Optimum Population Size

Not too big, not too small, but just right

Econ/Demog c175
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Week 2, Lecture A
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Our agenda

- What do we mean by the optimum?
- Two specific examples from Sauvy:
  - economic optimum
  - power optimum
- Also:
  - minimum population
  - maximum population
- Ordering the optima by population size
- Population "evolution"

A happy medium?

"If there is such a thing as over-population and such a thing as under population, it follows that between the two there must be such a thing as just the right population"

-- H.P. Fairchild

What size population is best? A slippery question

- Who is asking it?
  - A peasant, a worker, the average citizen?
  - A king, a capitalist, a "society"?
- What do they want to maximize?
  - average welfare
  - longevity
  - cultural power
  - military power
  - sum of all welfare

Our approach

- Multiple answers → optima (not optimum)
- Our goal: a broadly applicable framework to help us think about optimum population
- We focus on two specific examples

  (1) Economic optimum

  (2) Power optimum
- Introduce concepts (MP, TP, ...) that we'll see again.

Contradictions

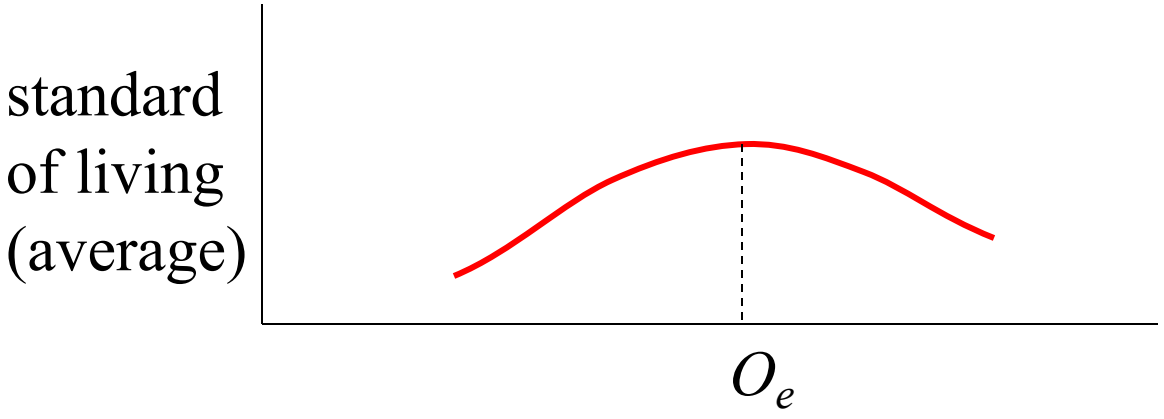
- Sauvy points to failure of understanding of those who define the optimum as when "the population arrived at its greatest strength and comfort"
- Bentham, the utilitarian, phrase: "the greatest amount of good for the greatest number"
- There's usually a trade-off

"Economic" optimum (issues)

- Many possible economic objective functions
- Sauvy's "economic optimum" maximizes average standard of living
- Note:
  - We assume we can define "standard of living"
  - An individual perspective: size benefits not "society" but rather the individual via his or her standard of living
  - Inequality not part of the objective function

Where is economic optimum?

- We assume fixed technology and resources
- Under-population = can't exploit the technology
- Over-population = run into resource constraints
- *Example: what is optimum size for a Freshman English seminar? (a) 1, (b) 2-4, (c) 5-9, (d) 10+*



Another example: family size

- How many people should a "marriage" have in order to maximize welfare of spouses?

Another example: family size

- How many people should a "marriage" have in order to maximize welfare of spouses?

- How many children should parents have (assume, for now, altruism, that they derive utility from their children's wellbeing)

Some reasons for being "too small"

- Can't *specialize* (Smith on pins) (https://www.econlib.org/library/Smith/smWN.html?chapter_num=4#book-reader)
- Can't *complement* (sex, holding a ladder to change a bulb)
- Can't afford *fixed cost investments* (roads, a machine, a teacher, ..)
- What else?

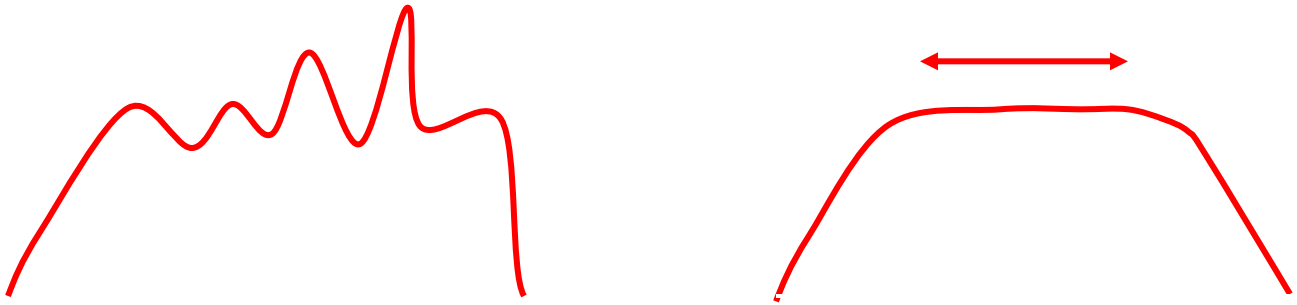
Reasons for being "too big"

- "diminishing marginal returns"
- Classical version: variability in quality of inputs (so we choose best acre of land 1st, and it gets worse from there)
- Neo-classical version: with fixed capital, beyond some point, each additional worker will be less productive

Critiques of the idea of optimum population size

(1) We assumed fixed technology; but maybe each density has its own appropriate technology (later we'll read Boserup)

(2) Perhaps maximum is not a single point -- rather, a wide range



An example:

N	1	2	3	4	5	6
MP	0	4	3	2	1	0
AP	1	2				

Copy on a separate sheet (also for later)
What size is economic optimum (max of AP)?

Power optimum (issues)

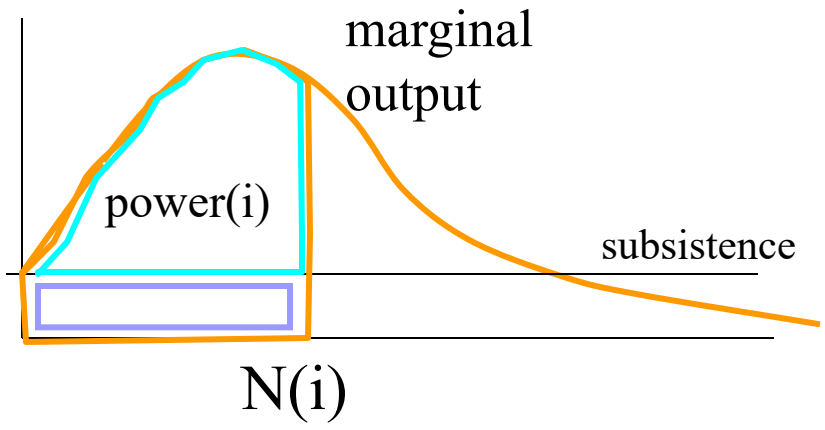
- Let's not think about average individual but about the sum of the society
- Can think of a ruler, or of entire society *("La France")*
- Sauvy defines power as the sum of production beyond subsistence

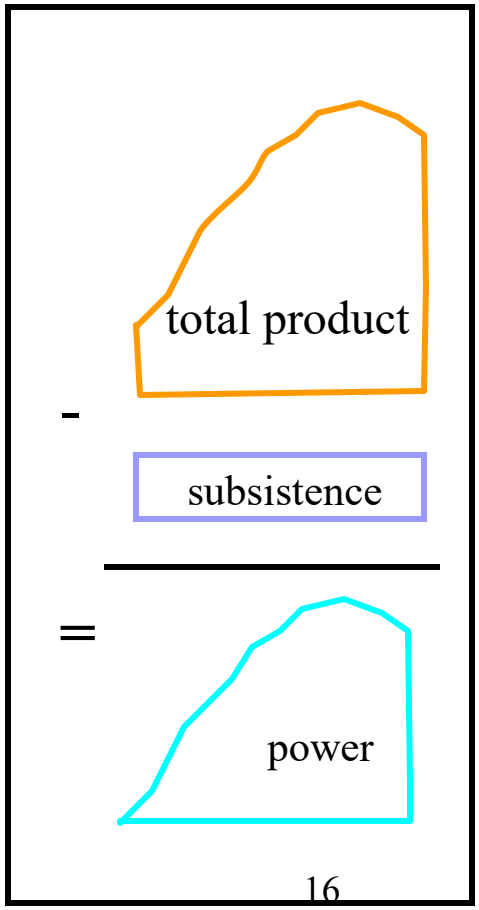
  (for pyramids, armies, culture, ...)
- Question: *Do more people always mean more power?*

Marginal productivity

- MP(i) = output of the i'th additional person (the additional increment of production) (*NOT the average*)
- power(N) =

  sum(marginal output of first N people) -
  their subsistence requirements





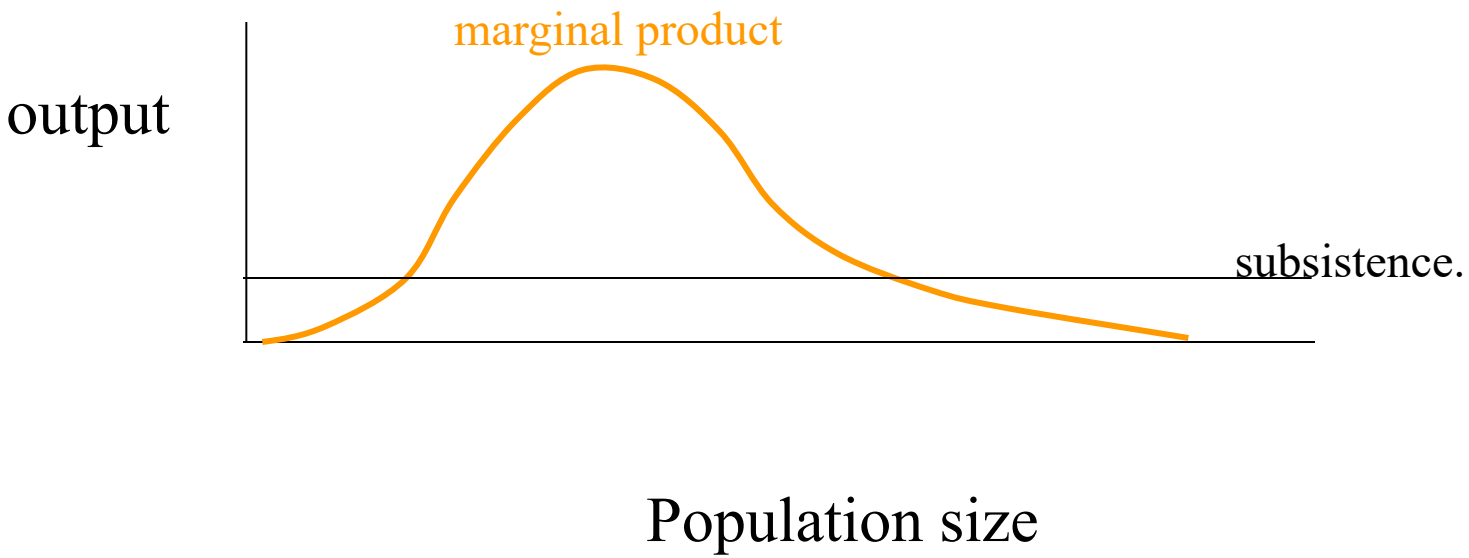
Example (cont.)

N	1	2	3	4	5	6
MP	0	4	3	2	1	0
AP	1	2	2.33	2.25	2	1.67
Subsist.	2	2	2	2	2	2
"Power"	-1	0				

What size maximizes power? sum(MP – S)

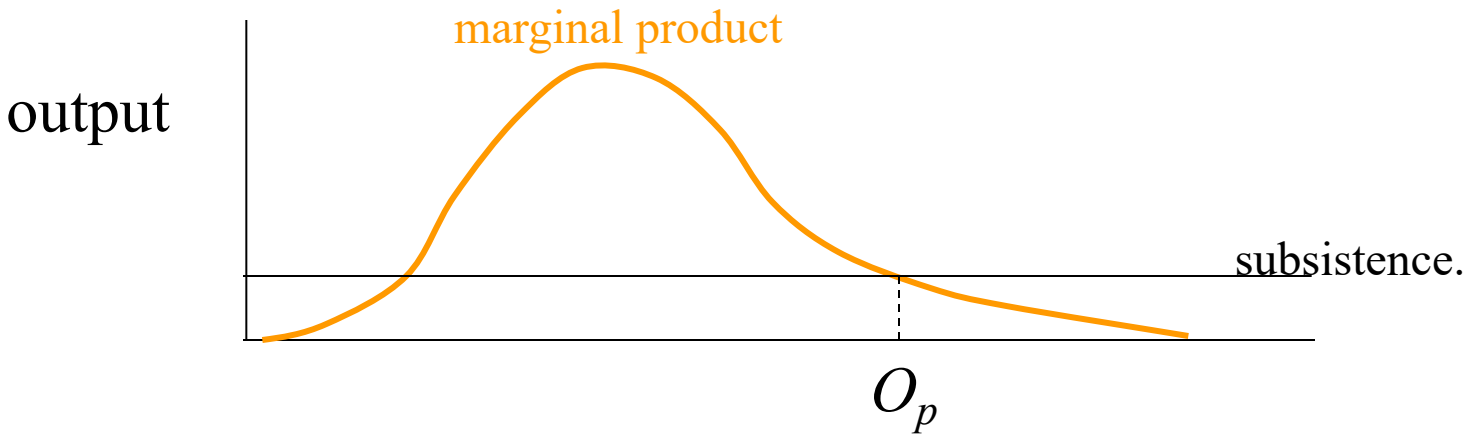
The Power Optimum

What population size maximizes power?



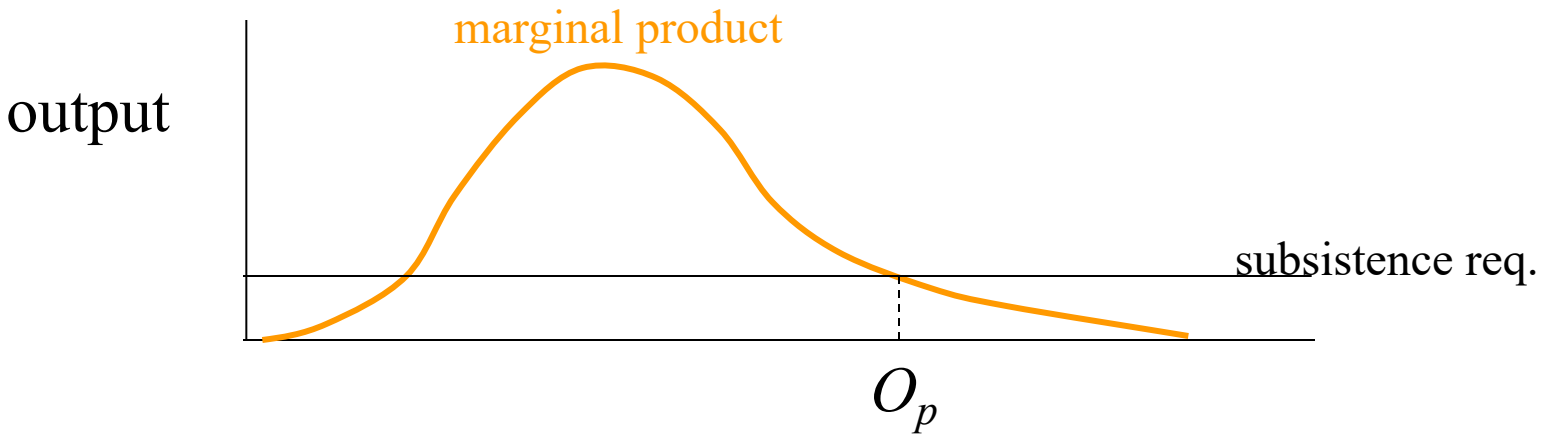
The Power Optimum

What population size maximizes power?



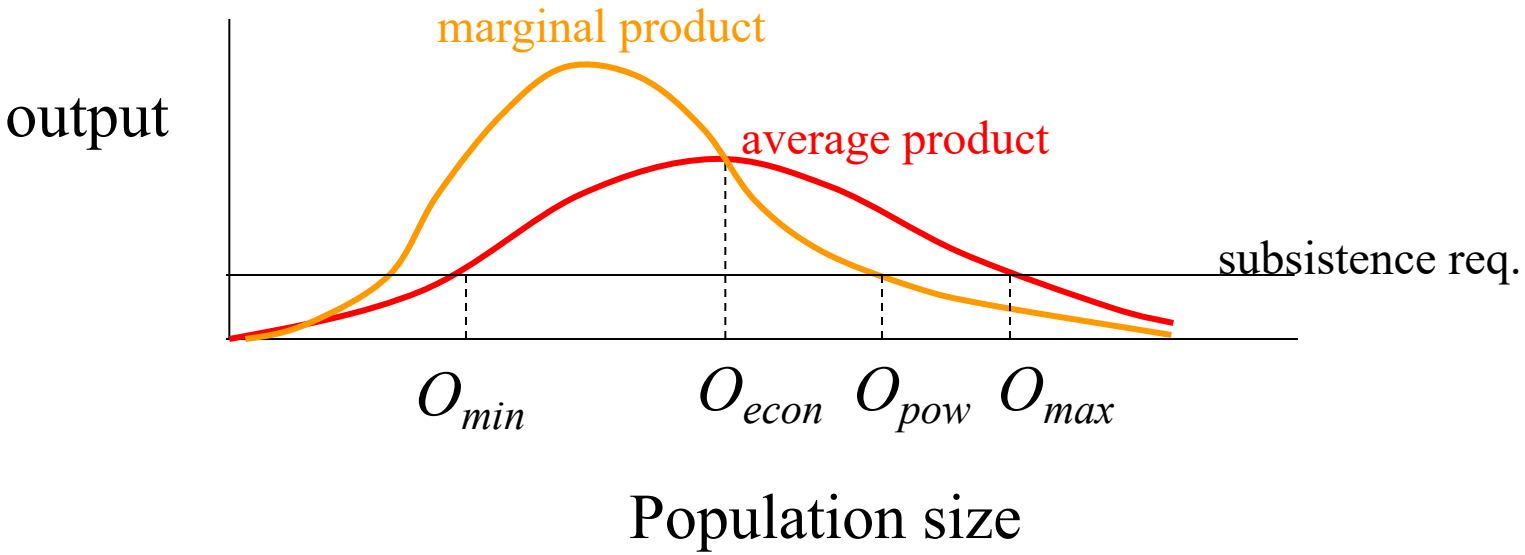
Why does equality with subsistence mark the power maximum?

- Below O_p, each additional person increases social surplus
- Above O_p, each person is a "net cost"



Ordering the optima

Econ.optimum < Power optimum < Max. population

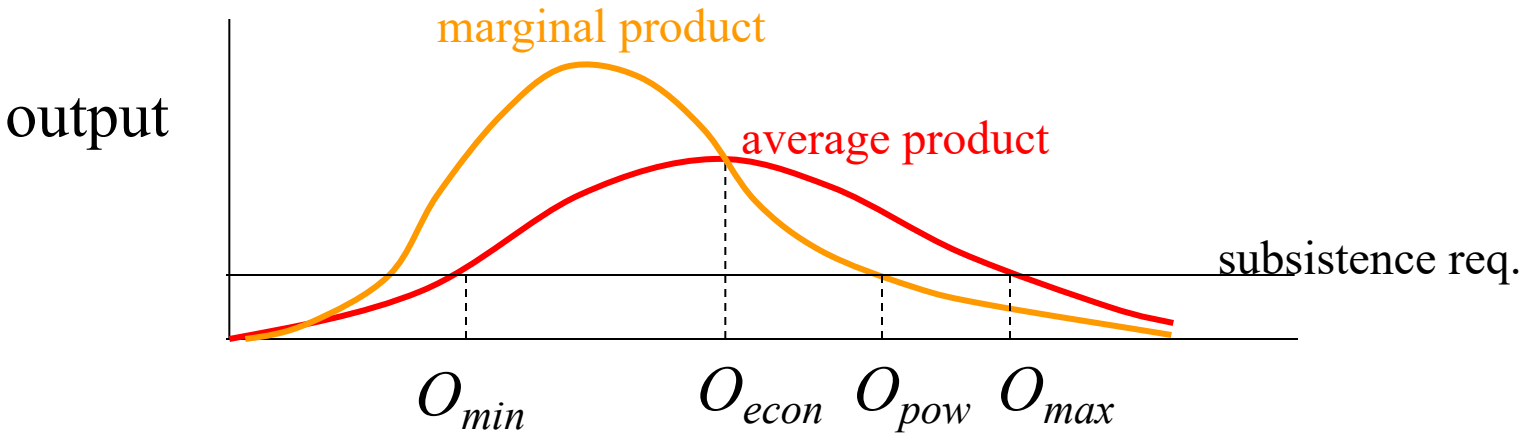


Q1. Why does intersection of MP and AP occur at max(AP)?

Q2. How can people survive after MP < subsistence?

Ordering the optima

Econ.optimum < Power optimum < Max. population



Q: Does this ordering always hold? (With any MP pattern?)

Population "evolution"?

If technology and other factors remain constant -- a big "if" -- then a growing population will experience the following stages:

1. The minimum (viable) population
2. Maximum marginal productivity
3. Maximum standard of living (econ opt)
4. Maximum power (power opt)
5. Maximum (viable) population

Government and choice of optimum

"Before the 19th century this desire for power used to be so predominant that it hampered for a long time the understanding of the economic optimum. At about the time when this was understood, regal authority began to decline."

(Sauvy p. 62)

Conclusions

- Theoretical optimum, not a requirement

  (doesn't mean we should kill off our pop if we are over the optimum)
- Ignores feedback between pop size and technological level
- BUT, still a very useful framework:
  - the relative positions of different optima in general
  - we can understand how optimum depends on objective (whose perspective)

Total Product: Understanding Sauvey's Figure 14

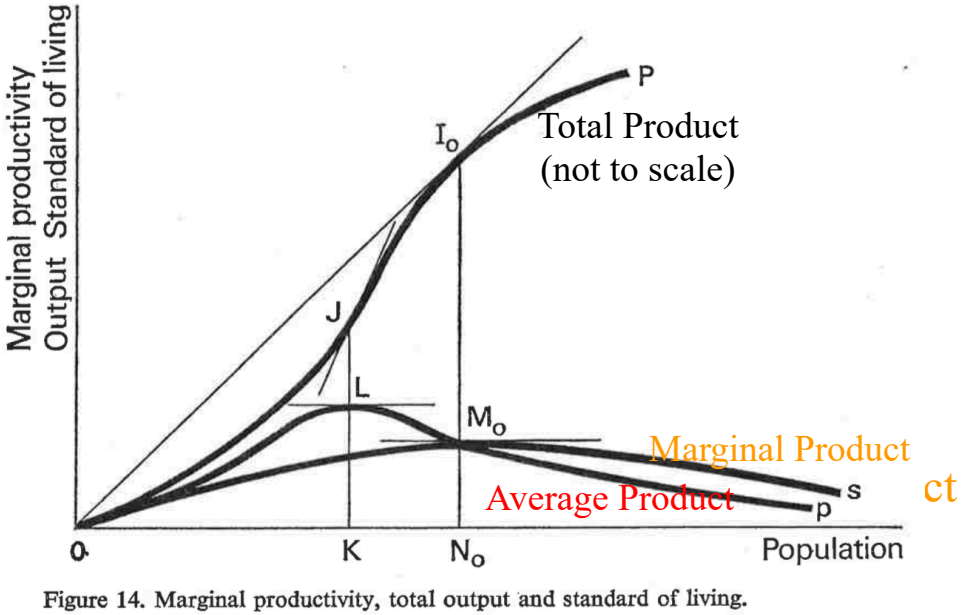


Figure 14. Marginal productivity, total output and standard of living.

- *Total prod = sum (MP)*
  $TP(N) = \sum_1^N MP(i)$
- *Tangent TP = MP*
  $TP' = MP$
- *Angle from origin to TP is AP. Why?*

TP picture will be useful when working with Solow model
MP picture will be useful with Malthus, Migration, and elsewhere