

# **Competition and Location:**

Article:

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Toulouse-I, Université des Sciences Sociales

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Jorim Schraven

## 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  $\rightarrow$  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')