Micro-economic models of fertility (1): "the cost of time"

Economic Demography

Econ/Demog c175

Prof. Goldstein

UC Berkeley

Week 8, Lecture A

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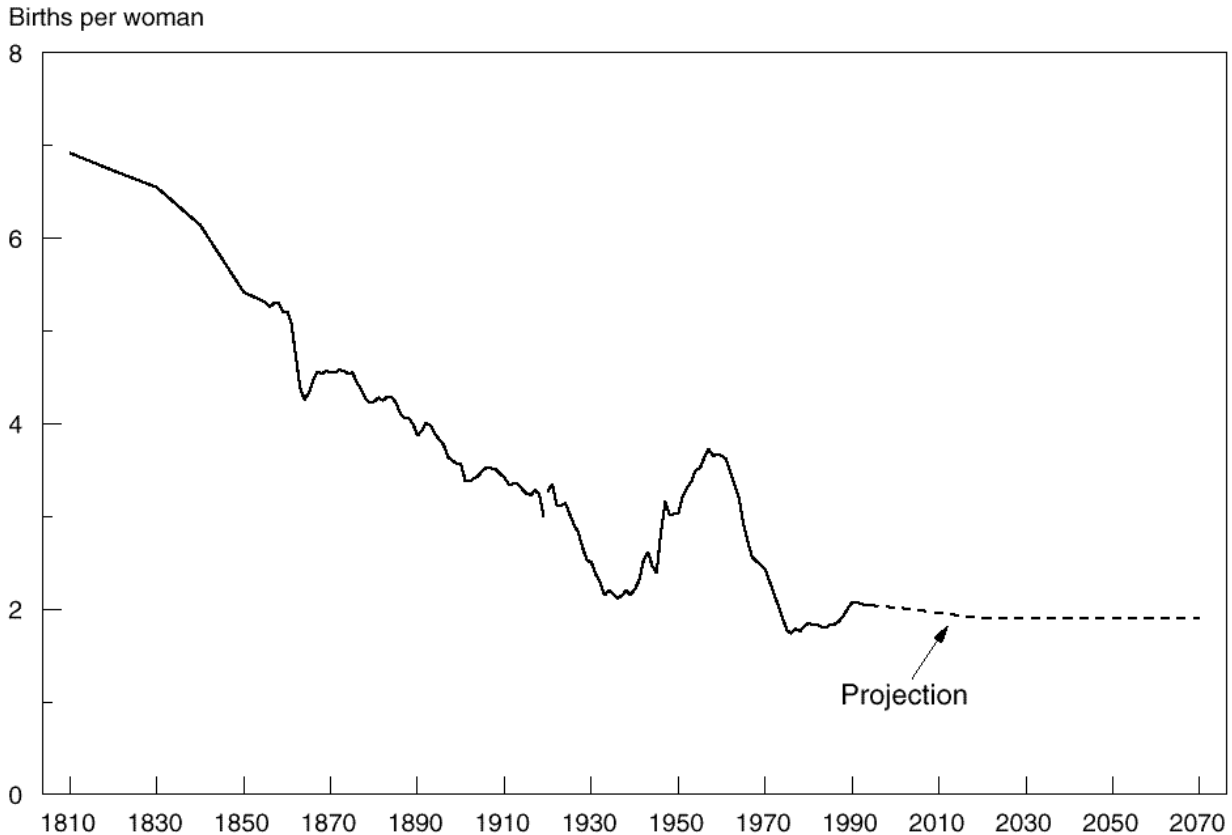
The big questions

- Big Puzzle: If kids are “normal” goods, why has fertility fallen as incomes have climbed?
- A big problem in socio-biology: why doesn’t social/economic success produce more offspring?
- Two kinds of questions:
  - Temporal
  - Cross-sectional (within a society & between societies)
- Additional motivation: what will happen in the future?

Example of temporal decline

Chart 3-1 **Total Fertility Rate**
The total fertility rate has been falling steadily over time, with the exception of the post-World War II baby boom.

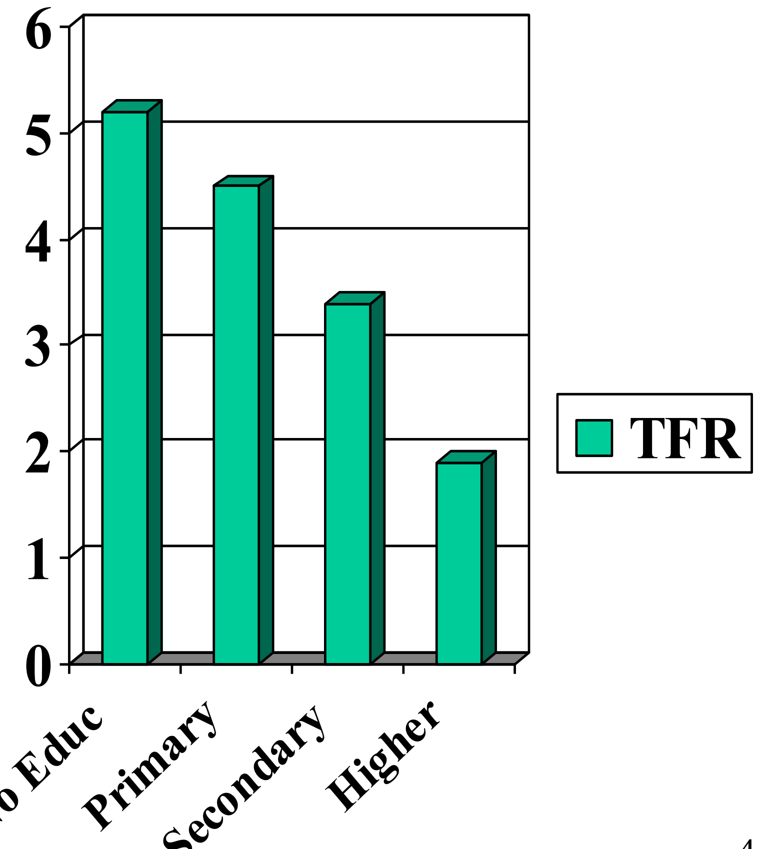


Note: The total fertility rate is the average number of births per woman during childbearing years. Data prior to 1920 are for whites only.
Sources: Data prior to 1920: Coale, A. and M. Zelnick (1963), "New Estimates of Fertility and Population in the U.S.;" 1920-1969: Department of Health and Human Services; 1970-2070: Social Security Administration.

Example of differential fertility

- Total Fertility Rate for everyone is 4.0
- A very strong educational gradient
- (Note: TFR is a period measure and has some caveats.)

Zimbabwe 1999



Fertility differences between populations

In 2000, TFRs

- Austria (1.3)
- France (1.8)
- Italy (1.2)
- Greece (1.3)
- Spain (1.2)
- UK (1.7)
- US (2.0)

Micro-economic models

- Today, opportunity cost of childbearing
- Thursday, Becker’s quantity-quality tradeoff model

Set up of our model

1. Utility is a function of goods and kids

   U(X = goods, N = # of kids)

2. Budget constraint: can only spend what you earn
3. Earnings a function of wages, hours worked, and "other income"
4. Time spent only working or taking care of children (leisure is left out of simple model)

- Model will take into account opportunity costs of time
- (For convenience, fix costs of X = 1)

Time constraint

number of kids

$$T = L + cN$$

total available hours

hours in labor force

hours caring for kids

Budget constraint (1)

$ expenses = $ income

$$X + pN = \text{earnings} + I$$

goods

money cost per kid

other income

Budget constraint (1)

$ expenses = $ income

$$X + pN = \text{earnings} + I$$

goods

money cost per kid

$wL = w(T - cN)$

hours worked = T – hours caring for kids

other income

Can rewrite earnings

$$X + pN = (wT - wcN) + I$$

Budget constraint (2)

We have

$$X + pN = wT - wcN + I$$

Reconceptualize in terms of "full income" and all expenses (including opportunity costs).

A decision-making framework incorporating full cost of kids.

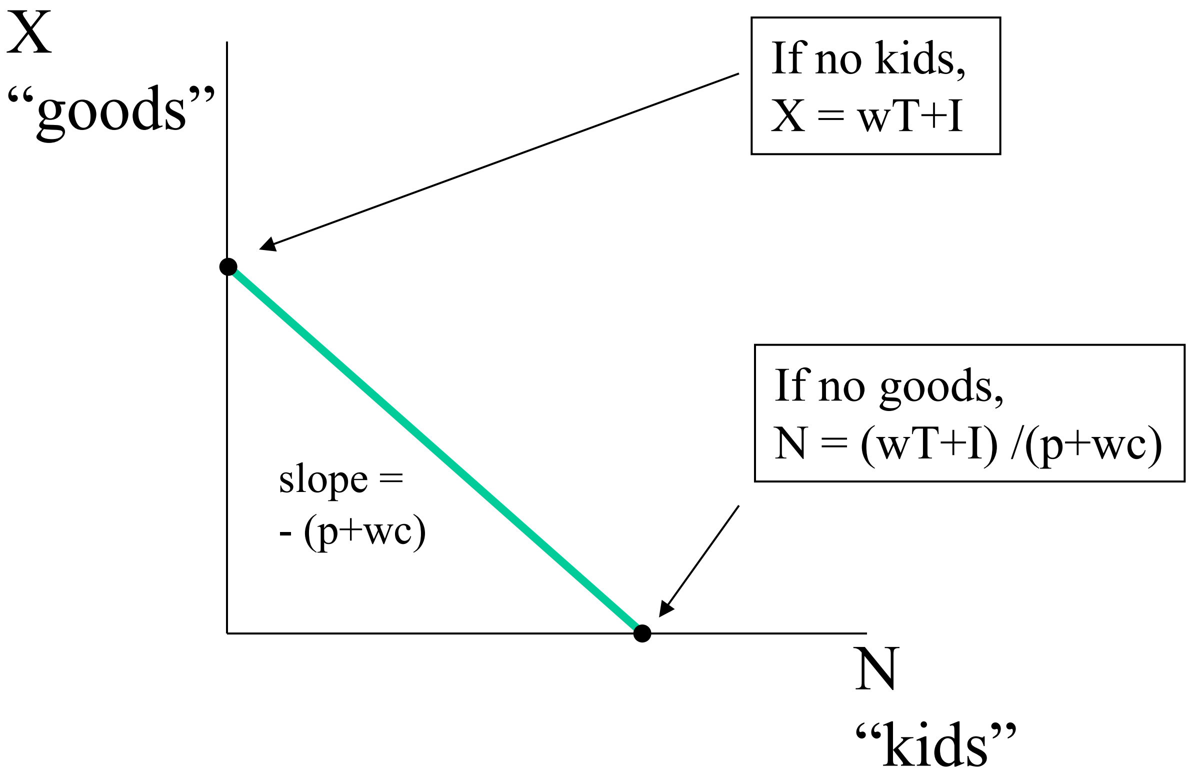
$$X + (p+wc)N = \underbrace{wT + I}_{\text{"full income"}}$$

money cost per kid (food, ...)

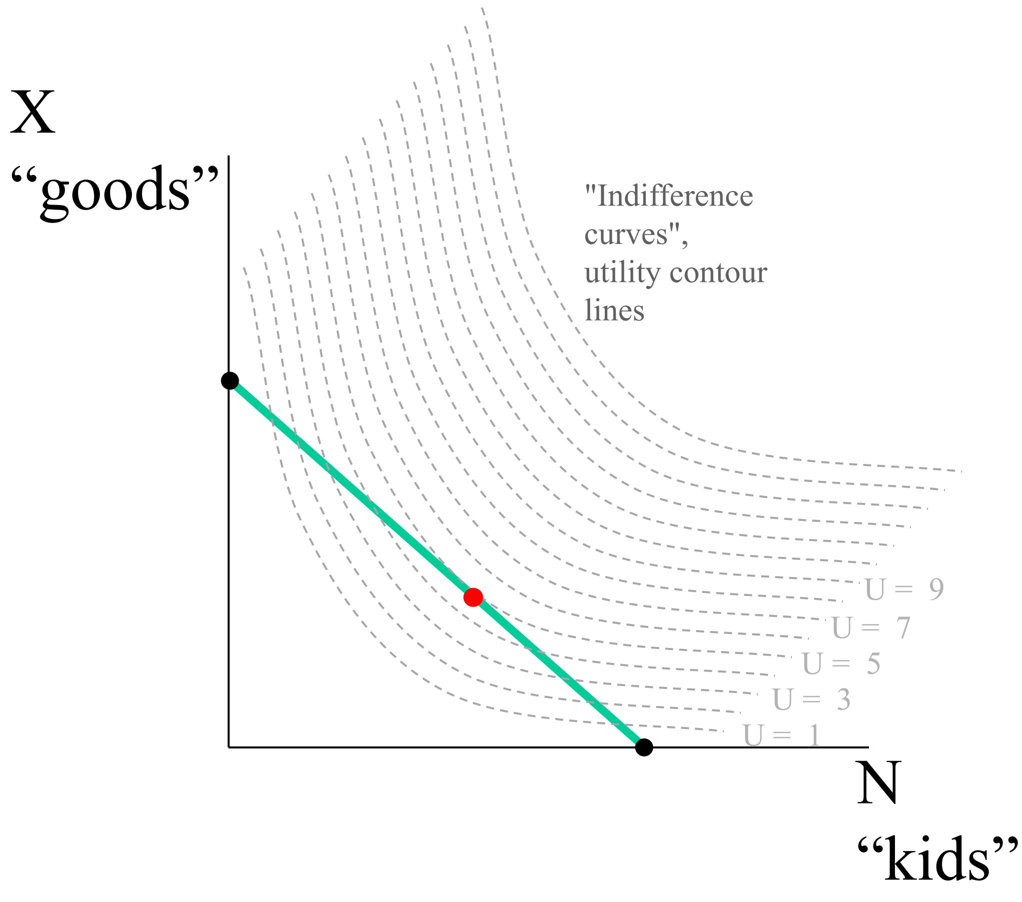
opportunity cost per kid

Graph of budget constraint

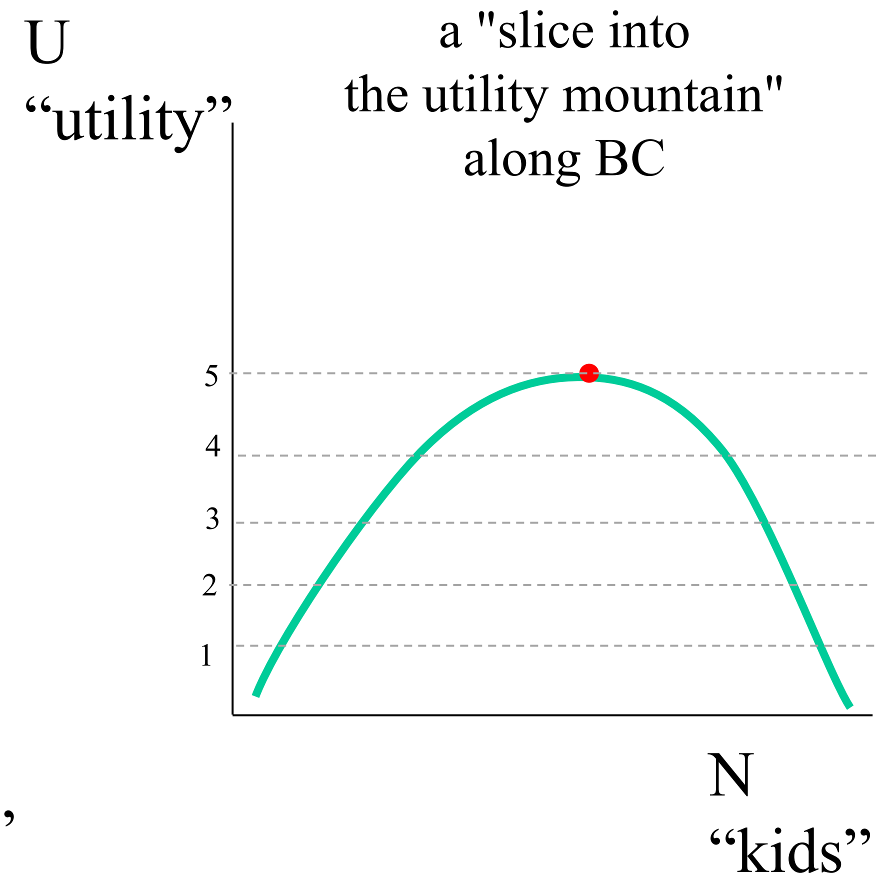
$$X + (p+wc)N = wT + I$$



Maximizing utility along the budget constraint



Cross-sectional view, a "slice into the utility mountain" along BC



$$X = wT + I - (p + wc)\,N$$

Assume

w = \$20 per hour

T = 40 hours per week

I = \$1,000 per week

p = \$200 per kid per week

c = 5 hours per kid per week

Let's calculate for $N = 5$

(N, X) bundles along BC

N	X	U?
0	1800	
1	1500	
2	1200	
3	900	
4	600	
5	300	

Let's assume Cobb-Douglas utility

$$U(N, X) = X^{0.7} N^{0.3}$$

N	X	U(N,X)
0	1800	0
1	1500	167
2	1200	176
3	900	?
4	600	?
5	300	?

A picture

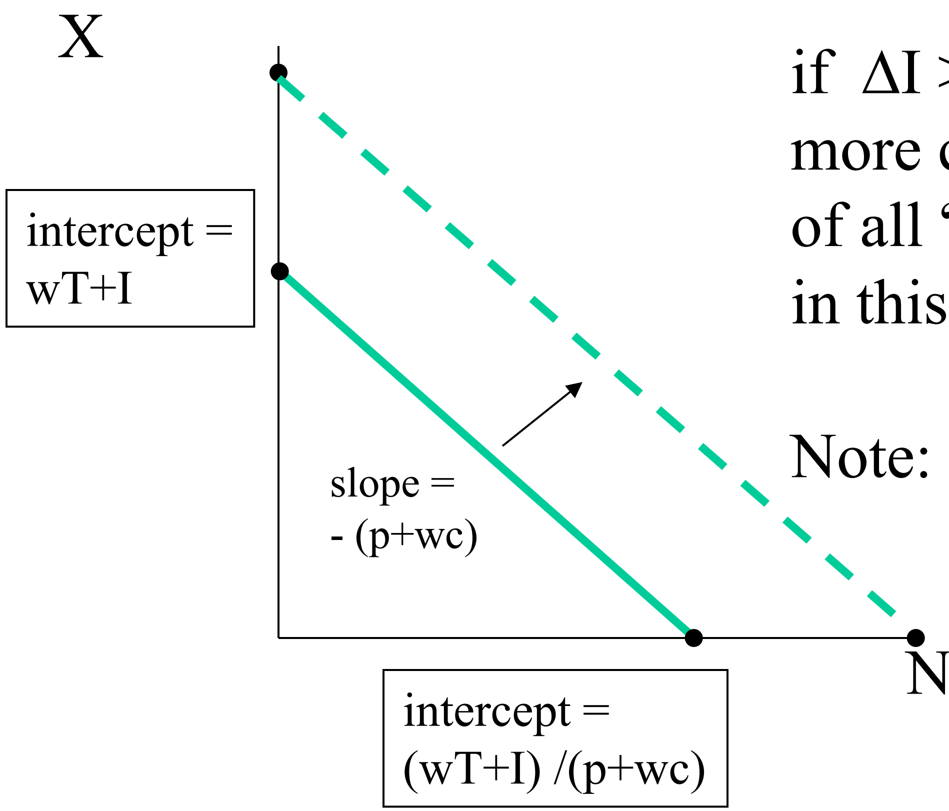
```
## some parameter values
p = 200; c = 5; w = 20; I = 1000; T = 40

## X = f(N) along BC
N.vec = seq(0, 5, .1)
X.vec = w*T + I - (p + w*c)*N.vec

## Utility for each "bundle"
a = .7 ; U.vec = X.vec^a * N.vec^(1-a)

## Maximization
plot(N.vec, U.vec)
N.opt = N.vec[which.max(U.vec)]
abline(v = N.opt, col = 2)
title(paste("Utility maximized when N =",
                  N.opt))
```

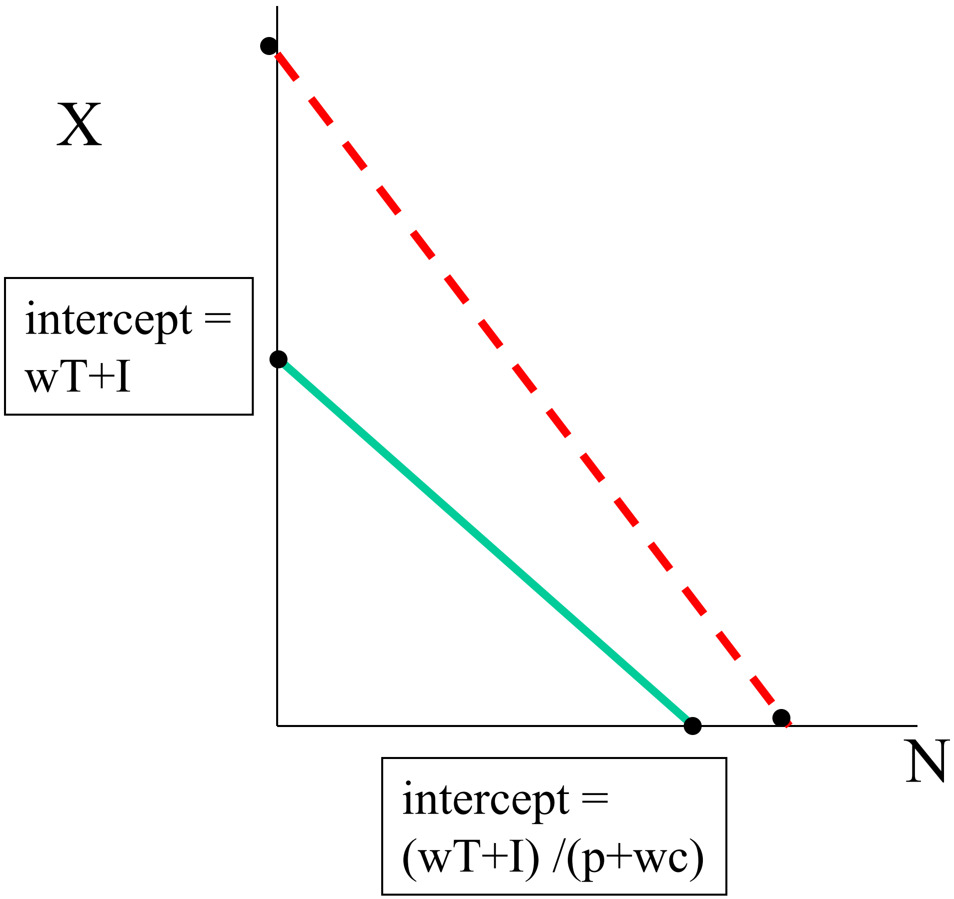
What happens if non-wage income increases by ΔI?



if $\Delta I > 0$, then
more consumption
of all "normal" goods:
in this case both X and N

Note: slope unchanged

What happens if wages increase?

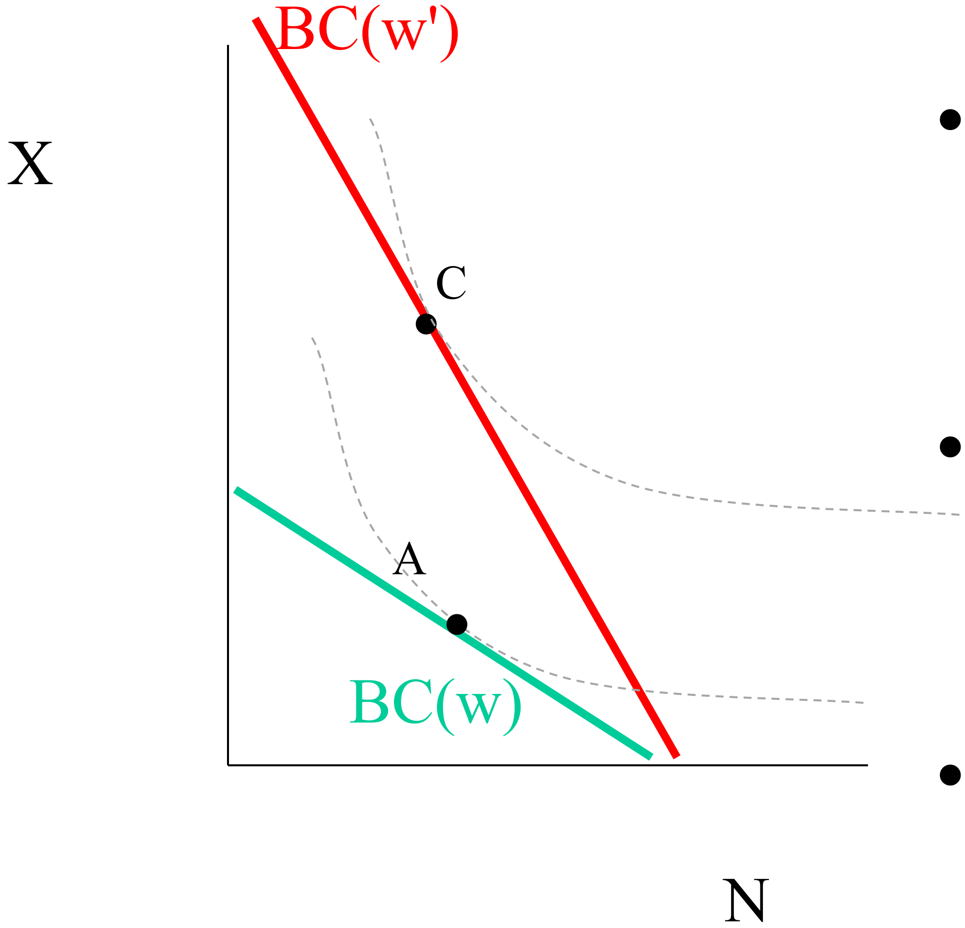


slope will change: effect on number of kids is *ambiguous*

*could increase fertility because more income to spend on fixed costs of childbearing (*income effect*)*

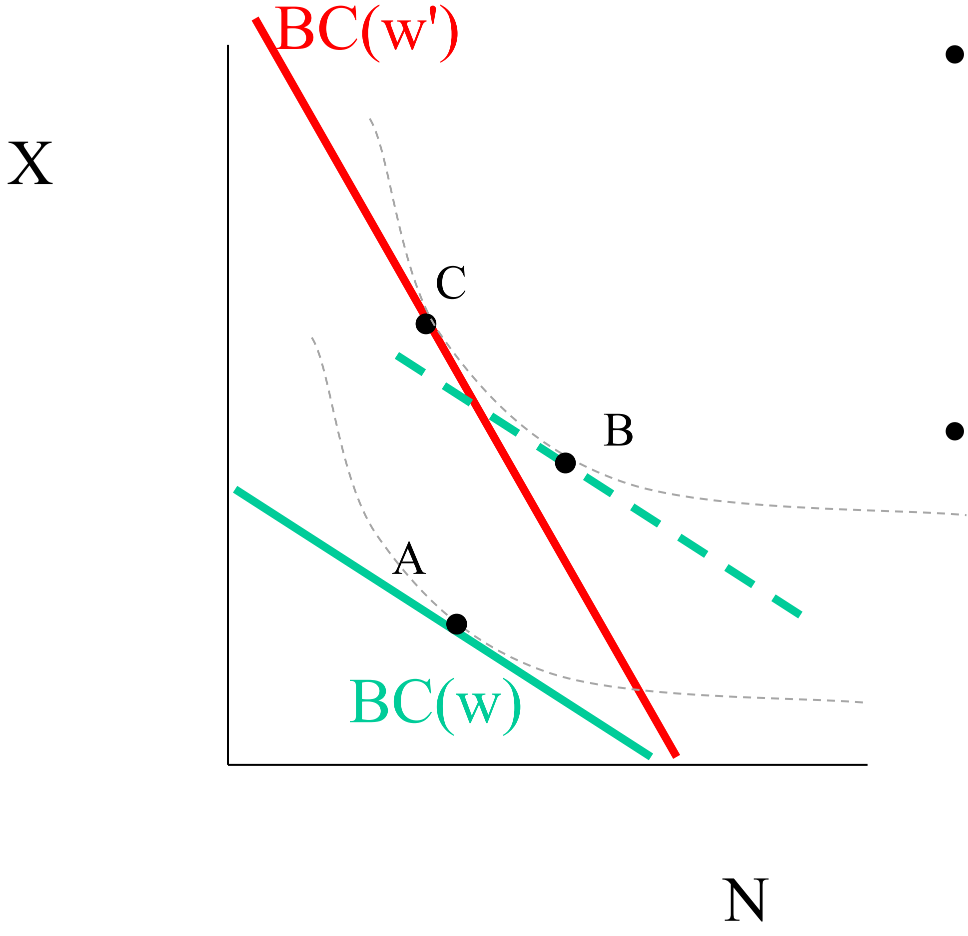
*OR, could decrease fertility because opportunity cost of childbearing increases (*substitution effect → *goods)*

What happens if wages increase?



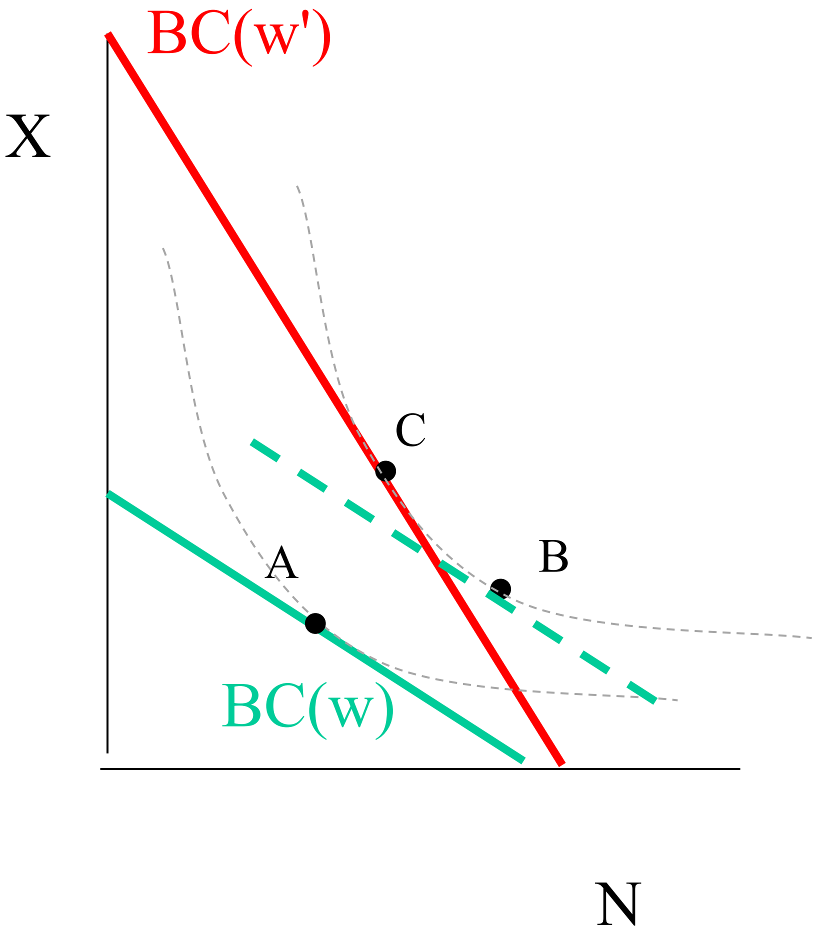
- When we change wages, we go from bundle A → C
- Here, we choose fewer children (!) and more goods
- "Substitution effect dominates income effect"

Income and substitution effects



- A→ B = *income effect*
  We hold prices (slope) constant and move <u>to</u> new U
- B→ C = *substitution* (or "*price*") effect
  We change price, moving <u>along</u> new U

A different picture (when income effect dominates)



- A→ B = *income effect*
  Always positive
- B→ C = *substitution effect*
  Always negative
- But now net effect of wage increase is to increase consumption of both kids and goods

Is our model great, or terrible?

- Effect of wage increase goes either way
  - bad for prediction
  - good for after-the-fact
- Stronger predictions for other changes

Other changes

- d N / d p? (lower price of schools?)
- d N / d I? (increase "male" income?)
- d N / d c? (clothes washing machine?)
- d N / d f(U)? (changing preferences?)

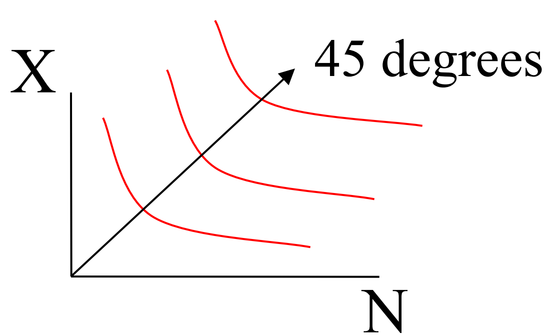
We'll look at these more on Thursday

Tastes and the utility function

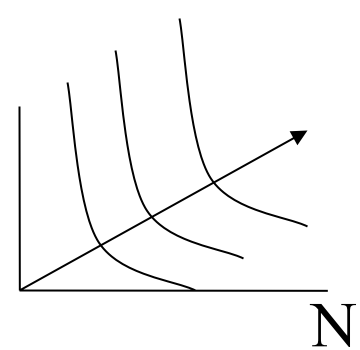
Let U(X, N) be the standard Cobb-Douglas utility function $= X^{a} N^{(1-a)}$ for $0 < a < 1$

a is an index of marginal rate of substitution between goods and children: big *a* means lot of N for little X
small *a* = little N for lot of X

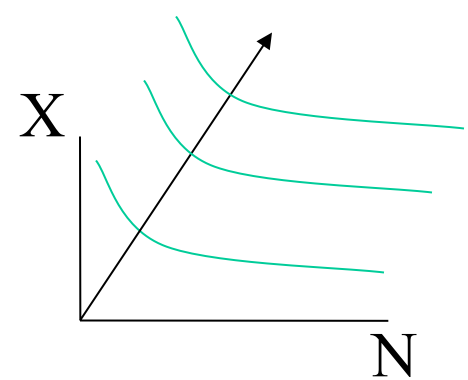
a = 1/2



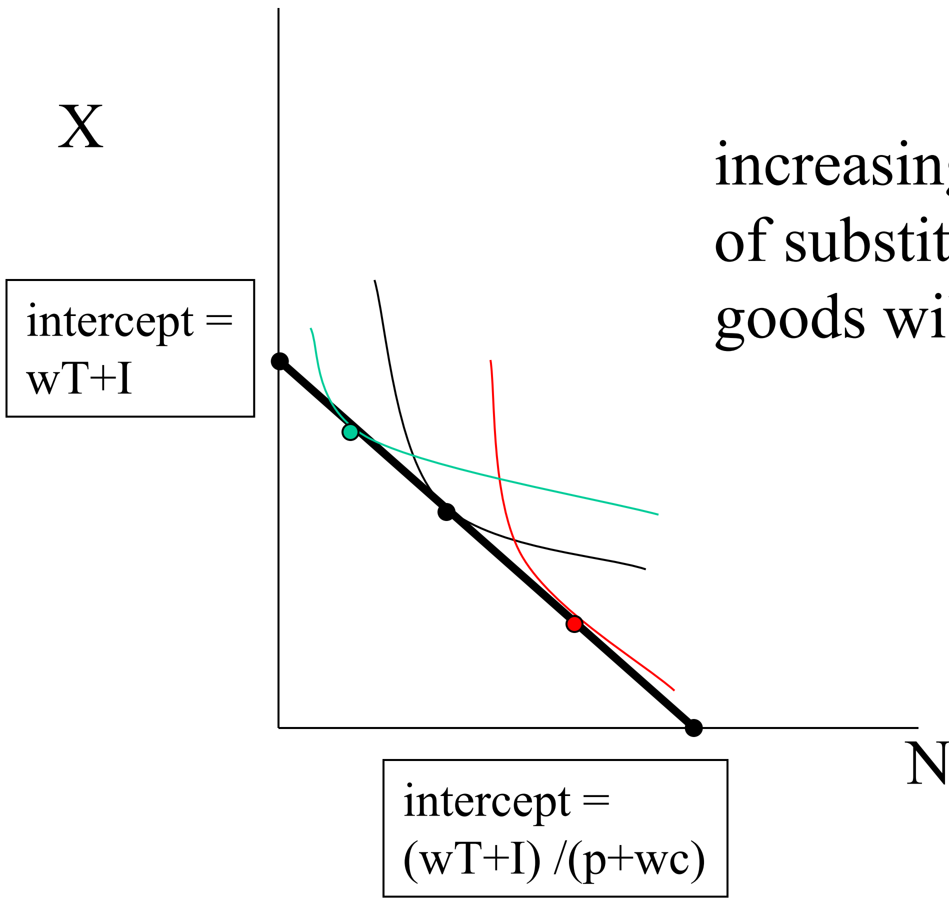
a < 1/2



a > 1/2



Effect of changing tastes



increasing the marginal rate of substitution of kids for goods will increase N

Conclusions from model

(If kids are "normal" goods)

- increasing price of kids (p), decreases fertility
- increasing non-wage income (I), increases fertility
- increasing preferences for kids (1-a), increases fertility; increasing preferences for goods (a) decreases fertility
- but: increasing wages (w), is ambiguous
- *So the idea that increasing wages reduces fertility is based on empirical research, not theoretical necessity*

Explanations?

- Kuwait vs. Switzerland.
- Why as an increasing share of income comes from women, fertility declines
- Why increasing female education decreases fertility
- Next time, endogenizing costs per child (what happens if costs per child depends on number of children?)