

# CM 2: DISCOUNTING: HIGHER EDUCATION AND CHILDREN (1/13/17)

## MOST, BUT NOT ALL, OF WHAT YOU SHOULD KNOW

1. What is the difference between the value of something and its price?
2. What is a "shadow" price?
3. Why is it important to try to place a dollar value (an implicit price) on statistical life extension?
4. What are the reasons that economists talk about statistical life extension rather than the value of a life?
5. What are the differences between explicit and implicit costs and benefits?
6. Which items listed in the WWU Bulletin are costs of attending WWU?
7. What, for most students, is the largest cost of a university education?
8. What are the benefits of a university education?
9. How do we calculate the rate of return on an investment?
10. What is compounding and what, if anything, does it have to do with inflation?
11. What is the Rule of 72 and what has it to do with compounding?
12. What is discounting and how does it relate to compounding?
13. Why is it necessary to discount the flows of expenditures and incomes over time?
14. Why is a student loan like a mortgage?
15. What are the two problems with the USDA estimate of the cost of a child?

# 1. SHADOW PRICES

*"A cynic is a man who knows the price of everything, and the value of nothing"*  
Oscar Wilde *"Lady Windermere's Fan"* 1892

## 1. VALUE VERSUS "SHADOW" PRICE.

1. Oscar Wilde's definition of a cynic fits an economist well.<sup>1</sup> Although microeconomics was once called the theory of value<sup>2</sup>, what economists do is to attach prices to economic activities. The "value" of something is its intrinsic worth, but what you value I may not, and your valuations will be different because they will involve different value judgments than mine. An economist cannot assess the "value" of something because that would involve her in making a value judgment. Instead she seeks a money price that reflects other people's valuations – how much they are willing to pay is a proxy for the "value" that they attach to the marginal<sup>3</sup> unit. Some of those prices are ready to hand, there is already a market price attached to the activity, but sometimes the economist has to estimate a price of an activity, estimate or impute a price. Such a notional price is said to be a "shadow" price or just an implicit price. It is a way of attaching a monetary value to something that is not sold in a market. (Economics requires more than an ability to do some elementary mathematics. A good economist is someone who can come up with creative solutions to these problems of imputing values.)

2. For example, when national income accountants attempt to estimate how much of your house you use up in a year they use what you could rent the house for as an estimate (sophisticated guess) of the housing services it provides to you as owner-occupier. The obvious number to use is the annual rent your house would generate if you rented it rather than occupied it yourself.

If an economist is asked to estimate the cost of commuting in Seattle she will look for two people doing the same job, but who have different commuting times. She will assume that the person with the longer commute will have to be

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<sup>1</sup> My favorite definition of an economist is that she is the sort of person who comes onto the battlefield, after the battle is over, and bayonets the wounded. (Someone who has the courage to put them out of their misery.)

<sup>2</sup> And later the theory of price, a terminology still used by the economics department at the University of Chicago.

<sup>3</sup> If you look back at CM1 you will see that we have already defined marginal there.

compensated for the time wasted sitting in traffic jams, and she will use the higher wage per hour as her shadow price of commuting.

3. My ex-colleague, Julia Hansen, did a study in which she estimated shadow prices of the value of the view from a house in Bellingham. She looked at how the prices of essentially identical houses vary with the quality of the view from the house – overlooking the San Juan islands or down Lake Whatcom or the back of Walmart – by rating the views from 7,000 houses on a scale from 5 (gorgeous view) to 1 (lousy view) and then holding constant all of the other things that affect the price of the house – the size of the house, the number of bedrooms, the number of bathrooms, the age and composition of the roof, the type of heating system, access to schools and shopping etc., etc. She estimated that the very best views added 120% to the price of the house. So, if there were two otherwise identical houses, A with no view and B with the best view in Bellingham, and if A sold for \$750,000 then B would sell for \$1,650,000

4. The Northern Spotted Owl is an endangered species in Washington (although there are more of them in Oregon and Northern California). At the beginning of the first Clinton Administration there was a policy debate about whether logging should be allowed in the “Old Growth” forests of the Pacific North West. The policy argument focused on employment issues but conservationists argued that logging would destroy the habitat of the Northern spotted Owl, an indicator species. My ex-colleague, Dan Hagen, (who is married to Julia Hansen) did a very sophisticated study in which he sent an extremely carefully designed survey to randomly selected households in the US and asked them how much they would be willing to pay – each year – just to know that there were Old Growth forests in Washington. This was a way of pricing or valuing the “existence” of those forests – it had nothing to do with using the forests, or visiting the forests in the future, all of which can be “valued” by environmental economists. He found that if he multiplied the number of US households by his most conservative estimate of the existence value of the forests that the dollar existence value far outweighed the value of the cut timber. And, as noted, the existence value is only part of the value of the forest. The Clinton Administration allowed timber firms to log some of the publicly owned Old Growth forests because the logging kept loggers employed – in jobs that would not exist if the US Forest service did not supply the industry with a subsidy by cutting roads into the forests so that the lumber companies can access and transport the timber.

5. Economists argue that we cannot just refuse to talk about the value of a human life, although economists would argue that we should rephrase this as

the value of statistical life extension<sup>4</sup>. If we refuse to place a “shadow” price on human lives then we are reduced to claiming that either, a life is infinitely valuable, and you do not behave as if you believe this even if you say that this is what you believe, or that a life is valueless, which is equally absurd. In practice government agencies have to choose between implementing policies that involve the probability that different numbers of lives will be “saved”. For example, straightening out a dangerous curve in the road. It surely would make sense for the government agencies to all use the same dollar value but as you will see if you read the links they do not do so. The problems of placing a shadow price on statistical life extension are fascinating but I do not want to go into this issue at this point; here are some links that you can follow up if you are interested.

Here is a link about the Northern Spotted Owl

<http://www.nytimes.com/2011/07/01/us/01owls.html?pagewanted=all>

And here are three links on Statistical Life Extension

[http://web.archive.org/web/20111015082515/http://stats.org/stories/2011/value\\_statistical\\_life\\_jun27\\_11.html](http://web.archive.org/web/20111015082515/http://stats.org/stories/2011/value_statistical_life_jun27_11.html)

<http://conversableeconomist.blogspot.com/2014/11/the-origins-of-value-of-statistical.html>

<http://www.motherjones.com/blue-marble/2011/07/statistical-value-human-life>

## 2. THE COSTS OF HIGHER EDUCATION

### 2.1 HOW MUCH DOES IT COST TO ATTEND WWU?

1. In CM1 we saw that just as there are explicit costs (dollars that you pay), there are also implicit costs (opportunity costs that are not actual dollar expenditures but are nonetheless costs, you have to give up something). But implicit costs should be treated on a par with explicit costs. For example, when you buy a textbook then you have an explicit cost (the payment to the bookstore) and an implicit cost (the value – shadow price – or cost of the time spent acquiring the book).

2. Only some of the items listed in the University Bulletin are true costs of attending WWU. Tuition and Fees and Books and Supplies are explicit costs (ECs), say about \$10,000 per year or \$40,000 over four years (although the costs

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<sup>4</sup> Economists talk about statistical life extension because they want to keep the discussion as dispassionate and objective as possible. So we talk about an abstract statistical person not your Mom and we acknowledge that we all eventually die – even you will croak someday – and so we only extend lives we do not save them.

in years 2-4 should be discounted when making your human capital investment decision). On the other hand, as economists love to say, housing and meals, transportation, and personal expenses (\$55,000) should only be included as costs if they are specific to WWU.<sup>5</sup>

3. For most students the largest cost of spending four years at WWU will be the lost earnings and benefits (health insurance and contributions to pension plans), say \$30k per year or \$120k over four years – again not discounted. \$30k is a conservative estimate for what you would earn in a full time career job given your superior performance in high school; if you work 40 hours per week for 50 weeks during the year then your annual hours of work would be 2,000 – most people work less than this, and some of us work more than this – and that would mean that you were making \$15 an hour. Your lost earnings, although they are expressed in money terms, are not actual money expenditures and so they are implicit costs (ICs). Note that the ICs vary from student to student depending on their abilities. Think of Mick Jagger deciding to be the lead singer of a rock band, dropping out of the LSE and giving up the chance to be an accountant. (As all Monty Python fans are aware accounting is the most boring subject ever devised to torture students, and if you become an accountant you will become an unutterably boring person! 😊)

So  $TC = EC + IC = \$40,000 + \$120,000 = \$160,000$  over four years (again not discounted) versus the WWU estimate of \$95k (a difference of 40%).

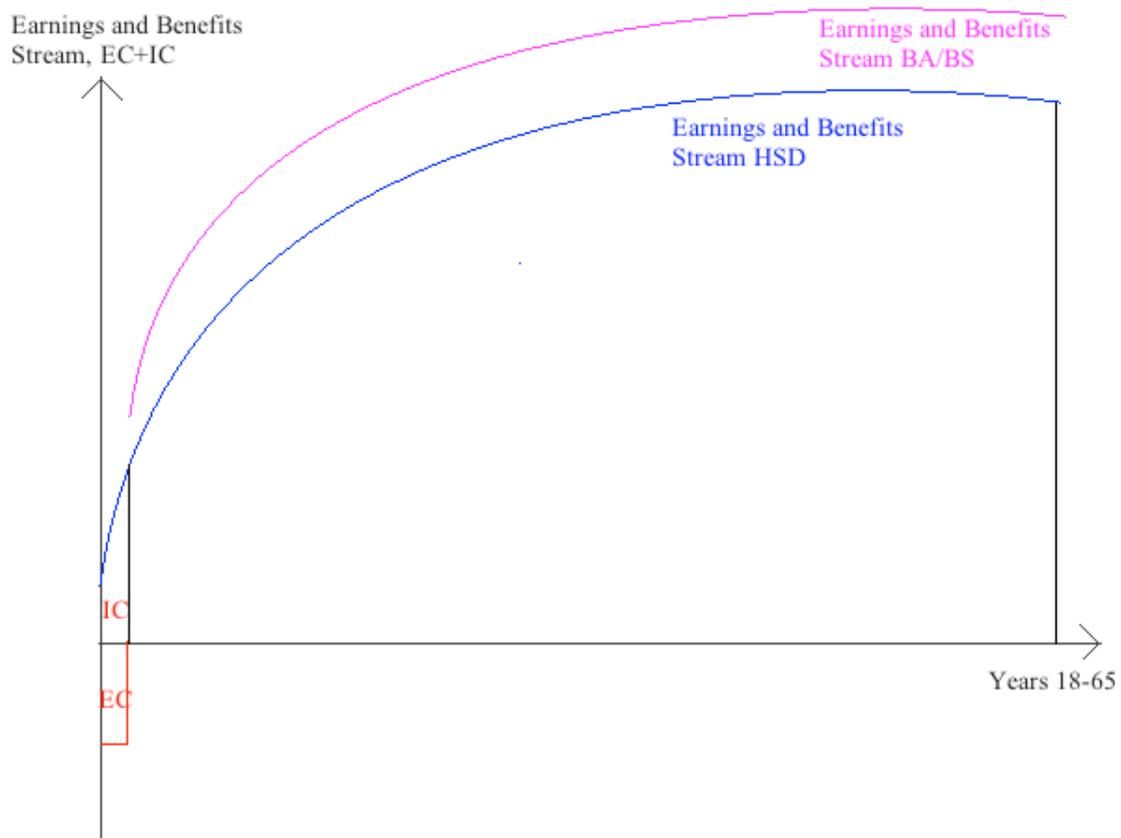
<http://www.celebritynetworth.com/articles/entertainment-articles/richest-rock-lead-singers-world/>

## 2.2 WHAT ARE THE BENEFITS OF ATTENDING WWU?

1. Benefits also come in two flavors: explicit benefits (EB) that are benefits that we receive in monetary form, and implicit benefits (IB) such as psychological gains that are not received in monetary form. The EB from getting a degree are the higher lifetime earnings and health and pension benefits that you receive because you have an undergraduate degree. Just attending a community college for a year will raise your lifetime earnings relative to a person with a high school diploma. The IBs are the psychological benefits that you get from being better educated, and the intangible but glorious benefits that you get from listening to me droning on for hour after hour!

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<sup>5</sup> Some of the money that we spent in the wars in Iraq and Afghanistan would have been spent anyway. Soldiers have to be fed and housed wherever they are; ordinance has to be used in training and some personnel die in training. Only expenditures specific to the wars should be counted in their costs.



2. In the diagram the ECs are the actual money costs of attending WWU, and the ICs are forgone earnings relative to someone with a high school diploma. The Blue line is the earnings and benefits stream of someone who enters the labor force at 18 having completed high school, and the magenta line is the earnings and benefits stream of someone who completes an undergraduate degree and enters the labor force at age 22. **These benefits should be discounted.**

Unemployment rates and median weekly earnings by educational attainment in 2011 are available in this link:

<http://www.frbf.org/economic-research/publications/economic-letter/2015/january/wages-education-college-labor-earnings-income/>

[http://www.bls.gov/emp/ep\\_chart\\_001.htm](http://www.bls.gov/emp/ep_chart_001.htm)

This link quotes lifetime earnings of people with only a high school diploma, \$1.3m versus \$2.27m with a degree (I don't know if these figures include benefits such as contributions by your employer to your 401k.)

<http://www.usnews.com/education/best-colleges/articles/2011/08/05/how-higher-education-affects-lifetime-salary>

<https://www.newyorkfed.org/research/college-labor-market/index.html>

This link provides data on earnings according to major. Clearly the return to math and IT are higher than to social and helping skills. Choice of major may be more important than choice of university except for very prestigious (and expensive) colleges the so-called Ivy League.

<http://www.payscale.com/best-colleges/degrees.asp>

If you are interested there is a lot more information in these links:

<https://www.princeton.edu/futureofchildren/publications/journals/article/index.xml?journalid=79&articleid=580>

<http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/collegepayoff-summary.pdf> one, two, three and four

## 2.3 WHAT IS THE RATE OF RETURN ON YOUR INVESTMENT?

1. To calculate the return to your human capital investment we must convert *future* dollars (whether spent or earned) into their *current* dollar equivalents. *A dollar received in the future is worth less than a dollar received today* because *the future dollar cannot be invested today and so we forgo interest*. This has **nothing** to do with inflation. We cannot just add dollars spent in years one, two, three, and four because they are paid in dollars with different values, and we cannot add forgone earnings and benefits in year one to those in year four because the dollars received have different values today.

2. **Compounding:**<sup>6</sup> Say you invest \$100 at a 10% rate of interest (a reasonable approximation to the nominal return on stocks 1926-2000 although the rate of return in the 21<sup>st</sup> century has been lower) at the beginning of year 1. At the end of the year you get your \$100 back plus \$10 interest = \$100 + \$10 = \$110. You then reinvest the \$110 for a second year at the end of which we have \$110 plus 10% interest on \$110 = \$11. Therefore your initial investment of \$100 is worth \$121 at the end of year two. You now invest the whole \$121 for another year at 10%, then at the end of the year you have \$121 plus \$12.10 in interest making a total of \$133.10 at the end of year three. If you invest the \$133.10 for another year you would have \$133.10 + \$13.31 = \$146.41. Therefore your \$100 on day 1 of year 1 is worth \$146.41 at the end of four years if you can earn a 10% rate of return.

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<sup>6</sup> Compounding is a form of exponential growth.  $2^2 = 4$ ,  $2^5 = 32$ ,  $2^{10} = 1,024$ ,  $2^{15} = 32,765$ ,  $2^{20} = 1,048,576$ . Continuous compounding uses the constant  $e = 2.7182818284\dots$

3. But these returns ignore inflation; those future dollars have less purchasing power than they do today because the average price level increases because of inflation. A very rough rule of thumb would lower nominal returns by three-percentage points to account for historical inflation; that is from 10% to 7%, although inflation in recent years has been below 2%.

4. **The Rule of 72** is a useful way to approximate doubling times when compounding. [Anything growing at a compound rate of 1% will double in value in approximately 72 years \(periods\).](#) Therefore something growing at 10% will double in approximately 7.2 years. Say you invest \$1,000 out of your first year's salary. Your \$1000 will be worth \$2,000 after 7.2 years (x2), \$4,000 after 14.4 years (x4), \$8,000 after 21.6 years (x8), \$16,000 after 28.8 years (x16), \$32,000 after 36 years (x32), \$64,000 after 43.2 years (x64). If you join the labor force at 22 and retire at 65 you will have worked for 43 years and so that \$1,000 you saved from your first year's salary will have grown to almost \$64,000 *if* you get a 10% rate of return. If the rate of inflation is 3% over that period, then your real rate of return will only be 7% with a doubling time of 10.29 years and so your \$1,000 will grow to about \$16,000 of real purchasing power by the time you retire.

If you invest \$1,000 at the beginning of every year for 43 years at a 10% rate of interest then you will end up with \$592,000; \$43,000 invested and \$549,000 of interest.

Notice how compounding starts slowly but builds up rapidly towards the end; in the first 7.2 years you added \$1,000 but in the last 7.2 years you added \$296,000.<sup>7</sup> This is why people with high incomes who also save a significant part of their income, become wealthy and why the wealthy become wealthier if they invest sensibly.

5. **Discounting is the inverse of compounding.** If you are paid \$64,000 in 43 years time how much is that worth today if the interest rate is 10%? The answer is \$1,000 because \$1,000 will compound to \$64,000 in 43 years if the rate of return is 10%. Therefore [we have to discount future earnings and benefits to get Present Values \(PV\) – the amount that we would need to invest today, at a given rate of interest, in order to get a certain Future Value \(FV\).](#)<sup>8</sup>

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<sup>7</sup> An invasive weed doubles its coverage of a lake every year. When the weed has covered half the surface of the lake, how many years will it take for it to completely cover the lake?

<sup>8</sup> If this sort of thing turns you on take an introductory finance course. There are, of course, simple formulas for calculating Present and Future values.

Notice that compounding is a multiplicative process and increases things, whereas discounting is a division process and reduces things.

6. If you convert the flow of earnings and benefits into a PV and the four years' explicit cost into a PV then you can work out a rate of return on your investment – the \$40,000 you pay to WWU. What your rate of return will be will depend on how much you earn over your lifetime, but currently the average college student is doing better than the stock market.

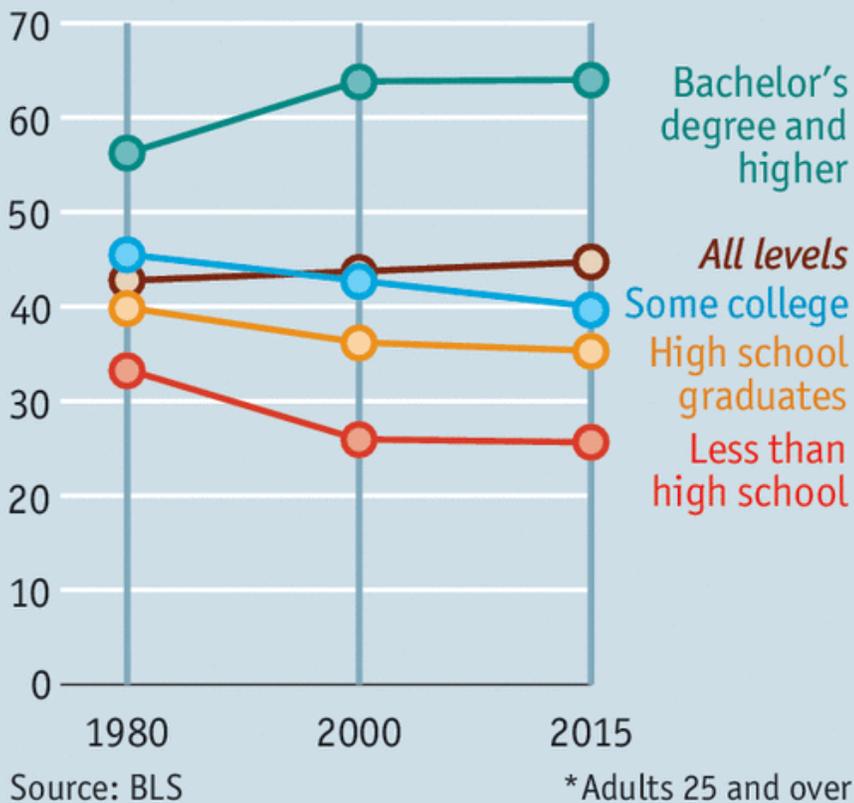
<http://www.aei.org/article/education/higher-education/is-college-worth-the-investment/>

A rate of return is the ratio of what you gain (what you end up with minus what you started with) to what you started with. If you started with \$100 and a year later you have \$110 (\$10 of interest) then your rate of return is  $(\$110 - \$100) / \$100 = 10 / 100 = 0.10$ . We usually multiply the decimal by 100 to get a percentage return:  $0.10 \times 100 = 10\%$ .

7. Benefits should include the implicit benefits you get from the education process and the future benefits of being educated (a better spouse?). Because of "credentialism" you may need to go to university in order to get an interview for a job that once required only a high school diploma (when a high school diploma was a high school diploma!)

## The gap

Median annual earnings, by educational level\*  
2015 prices, \$'000



Economist.com

## 2.4 WHAT ABOUT LOANS?

1. Most students finance all or part of their total expenditures while at university by taking out loans. You should think of the loan as a way of spreading out the cost of an expenditure over a longer time period. A student loan is just like a mortgage or a car loan. You do not hear people complaining about the burden of their car loans or the burden of their mortgages, although there are frequent complaints about the burden of student loans: "I left college owing \$100,000". Poor baby!

2. The way to think of a student loan is that you are borrowing at a lower rate of interest in order to buy an investment that will yield a higher rate of return. The trick is to get the higher ROR, which involves three things: choosing the right major, getting an excellent GPA, and getting into the right school. The last of

these three is probably only really important if you extend your higher education into graduate work, law school, MBA's, and medical school. Pay careful attention to my "Grandfatherly Advice" and my advice on how to study in the Syllabus.

3. Shop around for the best loans – do research using your web browser. The Federal government finances 90% of all student loans. The rates on these loans are tied to the rate of interest on 10-year Treasury notes. Most rates are around 4%, slightly higher for post-graduate loans. If you borrow \$100,000 to cover all your expenses for your four years at university and you repay this over 10 years your total repayment will be about \$120,000 = \$100,000 (Principal) + \$20,000 (Interest) – your monthly payments would a bit more than \$1,000.) Over the 43 years you will be in the labor force you will earn roughly \$1,300,000 more than if you just had a high school diploma. That \$1.2m should be discounted to get a PV.

## 2.5 TOO MANY GRADS?

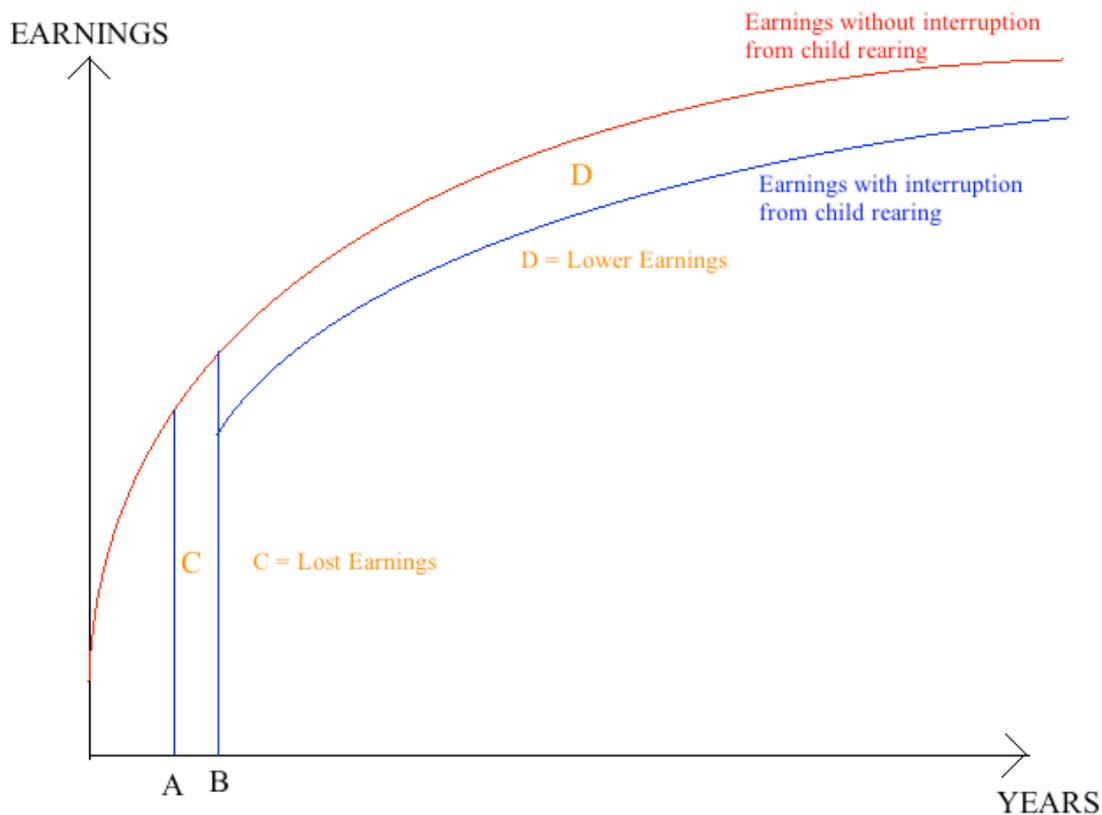
1. This is my personal opinion. Treat it with skepticism.
2. In March 2017, for the first time, more than 30% of U.S. adults 25 years and older had at least a bachelor's degree (in 1998 there were less than 25%). Approximately 70% of high school graduates spend at least some part of their life in higher education. Slightly more than 36% of 18-24 year olds were in college in 2009. When I went to the LSE slightly less than 11% of the age group attended college. (I paid no fees and had a grant of about \$25,000 a year for three years.)
3. Is it necessary to keep so many young people out of the work force when many of them do not have any real academic interest in what they study? I think that anyone should be more than adequately educated after 12 years of schooling. I believe that most of the money spent on higher education would be better spent on improving K-12 and in providing specialized technical training for the average person.

## 3. THE COSTS OF CHILDREN.

1. Your first child may be the most expensive thing you ever buy: \$240,000 expenditures over 18 years for a middle income family, which does not include prenatal costs or college costs, say, about \$325,000 over 22+ years. The data is usually taken from USDA calculations; **they are not discounted** and **they only include the EC.**

2. IC would include the time costs of raising children plus the psychological wear and tear associated with "terrible twos" and "teen angst". Your parents are probably happier because they have finally got you out of the house.

3. The most important IC is lost earnings and benefits when a parent – traditionally, and still usually, the mother – leaves the labor force to raise the child or children. In 1950 only about 19% of mothers with children under 6 were in the labor force and about 39% of mothers with children 6-17; in 1970 the percentages were 30 and 49; in 1980 they were 45 and 62; in 1990 they were 59 and 74; in 2000 they were 63 and 77; and in 2011 they were 65 and 78 (there has been a decline in labor force participation by women with children because of the Great Recession and its aftermath). The US is the only industrialized country that does not have federal laws entitling women to paid maternity leave.



4. If you leave the labor force for five years (it used to be an average of twelve years), A to B, then you lose earnings and benefits during those years (C), and when you return to the labor force you have lost five years seniority and your human capital will have depreciated and so your earnings/benefits trajectory will

be lower than someone without a career gap (D). These losses should be discounted too. They are probably the largest cost of having children.

5. [The cost of a child is the discounted explicit expenditures on food, clothing, etc., plus the discounted lost and lower lifetime earnings.](#)

6. [Children also generate benefits.](#) They can look after you when you are too old to look after yourself – a burden born disproportionately by daughters and daughters-in-laws.<sup>9</sup> In Less Developed Countries (LDCs) high child mortality was associated with large family size. There are psychological IB from children, although the Happiness data shows a clear dip during the years children are at home!

<https://www.youtube.com/watch?v=3FzgvXdQ9vE> (This is hilarious.)

<http://www.sciencedaily.com/releases/2011/03/110302152813.htm>

This may be why parents are so keen for their children to have children. Being a grandparent generates many of the benefits of children without incurring the costs. (3,136)

<http://economix.blogs.nytimes.com/2010/12/06/m-b-a-s-have-biggest-mommy-penalty-doctors-the-smallest/http://www.voxeu.org/article/why-do-highly-educated-mothers-opt-out-labour-force>

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<sup>9</sup> Women usually live longer than their spouses and usually provide for spouses who become medically or psychologically handicapped.