EE366/EE382 Economics of Services Sector

CHAPTER 6

Supply, Demand and Market Equilibrium in service

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Supply, demand and market equilibrium in service

1. Service costs

1.1 Production costs of non-storable goods

1.2 Distribution costs of non-transportable goods

1.3 The basic trade-off and the resulting market areas

Reading: Jansson (2013) Chapter 3, 4, 5

2. Supply and demand at system level and market equilibrium

3.1 The system cost function

3.2 The system demand function

3.3 Market equilibrium

Reading: Jansson (2013) Chapter 7

3. Demand for service (macro perspective)

2.1 Demand for service consumption and its income elasticity

2.2 Intermediate demand for service

Reading: Zhou (2016) chapter 4

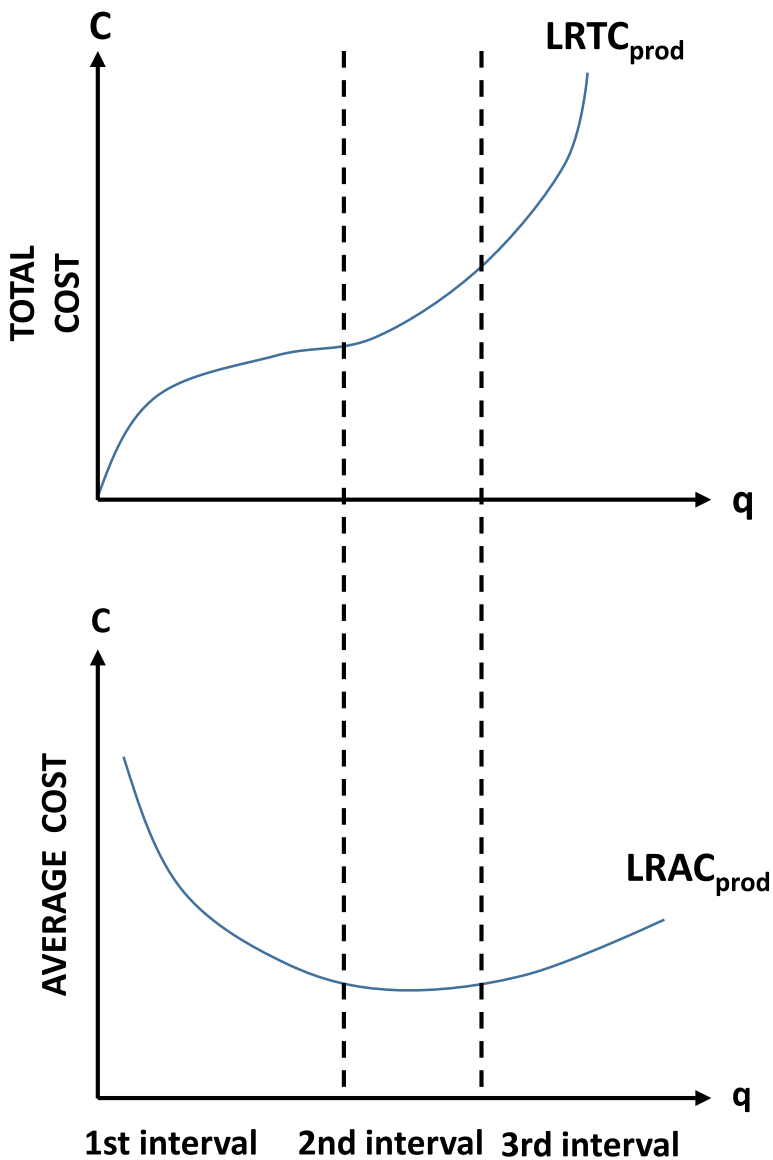
1. Service costs

- Conventional microeconomic cost theory treats **production costs** and **distribution costs** as one, in analysis of service sector look at both costs separately and together.

- **Non-storability of immaterial goods**
  - ✓ Concern about production costs of non-storable goods
  - ✓ Variability of demand cannot be met by the buffer stock → concern about peak-load pricing
  - ✓ Random fluctuations of demand → the application of queuing theory

- **Non-transportable goods**
  - ✓ Concern about distribution costs of non-transportable goods

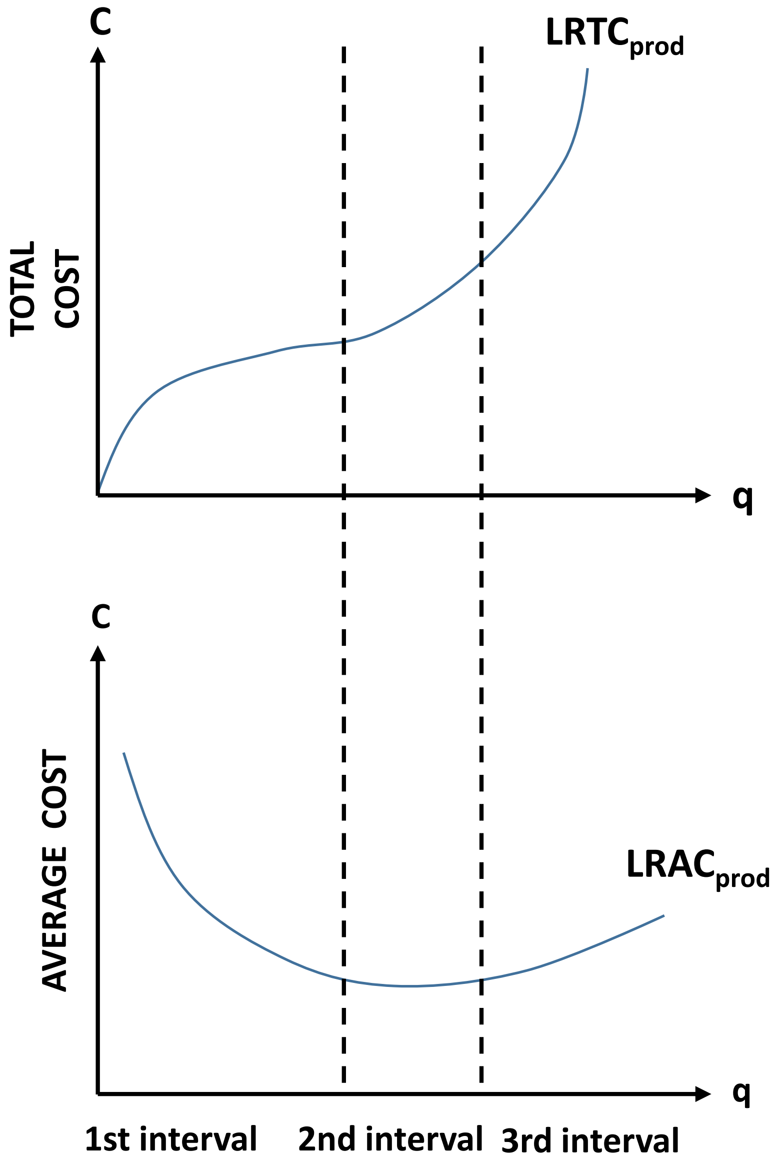
The General Shape of long-run total production cost ($LRTC_{prod}$) and long-run average production costs ($LRAC_{prod}$)



Source: Jansson (2013), Figure 3.1, P.32

- Initially, with increasing return to scale (IRS) production, $LRTC_{prod}$ increase digressively with respect to q
- Then, with constant return to scale (CRS), $LRTC_{prod}$ increase proportionately with respect to q
- After that, with decreasing return to scale (DRS) production, $LRTC_{prod}$ increase progressively with respect to q
- $LRAC_{prod}$ is in U-shaped form, relative flat part of $LRAC_{prod}$ corresponds to the part where $LRTC_{prod}$ increases nearly proportion to q
- There could be case that $LRAC_{prod}$ is closed to L-shape form

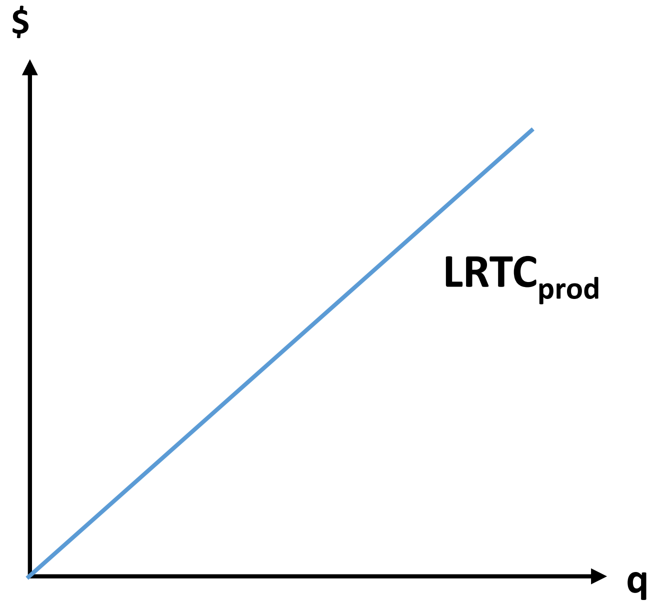
The General Shape of long-run total production cost ($LRTC_{prod}$) and long-run average production costs ($LRAC_{prod}$)



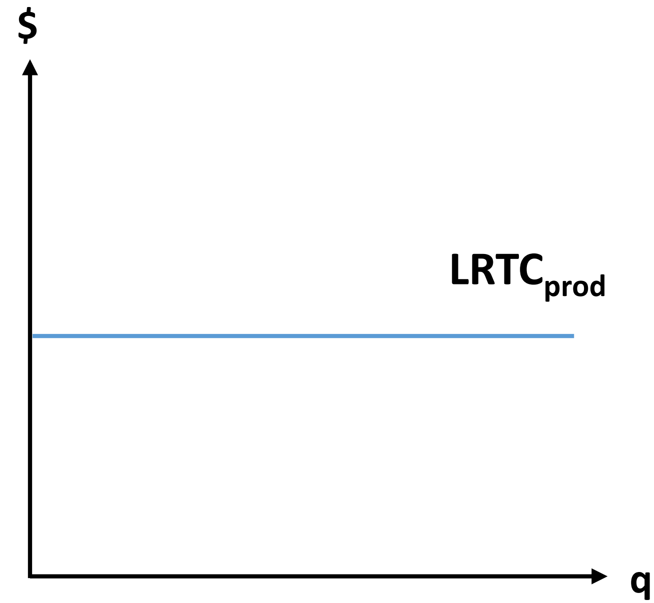
Source: Jansson (2013), Figure 3.1, P.32

- ❖ **Observations in the 3rd output interval is less likely to occur in reality**. A production plant with such a large capacity would not be realistic since the same output could be produced at lower cost per unit of output by two plants
- ❖ **Observations in the 1st output interval is less likely to occur in reality**. Low capacity plants (of storable and transportable goods) could not exist if it is possible to produce such goods for substantially lower average cost at plants with higher capacity
- ❖ **However, low capacity, relatively high cost plants are kept in operation as long as the price (or marginal revenue) > current cost**
- ❖ **Mainstream price theory focuses on the second output interval**.

Two extreme cases of the shape of $LRTC_{prod}$ and output relationship



$LRTC_{prod} = aq$



$LRTC_{prod} = F$

- ✓ Small-scale operations are natural
- ✓ Represented by simple service such as manual car wash, shoeshine service in the street
- ✓ Could Still incur small-scale-disadvantages (like higher queuing costs)

- ✓ Public good characteristics –>

  ……………………………………………………………

- ✓ Examples: ………………………………………………

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Source: Jansson (2013), Figure 3.2, P.34

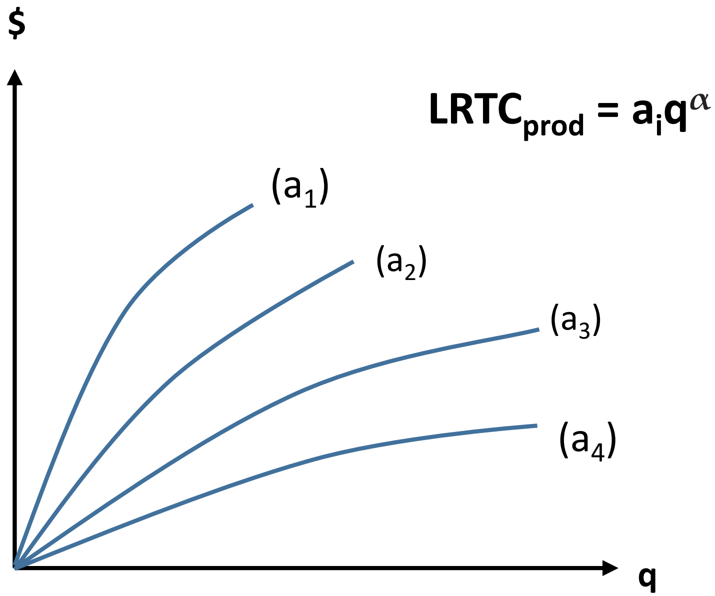
Combination cases

$LRTC_{prod} = F + aq$

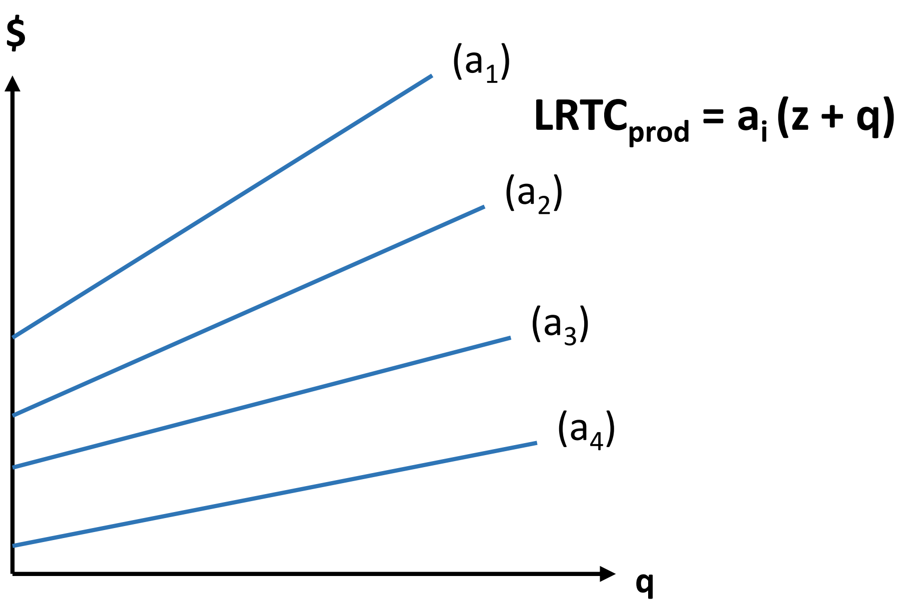
$LRTC_{prod} = F + aq^{\alpha} + kq$ whereas $0<\alpha<1$

$LRTC_{prod} = az + aq = a\,(z + q)$

- **F or az represents "public" factor of production or fixed cost such as costs of R&D, costs of preparing final manuscript for publishing a book**
- **aq represents costs that are strictly proportional to output**
- **aq^{α} represent costs that increase digressively with output**



Total production costs,
given the elasticity α, α < 1



Total production costs,
given the scale-elasticity indicator *z*

- "**az**" represent **fixed cost**
- "***a***" represent **slope of $LRTC_{prod}$**
- "***z*** and ***q***" indicates plant size economies
- **total cost elasticity** = e+1

$$e = \frac{\partial LRAC_{prod}}{\partial q} * \frac{q}{AC_{prod}} = \frac{-z}{z+q}$$

- **Total production cost elasticity with respect to q is continuously increase from low positive values towards unity in the limit**

Source: Jansson (2013), Figure 3.5a and Figure 3.6b, P. 45

Small-scale diseconomies

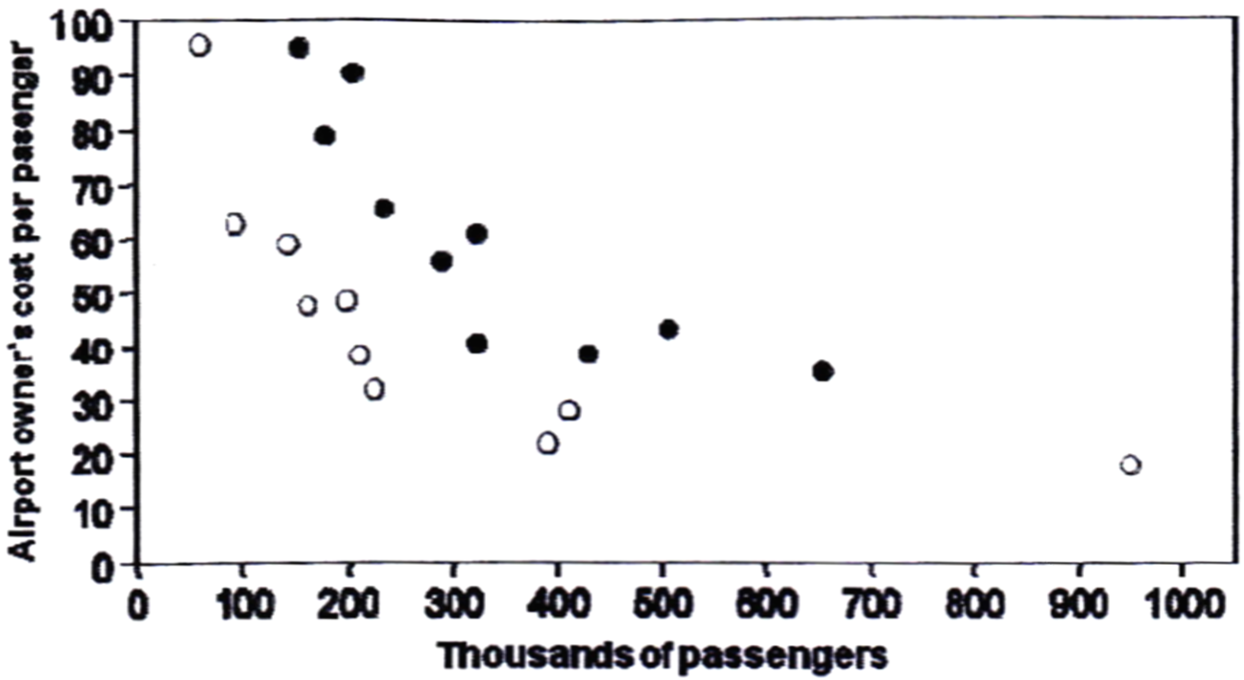
Two main causes of small-scale disadvantages

- **A relatively high F-value**
  - ✓ Normally services produced by technical sophisticated, industrial methods such as airport service, high speed train, etc.
- **Services of a relatively low unit cost (low-value service)**
  - ✓ not require sophisticated production apparatus
  - ✓ pre-booking system would be too cumbersome
  - ✓ the main cause of small-scale disadvantages is non-storability
  - ✓ So, random arrival of customers gives rise to high queuing costs unless the rate of capacity utilization is initially kept low.

Empirical evidence of small-scale diseconomies

Airport service

Regional airport cost per passenger versus passenger volume



Source: Jansson (2013), Figure 3.3, P. 40

Data sample:
- ✓ 20 regional airports in Sweden
- ✓ 2 categories
  - ▪ State-owned civilian airports
  - ▪ Military and/or municipal-owned airports

Results
- ✓ From graph: **airports in the range of 100,000 to 200,000 passengers per year are five times more costly per passenger than airports serving one million passengers**
- ✓ Corresponds to regression results: **an elasticity of the average airport cost with respect of output = -0.67**

Empirical evidence of small-scale diseconomies

Airport service

Results of logarithm regression of average airport cost on passenger volume

Explanatory variables	Coefficients	t-values
Constant	12.02	20.57
Passenger volume	**-0.67**	-14.22
Dummy for airport category	0.53	9.25

Source: Jansson (2013), Table 3.2, P. 41

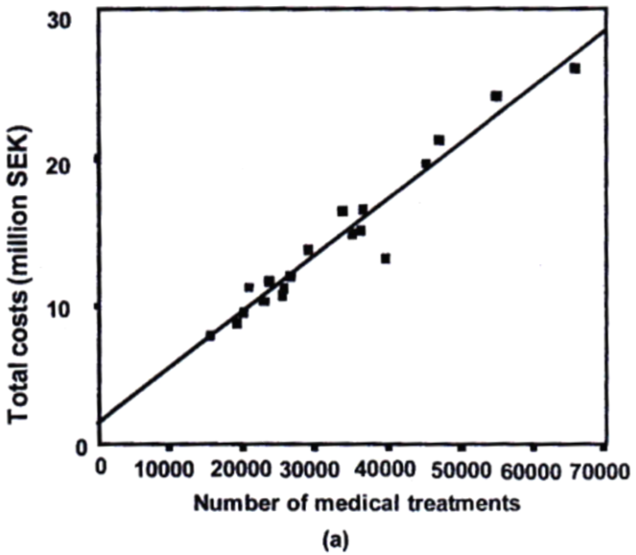
Data sample:

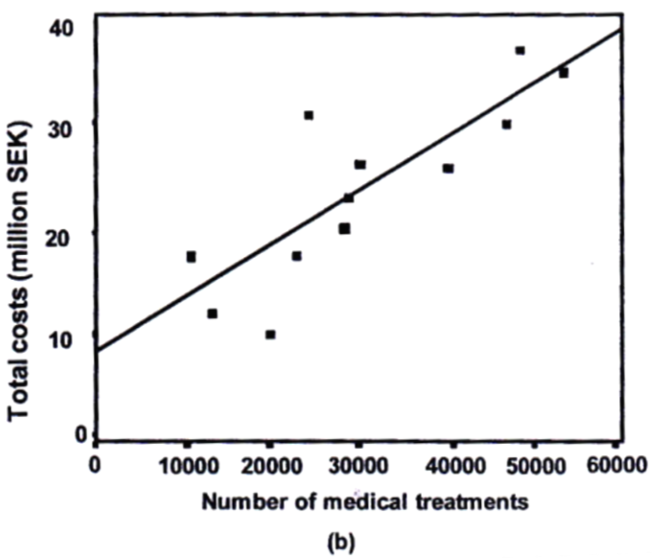
- ✓ 20 regional airports in Sweden
- ✓ 2 categories
  - State-owned civilian airports
  - Military and/or municipal-owned airports

Results: An elasticity of the average airport cost with respect of output = -0.67

Empirical evidence of small-scale diseconomies

Variable Elasticity Cases (LRTC elasticity with respected to q)





Source: Jansson (2013), Figure 3.6, P. 47

Long-run total production cost and output functions for public health centres in

(a) Östergötland, a south eastern county (top chart)
(b) The northernmost part of Sweden (bottom chart)

Huge difference in density of demand in the two areas

(a) The annual number of treatments per km^2 is 70
(b) The annual number of treatments per km^2 is 4

Regression results

(a) $TC_{prod} = 188{,}511 + 42\,q$ $\quad \bar{R}^2 = 0.84$
$\quad\quad (2.34) \quad\quad (18.20)$

(b) $TC_{prod} = 898{,}403 + 55\,q$ $\quad \bar{R}^2 = 0.67$
$\quad\quad (2.38) \quad\quad (4.84)$

Assuming **a linear long-run total cost function**, the **total cost elasticity (e+1) with respect to output** is **non-constant, and goes up with increases in output volume** with two following range

(a) 0.78 < e+1 < 0.94
(b) 0.38 < e+1 < 0.75

Empirical evidence of small-scale diseconomies

A word of caution

- **In reality we seldom see the small scale disadvantages fully reflected in the service producer's production function costs alone**.

  They are to some extent passed on to the users, either in the form of a low quality of service (e.g. longer expected queuing time, higher travel costs for the users or both)

- **In modeling work based on empirical cross-section study**
  - ✓ it is essential to take a wide view, and include both the producer and user costs in the analysis
  - ✓ At least make sure that the quality of service is kept constant when examining the economies of scale and similar production and distribution system concerned

Discussion

1. Do you think there exist the situation of small-scale diseconomies in your group service industry? Explain.

2. Do you think how do the shape of your group service industry **$LRTC_{prod}$** and **$LRAC_{prod}$** look like? And explain why do you think they look like that.

Distribution costs of non-transportable goods

- Distribution costs in this part focuses on "**transport cost**" of "**non-transportable services**" (although indeed distribution costs is much wider concept than transportable cost)

- What distinguishes "**services**" from "**material goods**" is the relative importance of the "**cost of personal transport in order for producer and consumer to meet and carry out the simultaneous production and consumption**".

Source: Jansson (2013), Chapter 4

Distribution costs of non-transportable goods

Bridging the special separation of service producers and consumers (4 categories)

1. Consumer goes to service production plants
   - Example: ____
   - Normally, consumers bear all the transport costs
   - Two-stage travel:
     such as ____

2. Concerning producer services
   - Producers goes (drives) to the consumer's place (may bring necessary tools with them and go to consumers.
   - Example ____
     ____

Source: Jansson (2013), Chapter 4

Distribution costs of non-transportable goods

Bridging the special separation of service producers and consumers (4 categories), cont.

3. Producers and consumers meet half way
   - Example: ____

4. Transport
   - Transport itself is a service that is both **non-storable** and **non-transportable**. So bears with it **relatively high distribution costs**
   - **Transport infrastructure service** (such as, airport, train station, motorway etc.) ____
   - **Public transport** (such as, bus ,train) ___________________________
   - **Transport for hire** (such as called taxi) ________________________

Source: Jansson (2013), Chapter 4

Distribution costs of non-transportable goods

Bridging the special separation of service producers and consumers (4 categories), cont.

Two borderline cases (not include in distribution models that follow)

- **Public utilities** (such as electricity, water supply, etc.)
  - ✓ **Water** is **material** enough to be **storable** and **transportable** (via water pipeline) and could be viewed as good
  - ✓ **Electricity** is arguably **immaterial** and **non-storable**, but could be **transportable** via electricity cable
  - ✓ In general **transportable costs are high** in relation to production costs (normally distribution systems are tailor-made in each case)
- **Information and communication**
  - ✓ In case where **information** can be stored on tape or disc, printed on paper or written in a letter, it becomes **transportable good**. Such goods can give rise to service, e.g. when a reel of film is enjoyed as a movie in a cinema)
  - ✓ **Communication** means the **transportation of information** (e.g. by telephone wire or by wireless distribution). A telephone conversation does not require a meeting, but simultaneity in time is necessary for the production and consumption of information (distinct from email)

Source: Jansson (2013), Chapter 4

Generalized Travel Cost with Respect to Distance

- When it comes to **personal transport to obtain service**, or **service producer to go to the consumer's place and provide service**, the **resistance of distance** is more pronounced than for trade of goods

  (one main reason for this is that non-motorized modes of transport, which nearly extinguished for goods transport still play an important role in the case of consumer services)

- Here explains "**Individual modes of travel** and **Public transport generalized cost**"

Source: Jansson (2013), Chapter 4

Individual modes of travel

The generalized cost structure for different modes of downtown travel under uncongested conditions

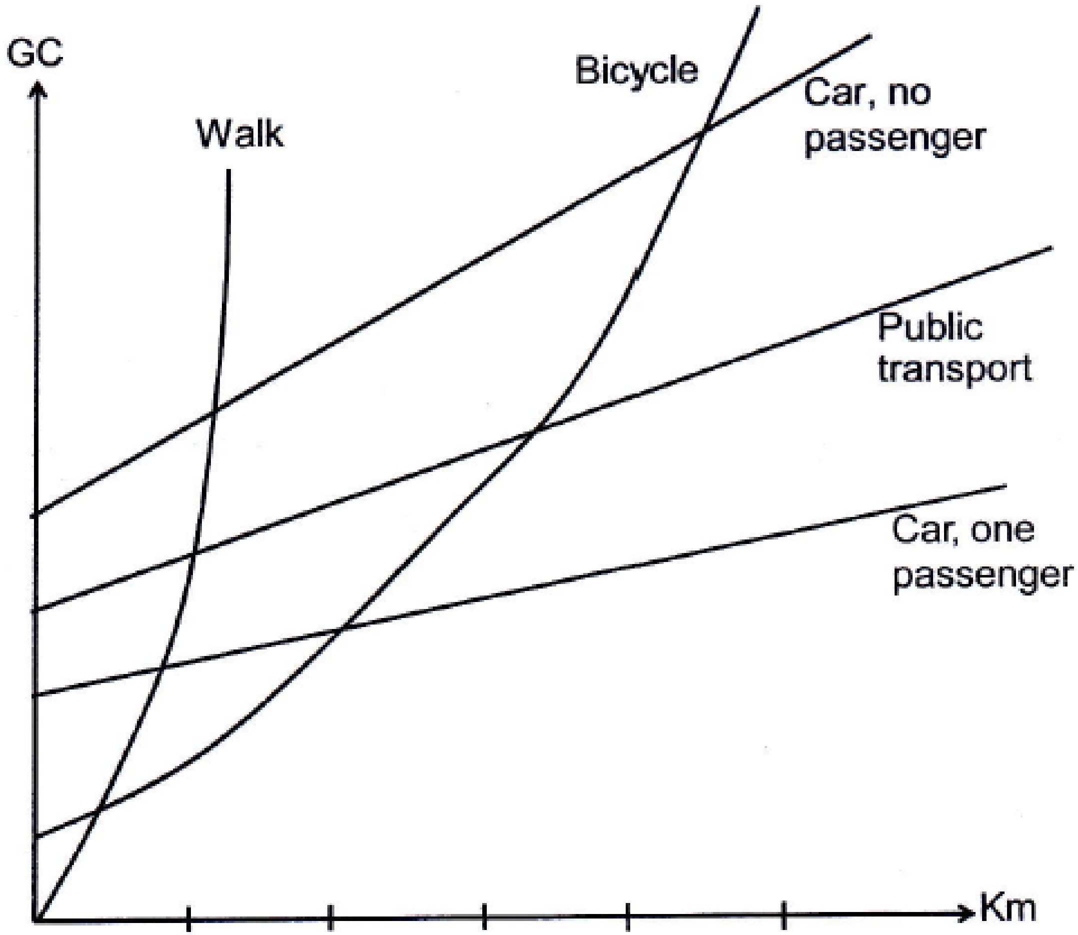


Figure 4.3 The generalised cost structure for different modes of downtown travel under uncongested conditions.

Source: Figure 4.3 in Jansson (2013), P.59

Individual modes of travel

- There are limits for **walking** and **cycling**, the limits varies widely between individuals
- The reasonable **cycling distance** is longer than **walking distance**
- When heavy or bulky goods are to be carried the car is indispensable
- The **generalized cost (GC)** of **travel on foot increases progressively with distance** (sometimes use a quadratic functional form)
- Local transport modal choice studies indicate that **walking time on the margin** is valued (that is **costs**) **between 1.5 to twice as much as car driving or bus riding time cost**.
- Unfortunately, there is no firm empirical evidence of the exact rate of increase with distance, either of **walking time cost** or of the **cycling time cost**

Note: Time cost of each travel mode is travelers' willingness to pay for saving time under a particular circumstance for that mode of travel.

Source: Jansson (2013), Chapter 4

Individual modes of travel

- **After the initial stage where the cost of walking is increasing progressively with distance, the all mode GC is more or less proportional to distance** when the different modes are represented only in their respective niche range

- **A linear approximation of all the GC-curve seems reasonable with one exception**: the effort of a walk with a burden is increasing progressively with distance. In that case a quadratic functional form is more adequate

- In the case of **long-distance travel**, further consideration may include **value of time differs between different modes of travel due to comfort differences**. **Time cost per hour tends to increase with total travel time**

Source: Jansson (2013), Chapter 4

Individual modes of travel

The research based on the Norwegian national travel survey RVU2001 (Samferdsel nr3, 2003) shows that

- For travel to/from work **walking** is the main mode of transport up to a **distance of 1 km**, where walking and car travel are equally frequent
- For a **distance 3 km** **walking is almost down to zero**
- The **parking price and availability** at the place of work is quite important for the modal split.
  - ✓ For work trips **up to 3 km**, the share of **walking** and **cycling** rises from 36% to 80% when the parking goes from "**free, always available**" to "**no parking**"
- Cycling is not as common in hilly Norway as in Denmark, Holland and northern Germany, as well as generally in Sweden.
- In small and medium-sized towns where travel distances are relatively short, cycling is more important than public transport in Sweden, from south to north

Source: Jansson (2013), Chapter 4

Individual modes of travel

- When it comes to **motorized mode of transport**, it is well known from **travel demand**, and **value of time research** (for example in SIKA, 2008), that the **time cost is about twice as high for long-distance travel compared to short-distance travel**. This reflects a gradually rising cost of travel time, when the journey takes more than 1 or 2 hours.

- **A linear approximation of travel time cost function up to a journey time of about one hour seems justified in the case of car travel** (more in literature regarding travel demand and time cost)

Source: Jansson (2013), Chapter 4

Individual modes of travel

- The **distance independent part of the generalized cost of a car trip** include
  - ✓ ____
    ____
    ____
    ____
    ____
  - ✓ ____
    ____
  - ✓ ____

Source: Jansson (2013), Chapter 4

Individual modes of travel

- The **main disadvantages of car travel compared to walking or biking** is

  ____

- **In the areas where parking fees are substantial**, the ordinate of the starting-point of the GC_{car} in figure 4.3 would be relatively high, which could considerably extend the distance range within which walking and/or cycling have lower generalized costs than travel by car

- **Whereas walking and cycling can be assumed free of monetary costs, car use causes substantial monetary costs that can be influenced by petrol taxes and road pricing**. That means the slope of the GC_{car} could be steeper. This will boost the non-motorized modes and the public transport alternatives if there is one.

Source: Jansson (2013), Chapter 4

Public transport generalized cost

- The cost structure of public transport is more complex than modes of individual transport
- **Public transport is an important service itself**
- The necessary access and regress trips at either end constitute the distribution costs of public transport services
- The **strong dependence of the public transport generalized costs on trip volume along a particular route** is a distinguishing characteristics
- Given the transport infrastructure, **the individuals modes of transport** (walk, bicycle, and private car) are **constant cost activities for low to medium rates of the infrastructure capacity utilization**. As the capacity limit is approached, car transport (in particular) shows accelerating increasing costs.
- The **public transport infrastructure** also has capacity limit, but before this limit is approached, the **generalized cost per trip is steadily falling** in the whole preceding range of infrastructure of capacity utilization due to the "**Mohring effect**" and **marked economies of vehicle size** (see for example Nash and Matthews, 2005 and Jansson et al. 2013)

Source: Jansson (2013), Chapter 4

Public transport generalized cost

"Mohring Effect"

- Mohring (1972) argues that urban public transport exhibits considerable **economies of scale** if **users' waiting time** is included in the cost function.

- The "**Mohring effect"** is the observation that**, if the frequency of a transit service** (e.g., buses per hour) **increases with demand, then a rise in demand shortens the waiting times of passengers at stops and stations**.

- Because waiting time forms part of the costs of transportation, the Mohring effect implies **increasing returns to scale** for scheduled urban transport services.

- The implication is that without subsidisation, frequencies will be lower than socially optimal.

Source: Jansson (2013), Chapter 4

Distribution cost per unit of service

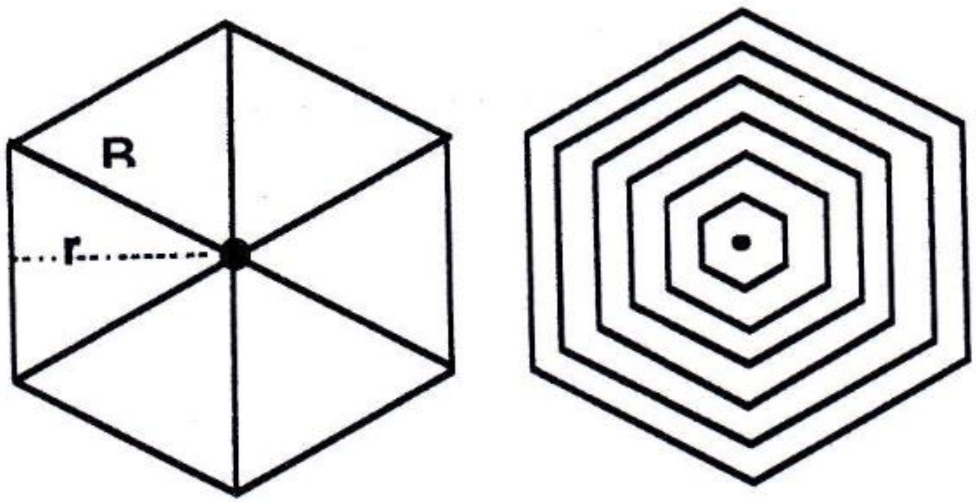
- **Important factors in Distribution cost of non-transportable goods**
  - ✓ ____
  - ✓ ____
  - ✓ ____
- **Distinction between producer and consumer services matter**
  - ✓ **Consumer service**: Households are customers. It is more reasonable to assume that the **customer are evenly spread**, so that the total number of potential customers will increase approximately in proportion to the size of the market area
  - ✓ **Producer service**: Their customers are other **firms and/or public authorities that are located in the central cities** to a large extent. So, producer service firms typically form clusters in the central city or in science parks because they want to be close to each other
- Here, producer services are left out of consideration for a moment

Source: Jansson (2013), Chapter 4

Distribution cost per unit of service

Shape of market area: it is of very little consequence for the present analysis whether circular, square or hexagonal market areas are assumed as long as the density of demand is constant over space

Hexagonal market area



$$Radius = r = \frac{\sqrt{3}\,B}{2}$$

$$Perimeter = 6\,B = \frac{12r}{\sqrt{3}}$$

$$Area = 2\sqrt{3}\,r^2 = 1.5\sqrt{3}\,B^2$$

Source: Figure 4.4 in Jansson (2013), P.62

B is base of each triangle

Distribution cost: Hexagonal market area

- Observing that travel for service requires a return trip, so the **average service distribution cost** can be written as (except for the case of walking with a burden)

$$AC_{distr} = 2\left[C_j + \frac{T_j}{S_j}\right]k_j r \qquad , 0.67 \leq k_j < 0.77$$

j = different modes of transport
C_j = vehicle cost per km
T_j = Time cost
S_j = speed

- The **distribution cost as a function of market area** (m)

$$AC_{distr} = b_j\sqrt{m}$$

, b_j is closed to generalized travel cost per kilometer

- Everyday commodity shopping trips by foot do not fit into the simple formula above. One way the shopper walks without a burden, while the return trip can be quite strenuous depending on the amount of groceries bought and whether or not some kind of handcart is used.

Source: Jansson (2013), Chapter 4

Distribution cost: Hexagonal market area

❖ The **distribution cost as a function of market area (*m*)**

$AC_{distr} = b_j\sqrt{m}$, b_j is closed to generalized travel cost per kilometer

❖ Write **distribution cost as a function of total output (q_i)**

$AC_{distr} = b_j\left[\frac{q}{X}\right]^{\beta}$, from $q = Xm$ So $m = q/X$

where q = total output, X = density of demand per km^2

❖ **The standard value of β is ½, but higher value are conceivable in certain cases**

❖ **If β is ½** how dose **average distribution cost curve (AC_{distr})** look like when plot with **total output (q)**, given the value of **density of demand (X)**?

Source: Jansson (2013), Chapter 4

Parameter values in the distribution cost function

MODE of travel	Vehicle cost (C), €/km	Value of time (T), €/h	Speed (*S*), km/h	Geometric constant (*k*)	*b*
Walking within walking distance	-	9	5	0.72	1.4
Cycling within cycling distance	-	6	15	0.72	0.3
Car driving for private purpose in urban area	0.3	5	40	0.77	0.4
Car driving on business in urban area	0.3	20	40	0.77	0.7
Long-distance car driving for private purpose	0.2	10	85	0.77	0.3

Source: Table 4.1 in Jansson (2013), P.64, original data from SIKA (2008) and traffic planning rules-of-thumb

Optimal market area

- Earlier we learned about production and cost functions of individual service provider
  - ✓ **production cost function *f(q)***
  - ✓ **distribution cost function *g(m)***
- Now we try to combine these two cost functions and examine the result of **basic trade-off** to determine the **optimal market area** of a particular service producer.
- ***Market area*** is the central concept of spatial economics and typically left out of consideration in mainstream economics, where instead the ***market form*** in the sense of competitive conditions in different industries is fundamental
- In this part, we focus on the concept of **market areas**. It is explained why the sizes of market areas of different service providers are systematically very different.

Source: Jansson (2013), Chapter 4

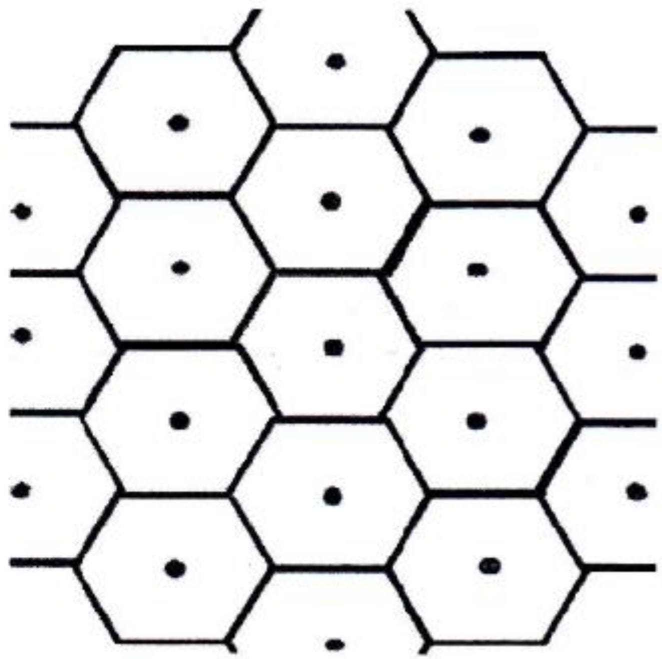
Optimal market area

Assumptions (Fundamental model)

- A particular country is divided into a number of regions, such that each region can be assumed to have a reasonably **uniform population density**
- There are densely populated, mainly **urban areas**, and there are more or less **sparsely populated regions**.
- One region is now considered a **possible market** to be supplied with a particular service.
- Start from a situation in which there is no supply at all of this service in the region concerned, and take the point of view of a producer considering the establishment of a single plant.
- Relevant questions are
  - ✓ **What production capacity should be chosen and**
  - ✓ **How large market area should be covered in the distribution to minimize the sum of the average production and distribution costs**.
- If the whole region is to be supplied with the service concerned similar plants should be established in **the middle of market areas** of the same size until the total area of the region concerned is covered

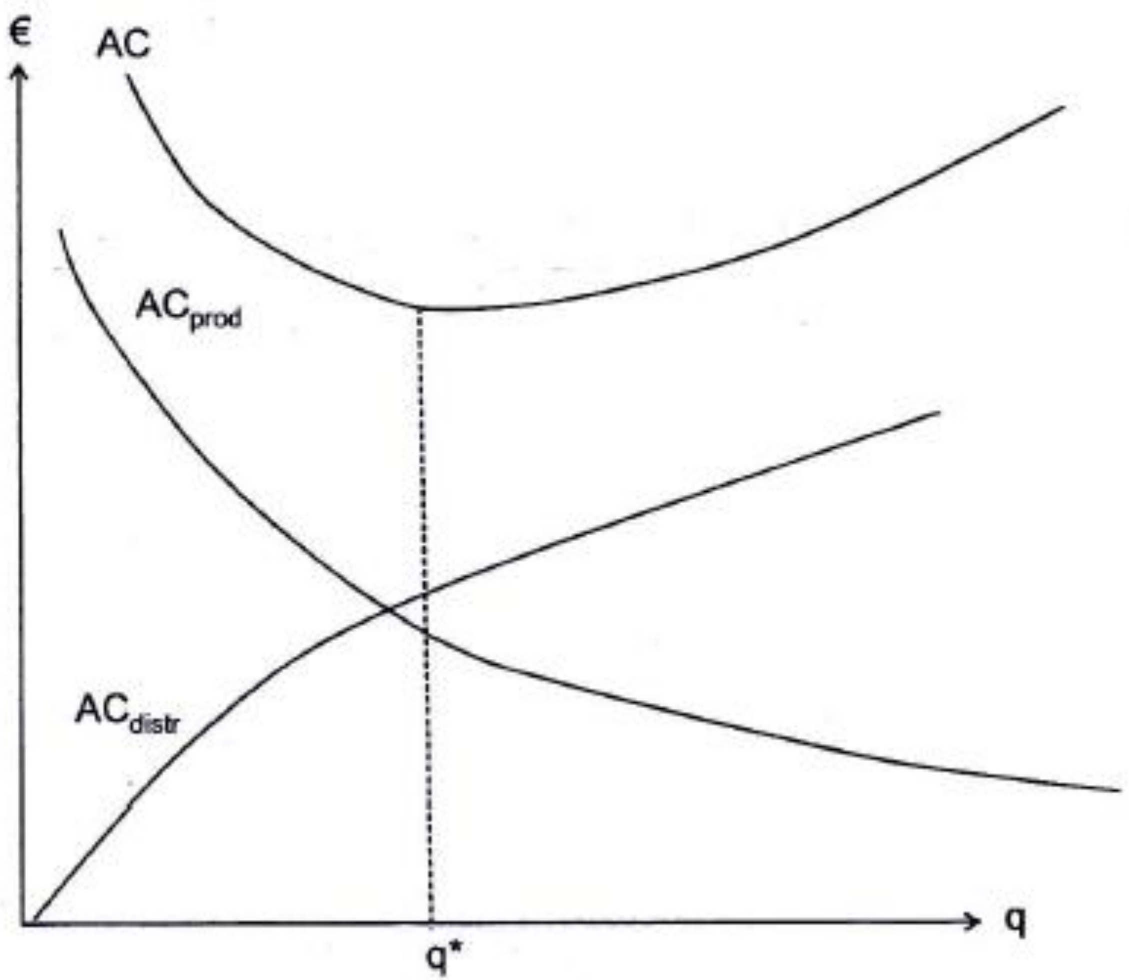
Source: Jansson (2013), Chapter 5

Slice of a service-supply system in a uniformly populated region



Source: Figure 5.1 in Jansson (2013), P.68

The basic trade-off between the production and distribution costs



Source: Figure 5.2 in Jansson (2013), P.69

Optimal market area

In figure 5.2

- The **average production cost** **(AC_{prod})** falls with increases in output (q)
- The **average distribution cost** **(AC_{distr})** increases with the size of the catchment area, that is the **market area size** ***(m)***
- The link of the production cost and distribution cost is that

  q = mX,

  where q = output of individual plant

  m = market area of individual plant

  X = quantity demand per km^2 (density of demand)

- The average total cost is

  $$AC = AC_{prod} + AC_{distr} = f(q) + g(m)$$

- Taking derivative of AC with respect to q (where q = mX) and set it to zero gives the following least cost function

  $$\frac{\partial AC}{\partial q} = \frac{\partial f}{\partial q} + \left[\frac{\partial g}{\partial m} * \frac{1}{X}\right] = 0$$

Optimal market area (catchment areas for public service providers)

- In a **welfare state** (like Sweden)
  - ✓ a majority of the total service consumption is **tax-financed**
  - ✓ These services are provided **free of charge**
  - ✓ Therefore, it is natural to regard **X (density of demand or quantity demand per km^2)** as given, and just consider the number of plants in the service supply-systems that **minimizes the total production and distribution costs of given level of demand**.
- It is quite interesting that the **average market area size is widely different** between service sub-sectors
  - ✓ **Typical neighborhood services**: e. g. nurseries, primary school and public health centers.
  - ✓ **City district level**: e.g. high school, a sports ground and a public swimming pool
  - ✓ **City level**: e.g. municipal library, a theatre and various local authorities rendering different services to the citizens, and some cases a university
  - ✓ **County wide market area**: e.g. big hospitals with a comprehensive range of facilities.
  - ✓ **National level**: e.g. major museums, the opera, the national theatre, the supreme court (typically located in the capital)

Source: Jansson (2013), Chapter 5

Optimal market area (catchment areas for public service providers)

- Why **average market area size is widely different** between service sub-sectors?
  - ✓ **Jurisdiction**: the reception areas of schools, health care centers, and so on should be confined to the administrative areas of the financing body (such as different municipalities, countries, or state)
  - ✓ **Based on model of the production and distribution cost trade-off** (explained in the next slides)

Source: Jansson (2013), Chapter 5

Distribution cost: Hexagonal market area

- Observing that travel for service requires a return trip, so the **average service distribution cost** can be written as (except for the case of walking with a burden)

$$AC_{distr} = 2\left[C_j + \frac{T_j}{S_j}\right]k_j r \qquad , 0.67 \leq k_j < 0.77$$

j = different modes of transport
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T_j = Time cost
S_j = speed

- The **distribution cost as a function of market area** (*m*)

$$AC_{distr} = b_j\sqrt{m}$$

, b_j is closed to generalized travel cost per kilometer

- Everyday commodity shopping trips by foot do not fit into the simple formula above. One way the shopper walks without a burden, while the return trip can be quite strenuous depending on the amount of groceries bought and whether or not some kind of handcart is used.

Source: Jansson (2013), Chapter 4

Optimal market area (catchment areas for public service providers)

- **Optimal market area *(m*)***

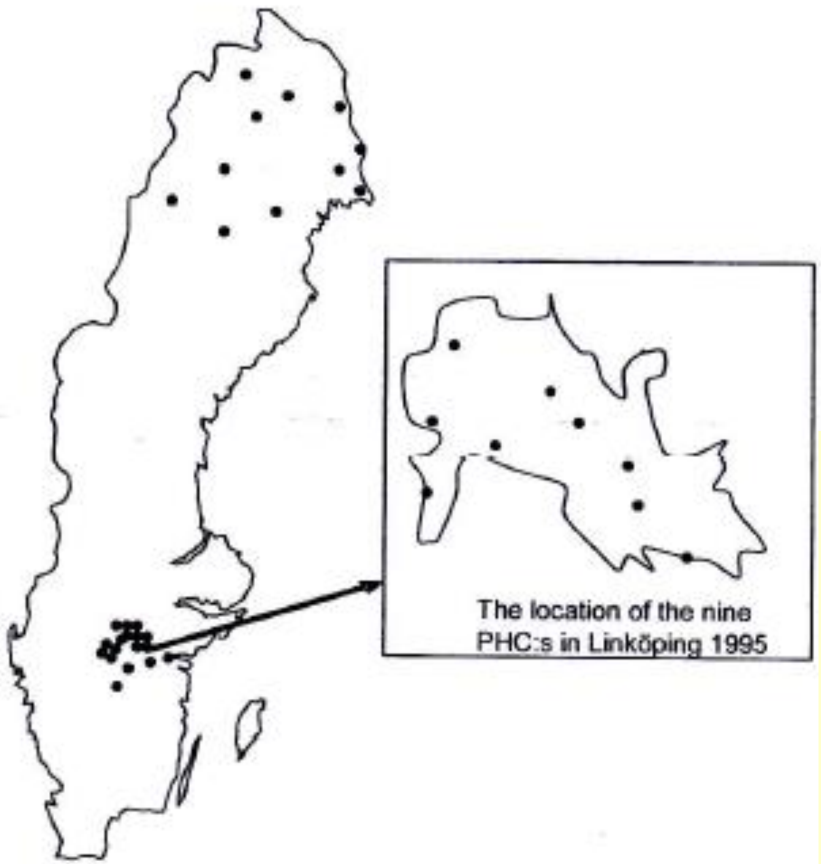
$$m^* = 1.59\left[\frac{az}{bX}\right]^{\frac{2}{3}}$$

a = unit value of service
z = the plant size economies
b = mode-specific travel cost indicator
x = density of demand
m = market area

- Among the determinants of ***m****, the widest variation variables are ***a*** and ***X***
  - ✓ **Variation in value of service *(a)***: High value and low value of service
  - ✓ **Variation in density of demand *(X)***: might be from
    - **Population density** is very different in various parts of the country
    - **The purchase frequency per household** differs greatly among different articles (services as well as goods): there are infrequently bought articles and there are "everyday commodity"
- When walking is the forced mode of transport (implying high value of ***b***), it is rational to provide service such as child care within the "neighborhood services"
- If **density of demand *(X)*** is high, optimal market area could be within neighbor hood (like school that children have to go every week, whereas injury or illness requiring hospital treatment will happen to the average individual only interval of several years so ***m**** might be larger than school)
- High value of ***bX*** causes ***m**** to be small for each plant in the system
- High value of ***az*** causes ***m**** to be large for each plant in the system

Source: Jansson (2013), Chapter 5

The location of public health centres (PHCs) in different parts of Sweden.



Supply system in the case of PHCs in three areas of different parts of Sweden

(1) The sparsely populated, most northerly region of Sweden (county of Norrbotten)
(2) The relatively densely populated county of Östergötland
(3) The built-up area of Linköping, the chief town of Östergötland

- ❖ Compared to Norrbotten,
  - ✓ the density of demand of Östergötland is 17 times higher
  - ✓ the density of demand of Linköping is 747 times higher
- ❖ Compared to Linköping
  - ✓ the average travel distance for PHC patients in Östergötland is 4 times longer
  - ✓ the average travel distance for PHC patients in Norrbotten is 25 times longer

Source: Figure 5.3 in Jansson (2013), P.72

Catchment areas of Public Health Centres.

District	Density of demand: annual number of patients/km^2	Average catchment area, km^2	
		actual	Model estimated
(1) The county of Norrbotten	4	7855	9503
(2) The county of Östergötland	67	485	499
(3) The town of Linköping	2986	13	17

$m^* = 1.59 \left[\frac{az}{bX}\right]^{\frac{2}{3}}$ can be applied in this case

Source: Table 5.1 in Jansson (2013), P.73, original source from Wall (2001)

Market areas of private service provider

Optimal market areas could be found based on three approaches

- Supply system cost-minimization
- Chamberlinian monopolistic competition
- Clustering

Source: Jansson (2013), Chapter 5

Chamberlinian Monopolistic Competition Model

- **Every one of the firms have some monopoly power, but entry drives monopoly profits to zero**.

- The concept gets its name from **Edward Chamberlin**

- Example Chamberlinian monopolistic competition: **Book market**

    - ✓ A publisher has a factual monopoly over certain titles via intellectual property rights.

    - ✓ However, this doesn't lead to high monopoly profits on any particular titles as close substitutes still remain. A best-seller cookbook for Asian cuisine still competes with other cookbooks about Asian cuisine as well as the whole cookbook genre.

Source: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=730523

Chamberlinian model of the spatial industrial organization

- Assuming Hexagonal market areas, each firm has 6 equally close competitors
- Initial situation, given the plant location, all firms have market areas of the same size
- Assume production cost function ***$LRTC_{prod} = a\,(z + q)$***
  - ✓ ***z*** **determines cost elasticity with respect to output**
  - ✓ ***a*** is **long-run marginal cost of production**
- After specifying total output of individual firm (q) and market demand (D) and set equilibrium conditions
  - ✓ Individual firm profit maximization ***MR = MC***
  - ✓ Normal profit in the industry in long run equilibrium ***$P = AC_{prod}$***
- So the **equilibrium output of individual firm** ***(q')*** and **equilibrium market area** ***(m')***

$$q' = 0.87 \left[\frac{az}{b}\right]^{\frac{2}{3}} X^{\frac{1}{3}} \quad , \quad m' = 0.87 \left[\frac{az}{bX}\right]^{\frac{2}{3}}$$

- The **equilibrium market area** ***(m')*** in this case (Chamberlinian model of private sector provider) is similar to **equilibrium market area** ***(m*)*** in public sector case

$m^* = 1.59 \left[\frac{az}{bX}\right]^{\frac{2}{3}}$ the difference is the proportionality constant.

- This shows that the market area per firm in the case of supply-system consisting of independent profit maximizing single-plant firm is only half of the cost minimizing size.
- It implies that overestablishment seems to be the results of free market forces in this model

Source: Jansson (2013), Chapter 5

The costs of clustering

- The concept of "**agglomeration benefits**"
- The observed **concentrations of firms/plants** in some new industries
- **Clusters are normally formed by producer service firms.**
- In the case of consumer services where agglomeration benefits can be assumed to be negligible.
- The basic trade-off model,
  - ✓ the question is "**if the total costs, including all of the user efforts, were substantially higher in a cluster than with an evenly dispersed pattern of plant location, the latter pattern tends to arise**"
  - ✓ A comparison of the **average total cost** of **an even dispersal of plants of an industry** and **a cluster of firms' plant**
- The simple model's assumptions
  - ✓ It is assumed that **customers are evenly spread over space**
  - ✓ The **transportation cost per kilometer is the same everywhere**
  - ✓ We start from the **cost-minimizing pattern of location**, where each firm/plant has a market area of its own. **Then we take 5 plants and put them in the middle of the total area covered by those five**.
- Sensitivity analysis shows that
  - ✓ The **unit value *(a)*** and the **demand density *(X)*** are the most important factors

Source: Jansson (2013), Chapter 5

Relative additional cost (percentage) of a cluster of five compared to a total cost-minimizing dispersal of plants

Unit value proxy, a	Demand density, X				
	1	10	100	1000	10000
1	117	110	98	80	57
10	98	80	57	35	19
100	57	35	19	10	6
1000	19	10	6	2	1
10000	6	2	1	0	0

Source: Table 5.2 in Jansson (2013), P.78

Note:

- The table shows the **relative cost additions** for a wide range of **unit value *(a)*** and the **demand density *(X)***
- The calculation assume general travel by car, and **total cost elasticity with respect to output** or the **plant size economies variable *(z)*** is set as 5, value from previous research

The costs of clustering

From Table 5.2: interesting points are

- It is striking how difference the figures are in the upper left and the lower right parts.
- It does not matter very much if a number of providers of **very high-value service (high value of *a*)** are **located in the same street** in a **densely populated town or city**.
- On the other hand, it is obvious that it would be very cost inefficient to allow a considerable number of **low-value service providers** in a more **sparsely populated area** to **form a cluster**

Source: Jansson (2013), Chapter 5

3. Supply and demand at the system level

- When we learn about **supply of service** we talk about
  - ✓ **Average production cost function *f(q)***, q is quantity of service
  - ✓ **Average distribution costs** of the circle of consumers provided for by a representative service producer ***g(m), m*** is market area of a service provider
  - ✓ The system analysis required for considerable trade-off between production and distribution costs, **optimal market areas** by assuming a **constant density of demand *(X)***

- **In this part we will relax the constant density of demand assumption and look at**
  - ✓ **The system cost function**
  - ✓ **The system demand function**
  - ✓ **Market equilibrium**

The system cost function

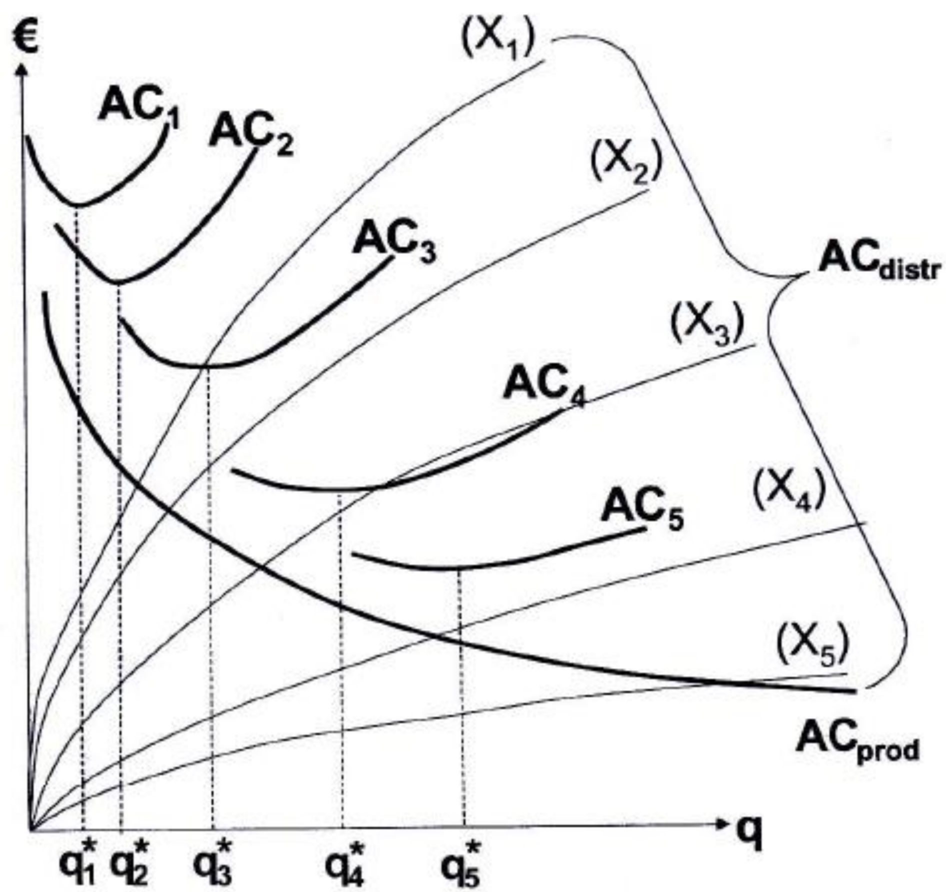
- The purpose of this section is **to derive a long-run** (total adjustment) **system cost function**

- The **production and distribution cost trade-off** is the core of this derivation

- Now, the **density of demand** ***(X)***, which kept constant in the previous discussion, is the central variable and determinant of the system cost

Source: Jansson (2013), Chapter 7

The production and distribution cost trade-off with respect to plant output for achieving the minimum average total cost for different values of the demand density (X_i)



Source: Figure 7.1 in Jansson (2013), P. 91

The system cost function

Based on Figure 7.1 in Jansson (2013),

- The figure shows how to move from the costs of an individual plant to the system cost level
- It is not the regional demand that matters but the **density of demand** ***(X)***
- The figure shows a bundle of AC_{distr} curves, each associated to a particular level of the **density of demand** ***(X)***
- The higher the value of X the lower the distribution cost per unit. So the AC_{distr} successively falling as X increasing (from X_1 to X_2, X_3, X_4, X_5)
- The AC_{distr} have a shape that follows from assuming that the trip cost is proportional to distance
- Where the slope of a particular distribution cost curve is equal to the absolute value of the slope of AC_{prod}, the **cost-minimizing plant output** ***(q*)*** is found for that particular **demand density** ***(X)***

Note: The last point is from when we learned about basic trade-off between average production cost and average distribution cost (explanation of Figure 5.2 and relevant equations in Jansson (2013), chapter 5

Source: Jansson (2013), Chapter 7

The system cost function

Generalised Costs

- In general, system cost is the sum of the **producer costs** and **user costs**
- The users normally have to go to the place of production to get service, so far from what we learned this was called "**distribution**"
- The cost to the user of taking possession of non-transportable goods consequently includes both the **ordinary price charged by the producer at the place of production** and the **distribution cost** borne by the user.
- A corresponding complementary addition must be added to the demand side. This is standard procedure in transport economics, where "**generalized cost**" replaces price as the main argument in the demand function.
- ***Generalised cost function is***

  $$GC = P + AC_{distr} + c$$

- *C* is **other possible user cost item** that should be included in the generalized cost in supply and demand analysis of non-storable and non-transportable goods
  - ✓ For this kind of good, production and consumption must be done not only at the same place but also simultaneously, which means consumer must sacrifice their time in the production → consumer time cost
  - ✓ However, for now we ignore c by assuming that c is a constant which does not affect the basic producer and user cost trade-off

Source: Jansson (2013), Chapter 7

The system demand function

- The **demand function** that matches the system supply function is that the **dependent variable** should be the ***density of demand (X), the quantity of demand per km²***. As long as it can be **assumed that the uniformly populated region in question is large enough to house a fair number of plants/firms**

  P.S. If the region concerned is **a limited urban area**, the appropriate **demand function** can be defined to represent the whole town, and the **dependent variable (Q)** stands for **the demand of all people in the whole town**

- The idea is that the result of the **interplay of supply and demand** in a particular region of uniform population density **results in the same price charged and quantity produced at all plants in the region**, and the focus is on the **demand density**

Source: Jansson (2013), Chapter 7

The system of demand function

A product of two factors

- Now we explicitly specify the market demand function at the system level as a products of two factors

  $X_i = h(GC) * D_i$

  X_i = demand for a particular product per km^2 in region I
  h(GC) = demand of the representative consumer
  D_i = density of population in region i

- **In a national perspective**, the **demand of a representative consumer can be assumed to be the same for each particular product all over the country**, while **the population density obviously displays a very wide variation**

- For the choice of production plant capacity in the case of most transportable goods **these extreme wide variations** are relatively inconsequential because of low transport costs, but certainly **a main concern for providing non-transportable goods**

Source: Jansson (2013), Chapter 7

Market equilibrium

Based on Figure 7.2 in Jansson (2013)

Demand function and demand curve

- From Demand function or density of demand (X) is from multiplying the individual demand by the population density

  $X_i = h(GC) * D_i$

  X_i = demand for a particular product per km^2 in region I
  $h(GC)$ = demand of the representative consumer
  D_i = density of population in region i

  - ✓ This means that the slope of the demand functions becomes successively flatter the higher the population density
    - Non-urban regions represented by the three steep demand functions (X_1, X_2, and X_3)
    - An urban region represented by the flatter demand function (X_n)
  - ✓ It is the individual demand of representative consumer that determines the elasticity of demand function of each particular region

Source: Jansson (2013), Chapter 7

Market equilibrium

Based on Figure 7.2 in Jansson (2013)

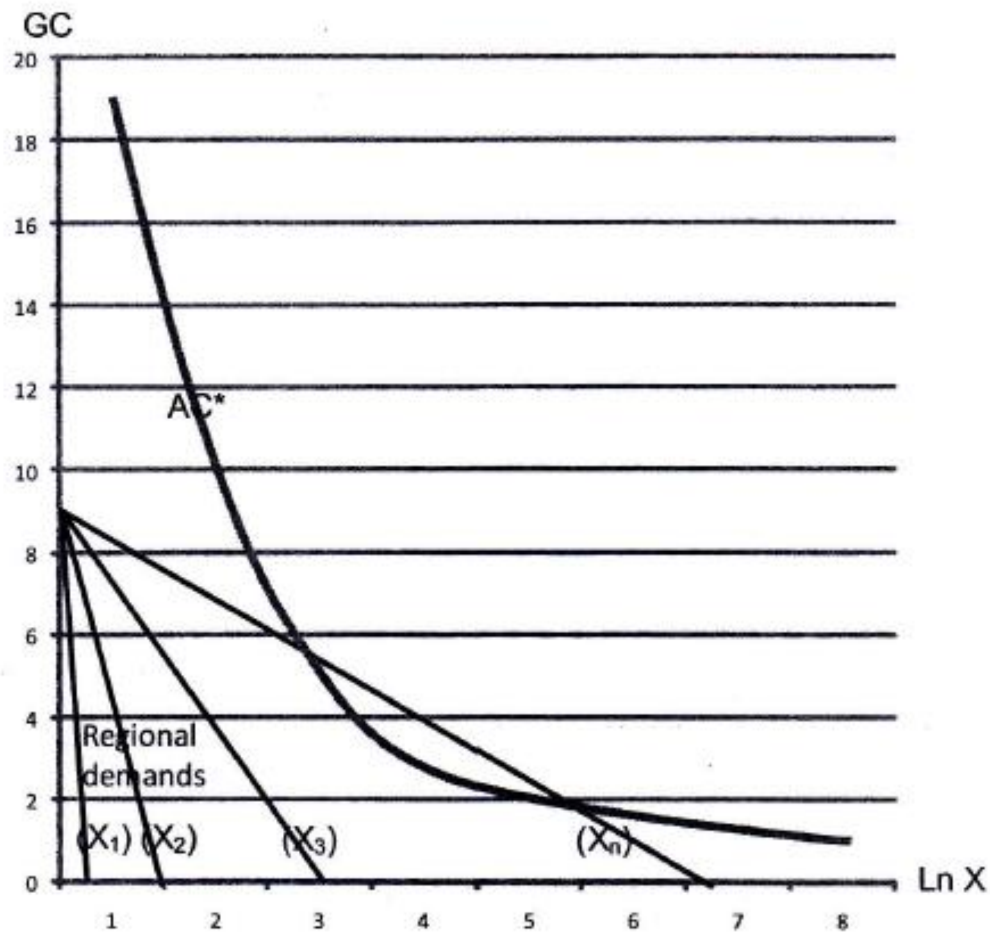
Demand function and demand curve

- It can be assumed that each regional demand has the same starting point at the GC-axis called "**reservation GC**" such as the cost of a taxi trip of the same length if we consider demand and supply of local bus transport

- In an actual case study of a particular region, just one regional demand is applicable. **The regional demand must not be aggregated for matching the supply curve** (for the study of the D&S of bus transport service, it would not make sense because the demand for local bus transport in one part of town cannot be satisfied by local bus transport in another part, let alone in another town)

Source: Jansson (2013), Chapter 7

Typical supply and demand constellation for non-transportable goods in regions of different population density.



Source: Figure 7.2 in Jansson (2013), P. 99

Market equilibrium

Based on Figure 7.2 in Jansson (2013)

The system cost function and the AC-curve

- The **AC-curve is a constant-elastic average system cost function** (representing a local bus transport system estimated in Jansson et al. (2013).
- **The system cost function can be assumed to be applicable everywhere**, but it is just that different sections of the function would be relevant for different regions depending on the actual ***density of demand (X)***

Source: Jansson (2013), Chapter 7

Market equilibrium

Based on Figure 7.2 in Jansson (2013)

Market equilibrium

- **Market equilibrium** could be obtained **where a regional demand curve and the supply curve intersect or at least tangent to each other**
- In Figure 7.2, **it is only one demand curve in the bunch of regional demands that the requirement for equilibrium is met**
- This means to suggest that **many regions in the sparsely populated parts of Sweden lack local bus transport altogether. Only the urban demand curve gives rise to a viable market.**

Source: Jansson (2013), Chapter 7

Market equilibrium

The crucial difference

The difference between graph for non-transportable goods (Figure 7.2) and the structure of supply and demand of easily transportable goods

- **The easily transportable good case,**
  - ✓ The quantity along the horizontal axis does not represent density of demand (X) but the **total demand facing the whole industry concerned** ***(Q)*** which is a function of ***P*** since **the distribution cost**, including the cost of transport to wholesalers and retailers, **is internalized in the producer's total costs**.
  - ✓ **The industry demand is the aggregate of all the regional demand functions**
  - ✓ The long-run **AC curve can be assumed to be horizontal** (constant) because it represents the plane section of a U-shaped curve of one or more producers operating at the minimum cost level
- **The non-transportable case (in Figure 7.2)**
  - ✓ The quantity along the horizonal axis is the **density of demand** ***(X)***
  - ✓ The regional demand is expressed as demand densities which cannot be added. Each local market must be dealt with one by one

Source: Jansson (2013), Chapter 7

2. Demand for services

Motive analysis of demand

- Demand for service consumption and its income elasticity
- Intermediate demand for service

Reading: Zhou (2016) chapter 4

Demand for service consumption and its income elasticity

Factors that might affect demand for service consumption (macro level)

For example

Source: Zhou (2016), Chapter 4

Demand for service consumption and its income elasticity

Income elasticity of demand

- Lower income groups have _________elasticity of demand for basic necessities
- Higher income groups would consider durable consumer goods and services.
- According **Maslow's hierarchy of needs** and **Engel's law**,
  - ✓ When income level is relatively low, most of consumer spending goes to food, clothing, shelter and other basic needs.
  - ✓ As income level rises, people spend more in meeting needs for security, social interaction, earning respect, self-realization, etc. These needs are mostly based on services.
  - ✓ So **it is possible that the proportion of service in consumer spending will increase as income rises**
- Note: **Maslow's hierarchy of needs**:
  - ✓ Maslow categorized people's needs into "**physiological**", "**safety**", "**belongingness and love**", "**esteem**" and "**self-actualization**" ascending like hierarchy, a developmental process from lower to higher levels.
  - ✓ Maslow distinguishes the different **layers of demand**, but not distinguish between **product demand** and **service demand**

Source: Zhou (2016), Chapter 4

Maslow’s hierarchy of needs

[Source: https://www.simplypsychology.org/maslow.html](https://www.simplypsychology.org/maslow.html)

Demand for service consumption and its income elasticity

Income elasticity of demand

- Note: **Engel's law**
  - an observation in economics stating that **as income rises, the proportion of income spent on food falls, even if absolute expenditure on food rises**. In other words, the income elasticity of demand of food is between 0 and 1.
  - The law was named after the statistician **Ernst Engels** (1821–1896).
- Like product, **service consumption of the same kind may have different layers of demand.** Example??

Source: Zhou (2016), Chapter 4

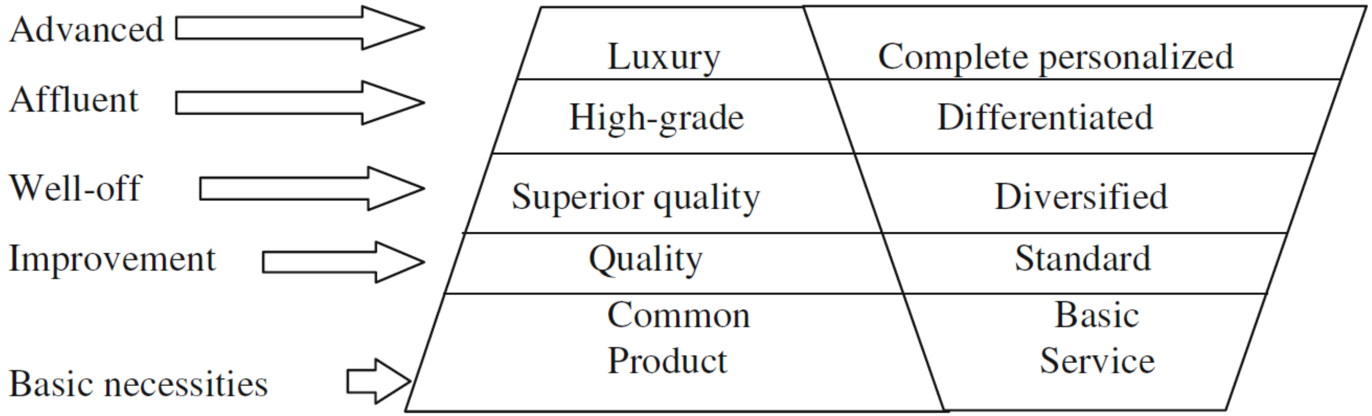
Demand for service consumption and its income elasticity

Income elasticity of demand for service

- To analyze income elasticity of demand for service, **Zhou (2016)** modified the categorization of people's needs to "**basic necessity**", "**improvement**", "**well-off**", "**affluent**" and "**advanced**" from low to high; at the same time, further differentiating product-based material needs and service-based non-material needs.
- Zhou (2016) makes 4 assumptions
  - ✓ **Hypothesis 1**: **When product and service are in parallel levels of needs, their income elasticity will be basically the same; when the two are in different levels of needs, there will be visible differences in their income elasticity**.
  - ✓ **Hypothesis 2**: For both product and service, their primary needs have relatively low income elasticity while their secondary needs have relatively high income elasticity; so **the higher the level of needs is, the higher the income elasticity is**.
  - ✓ **Hypothesis 3**: **On any level of needs, product and service, in terms of types and sizes of demand, each has its own specific composition**; corresponding to different level of needs, product and service, in terms of types and sizes of demand, are different.
  - ✓ **Hypothesis 4**: **In the composition of types and sizes of demand, the ratio of service demand increases geometrically as the level of needs advances**; the ratio of product demand decreases geometrically as the level of needs reduces.

Source: Zhou (2016), Chapter 4

The hierarchy and structure of needs for product and service consumption



Source: Figure 4.1 in Zhou (2016)

According to **Zhou (2016)**,

- As the level of needs advances, types and sizes of **product demand** tend to decrease demonstrating a **pyramidal structure**, while those of **service demand** tend to increase demonstrating an **inverted pyramidal structure**.
- **The higher the level of needs, the higher the income elasticity.**
- **As the level of needs goes up**, **the service demand ratio** on the basis of the gradual increase of income elasticity **will increase geometrically** and **will gradually play a dominant role in consumption demand.**

Conclusion: **As the income level increases and the level of needs goes up, types and sizes of service demand continuously extend and have higher income elasticity, which means that people's consumption demand leans towards service and service with higher income elasticity, causing the proportion of service industry to rise and promoting economic development**.

Intermediate demand for service

- **Final demand for service always plays a dominant role in the aggregate demand for service** and an important role in promoting the development of the service
- **However, the growth of income-based final demand for service, especially consumer demand is comparatively steady**, approximately at a uniform speed, despite some fluctuations when certain spending spree rises.
- In the circumstances of insignificant changes in consumptive demand structure, **the accelerated development of the service industry is mainly promoted by rapid increase of intermediate demand for service**.
- As production systems, production factors and production links change, service activities penetrate into every part of the production links and complement with commodities in the industrial process, which makes **the intermediate demand for service the most dynamic and the fastest-growing demand and renders service output a crucial factor in the economic development and operation** and gives it a gradually prominent status in the service economy.

Source: Zhou (2016), Chapter 4

Intermediate demand for service

Factors that might affect intermediate demand for service (macro level)

- **Specialization of social production and technological advancement: in both manufacturing and service sectors**
  - ✓ In **manufacturing**, due to the development of the complexity and diversity of material production and the specialized division of labor in production, some service functions separate themselves from manufacturing to form independent producer services.
  - ✓ As the sizes of the **service industry** grows, the intermediate demand for service between sectors within the service industry will increase, developing a powerful reproductive capacity in the service economy.

- **Level of economic development (income)?:**
  - ✓ In **the agricultural era**, the specialization of social production was low. When **the industrial era** came, with the development of roundabout production, the specialization of social production gradually enhanced and even suggested an accelerated feature. According to this logic, **the intermediate demand for service derived from the specialization of social production is ultimately determined by the level of economic development (income level)**.
  - ✓ However, **it may not be appropriate to directly use the theory of income elasticity of demand to explain the growth of intermediate demand for service and the development of producer service.**

Source: Zhou (2016), Chapter 4

Discussion

1. Do you think your group service industry is “**consumer service**” or “**producer service**” (In other words, it is related to “**final demand for service”** or “**intermediate demand for service”**)
2. What could be **factors affect demand of your group service industry**
3. How can you apply the concept of **“hierarchy of needs of product and service consumption”** to your group service industry.
4. Do you think your group service industry has **high or low income elasticity of demand.**