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1. (20 points) Human Capital

Suppose, to simplify, that the total adult population size in the USA in 2000 was $L = 1,000$. Let L_X denote the number of adults with X years of schooling. According to the distribution of education levels across the adult population in the USA in 2000, we have: $L_0 = 8$, $L_4 = 43$, $L_8 = 39$, $L_{10} = 229$, $L_{12} = 200$, $L_{14} = 236$, $L_{16} = 245$. The returns to education are 13.4% per year for the first four years, 10.1% per year for years 5 to 8, and 6.8% per year for any additional year of education after the eighth year.

1.a) (10 points) Calculate the fraction of wages that is being paid to human capital in the entire economy. (Give the details of your calculations with brief explanations.)

ANSWER:

Suppose that the salary of a worker without any schooling is \$1. The total salaries received by the 8 workers without education is thus $8 * \$1 = \$8$. The 43 workers with 4 years of schooling each receive a salary of $\$1 * (1.134)^4 = \$1.65$, for a total salary for this group of $43 * \$1.65 = \$71$. And so on as per the following table:

schooling	no of workers	salary	total
0	8	1	8
4	43	$1.134^4 = 1.65$	71
8	39	$1.65 * 1.101^4 = 2.43$	94.77
10	229	$2.43 * 1.068^2 = 2.77$	634.33
12	200	$2.77 * 1.068^2 = 3.16$	632.00
14	236	$3.16 * 1.068^2 = 3.61$	852.00
16	245	$3.61 * 1.068^2 = 4.11$	1006.95
TOTAL:	1000		3299.05

Total salaries add up to \$3299. Raw work, i.e. work that does not require human capital, receives an aggregate payment of $1,000 * \$1 = \$1,000$, thus leaving an aggregate payment of \$2299 to remunerate human capital. The share of wages due to human capital is thus

$$\frac{3299 - 1000}{3299} = 69.7\%.$$

1.b)(10 points) If salaries make up 2/3 of total national income, how important is human capital to explain total income levels? How does this compare to physical capital? And raw labor? Interpret birefly.

<div align="center">ANSWER:</div>

If salaries make up 2/3 of total national income, then human capital explains $0.66 * 0.697 = 46\%$ of total income in the economy. (Another equivalent way to show this is to note that if salaries make up 2/3 of total national income, then total national income is equal to $3/2 * \$3299 = \$4948.5$. The share of human capital is again $2299/4948.5 = 46\%$.)

We have seen that physical capital is responsible for 33% of total national income. This suggests that human capital, at 46%, is more important than physical capital to explain income levels by a good margin.

As for raw labor, it explains $1000/3299 = 30.3\%$ of total salaries, and thus $2/3 * 0.303 = 20.2\%$ of total national income. It is much less important than both physical and human capitals, but certainly still significant for welfare. (Another way to obtain the same figure is with the following fraction: $1000/4948.5 = 20.2\%$.)

2. A theory of intertemporal choice (20 points) Suppose that Ronaldo lives for two periods only, $t \in \{1, 2\}$. Y_{dt} is his disposable income at period t and W_1 is his initial wealth at period 1. He can save or borrow at interest rate r and cannot leave a bequest or unpaid debt after period 2. C_t is his consumption level at period t and S_1 represents the savings level in period 1. Ronaldo's indifference curves between the two period's consumption levels are convex.

With the help of graphical analysis, illustrate a case in which a drop in the initial wealth leads Ronaldo to go from being a net saver to a net borrower. Denote the high and low initial wealths as W_1^H and W_1^L respectively. Make sure to explain your steps clearly, both graphical and mathematical.

We have $C_1 = W_1^H + Y_{1d} - S_1$ and $C_2 = Y_{2d} + (1+r)S_1$.

This gives $C_2 = (1+r)(W_1^H + Y_{1d} - C_1) + Y_{2d}$ as represented by curve IBC.

With W_1^H, Ronald consumes C_1^* in period 1 at A and is thus a net saver since $C_1^* < W_1^H + Y_{1d}$.
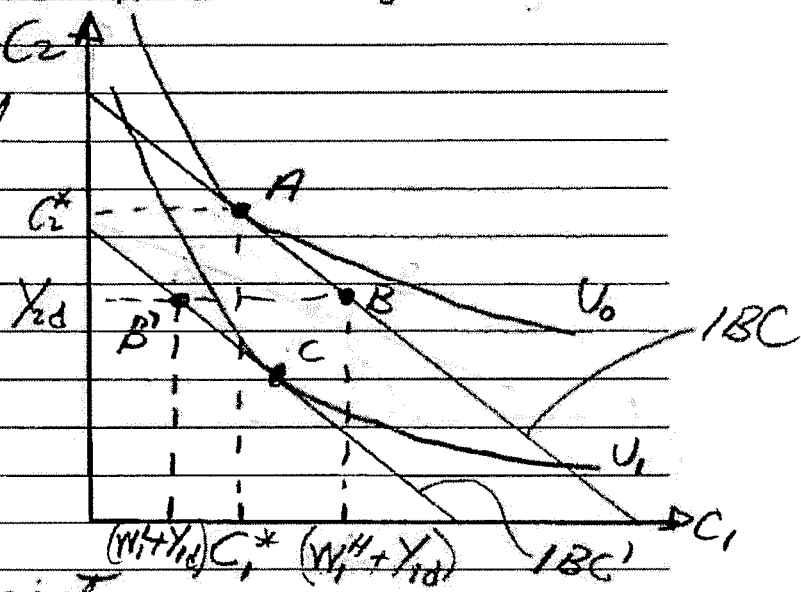
Suppose a drop in W_1 shifts the intertemporal budget constraint down from IBC to IBC'. The no-savings, no-borrowing point goes from B to B'. Point C denotes the consumption levels on IBC' where consumption at period 1 exceeds $W_1^L + Y_{1d}$. Ronaldo is thus now a net borrower.