Competition and Location:

Article:

Mayer, T. (2000), "Spatial Cournot Competition and Heterogeneous Production Costs Across Locations", *Regional Science and Urban Economics*, Vol. 30:325-252

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Competition and Location:

- What have we learned
- Empirics inform theory
- Modelling implications: Assumptions
- The model: Cournot competition with heterogeneous production costs across locations
- Implications:
  - Agglomeration
  - Location
- Application
- Extensions and critique
- Questions

What have we learned:

Hotelling (1929, EJ):

Minimum Differentiation in a Spatial Duopoly

D'Aspremont, Jaskold-Gabszewicz, Thisse (1983, EL):

Never minimum differentiation (agglomeration) in location price models à la Hotelling unless price is fixed exogenously.

Because Bertrand price competition → Profits = 0 under agglomeration.

Firms anticipate this in equilibrium and differentiate spatially.

Hence, each location is served by one firm.

Empirics inform theory:

- Many observations of **agglomeration** at the industry level (Detroit, Silicon Valley, Toulouse Aerospace)

- We often see several firms serving a single location (**market overlapping**)

- Changes in capacity and allocation of output across locations are, for a significant proportion of industries, less flexible than price changes

- This suggests **Cournot competition**. [Kreps and Scheinkman (1983, BJE) and Anderson and Neven (1991, IER)]

- **Production costs variations** across locations (labour costs, capital endowments, natural resources)

Modelling implications: Assumptions

- Two-stage Cournot competition game:
  - Simultaneous location choice
  - Simultaneous quantity setting

- Production costs vary across locations

- Location decisions of firms do not influence the cost-structure.

- Segmented markets with discriminatory pricing strategies

- Linear market over segment [0,l]

- Linear demand (A1)

- Consider only locations that can be chosen in equilibrium (sufficiently low transport costs (A2), and flat production costs (A3))

- For simplicity assume $z_1=z_2$

The Model (I):

Stage 2:

- Profit for firm 1 is (1)

- Take first derivative w.r.t. q_1 and w.r.t. q_2 and set to zero, which yields:

$$q_1 = \frac{1 - q_2 - t_1 - c_1}{2}$$

$$q_2 = \frac{1 - q_1 - t_2 - c_2}{2}$$

- Substitute the latter in the former to obtain the equilibrium quantity q_1 (2a) and

- Equilibrium price (2b) by substituting q_1 and q_2 into the demand function (A1).
    - Note that arbitrage between locations is impossible

- Obtain a simplified profit function in terms of exogenous variables (3)

The Model (II):

Stage 1:

- The overall profit of the firm is the sum of its profits at each location (4).

- Sub game Perfect Equilibrium (given the structure of Stage 2):
  - for firm 1 maximise (4) w.r.t. z_1 to yield (5)
  - integrate and manipulate to yield (6)

- We check concavity through the second order condition (7):
  - Using the F.O.C the first term is negative
  - By $z_1=z_2$ and convexity of the cost function, the second term is also negative
  - By (A1) and (A2) the third term is also negative

  Hence, the F.O.C gives a maximum

Implications of the Model (I):

Agglomeration:
Interpreting the first order condition (6):

- We see that the transport cost effect (second term) provides an incentive to agglomerate.

- Intuition: Contrary to Bertrand competition, under Cournot competition spatial differentiation does not yield local monopoly power → transport cost minimisation generates agglomeration

- Transport cost effect pushes toward *central* agglomeration

- Unless the global minimum of production cost distribution is at l/2 agglomeration will not occur at the centre because the production cost term is non-zero at l/2.

Implications of the Model (II):

Location:

- Firms will locate closer to the production cost minimising point than to the transport cost minimising point.
    - Oligopolists locate at the same place as a discriminating monopoly under a globally convex cost distribution: not at the median of the quantities (see (10) and (11))
    - Intuition: When in between those points, a move towards the production minimising point lowers production costs on all locations, whereas it must decrease transportation costs for some locations
- Firms locate closer to the production cost minimising location than necessary to minimise unit costs
    - Hence production costs are more important than transportation costs in the location decision
    - Why? Lower production costs allow more aggressive quantity setting and thus higher profits.

Application (I):

Different cost distributions:

- *Globally convex:*
  - One agglomerated equilibrium (see (8) and (9))
  - Not necessarily unique

- *Linear and convex:*
  - One unique agglomerated equilibrium

- *Concave symmetric around l/2:*
  - If $c'(0) > t$: firms locate symmetrically around the end-points of the segment
  - If $t^* > t > c'(0)$: firms locate symmetrically
  - If $t > t^* > c'(0)$: 1 unstable agglomerated equilibrium coexists with a stable symmetric one

Application (II):

Conclusion: location patterns differ according to production cost distributions

What sort of Geography might yield these distributions?

Linear:

A country with a single port of entry (e.g. a river perpendicular to the coast), where inputs are transported via the river.

This would yield agglomeration between the port of entry and the median of the final market.

Inverted U shape:

Agglomeration economies yielding declining land rents or real wages w.r.t. distance to a central place

This type geography would tend to yield dispersion

Extensions and Critique:

Distribution of consumers:
Gupta, Pal, Sarkar (1997, RS&UE):

Find that agglomeration obtains for a wide range of consumer distributions. *Centrality* obtains only for specific distributions.

Market structure:
Pal (1998, EL):

Finds that for Salop's circular city model firms locate equidistant both in Bertrand and Cournot competition.
Transport costs are minimised

Externalities:

Agglomeration economies may yield agglomeration in the concave cost distribution case

Discrete or discontinuous functions:

May allow for differentiation or agglomeration depending.

Can account for sudden ('threshold') change.

Can cause counter-intuitive effects of changes in transport costs (see Krugman: 'Geography and Trade')

Summary:

- The type of competition in a market may have profound effects on the location decisions of firms

- Depending on the geography firms may agglomerate or differentiate spatially.

- *Central* agglomeration is a special case

- Production costs will tend to figure more importantly in the location decision than transportation costs (i.e. 'being near to the market')