Lecture 11

Secondary and Post-Secondary Education

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Today

- What is education?
- Why is education subsidized?
  - discounting
  - positive externalities
- What are the returns to schooling for individuals?
- Can education be improved by more investment?

Role of Education

- Education generates Human Capital
  - It is not the only way, but it is certainly one of the major ways
- Human Capital is the ability of people to create goods and services
- Skill biased technological change
  - Technology changed the demand for different types of human capital

Role of Education

This gives the first answer to the question: what is education?

- Education is an investment
- Workers, parents, or firms invest in education and training
  - because the net present value is positive

$$Net\ Present\ Value = Present\ Value\ Benefits - Present\ Value\ Costs$$

Detour to Discounting

When thinking about the value of things in the future economists use a discount factor:

- The discount factor represents how much more valuable something is today than it is tomorrow
- A simple example of a discount factor is an interest rate:
  - Lets compare \$50 today with \$100 ten years from now
  - Suppose we have a savings account with a 1% interest rate
  - Two options:
    - Take the money now and put it in savings account
    - Or wait for the \$100

Detour to Discounting

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    - Or wait for the \$100

Detour to Discounting

When thinking about the value of things in the future economists use a discount factor:

- How much money would we need now to get \$100 in two years?
- Lets suppose we have x dollars today then in two years we will have:

$$FV_2 = x + xr + (x + xr)r = x(1 + 2r + r^2) = x(1 + r)^2$$

- This pattern generalizes of course: $FV_n = PV(1 + r)^n$

If we want $FV_2 = 100$ then $PV = \frac{100}{(1+0.01)} \doteq 98.03$

Detour to Discounting

When thinking about the value of things in the future economists use a discount factor:

- We would have to give someone \$98.03 today to give them the same value in the present as they get from waiting
- The cost of waiting is \$50 (opp. cost) and this is a present value
- The benefit of waiting is \$100 in the future which is equivalent to \$98.03 dollars today
- The Net Present Value is $98.03 - 50 = 48.03 > 0$
  - The decision maker chooses to wait

Detour to Discounting

When thinking about the value of things in the future economists use a discount factor:

- Would you wait?
  - I probably would not wait
- For most people the relevant discount rate is greater than the interest rate

$$PV = \frac{FV}{(1+r)^n}$$

- Increasing r lowers the PV

Detour to Discounting

When thinking about the value of things in the future economists use a discount factor:

- What r is needed to make not waiting rational?

$$
\begin{aligned}
50 &= \frac{100}{(1+r)^2} \\
\Rightarrow \quad r &= \sqrt{\frac{100}{50}} - 1 \\
&\doteq 0.4
\end{aligned}
$$

Detour to Discounting

When thinking about the value of things in the future economists use a discount factor:

- Now finally lets re-write this in the form of a discount factor rather than an interest rate:
- Suppose peoples utility from consumption/money overtime is:

$$U = \sum_{t=0}^{n} \beta^t u(x_t)$$

- β is the discount rate
- $u()$ is a utility function lets say $u(x) = x$
- x_t is the amount of money that person has in period t

Detour to Discounting

When thinking about the value of things in the future economists use a discount factor:

- If the person waits two years to get \$100 then his total utility would be:
  - $0 + \beta \cdot 0 + \beta^2 \cdot 100$
- If the person takes the money now then he gets utility 50
- The β required to make the two equal is given by the equation: $100 \cdot \beta^2 = 50$

Detour to Discounting

When thinking about the value of things in the future economists use a discount factor:

- The β required to make the two equal is given by the equation: $100 \cdot \beta^2 = 50$
- Note the similarity to the equation for the interest rate to make the two equal:
  - $50 = \frac{100}{(1+r)^2} = 100 \cdot \frac{1}{(1+r)^2}$
- So the β that would make our utility function make the same choices as the person with a savings account with interest rate r is:
  - $\beta = \frac{1}{1+r} \doteq 0.71$
  - So things one period the future are worth about 30% less to us than things today

Applying this to education

What is the net present value of education?

- Parents or prospective students face costs today (and during the period of education)
  - Tuition, fees, and books
  - Opportunity costs: if you don't send you kid to school you will need daycare or to stay at home
- Students when the graduate receive wages and income proportional to the value of their human capital
  - Lifetime earning potential
- If the discounted value of their lifetime earning potential is larger than the discounted costs of education
  - Then they will invest in education
- In a few slides we will try to get an idea at least what the lifetime earning potential is in order to understand the value of education

Applying this to education

One key point about these discount factors:

- Individuals will do this discounting according to their personal discount factor
- If individuals are too impatient they may not invest enough in education
  - what does it mean to be too impatient?
- We can think about a social discount factor–the way that society as a whole would choose to discount the future
  - i.e. this is part of the social choice function
  - depends on values of society
  - So a statement like "people are too impatient" is inherently subjective

Applying this to education

The U.S. government actually uses a social discount factor when it does policy evaluations

- The social discount factor is recommended to be between approximately 0.93 and 0.97 depending on how it is calculated
  - 2003 Office of Management and Budget guidelines
- This is based on rates of return on capital and government bonds
  - Which in competitive markets are related to individual discount factors
- Experimentally and from microeconomic studies economist estimate that people often are much less patient, however, it is unclear how this generalizes to other decisions like the decision to invest in education

Applying this to education

- So it may be possible that society provides subsidies to education because it values the future more than individuals
- It is also possible that there is a positive externality from schooling that makes society want to subsidize schooling

Returns to Education

In order to evaluate the positive externalities to schooling and estimate its value to individuals we face a problem:

- Since individuals choose their level of education there are many confounding effects
- Also workers who are more educated may choose to live in places that are more productive
- We cannot easily compare the wages of two people with different number of years of education

Returns to Education

Acemoglu and Angrist (2000) use variation in compulsory schooling laws to solve this problem:

- A compulsory schooling law (CSL) requires children to stay in school an additional year
- CSLs are correlated with the amount of schooling that people achieve, but do not represent individual choices
- Basically we compare people who had no choice but to get an additional year of schooling with those who did not

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Returns to Education

Acemoglu and Angrist (2000) use variation in compulsory schooling laws to solve this problem:

- Data comes from 1950-1980 census focus on males age 40-49
- Estimate external return to individuals from living in a state with higher levels of secondary education
- They find modest external returns
  - Estimates lie between 1% and 3%
- These kinds of returns are significant enough to justify subsidization

Returns to Education

Acemoglu and Angrist (2000) use variation in compulsory schooling laws to solve this problem:

- Median wage: \$17.09[1]
  - 2008 working hours in 2015 gives an annual income of: \$34,316.72
- If your wage goes up by 2% due to an increase in the average level of schooling
  - Thats a new annual income of \$35,003.05
- So the external benefit gives you on average a \$686.33 raise in a given year
  - This raise occurs in each year of your working life

[1] May 2015, BLS

Returns to Education

Acemoglu and Angrist (2000) use variation in compulsory schooling laws to solve this problem:

- If you work for 50 years you would get a total $34,316.72 from this external benefit
- Per student spending has risen from $3,408 in 1960 to $12,957 in 1990
- So by this back of hand calculation we can already see why states might subsidize
  - Note these are my calculations based on Acemoglu and Angrist (2000)
  - I would not conclude we should raise spending to $34,316.72 per student

Returns to Education

Acemoglu and Angrist (2000) use variation in compulsory schooling laws to solve this problem:

- They also report the private returns from increasing schooling
  - They estimate this to be between 6% and 10%
- If we take it to be 7% and repeat the previous calculation
  - Leads to a yearly raise of $2402.17

Returns to Education

Moretti (2004) uses a similar approach with both panel data and census data:

- Finds the following effect of increasing the number of college graduates in a city
  - 1.9% increase in wages for high-school dropouts
  - 1.6% increase in wages for highs-school graduates
  - 0.4% increase in wages for college graduates

Returns to Education

Oreopoulos (2006) uses a change in British schooling laws to measure the returns to schooling:

- In 1947 Britain raised the minimum age at which someone could leave school to work from 14 to 15
- This did more than just add a year of school, as it made the 1st year of high-school (secondary school) mandatory
- The problem with previous studies may have been that the changes in compulsory schooling were not affecting a large group of students
- The 1947 change had an impact on the majority of students as leaving school at 14 was normal
  - From 1945-1948 the percentage of students leaving school at 14 fell from 59.7% to under 10%
- He finds a total return between 10-14% on average wages in Britain

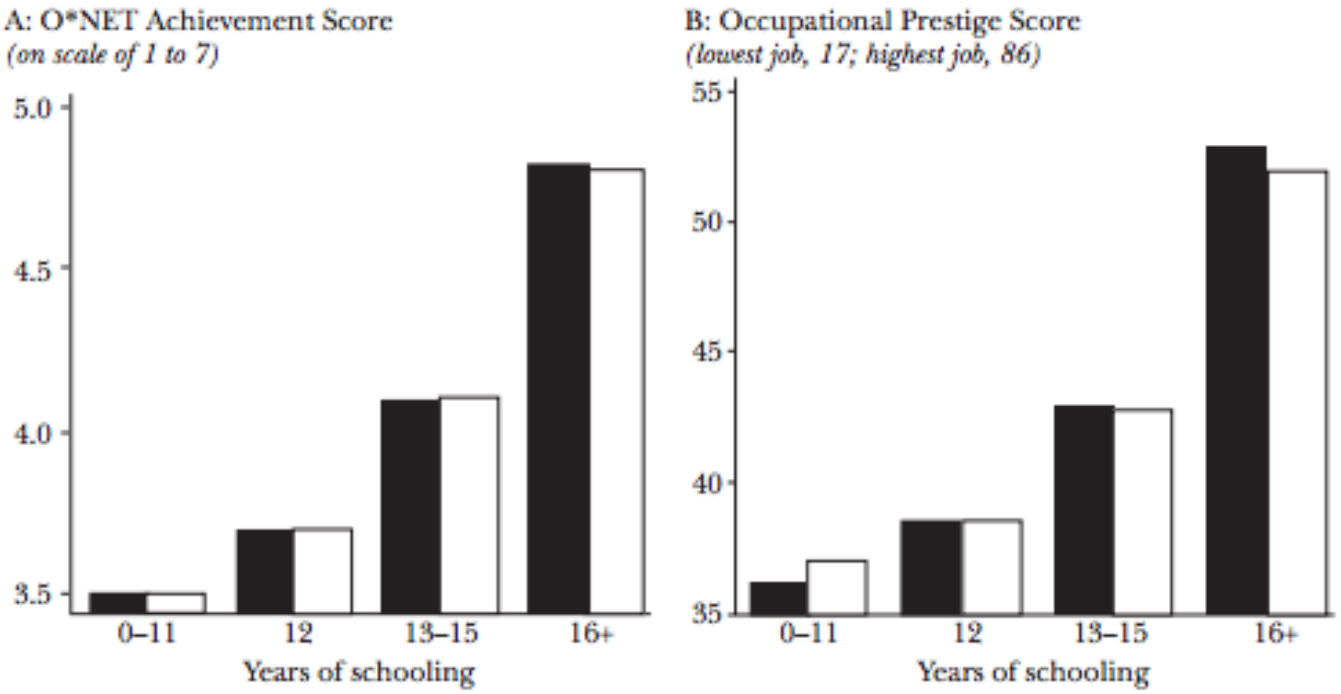
Returns to Education

Oreopoulos and Salvanes (2011) survey some non-pecuniary benefits from schooling:

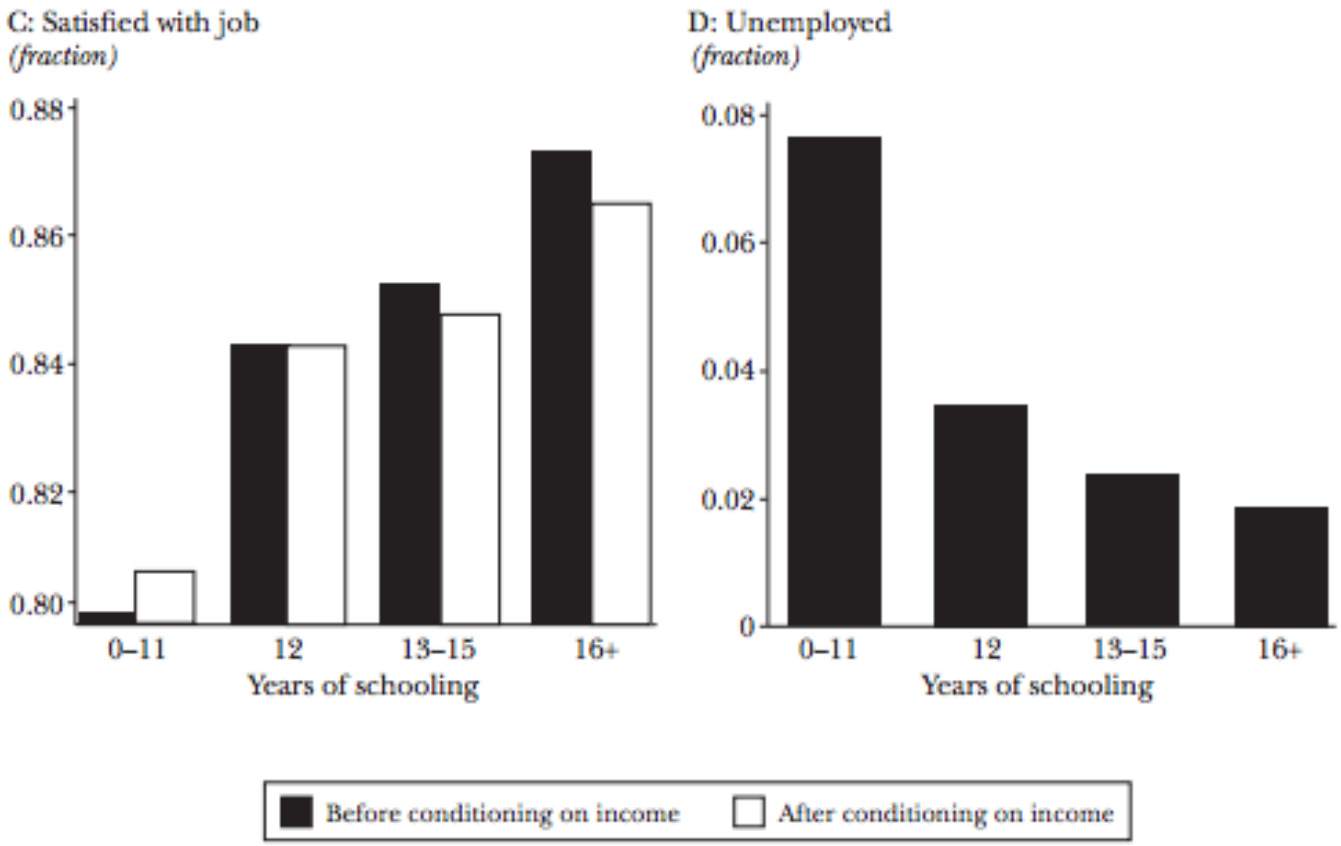
- Results are mostly correlational rather than causal

Returns to Education

Labor Market Outcomes by Years of Completed Schooling before and after Conditioning on Income



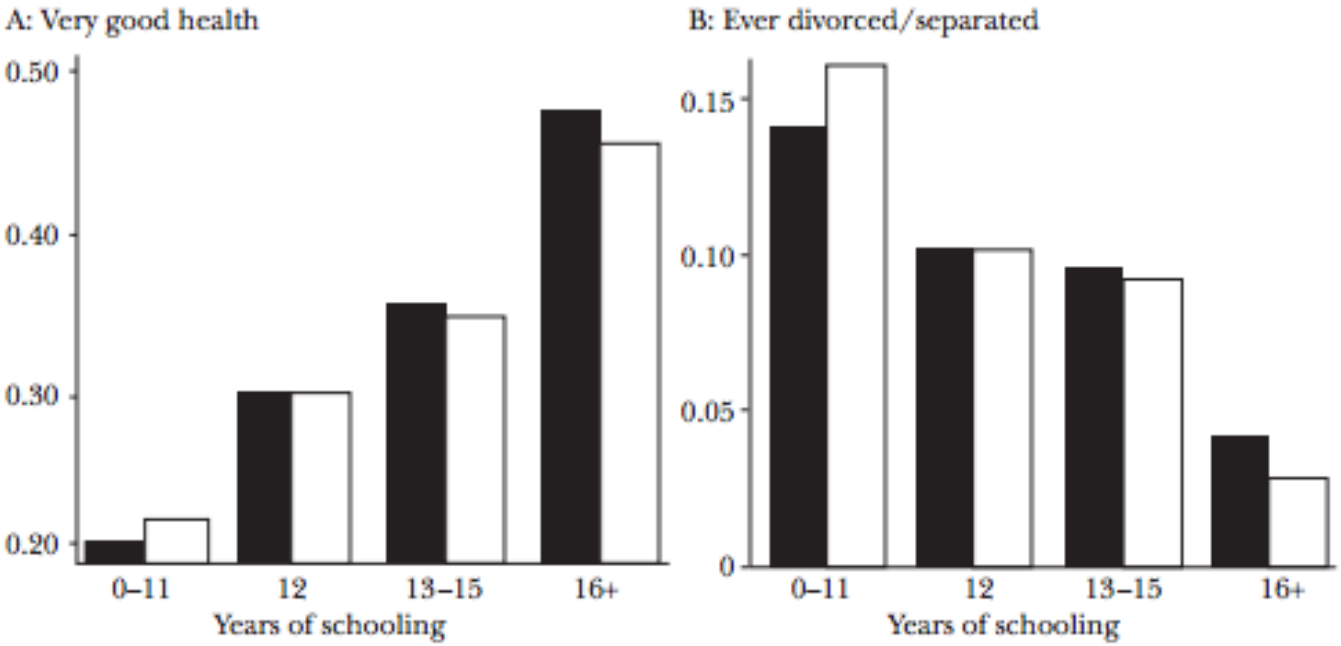
Returns to Education



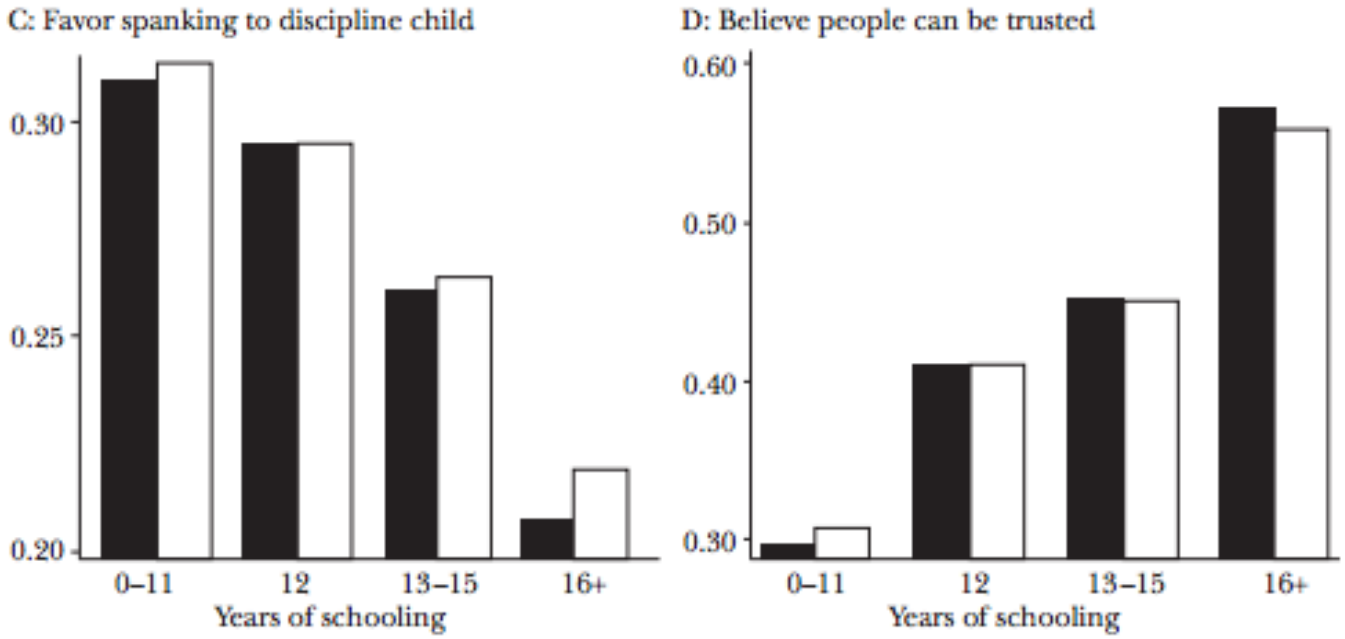
Returns to Education

Non–Labor Market Outcomes by Years of Completed Schooling before and after Conditioning on Income

(fraction of respondents)



Returns to Education



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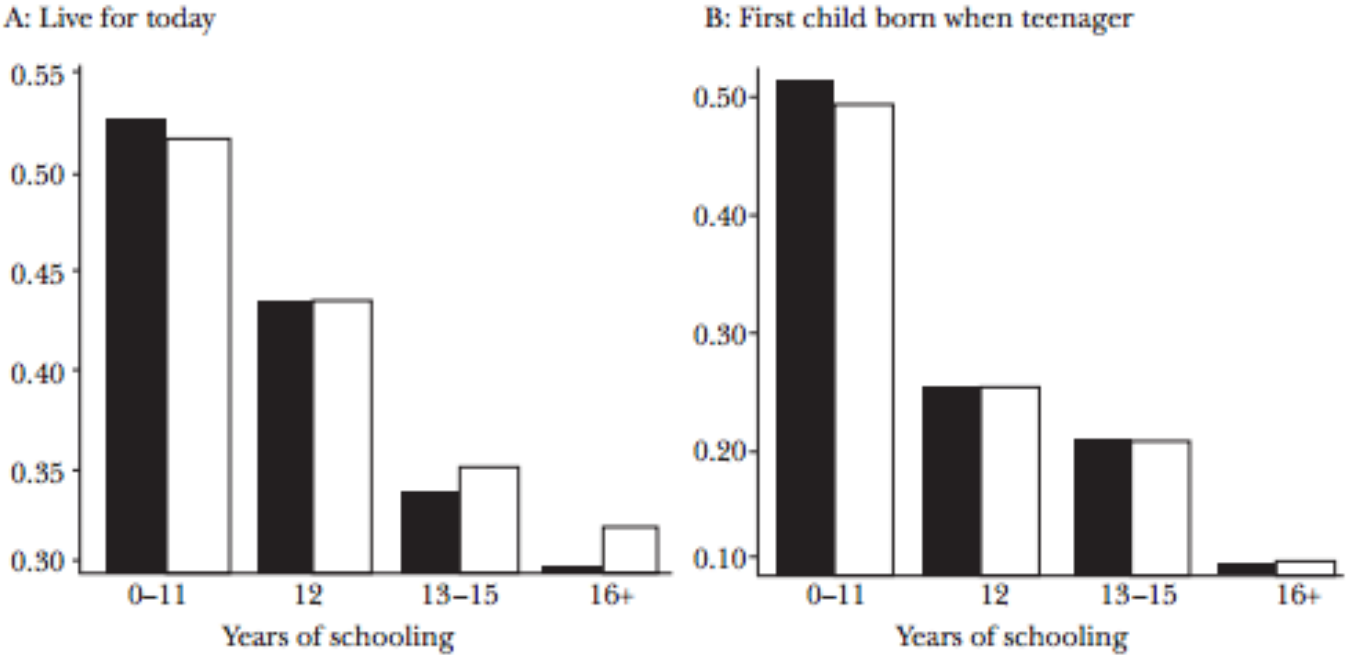
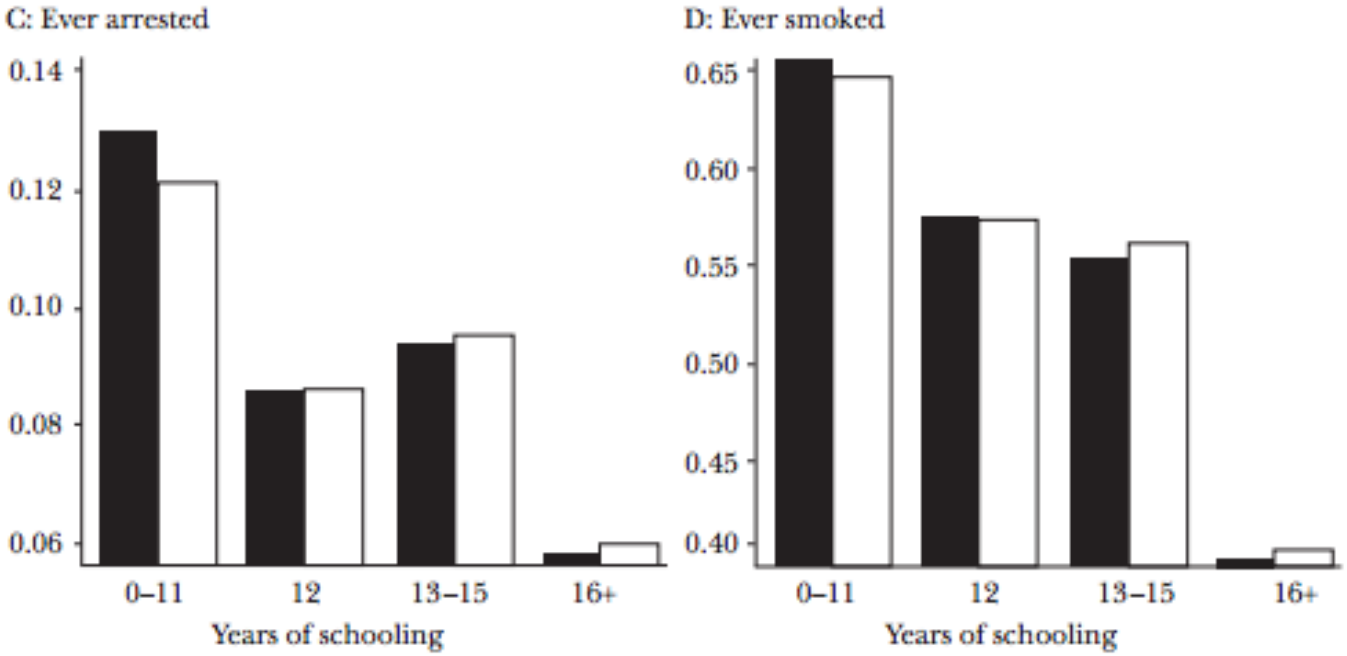


Returns to Education



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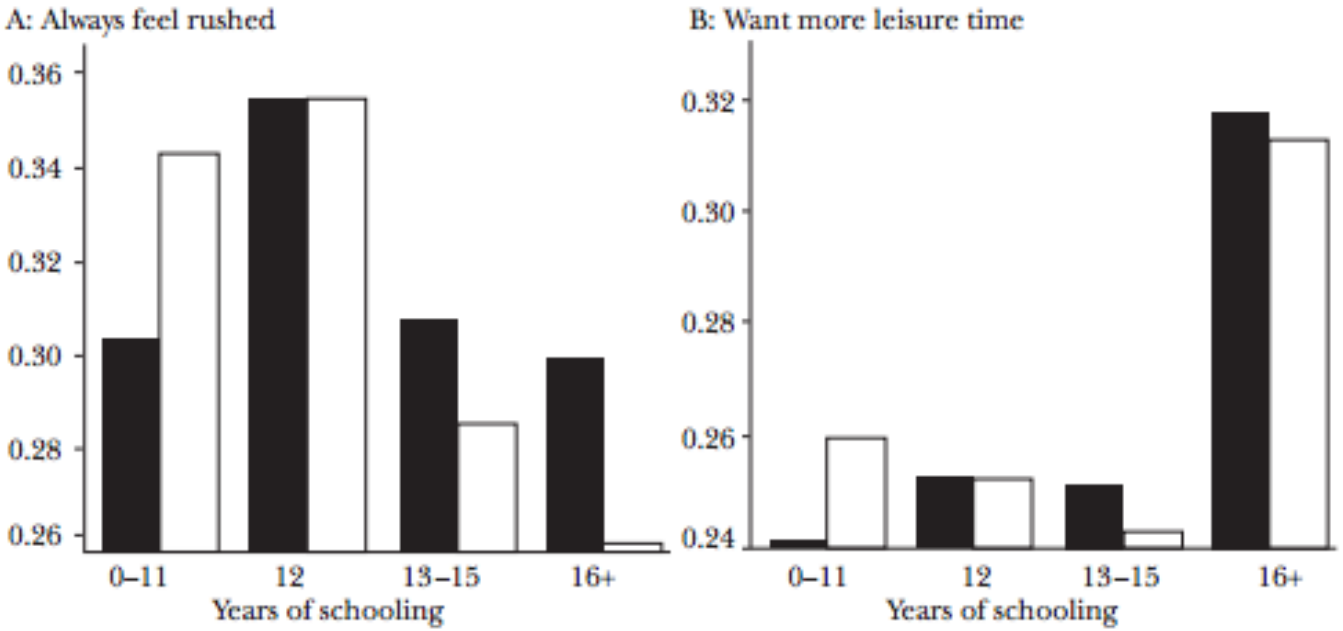
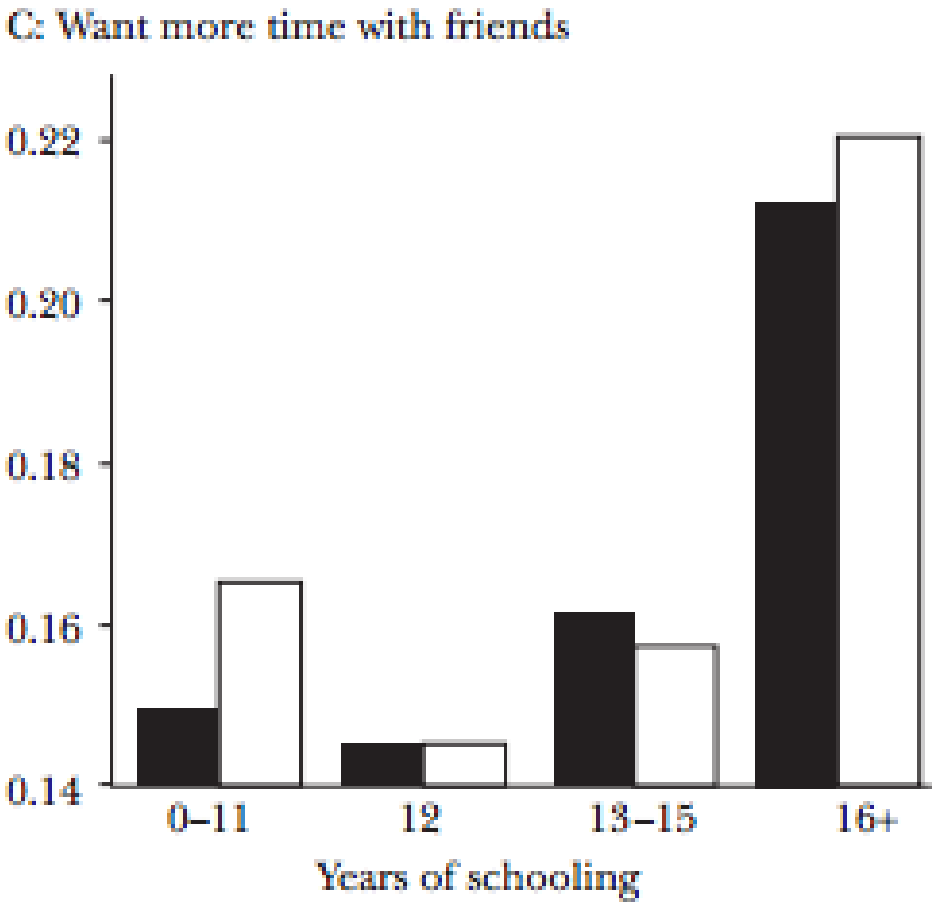


Returns to Education



Returns to Education

Milligan, Moretti, and Oreopoulos (2003) examine whether or not more educated people make better citizens:

- Education may effect the quality of participation and the level of participation
- They focus on the level of participation
  - High school graduation increases the probability of a voter voting by 0.34
  - This number is lower around 0.15 when conditioning on registration
  - Indicates registration for voting is a major channel for how education can alter participation
- They predict that voter participation could have been around 10% lower in 2000 had the number of high school graduates not risen since 1964

Returns to Education

Oreopoulos (2007) studies whether or not high school drop out behavior is consistent with discounting:

- Basically he calculates the return to schooling as being well above the returns from dropping out
  - Discounted at levels above 0.9 (like the typical social discount rate)
- Conclusion something is forcing dropouts to use a much lower discount factor
- He concludes based on survey evidence that this is not likely to be a general dislike of high school or concerns about risk aversion
- Whether this reflects emergency situations or psychology or both is unclear

Returns to Education

Table 3
OLS and IV estimates for effects of compulsory schooling on health and other social-economic outcomes

Country (schooling variable)	(1) Mean (<HS sample)	(2) OLS (<HS sample)	(3) IV (<Full sample)	(4) IV (<HS sample)
Health outcomes (ages 25–84)				
U.S. (total years of schooling)				
Physical or mental health disability that limits personal care	0.092	−0.014	−0.025	−0.029
		[0.0008]***	[0.0088]***	[0.0160]*
Disability that limits mobility	0.128	−0.020	−0.043	−0.031
		[0.0012]***	[0.0118]***	[0.0183]
UK (age left full-time education)				
Self-reported poor health	0.150	−0.037	−0.032	−0.019
		[0.0016]***	[0.0113]***	[0.0085]**
Self-reported good health	0.564	0.065	0.060	0.025
		[0.0021]***	[0.0155]***	[0.0115]**
Other social-economic outcomes (ages 25–64)				
U.S. (schooling variable: total years of schooling)				
Unemployed	0.064	−0.004	−0.005	−0.026
		[0.0003]***	[0.0050]	[0.0153]
Receiving welfare	0.067	−0.013	−0.011	−0.020
		[0.0005]***	[0.0046]**	[0.0102]*
Below poverty line	0.220	−0.023	−0.064	−0.085
		[0.0015]***	[0.0190]***	[0.0312]***
Canada (highest grade attended)				
Unemployed; looking for work	0.062	−0.009	−0.010	−0.013
		[0.0004]***	[0.003]***	[0.004]***
Below low-income cut-off	0.227	−0.038	−0.026	−0.019
		[0.0004]***	[0.0038]***	[0.0068]***
UK (age left full-time education)				
In labor force; looking for work	0.110	−0.030	−0.032	−0.020
		[0.0044]***	[0.0150]**	[0.0166]
Receiving income support	0.066	−0.025	−0.059	−0.031
		[0.0024]***	[0.0259]**	[0.0150]**

Notes: All regressions include fixed effects for birth year, region (state, province, Britain/N. Ireland), survey year, sex, and a quartic in age. The U.S. results also include a dummy variable for race and state controls for fraction of state living in urban areas, fraction black, in the labor force, in the manufacturing sector, female, and average age based on when a birth cohort was age 14. Similar province controls for Canada include fraction in urban areas, fraction in the manufacturing

Returns to Education

Table 4
The effect of schooling on subjective well-being least squares and IV estimates using UK and Irish changes in school-leaving age

	(1)	(2)	(3)	(4)
	Mean	OLS	IV	Initial observations
Life satisfaction (1 = not at all satisfied, 4 = very satisfied)	3.14	0.073	0.059	89279
		(0.0093)***	(0.0073)***	
Satisfied with life (1 = very or fairly satisfied, 0 = not satisfied or not at all satisfied)	0.86	0.040	0.0516	89279
		(0.0046)***	(0.0033)***	
Very satisfied (1 = very satisfied)	0.325	0.027	0.0235	89279
		(0.0023)***	(0.0135)*	
Happy (1 = not so happy, 2 = fairly happy, 3 = very happy)	2.14	0.044	0.0667	24565
		(0.013)***	(0.0093)***	

Notes: All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Data are grouped into means by age, sex, birth year, nation, and survey year. Huber–White standard errors are shown from clustering by nation. Single, double, and triple asterisks indicate significant coefficients at the 10%, 5%, and 1% levels respectively. Samples include all adults aged 18 to 65. See text for more data specifics.

Returns to Education

Table 5
Percent increase in present value wealth from one year of compulsory schooling

	(1)	(2)	(3)
	Discount rate		
	0.03	0.05	0.08
Percent change in present value wealth, OLS estimate	11.0%	10.8%	8.5%
Percent change in present value wealth, IV estimate	17.6%	16.9%	16.0%
Percent change in present value wealth, assuming 8% return	7.1%	6.4%	5.6%
Hurdle rate	1.20%	1.80%	2.60%

Notes: The regression specification follows Table 3 for the sample of U.S. males and with log annual income as the dependent variable. Estimated income profiles from ages 15 to 65 and estimated annual returns to compulsory schooling (17.4% for the IV estimate and 9.5% for the OLS estimate) are used to calculate present value changes in wealth using the discount rate indicated in the table. The overall change in wealth includes the expected income loss from attending school an additional year. The hurdle rate is the minimum annual return required to make an individual financially better off from taking one year of school instead of one year of work. It is based on the projected earnings profile for a 15-year old high school dropouts and uses the discount rate indicated in the table.

Improving Education

There is a great deal of discussion surrounding improving education:

- Improving dropout rates in order to get more benefit from the returns to education
- Improve the effectiveness of education
  - These average returns may not accrue evenly
  - Possibility of getting more out of the same number of years of schooling
- Interesting to note that there have been no serious calls to increase mandatory schooling recently

Improving Education

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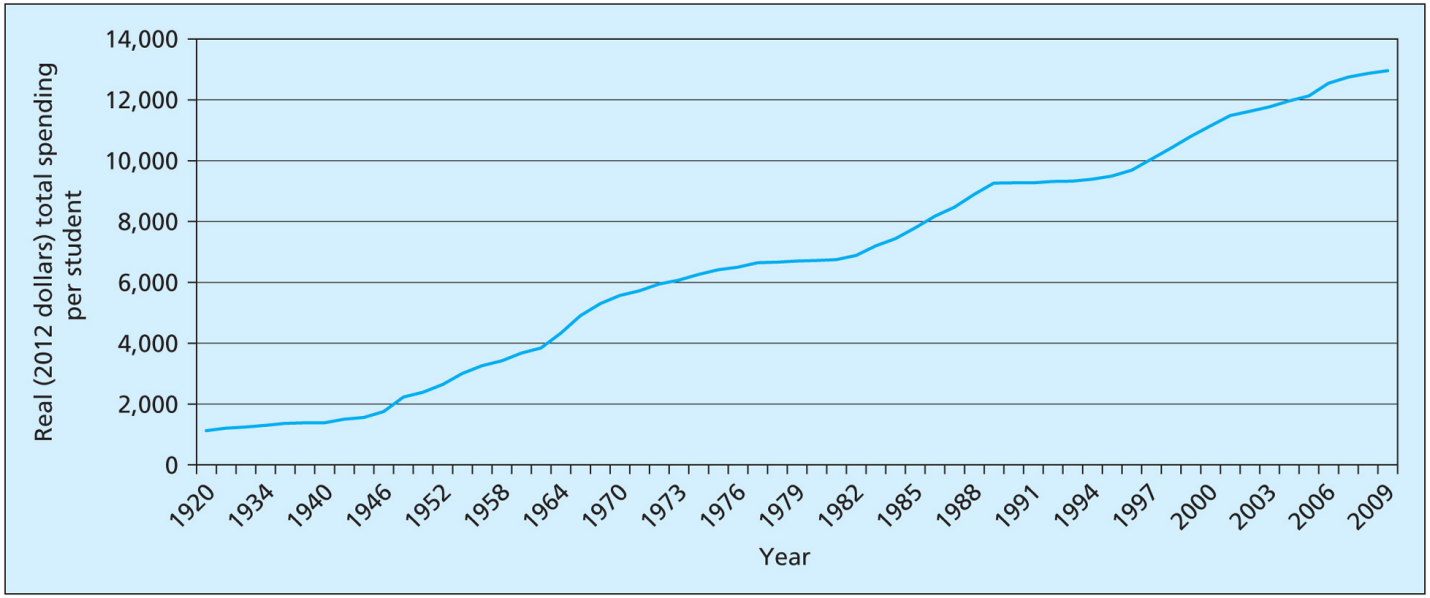

Improving Education

Should more be spent per student?

- On the one hand we have already made the price of education essentially $0
  - Ignoring opportunity/time costs and some fees
- This was argued to correct for the social return exceeding the private return
- So further spending has more to do with the quality of education
- Still some people do not graduate and spending may aid that problem

Improving Education

- Currently we spend $12,957 per pupil
  - That is raw total spending divided by total number of pupils in the U.S.
- In 1960 we spent $3408
- What have been the effects of this?

Improving Education

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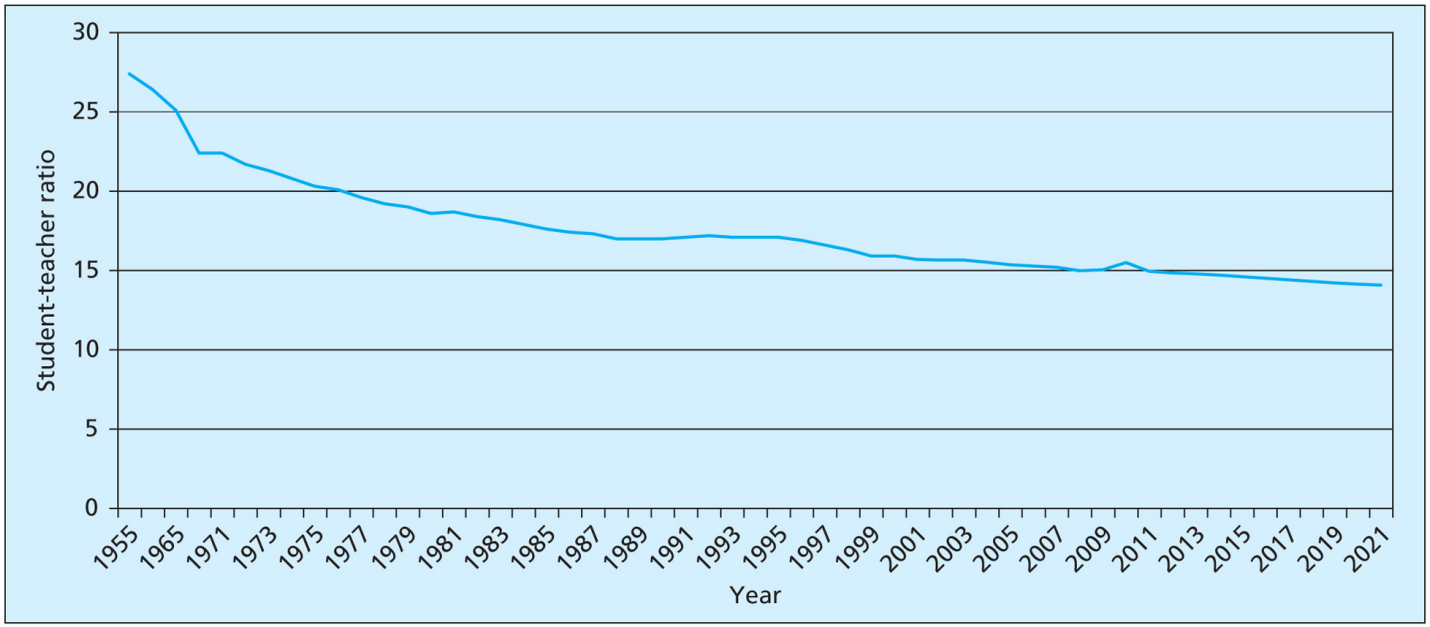

Improving Education

- Student teacher ratios have fallen from 26 to 15
- However this does not account for the increase in special education
  - Correcting for that leaves the current ratio at 19

Improving Education

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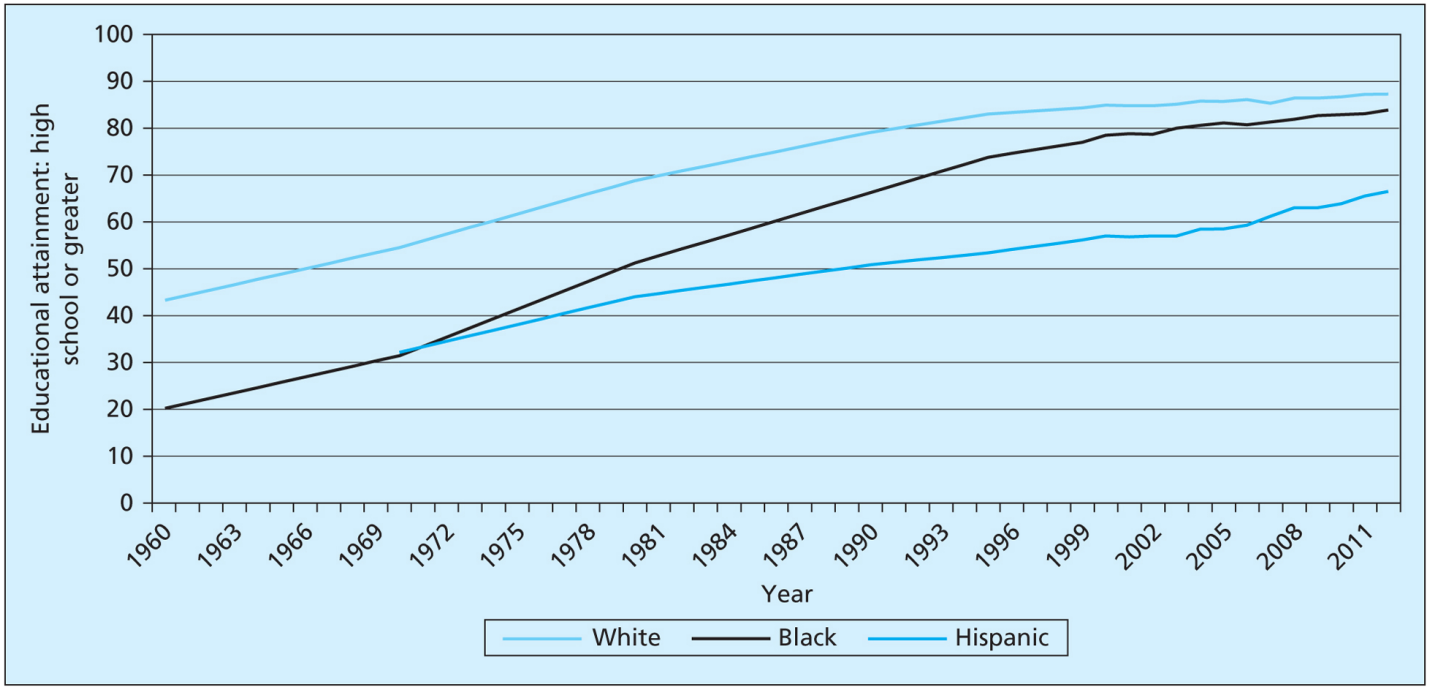

Improving Education

- Since 1960 graduation rates have doubled for whites and hispanics
  - Quadrupled for african-americans
- These numbers include GEDs
  - The return on GEDs is much lower than on actual high school diplomas
  - So it is unclear whether increases in this measure are giving the full returns calculated above

Improving Education

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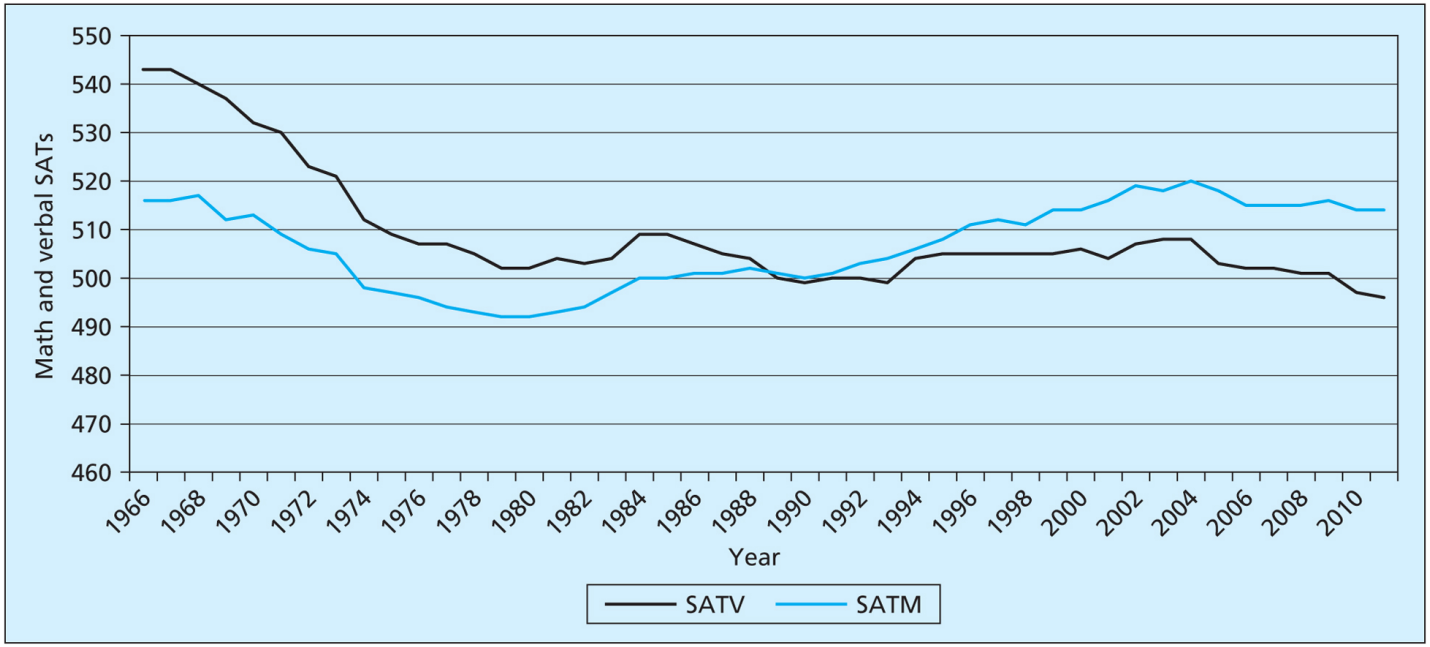

Improving Education

- SATV (verbal) and SATM (math) scores have been falling
- This may be accounted for by selection effects:
  - Now more students take the exam
  - Students may be less selective

Improving Education

Does spending per pupil actually improve any of these measures?

- If spending per pupil improves the resources like student teacher ration then we might expect it to
- However, there is a limited relationship between increases in student teacher ratios and test scores
- Teacher education and teacher experience also had a limited relationship

Improving Education

Test scores are not necessarily the best measure of success in education, what about earnings?

- More spending per student is associated with higher earnings over the lifetime
- The most important factors are outside of schools:
  - Family income and structure seem to play a bigger role

Improving Education

Public schools are a monopoly:

- (This is not the case in every community)
- This means that the administrators have a reduced incentive to fix problems
- Privatization and school voucher programs are proposed to deal with this
- Studying their effects is difficult since there are significant selection effects
  - Parents that care more about education self-select into these programs
- Both seem to have only a modest effect on outcomes when this bias is controlled

Improving Education

Tenure and teacher pay:

- Economists have found the teacher quality does matter
  - Some teachers are better than others
- Merit base pay proposals aim to reward these good teachers
  - Also allow tenured teachers to be fired for poor performance
- The counter-argument is that principals will not really use performance but personal preference

Improving Education

Tenure and teacher pay:

- It is clear though that pay will need to rise to attract talented people back to teaching
  - There is a documented trend of the most talented women (and men) choosing more and more not to become teachers
  - Also a trend of less talented women moving into education
- Specifically, Hoxby and Leigh (2004) look at changes in teaching employment broken down by SAT score
  - Share of teachers in the highest 1/6 fell from 5% to 1%
  - Share of teachers in the bottom 1/6 rose from 16% to 36%

Improving Education

Tenure and teacher pay:

- Pay of teachers has compressed so that most teachers make close to the average accross all aptitude groups
  - This effect explains 80% of the decline of top aptitude teachers in education
- More low aptitude women (and men) have been graduating from college
  - This explains most of the change in the bottom aptitude levels
- Traditionally pay parity (with men) is blamed
  - But all aptitude levels were affected by this across the economy
  - Leaving the pay compression to play a major role in the changes in aptitude

Improving Education

Tenure and teacher pay:

- Intuitively (and in the data) aptitude as measured by SAT scores is only a weak predictor of student test scores
- However this does point to a problem in pay of teachers
  - or in how they are trained
- How to solve this problem while avoiding new issues is unclear