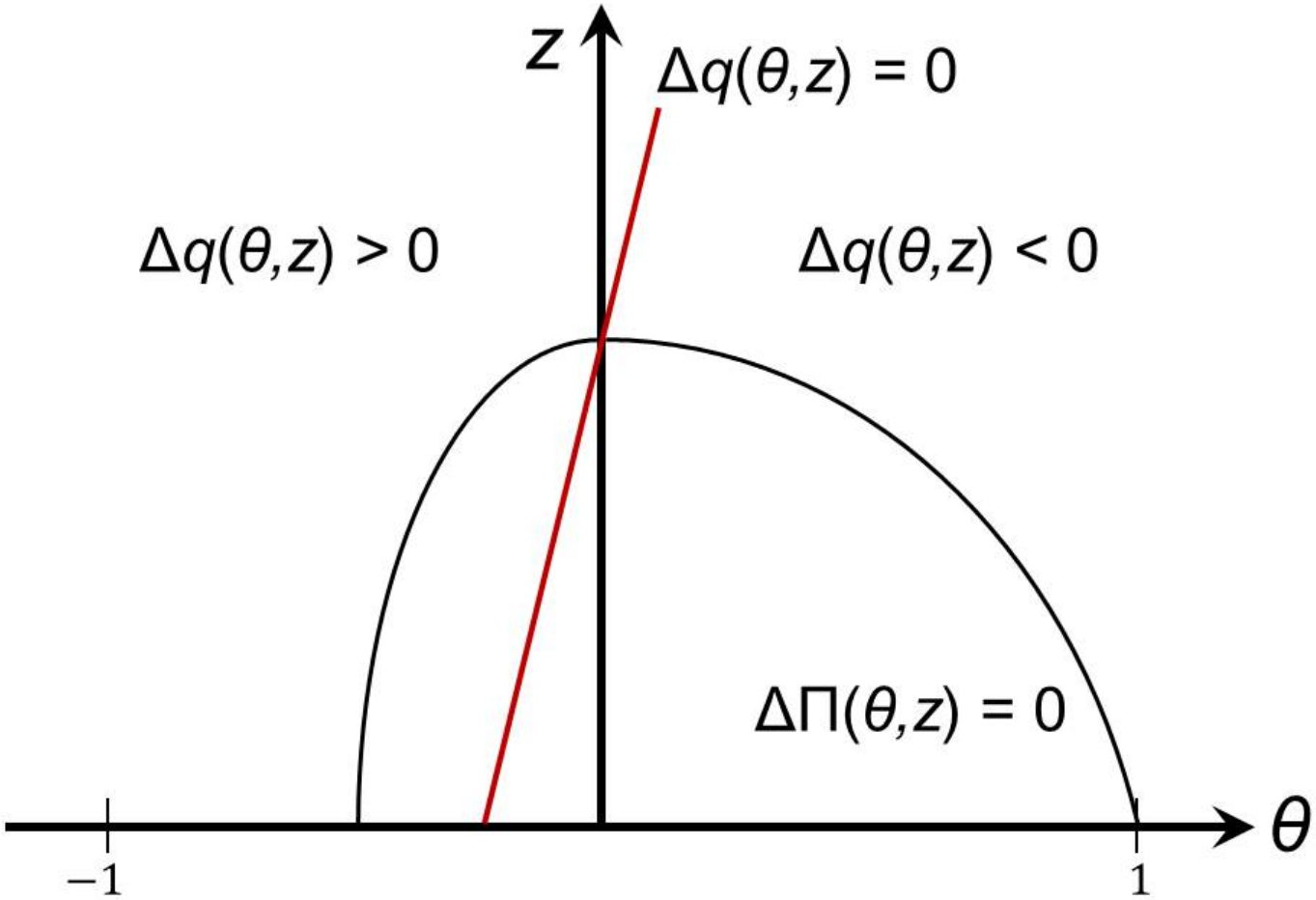

Figure: $\Delta q(\theta, z) = 0$

Propositions Trade and CAT

Proposition (Intensive Margin)

Quantities exported are higher (lower) in the CAT mode when products are complements (substitutes). When products are unrelated CAT always increases the quantities traded.

Proposition (Price Effects)

When products are complements, CAT prices are lower than DOG prices. When products are substitutes, CAT prices are higher than DOG prices.

Corollary (Collusion)

Carry-along trade is isomorphic to a product-market specific collusion.

Asymmetric Quantities

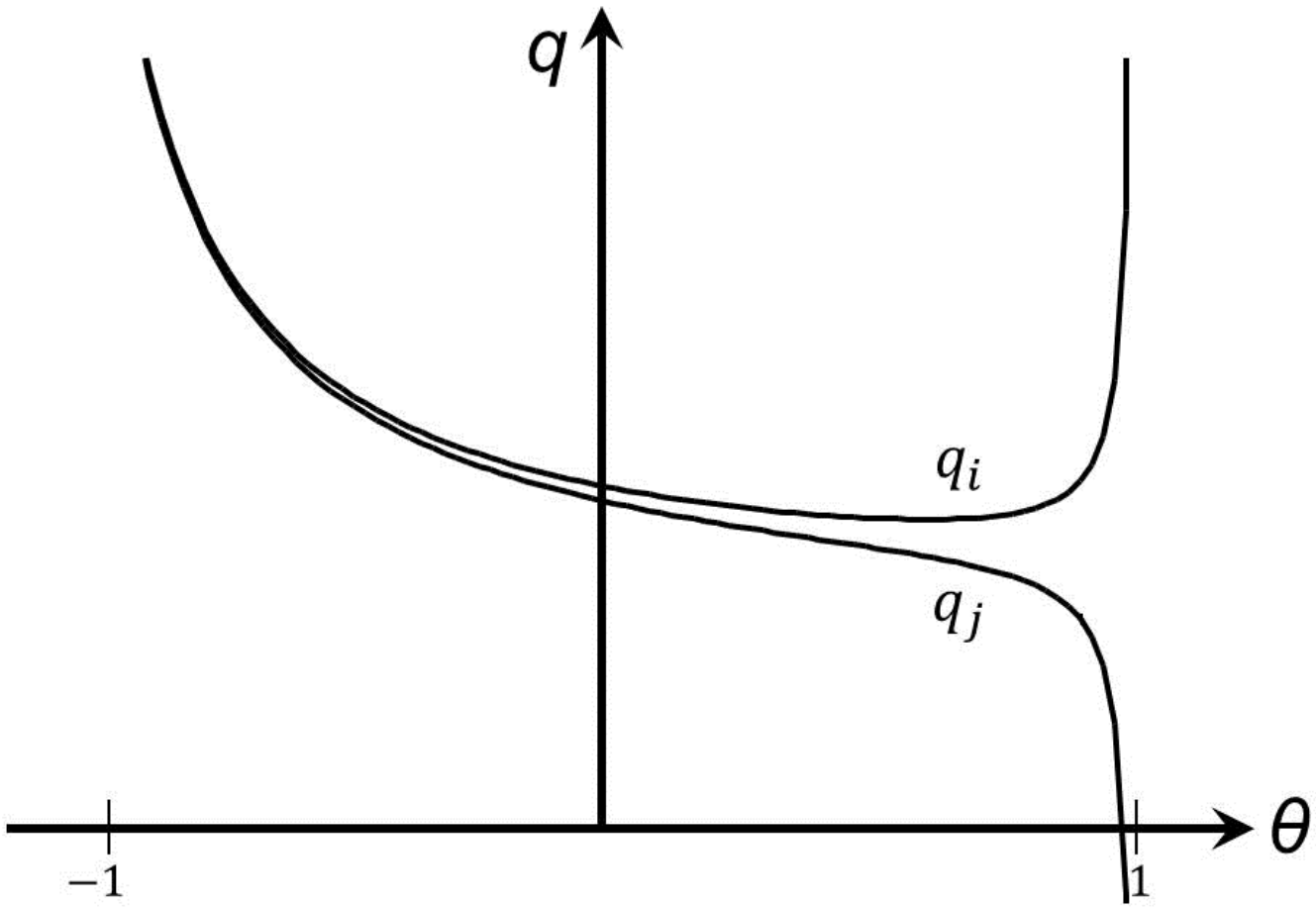

Figure: Asymmetric Quantities

Trade Creation through CAT

- Trade creation implies that $q_j^c > 0$ and $q_j^d = 0$
- Requires $-\frac{\theta}{1-\theta} > \frac{2t\xi_i}{a_i - c_i - t}$

Proposition

CAT can only lead to trade creation when products are substitutes ($\theta > 0$) and when CAT reduces transportation costs ($\xi < 0$).

CAT in Oligopolistic Equilibrium

Additional assumptions:

- Exogenously given number N of products: $N = n^d + (1+\mu)\, n^c$
- Demand for product i: $p_i = a - bq_i - b\theta\,(Q - q_i)$, where $Q = \sum_N q_i$
- All products within an industry are substitutes ($\theta > 0$)
- Transportation costs: $\xi_i = \xi_i\,(\mu_i)$, where $\xi_i\,(0) = 0$, $\xi_i\,(1) = \xi_i$, $\xi_i\,(2) > \xi_i$
- All firms are identical w.r.t. production technology (a, c)

Extensive and Intensive CAT Margins

Extensive CAT margin ($\mu = 1$):

Proposition (Productivity)

(i) If CAT has a productivity discount for firm i ($z_i < 1$), the profitability of CAT is decreasing in this discount. (ii) CAT is always profitable if a firm has a productivity premium ($z_i > 1$).

Proposition (Competition)

More competition (a higher N) reduces the incentives for CAT. This is true for both an increase in n^d as well as in n^c.

Intensive CAT margins ($\mu > 1$):

Proposition (CAT Products)

More productive CAT firms will carry-along more CAT products.

Conclusion

Three key takeaways from our study:

1. In an oligopolistic market where market power and strategic interactions matter, CAT can be profitable even if it leads to higher transportation costs.
2. If the main driver of CAT is to internalize demand linkages (as opposed to saving transportation costs), we should expect CAT to be present in international *and* domestic transactions.
3. The mode of exporting affects pricing decisions and may lead to distributional conflicts.

$\Longrightarrow$ **CAT can produce outcomes that are identical to product-specific, market-specific collusion.**