Accounting for Investments in Formal Education

Presentation to the BEA Advisory Committee
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Introduction

- **Background paper talks more generally about measurement of investment in education**
  - Double-entry structure of satellite account for education
  - Real versus nominal measures of investment
- **Will focus this morning primarily on alternative approaches to measuring nominal investments in education**
  - Input costs (e.g. Kendrick)
  - Expected value of future returns (Jorgenson and Fraumeni)

Costs and value of output in an education satellite account

- In the core accounts, payments to factors of production and value of final output should in principle sum to same total
  - Expenditure side and production side estimates of output provide a check on one another
- If individuals are risk-neutral decision-makers who bear the full cost of investment in their own human capital, marginal costs of investment in formal education should be approximately equal to expected present value of marginal returns
  - Would not necessarily expect total cost of inputs to education to equal the expected present value of aggregate returns

Costs and value of output in an education satellite account (cont'd)

- Additional factors complicate decisions about investment in education
  - Individual investments are risky and individuals tend to be risk averse → Underinvestment (marginal social returns exceed marginal social costs)
  - Costs of education not borne fully by the individual → Overinvestment (marginal social costs exceed marginal social returns)
- Useful to account for both costs of inputs to education and returns to education, but do not provide a check on one another in same way as income and expenditure sides of the core accounts
- Account can be balanced by treating excess of returns over costs as "profits" accruing to the household, but large size of residual returns raises concerns about potential measurement problems

Total cost of inputs to formal education

- Total cost of investment in formal education includes both market and non-market components
  - Market: Teacher and staff salaries, materials, capital costs → Already included in existing accounts
  - Non-market: Student time, parent time, other volunteer time → Not included in existing accounts
- Value of non-market time devoted to formal education the new information needed to track full cost of formal education
  - Measure unpaid hours devoted to formal education
  - Value hours using opportunity or replacement wages

Amount of non-market time devoted to formal education

- Would like to have direct information on amount of time students and others devote to educational activities
  - American Time Use Survey (ATUS) collects data on time devoted to own education and helping with the education of children under age 18, 2003 to present
  - No data for persons under age 15
  - No data on secondary activities (e.g., parents supervising homework while preparing dinner)
  - Time volunteering in classroom not separately identified
  - Likely not capturing students who live in dormitories
- Absent direct data on time use, can use information on school schedules and school enrollments to estimate student time

Cost of non-market student time

- Opportunity cost valuation appropriate for student time
  - Students cannot hire other people to learn for them
- Adjustments to opportunity cost may be conceptually appropriate
  - Education may have a consumption component $\rightarrow$ Opportunity cost should be adjusted downward
  - Some students may find school more unpleasant than working $\rightarrow$ Opportunity cost should be adjusted upwards
- Making adjustments likely to be difficult in practice

Cost of parent and adult volunteer non-market time

- Replacement cost valuation appropriate for parent and adult volunteer time
  - Replacement wage may be lower than opportunity wage
  - If a person with a high opportunity wage chooses to perform activity rather than hire someone else at lower replacement wage, suggests that activity has a consumption dimension
- Adjustments to replacement cost may be conceptually appropriate
  - Parents and volunteers may be less productive than people doing similar work for pay → Replacement cost should be adjusted downwards
- Making adjustments likely to be difficult in practice

Valuing the returns to education

- Method developed by Jorgenson and Fraumeni calculates expected present value of future labor income for individuals by age, sex and years of education using data for synthetic cohort
  - Includes returns to any additional schooling the individual can be expected to acquire
  - Includes both actual market and imputed non-market labor income
- Value of investment in education equal to difference in expected value of future labor income for person of given age, sex and initial education level who acquires an extra year of schooling versus person of same age, sex and initial education level who does not continue in school

Calculating the present value of future earnings

- Start with person in last year of working life (age 75):

$$mi_{y,s,75,e} = ymi_{y,s,75,e}$$

- Expected present value of earnings for person age 74 then equals:

$$mi_{y,s,74,e} = ymi_{y,s,74,e} + (1+\rho)^{-1} sr_{y,s,75} (1+g) mi_{y,s,75,e}$$

- Continue recursively to determine expected present value of earnings for ages 73, 72, … 35

Calculating the present value of future earnings (cont'd)

- For persons age 5 through 34, also consider probability of acquiring additional education:

$$mi_{y,s,a,e} = ymi_{y,s,a,e} +$$

$$(1+\rho)^{-1} sr_{y,s,a+1}(1+g)\left[senr_{y,s,a,e}mi_{y,s,a+1,e+1} + (1-senr_{y,s,a,e})mi_{y,s,a+1,e}\right]$$

- Similar expression can be written down for non-market labor income
- Key determinants of expected future earnings include discount rate (ρ) and assumed annual rate of growth in earnings (g)

Questions about Jorgenson and Fraumeni (J-F) methodology

1) Are earnings a valid proxy for productivity?

2) Do synthetic cohort data provide a valid basis for forming expectations about future earnings?

3) What discount rate should be used for calculations?

4) Should anticipated future growth in real wage levels be incorporated in estimated returns to education?

5) What is the appropriate counterfactual assumption about future educational attainment for those who invest in additional schooling?

6) Are returns to other investments confounded with returns to education?

7) Is it appropriate to assume that education raises the returns to non-market time and, if so, by how much?

1) Using earnings to proxy for productivity

- If available, would want to use data on compensation including benefits rather than data on wages and salaries
- More fundamentally, J-F methodology assumes that higher compensation reflect higher productivity
- Assumption can be challenged
  - Do men earn more than women because they are more productive or for other reasons?
- Little alternative in practice to making this rather standard assumption

2) Basing estimates of future returns on cross-sectional data

- J-F methodology treats cross-section of people with different age, sex and education as a synthetic cohort
  - Assume that earnings of today's 20-year olds when they reach age 40, for example, can be predicted based on earnings of today's 40-year olds
- Methodology does not account for possible effects of future shifts in supply and demand on relative earnings, but that seems appropriate
  - Changes in relative earnings by age, sex and education from one year to the next can be treated as a revaluation
- In future work could ask whether given number of years of education represents same investment today as in the past
  - Is quality of instruction the same?
  - Is number of contact hours per year of schooling the same?
  - Is mix of subjects studied the same?

3) Choice of discount rate

- J-F calculation of expected returns uses a discount rate intended to reflect time value of money, but risk-averse individuals will demand a higher rate of return
- Implies that calculations will yield present value of marginal returns that exceeds marginal costs
  – Consider an investment of $1,000 in own education that yields a return of $100/year for 40 years
  – At a discount rate of 9.8 percent, expected value of marginal returns is $1,000, just equal to the marginal costs
  – At a discount rate of 4.0 percent, expected value of marginal returns equals $1,979 versus marginal costs of $1,000
- Could create an entry on the cost side of the accounts that represents compensation for risks taken by individuals in connection with investments in own human capital
  – Would need to make assumptions about both individual and social discount rates
  – In preceding example, value of this entry would be $979

4) Incorporating future growth in earnings levels

- Assumption that real earnings for person of given age, sex and education will grow at g percent per year has roughly the same effect on PV(earnings) as lowering discount rate by g percentage points
- Expected future growth in earnings levels relevant to individual decisions, but can ask whether it should be incorporated in calculations of social returns to education
  - If future increases in earnings levels are due to future investments in tangible capital or other forms of intangible capital (e.g., R&D), should not be included (would be double counting)
  - If future increases in earnings levels due to costless innovations, less clear how they should be treated
- Conservative estimates of social returns to education would set g=0

5) Counterfactual assumption about earnings of school enrollees

- J-F calculations assume that, had they not enrolled in school, people of given age, sex and education would have had earnings trajectories similar to others with same observable characteristics
- If those who continue in school are more able on average than those who drop out, seems more realistic to assume that these individuals
  - Would have had higher earnings than others of same age, sex and education even without additional education
  - Probability of returning to school if not enrolled in current year would have been greater than for those of same age, sex, and education who in fact were not currently enrolled
- Literature on returns to education suggests first concern may not be too significant (and no easy way to address)
  - Still a possible concern that returns to education may result from "signalling" rather than productivity enhancement

5) Counterfactual assumption about earnings of school enrollees (cont'd)

- Christian (2009) suggests a method for addressing second concern
  - J-F calculations of counterfactual earnings streams use future school enrollment rates for person of same age, sex and education who were not enrolled in current year
  - Christian's counterfactual uses school enrollment rates for person of same sex and education but one year younger
  - Choice makes a very large difference to estimated returns to education because odds of returning to school are low for those who have fallen "off track" educationally
- Conservative estimates of returns to education would use Christian (2009) counterfactual

6) Confounding returns to other human capital investments with returns to education

- Individuals with greater amounts of formal education also may have benefited disproportionately from other human capital investments
  - Parental investments at young ages
  - On-the-job-training investments subsequent to the completion of formal education
- Bias due to not measuring parental investments in concept a simple omitted variable problem
  - Let PV(earnings) = f (EDUC, PARINV)
  - Assume that both EDUC and PARINV raise PV(earnings) and cov(EDUC, PARINV) > 0
  - If effects of PARINV not taken into account, effect of EDUC on PV(earnings) will be overstated

6) Confounding returns to education and other human capital investments (cont'd)

- Bias due to not measuring investments in on-the-job-training (OJT) slightly more subtle
    - If individuals choose rationally among alternate career paths, careers that include OJT should have same present value to the individual as careers that do not
    - If discount rate that individuals apply to decisions about their career paths exceeds the social discount rate, social returns to OJT will exceed social costs
    - If cov(EDUC, OJT) > 0, and effects of OJT not taken into account, effect of EDUC on PV(earnings) using social discount rate will be overstated
- Although problem of omitted human capital investments simple in concept, developing measures of parental investment and on-the-job training needed to address problem will be difficult

7) Non-market returns to education

- Growing body of evidence that education has significant non-market benefits, but J-F calculations make strong assumptions
  - Assume effect on value of non-market time similar to effect on value of market time (only difference due to wedge created by taxes on labor income)
  - Assume returns realized 14 hours/day, 7 days/week
- Can question use of market wage to value non-market time
  - Individuals may not have the option of working as many hours as they like at their market wage, so that marginal value of non-market time may be lower than the average wage, even net of labor taxes
  - Potential wage for persons of given age, sex and education who are not working may lie below observed average wage for employed population

7) Non-market returns to education (cont'd)

- Can question assigning same value to all non-market time
  - May not be realistic to assume peak productivity 14 hours/day
  - Education plausibly raises productivity in certain home production activities (e.g., active child care), but not in others (e.g., laundry and cleaning)
  - Assigning higher value to leisure time of educated people raises additional issues
- Because so much of time spent in non-market activities, J-F find 60-65 percent of value of investment in education attributable to non-market returns (J-F 1992b)
- Most implementations of J-F methodology focus exclusively on market returns, but ignoring non-market returns likely understates total returns
- Could use data on time use to assign non-market returns only to selected activities

Producing real estimates

- **Nominal value (V) equals price (p) times quantity (Q)**
  - Given V, if a suitable price index p available, can calculate Q = V/p
  - Alternatively, if possible to construct a quantity indicator Q, can derive p implicitly
- **Typical strategy for producing real estimates has been to construct quantity indexes based on number of students**
  - Fraumeni, Reinsdorf, Robinson and Williams (2009) discuss past work in this area
  - Accounting for changes in the quality of education a major challenge

Looking ahead

- Useful to develop both cost-based and returns-based estimates of investment in education

- J-F approach or something like it the most promising way to develop estimates of the output of formal education
  - Have raised a number of questions about J-F methodology
  - Would not take existing estimates at face value

Looking ahead (cont'd)

- **Major challenges for the future include**
  - Refining counterfactuals about future schooling for those who invest in education
  - Measuring other investments in human capital and accounting for any confounding effects on estimated returns to education
  - Refining estimates of non-market returns to education
  - Developing better methods to account for changes in the quality of education over time
- **First-generation J-F estimates a foundation that can be built upon**