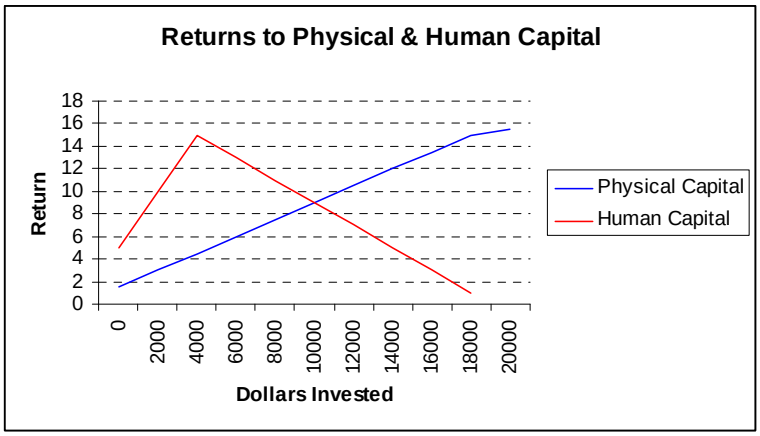
**EC 151 Homework III**
**Solutions**
**Inequality & Poverty**
**Due October 7th in class**

## 1) Inequality & Human Capital Investment

There two people, A & B, who each own their own investment bank. Each has two investment options in this period of financial turmoil. The time horizon is only two periods. So they make the investment today and then get the return tomorrow. Investment strategies can mean investing in either i, ii or a mix of both.

i) Invest in physical capital in the form of new leather chairs for the top management. Doing this costs $2000 per chair. Leather chairs will boost the morale of the management, increasing productivity and each increases the return by an additional 1.5%.
ii) Invest in human capital in the form of sending the CFO to finance classes teaching him about managing risk. Each class costs $2000. The first three classes are extremely useful and each class increases return by an additional 5% next period. Then the CFO starts getting progressively bored and zoning out, so the return declines by 2% for every class after the third.

a. Make a graph with investment amount on X-axis and return on Y-axis for both the options.




b. A $20,000 to invest. What would her investment strategy be?
She will invest $10K in human capital because till this point the return to HC is higher. Then, she will invest the remaining $10K in physical capital.

c. B has $4000 to invest. What would her investment strategy be?
She will invest it all in HC.

d. The government implements a program to "help" B by taking $2000 from A and giving it to B. What are the strategies of each now after this redistribution? Is the economy better or worse off now?

After the redistribution, A has $18K and B has $6K. A will invest this additional amount in HC because it has a higher return for this amount. A will still invest $10K in HC and the remaining $8K in PC. The economy is better off in this situation because essentially, more money ($2000) is being invested at a higher return rate. That is, the $2000 earns an additional 2% if invested in HC (which it is now) but only an extra 1.5% when invested in PC (where it was before).

What we see is that at low levels of investment, it is usually more beneficial to invest in human capital, but as the amount available to invest increases; at some point the incentive to invest in physical capital will become higher. What is driving all this? Human capital will usually have diminishing returns after

a point, because when you increase human capital, you are just adding it to the same person. However, with physical capital, you are not "installing" it in yourself, you can invest it somewhere else in a bank or rent it out to people. So it does not have to have diminishing returns it can be constant or increasing (From Solow, we know, economy-wide it will have diminishing returns, but right now we are thinking at a micro-level).

## 2) Inequality, Poverty & Imperfect Credit Markets

a. *Textbook. Chapter 7. Problem 9 part a) only.* Pooh is a country with only two occupations. You can work as a laborer or you can become an entrepreneur, who hires labor and makes profits. To become an entrepreneur, you need a loan of 20000 pah (unit of currency in Pooh). With 20,000 pah, you can set up a factory that hires ten workers, each of whom you must pay an income of w pah over the year. Together, the workers produce for you an output of 30,000. At the end of the year, you must sell your factory (for 20,000 pah) and repay the loan. The rate of interest in Pooh is 10% per year.

Suppose you were to contemplate running away instead. Imagine you would be caught, fined 5000 pah, and 20% of your business profits would be seized. You would also lose whatever collateral you put up with the bank (plus interest), but you would get to keep the 20,000 pah (plus interest you also owe). Find a formula that describes how much collateral the bank should ask for (in pah units) before it would advance you a loan. Examine this required collateral for different levels of wage income: w=1000, 2000 and 2500. Does the required collateral go up or down with the wage. Explain your answer.

**Answer**: Suppose the required (minimum) collateral size is $C_m$. We are going to find a formula for $C_m$.
If you repay the loan, you pay 20,000 plus an interest of 10% which is a total of 22,000 pah.
If you do not repay, you lose:

- \$5000 (since you are fined)
- collateral $C_m$ plus interest ➔ $C_m\,(1+r)= C_m\,(1.1)$
- your profits from business ➔ 30000-10w, where w is the wage you pay the workers

So if you do not repay, your total losses are $5000+ (1.1)\, C_m +5{,}000+.2(30000-10w)$

So you will repay when your total losses are equal to your total benefit (22,000). The equation for this is:

$$22000=5000+ (1.1)\, C_m +5{,}000+.2(30000-10w)$$

We can manipulate this to get an expression for $C_m$:

$$C_m=[\, 17000-(.2)(30000-w)]/1.1$$

Now you can plus in different values of w: 1000, 2000, 2500 to see what happens to $C_m$. As discussed in class, the minimum required collateral increases with the wage rte, because business profits are lower when wage rate is higher and therefore less valuable to the creditor in the event of default. Thus, a larger collateral is asked to start with.

*b. Textbook. Chapter 8. Problem 5.* Explain why a moneylender who relies on future credit cutoffs to enforce a loan repayment today will be less willing to advance loans to a poor individual for projects that guarantee future income security. Discuss the role of collateral in obtaining such loans.

**Answer**: Here is an example that illustrates the point of the question. Suppose that a moneylender is advancing a loan of size L today. The loan can be used by the borrower in different projects. Some of them may simply involve present consumption, and some of them might involve actual production activities that bring the borrower greater insulation against a future demand for credit. Let us arrange these various projects 1,2….,n in terms of what they imply for the borrower's future credit demans: call these D1, D2…Dn and let's say D1>D2>Dn [So for instance, project 1 may involve pure consumption credit so that the borrowers future needs continue to be high. And project n may involve setting up his own self-sufficient business so that the future credit needs to shrink to a small number.]

Now, suppose that the borrower puts up collateral C and gets a loan for some project i. When it comes time to repay the loan, the borrower's cost of repaying is L(1+r) where r is the rate of interest). If the borrower defaults, he loses his collateral and the ability to meet his future demand for credit Di, so his loss is C+Di. He will repay if: C=Di > L(1+r).

Knowing, this, it is clear that the lender will not advance loans for projects such that the above inequality fails. Note that it is more likely to fail for projects with a higher index (and consequently a smaller future demand for loans). Also note that the higher the collateral put up by borrower, the less likelihood of default and the better the projects that he can get loans for (in terms of reducing lower future dependence). It follows that poor borrowers who lack collateral are more likely to receive loans that are for current consumption or for working capital—for projects that do not reduce the borrower's future dependence on credit. So in a way, the lender keeps the borrower coming back for more by just giving small loans.

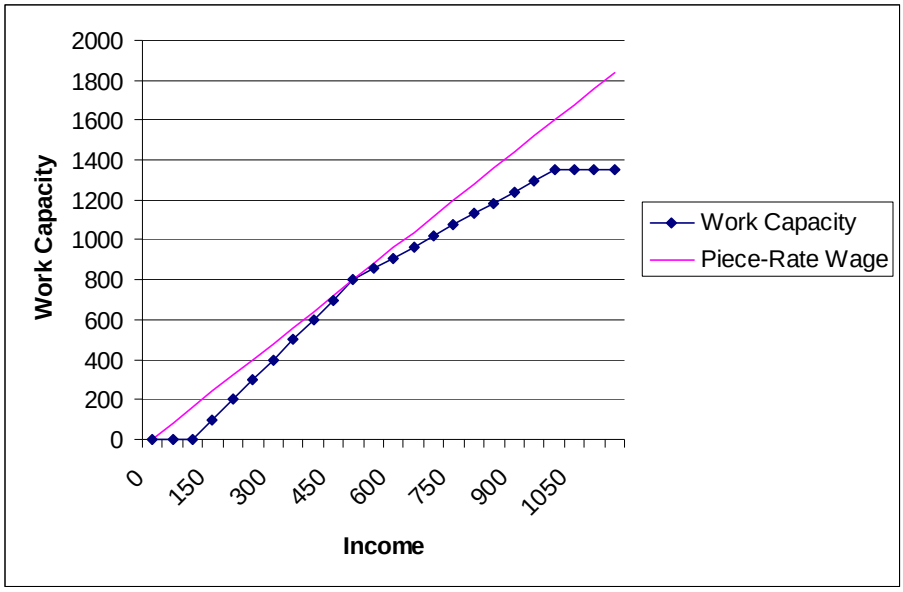
## 3) Poverty & Nutrition

*Textbook. Chapter 8. Problem 6.* Discuss the capacity curve and explain why the curve has an initial segment in which work capacity exhibits increasing returns with respect to nutritional input.

Suppose that you need 8,000 units of work (in capacity units) to be performed, and you can hire all the laborers you want. Assume that all income earned by the laborers is paid to them by you, and that all income is spent on nutrition. The capacity curve for each laborer is described as follows: for all payments up to $100, capacity is zero and then begins to rise by 2 units for every additional dollar paid. This happens until an income of $500 is paid out. Thereafter, an additional dollar paid out increases capacity by only 1.1 units, until total income paid is 1000. At this point, additional payments have no effect on work capacity.

a. Assume that you would like to get your work done at a minimum cost. Describe how many laborers you would hire to get your work done and how much you would pay each of them.

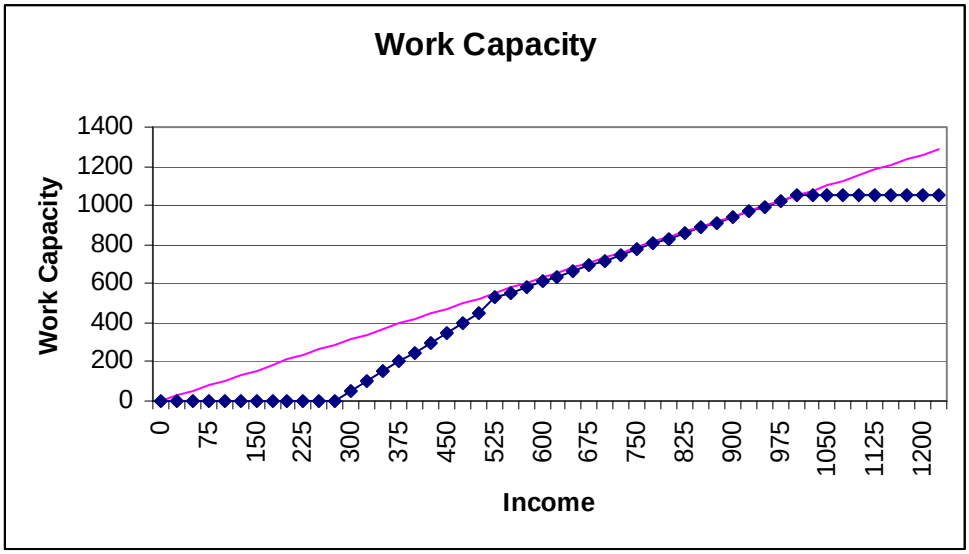
The graph looks like:




**Answer:** If you would like to get your work done at a minimum cost, one way to approach this is to pay your laborers practically nothing. But then no laborer would be able to perform any work. You realize that paying them more elicits greater work capacity. What you need to maximize, however, is not work capacity per laborer, but work capacity per dollar you spend.

On the same diagram that you have drawn the capacity curve in, draw a straight line from the origin (much like a piece rate). Notice that the slope of this line is just work capacity per dollar. You'd like to maximize this slope (but subject to the constraint that the line meets the capacity curve). Now you should verify that the highest slope is given by the fraction 8/5 and this is attained when you pay each laborer $500 and get 800 units of capacity. Hire ten such laborers and you're done. Your total expenditure is $5000. You should check that there is simply no other way to get $8000 units of work done at a lower cost.

b. The second part of this question asks you to do the same thing with different data. Now you should be able to check that each laborer should be paid $1000 and that eight laborers should be hired. Your total expenditure will be $8000. (It is not hiring 500 workers at $450; if you do this, you will need to pay $8888)




You see that when the income/nutrition threshold to do any work increases from 100 to 275, you need to pay workers more to get same amount of work done.