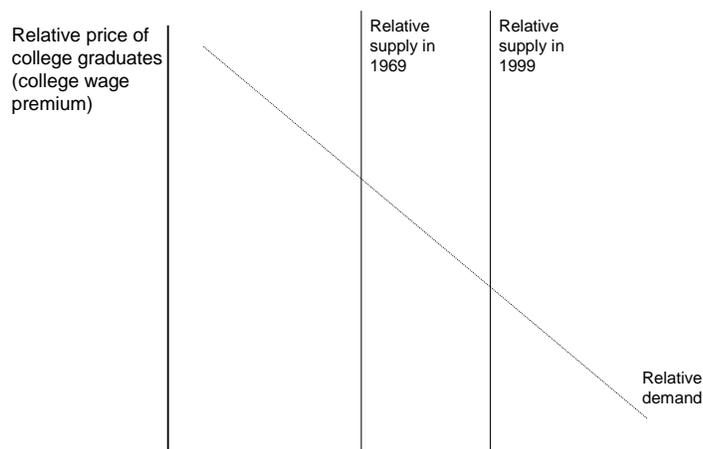
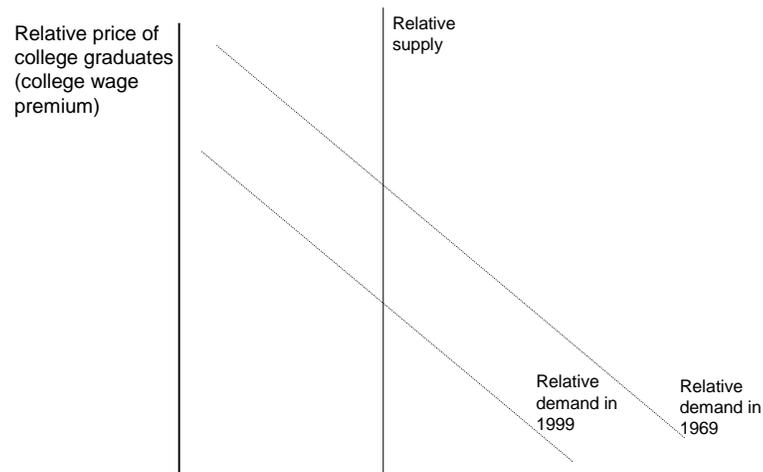


Answers to the First Midterm

- 1) (General Comment – this question could have been improved by explaining more carefully that unless otherwise noted, all answers should be based on the data for the Staten Island Economy – not the U.S. economy).
- a) Increasing economy-wide labor productivity (due to capital deepening and technical change) can cause wage levels to rise throughout the economy. We discussed this in the beginning of the course when we examined whether better educational attainment in the population was an important determinant of productivity growth – the determinant of rising living standards (it wasn't). Labor productivity growth can create a situation like that shown in the data for this problem: high school and college wages can both increase in absolute value even as they change *relative* to each other.
- b) The question refers to the data for 1969 and 1999 you were given in the problem. The fact to explain is why, over the 30 years, high school and college wages have become relatively closer. We know from 14.01 (or the secretary example in class) that this closing of the wage gap has two main explanations.
- i. A supply-side explanation is that the number of college graduates has grown faster than the number of high school graduates – i.e. the relative supply of college graduates has increased - while the demand for each group remains stable.



- ii. A demand –side explanation is that the relative demand for college graduates falls while the relative supplies of the two groups remain stable.



- c) To distinguish between these two scenarios, you would need data on the supply of college and high school graduates to see whether the college graduates grew at a faster rate (supply side explanation) or slower rate (demand side explanation) than high school graduates.
- d) This question was meant to refer to Staten Island, not the U.S. Thinking about college as investment involves both the benefits and costs of additional education. Due to the narrowing wage gap, the benefits must have narrowed. But college could still be a better investment if the cost of education had sufficiently fallen, either because tuition fell or because there was more financial aid, etc.

2)

a) In class, we have been discussing skill-biased technical change (SBTC) as it changes demand for college graduates versus high school graduates. But in the same way, SBTC can change demand for *among* college graduates with different skills. For example, the rapid development of information technologies might increase the demand for computer science majors relative to literature majors, widening the wage gap between them. This kind of phenomenon could account for growing wage variance among college graduates. At the same time, technology has limited job opportunities for less skilled workers by eliminating rules-based jobs and so it could

have produced a stable (or even declining) variance of wages for high school graduates.

b) As long as college graduates are more skilled on average than high school graduates, a college degree still has some signaling value. It does, however, have less signaling value than it used to have because of the variance of skills among college graduates.

3)

a) The coefficient means that in industries where the proportion using computers went up by 1% more, the proportion of workers with a college degree went up 0.152% more. We know that this coefficient is significant because it is more than two times its standard error.

b) One possible answer is that the increase in college-educated workers caused the increase in computer usage. For example, suppose that some industries are hiring more college labor for independent reasons, and college workers like to use computers. The computers are a perk for the college-educated workers that the industry would be hiring in any case.

Alternatively, some third factor could be causing both the increase in computer usage and the increase in college labor within an industry. Maybe some industries changed their organizational structure, e.g., to make it less centralized. The organizational change could have made it more profitable both to increase demand for college labor and to buy more computers (but the former would have happened even if computers weren't available).

You didn't need to talk about either of these specific scenarios; you just needed to explain why a significant regression coefficient isn't necessarily indicative of a cause and effect relationship.

c) The big thing to notice here is that the change in computer use is always measured from 1984-1993; it might have been clearer to put 1984-1993 superscripts on all of the ΔC_i . Notice that there is a significant relationship between the change in computer use from 1984-1993 and the change in college employment during the 1960's and the 1970's. That can't be causal, because the change in computer use is happening after the changes in labor demand. Since we observe a positive regression coefficient when we know it can't be causal, this should make you suspicious of interpreting the original regression as causal.

That was the main point. But you might also notice that the coefficients on computer use are going up over time; they're much higher in periods where it would make sense to interpret them as a causal effect. So perhaps a part of the original coefficient is causal after all. (It wasn't necessary to mention this part.)

Some of you thought that the change in computer use was measured over the same period as the change in college employment in each regression. This got

partial credit depending on what argument you made from there. One reasonable argument is that the regression relationship seems to be getting more important as computers have become a more important part of the economy. You might have thought that the causal effect of greater computer use should also be bigger when computers are important (in the 1960's, other changes swamp the introduction of computers in determining demand for college labor). So the pattern of regression coefficients seems to mirror the pattern of causal effects that we would expect, and we should become more confident in the original regression.

4)

- a) The basic idea is that you want to do a difference-in-difference design. That is, you find some states that increased their level of compulsory schooling over a period of time (say 1920-1930) and another set of states that didn't. You can figure out how much schooling people got in each state at each time by using the information on age and state of birth (assuming most people go to school where they were born). Then if we define the following,

A = average years of schooling for people in high school in 1930, born in state that tightened its law

B = average years of schooling for people in high school in 1920, born in state that tightened its law

C = average years of schooling for people in high school in 1930, born in state that didn't tighten its law

D = average years of schooling for people in high school in 1920, born in state that didn't tighten its law

one possible difference-in-difference estimator is $(A-B) - (C-D)$.

You could also say that you would regress years of schooling on the minimum schooling-leaving age in a person's state of birth when they were in high school. However, it is important in this case to say something about controlling for a person's state of birth and for a person's age (equivalent to the year they entered high school). If you don't control somehow for state of birth, you're saying that if schooling levels are always higher in (say) Massachusetts, and compulsory schooling requirements are high too, then the latter causes the former. That could very easily be false: a pro-education culture might lead people to go to school for longer *and* to require others to stay in school for longer too (by making the laws strict). If you don't control for age, you're saying that the increase in schooling levels from one generation to the next is due to the tighter compulsory schooling laws—but all sorts of other things are changing over time too.

- b) This question was easier if you remembered the Duflo paper on school construction in Indonesia, because the idea is almost identical. (Few people seemed to make the connection, though.) The important part was to note somehow that the changes in compulsory schooling laws might be a good source of “random” variation in years of schooling, and we could then use that random variation to see whether people’s earnings increased.

One way to do this is to set up the same kind of difference-in-difference design as in part (a). That is, let

A' = average earnings (or log earnings) for people in high school in 1930, born in state that tightened its law

B' = average earnings (or log earnings) for people in high school in 1920, born in state that tightened its law

C' = average earnings (or log earnings) for people in high school in 1930, born in state that didn't tighten its law

D' = average earnings (or log earnings) for people in high school in 1920, born in state that didn't tighten its law

The difference-in-difference estimate of the effect of tighter laws on earnings is $(A' - B') - (C' - D')$. That's a good start (worth most of the 10 points), but to get the effect of *schooling* on earnings, you want to divide this by the effect of tighter laws on schooling. So your estimate would be

$$\frac{(A' - B') - (C' - D')}{(A - B) - (C - D)}$$

Alternatively, you could say that you would use instrumental variables. You would regress a person's earnings (or log earnings) on their years of schooling, and you would instrument years of schooling by the minimum school-leaving age when the person was attending high school. Again, it is important to say you would control for state of birth and age, for the same reasons as in (a).

- c) This one was very tricky. The thing to notice is that tighter compulsory schooling laws increase years of education for everyone in my cohort, not just for me. The signaling theory is all about how if I have more schooling than other people, employers will conclude that I'm more productive and pay me more. But insofar as stricter laws increase everybody's schooling at the same time, employers won't conclude anything new about me, and I won't get paid anything more. So if the return to education is all about signaling, then we should estimate something pretty close to 0 in part (b). However, this *underestimates* an individual's return to education: the individual could

convince employers that she has higher productivity (at the expense of other people in her cohort) by staying in school for longer.