Wages, Truncation and Non-random Sample Selection

Quantitative Microeconomics

R. Mora

Department of Economics
Universidad Carlos III de Madrid

Outline

Motivation

- One argument of why women partly specialize in domestic production is because their market wages are lower than those of their husbands
- Beyond assuming they have different productivities, there are many alternative theories
  - Discrimination: employers and workers in mostly male professions dislike working with women, so they are only willing to do it with some compensation
  - Women are less competitive than men
  - The most productive workers (also the worst) are males
  - Women preferences and social roles drive them to work in a small number of occupations, driving their wages down

The Human Capital Gender Gap Explanation

Another possible answer is provided by the human capital theory

Two stylized facts:

- Women acquire less human capital than men (although the gap is fast decreasing)
- Women's human capital has less market value

- The human capital theory explains these two facts with economic incentives

What is Human Capital?

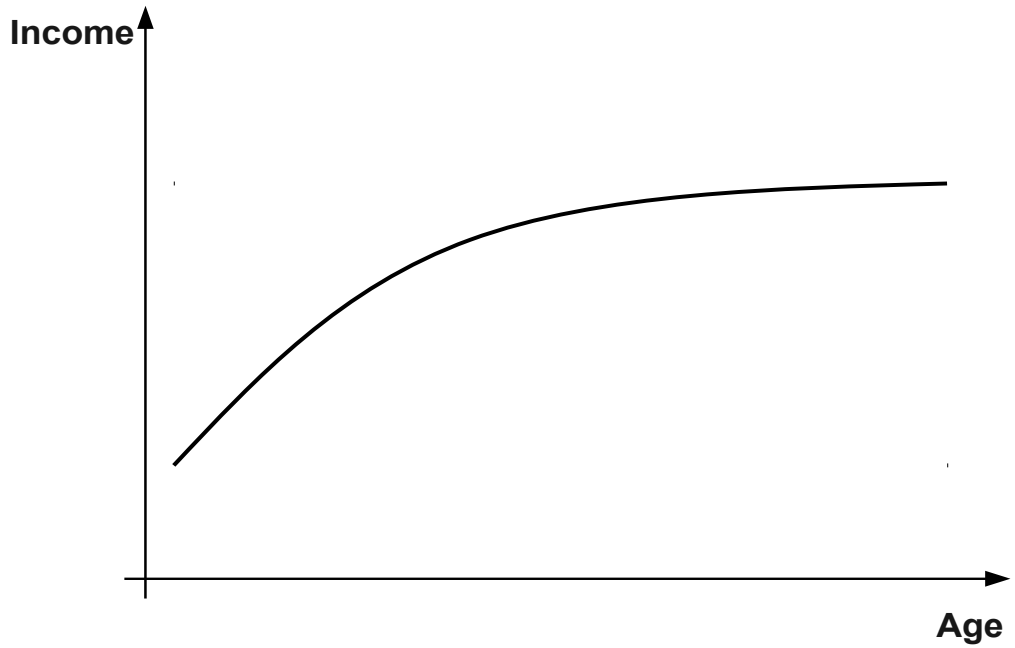
Skills which have market value and are obtained in a costly process

- There are several ways to obtain human capital: education, life experience, on-the-job training...
- There are general skills (adequate for many jobs) and job-specific skills
- As with physical capital, human capital depreciates and can be rented
- In contrast to physical capital, human capital is person-specific so that it cannot be sold and it is zero at beginning of life

The Human Capital Theory in a Sentence

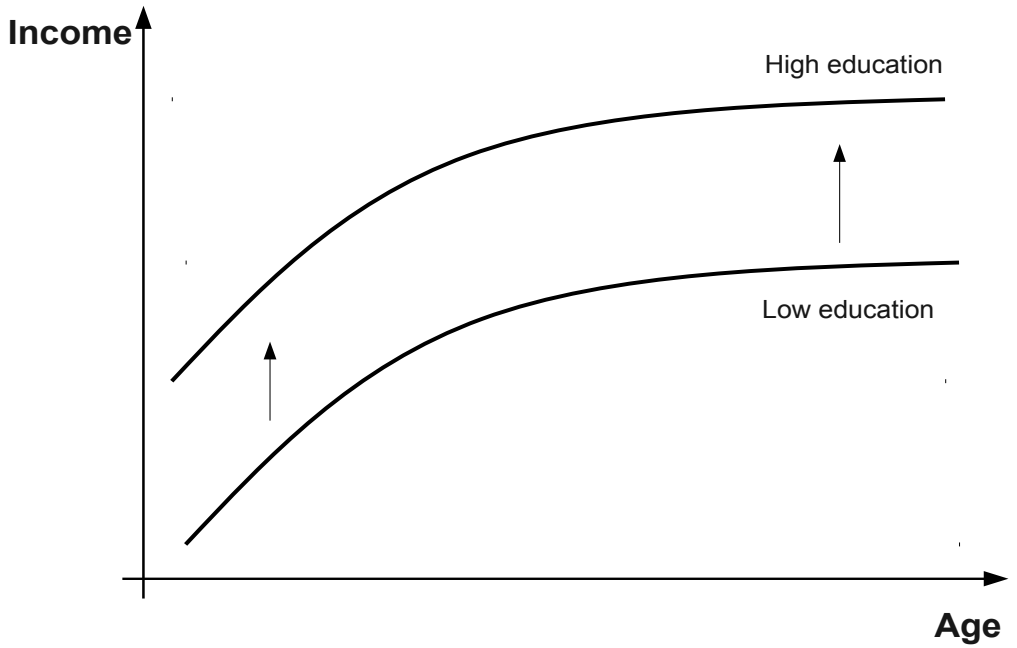
Individuals take Human Capital accumulation as an Investment Decision which affects their future wages

Experience increases income with age



$$w = \beta_0 + \beta_1 age + \beta_2 age^2 + \omega$$

Education increases income given age



$$w = \beta_0 + \beta_1 age + \beta_2 age^2 + \beta_3 educ + \varepsilon$$

The Human Capital Investment Decision

- Costs (fees, books, training wages) are incurred at the beginning: C_{t_0}
- Benefits (higher income & utility) are concentrated in the future: B_{t_0+s}, $s = 0, 1, 2, ..., T - t_0$

If total discounted future benefits $\geq$ current costs $\Rightarrow$ Invest

$$\sum_{s=0}^{T-t_0} \frac{B_{t_0+s}}{(1+r_m)^s} \geq C_{t_0} \Rightarrow \text{Invest}$$

The Internal Rate of Return

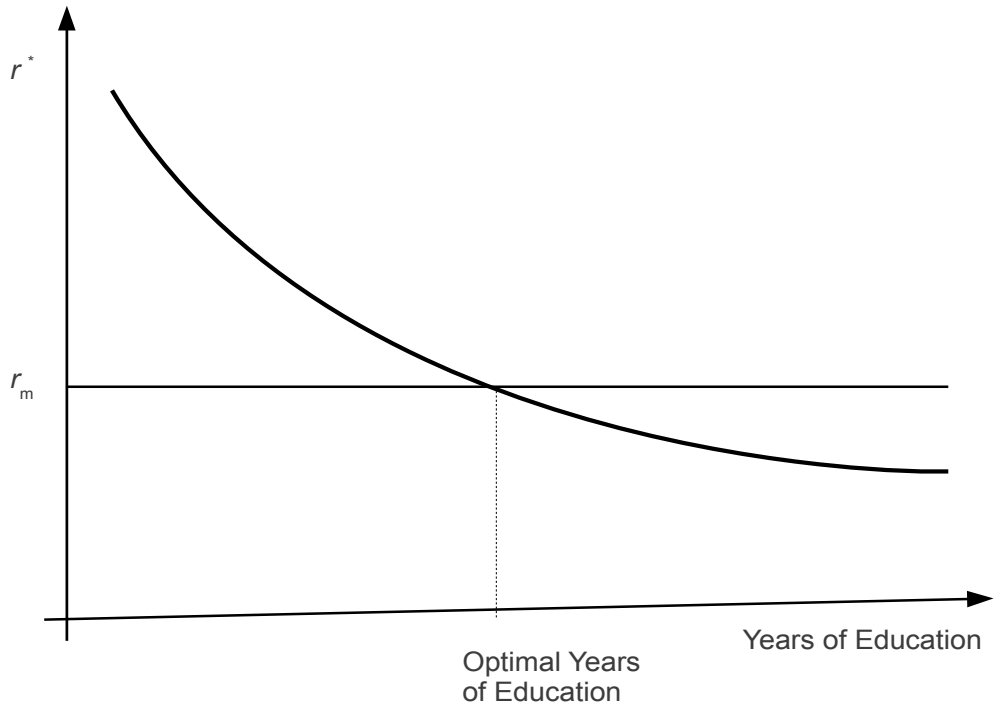
Internal Rate of Return

The interest rate r^* such that the present value of the stream of future benefits equals costs

$$\sum_{s=0}^{T-t_0} \frac{B_{t_0+s}}{(1+r^*)^s} = C_{t_0}$$

$$\text{If } r^* \geq r_m \Rightarrow \text{Invest}$$

Si $r^* \geq r_m \Rightarrow$ Invest



At equilibrium, $r^* = r_m$

Expected Labor Supply in the Life Cycle

Investments are more likely profitable the larger the expected working life (more years to collect incomes)

women will invest less in education if they expect to work less

- household-related duties: taking care of children and the elderly

Training in the Firm

General Human Capital (apprenticeship)

- Workers may accept a low/no wage today if training leads to higher wages in the future
  - Are women less likely to accept apprenticeships?

Specific Human Capital

- Firms more likely to accept incurring the costs if worker is likely to stay in the firm
  - Are women less likely to stay in the firm?

If women are (perceived) to interrupt/slow down their careers more, then they will receive less training in the firm

Differences in Education

- Years of education are similar across gender
- Fields of study are different: human capital for women with high w_R
  - do not depreciate fast with interruptions
  - is complementary to household production
  - increases the husband's productivity

Mincer Equations

$$w = \beta_0 + \beta_1 exp + \beta_2 exp^2 + \beta_3 educ + \varepsilon$$

- Are returns to years of education equal for men and for women?
  - for the same type of education, they should
- Are returns to years of working experience similar between men and women?
  - for the same type of experience, they should

Problems for Mincer Equations

- Education and experience are chosen by each individual (they are potentially endogenous)
- Wages are only observable for those who choose to work (there is potential sample selection bias)
- Wage data usually comes from firms. In those cases, there is no information of those who choose not to work (truncation)
- Here, we are going to
  1. explain endogeneity for education
  2. present the truncation model
  3. present the selection model when the selection mechanism is not driven by the dependent variable

Decision to Enter College

- Elements for the decision to enter college
  - present net value of High School: $E[v_{HS}]$
  - present net value of College: $E[v_{COL}]$
- Person goes to college if $E[v_{HS}] < E[v_{COL}]$

Self-Selection into Education Bias

- With observational data, individuals self-select into essentially different groups:
  - For those who go to college: $E[v_{HS}|col] \leq E[v_{COL}|col]$
  - For those who do not go to college: $E[v_{HS}|hs] > E[v_{COL}|hs]$
- But

$$\begin{aligned} E[v_{col}|col] - E[v_{hs}|hs] = & \{E[v_{col}] - E[v_{hs}]\} \\ & + \{E[v_{col}|col] - E[v_{col}]\} \\ & + \{E[v_{hs}] - E[v_{hs}|hs]\} \end{aligned}$$

A Numerical Example with Two Periods

	$wage_{HS}$	$wage_{COL}$
Bill	20,000€	40,000€
Wendy	15,000€	41,000€

$$PV_{HS}(\text{Bill}) = 20 + 20/1.1 = 38.1 > 36.7 = 0 + 40/1.1 = PV_{COL}(\text{Bill})$$

$$PV_{HS}(\text{Wendi}) = 15 + 15/1.1 = 28.6 > 37.3 = 0 + 41/1.1 = PV_{COL}(\text{Wendy})$$

$$\text{returns to college} \neq 37.3 - 38.1 < 0$$

Mincer Equations and The Returns to Education

$$w = \beta_0 + \beta_1 exp + \beta_2 exp^2 + \beta_3 educ + \varepsilon$$

- ε includes unobservable wage effects from personal characteristics, such as innate ability
- *educ* is chosen so that $r^* = r_m$, that is, *educ* reflects to some extent wage factors known by the worker but unknown to the econometrician, such as innate ability
- OLS will be inconsistent, IV provides a possible solution

The Truncated Normal Regression Model

When wage data comes from firms, there is no information of those who choose not to work

- $w = \beta_0 + \beta_1 exp + \beta_2 exp^2 + \beta_3 educ + \varepsilon, \quad \varepsilon | x \sim N(0, \sigma^2)$
- we only observe $(w_i, exp_i, educ_i)$ if $w_i > w_i^R$ (sample is not iid)

- In the Tobit model, we have observations of everyone (those who work and those who do not work)
- In the Truncated model, we only have observations of a selected sample (those who work)

Heckman's Selection Model

Wages are only observable for those who choose to work

we observe $(w_i, exp_i, educ_i)$ if $s_i = 1$, otherwise we observe z_i

- output equation: $w = \beta_0 + \beta_1 exp + \beta_2 exp^2 + \beta_3 educ + \varepsilon$, $\varepsilon | x \sim N(0, \sigma^2)$
- participation equation: $s = 1(\gamma' z + v)$
- $$\begin{bmatrix} \varepsilon \\ v \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_u^2 & \rho \\ \rho & \sigma_v{}^2 \end{bmatrix} \right)$$

- In Heckman's model, the participation equation is a different process
- Selection bias is a problem only if $\rho \neq 0$

Summary

- the human capital theory views education and experience as investment decisions
- the theory provides some testable mechanisms which may explain gender differences in human capital
- however, the key test cannot be directly tested using standard ols techniques because of endogeneity, sample selection, and sometimes, truncation
- there are several ways to control for truncation or nonrandom sample selection