Price, Real Output, and Productivity Measures for the Education Function of Government: Exploratory Estimates for Primary & Secondary Education

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New BEA Government Estimates

• Estimates of Real Government Spending by Function Released in October
  – NIPA Tables 3.15.1-3.15.6
  – Described in October SCB
  – Cost-weighted Input Indices = Real Output

• BEA Experimenting With Alternative Real Output Measures
• What Are the Implications of These New Measures for Productivity?
Experimental Output Measures
Research Approach

• Quality-Adjusted Volume Indicators
  – Atkinson Review Interim Report 2004

• Stripping Non-school Factors From an Outcome Measure

• Gleaning Information From Private Education

• Many Volume Indicators Are Not Purely Output Measures
Experimental Output Measures
Research Approach

• Initial Research
  – Review of Existing Economic Literature
  – Exploratory Estimates

• Decision on Adoption/Methodology
  – Main Accounts
  – Supplemental Estimates
What Quality Adjustments?
U.S. Exploratory Estimates

- Enrollments as the Base Index of Output Volume
- Significant Research Has Been Done on Possible Quality Adjustments, But Still Only a Beginning
  - Teaching Staff Composition
  - Class Size
- Research Yet to be Done
  - High School Drop-Out Rate
  - College Enrollment Rate
What Quality Adjustments? U.S. Exploratory Estimates
Teaching Staff Composition

• No Question That Teacher Quality Matters
  – Can Result in a Difference of 1.5 Grade Levels of Achievement Within a Single School Year - Hanushek (1998)
What Quality Adjustments?
U.S. Exploratory Estimates
Teaching Staff Composition

• The National Center for Educational Statistics (NCES 2000) Identifies 4 Teaching Quality Factors of 13 School Quality Factors:
  – Teacher Academic Skills
  – Teacher Assignment
  – Teacher Experience
  – Professional Development
What Quality Adjustments? U.S. Exploratory Estimates Teaching Staff Composition

• National Education Association (NEA) and NCES Surveys
  – Currently Used by BEA to Create a Teaching Staff Composition Index for Primary & Secondary Public Ed
  – Is a Fixed Weighted Labor Compensation Index
  – 6 Categories of Experience & 5 Categories for Highest Degree Obtained
    • From 1960-1990 the Percentage of Teachers With a Master’s Degree Doubled
    • Some Categories Have a Small Number of Entries
What Quality Adjustments?
U.S. Exploratory Estimates - Class Size

- Intuition Says That at Some Level, at Some Point, Class Size Must Matter, BUT
  - Hanushek
    - Only 14% of 276 Estimates Were Statistically Significant
    - Notes Intra-School Class Sizes Not Determined at Random
  - Krueger Uses Same Data and Disagrees
What Quality Adjustments?
U.S. Exploratory Estimates - Class Size

• Greatest Evidence for Primary Grades Effect - See Finn (1998) & Ivor Pritchard (1999) Summaries
• BEA Exploratory Estimates Use Minus the Pupil-teacher Ratio with a .1 Weight for Primary Ed Only as a Proxy for Class Size
  – Many Factors Affect the Pupil-teacher Ratio
  – These Include the Possible Increase in the Number of Instructional Specialists and Special Classes
What Quality Adjustments?
U.S. Exploratory Estimates - High School Completion

• A Decrease in High School (HS) Drop-out Rates is Indicative of Greater Success with at Least Those Students
• Drop-Out Rates Fall From 14% in 1980 to 11% in 2001
• But to What Extent are Drop-out Rates Determined by Non-school Factors, Such as Social Capital?
• Minus the Drop-out Rate with a .1 Weight Is Applied to HS Enrollments

• Further Research Needed
What Quality Adjustments?
U.S. Exploratory Estimates - High School Completion

- College Enrollment Rate as a Proxy for the Quality of HS Ed Received
  - But These Rising Enrollments May Be Primarily a Function of Changing Labor Market Conditions
  - Accordingly, College Enrollment Rates Are Not Used as a Quality-Adjuster
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<td>Teaching Staff Composition</td>
<td>0.13</td>
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<td>High School Drop-out Rate</td>
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U.S. Exploratory Estimates
Table 3: % Annual Rates of Growth in Volume Indicators - Assumptions

- Quality-unadjusted Unweighted Enrollment
  - Pupil Grade Does Not Matter
  - No Change Over Time in the Quality of Ed Received
- Chain-type Fisher Index of Enrollment
  - Allocations Reflecting Relative Average Cost Per Pupil
  - For Quality-Adjusted Index, Quality of Ed Received Can Change Over Time
U.S. Exploratory Estimates

Table 3: % Annual Rates of Growth in Price & Volume Indicators

- Chain-type Fisher Indexes: An Aggregate of Primary & Secondary Education, Explicit for Quantities, Implicit for Prices (Equations and Text pp. 31-35)
  - Growth Rates of Quality Adjusters Are Added to the Growth Rate of Enrollment for Primary & Secondary Education Separately
  - Quality Adjusters for Pupil-Teacher Ratio (Primary Grades) and HS Drop-out Rate are Entered with a Minus .1
  - Then the Fisher Indexes Are Calculated
Price Change vs. Quantity Change
Table 3

• For Periods Listed
  – Price Change Always > than Quantity Change
  – Education Price Changes About 2× Gross Domestic Purchases Price Changes

• BUT Price Changes Probably Overestimated
Exploratory Base Case Volume Indicator

- Teaching Staff Composition & .1 Pupil-teacher Ratio Is the Base Case
- More Research Needed on Drop-Out Rate
Rates of Growth of Prices as a % of Rates of Growth of Nominal Expenditures

• For Available Periods in the 90’s
  – UK 80%
  – Netherlands 75%
  – Australia 66%
  – US 75% Based on Quality-Unadjusted Index for Higher Education

• Rates of Growth of GDP Prices May Be < 50% of Rates of Growth of Nominal GDP BUT…..
Rates of Growth of Prices as a % of Rates of Growth of Nominal Expenditures

- If Not All Quality Changes Are Captured, Quantity Changes May Be Underestimated and Price Changes May be Overestimated
- Education Inflation May Differ From General Inflation, e.g., for Compositional Reasons
- E.g., Rise In Numbers of Special Ed Students (NEA 2004)
  - 30% Increase Over Last 10 Years
  - Average Ed Cost 2× Average Ed Cost Across All Students
U.S. Exploratory Estimates
Table 3: % Annual Rates of Growth in Price & Volume Indicators

- Educating Secondary School Pupils Is More Expensive Than Educating Primary School Students
  - On Average for Periods Shown Only 30% or 31% of all Primary & Secondary Students Attend Secondary School, Yet
  - Secondary Ed Average Cost Share for Periods Shown Are 55% or 56% of Total
- Explains Differences Between Unweighted and Fisher Index Quality-unadjusted Rates of Growth for Total
U.S. Exploratory Estimates

Table 3: % Annual Rates of Growth in Price & Volume Indicators - Quality Adjusted

- Show Quality-Adjustments Applied One-at-a-time

- Quality-Adjustment Impact On Prices For the Base Case Index Is:
  - 1980-2001 -0.21%
  - 1980-1990 -0.63%
  - 1990-2001 +0.17%

- However, All Are Exploratory
Initial Productivity Estimates

- Productivity Change Calculated as the ROG of the Exploratory Output Estimate Less the ROG of the New Input Index
- Shows Approximately a 2% Annual Rate of Productivity Decline
  - Period as a Whole 1980-2001
Empirical Productivity Results from Others

• Support a Productivity Decline
• Hoxby (2003) Finds Annual Productivity Declines of About 2%
  – For Reading From 1979-1998
  – For Math From 1991-1998
• Hanushek (1997) Refers to a Productivity “Collapse”
Estimated Multifactor Productivity Growth
1980-2001


0.6%  1.5%  -1.9%  -0.9%
BUT, There Is More to the Story

• Hanushek (2003) and Krueger (2003) Disagree About the Relationship Between Inputs and Outcomes
  – Neither Come Up With Specific Estimates
  – Class Size Debate Points Out Differences in Probable Productivity Conclusions

• Are We Missing Elements of Output?
Initial Productivity Estimates
Contributors to the Productivity Decline

- With Our Methodology, Two Factors Are the Most Significant Contributors to the Estimated Productivity Decline
  - Shrinking Class Sizes
  - Increases in the Share of Non-Labor Inputs Relative to Labor Inputs
Initial Productivity Estimates
Consequences of Assumptions

• Pupil-teacher Ratio Decreased by 15% over 1980-2001
  – On the Output Side, a 15% Decrease in the Pupil-Teacher Ratio Leads to a 1.5% Increase in Output in the Primary Grades Only
  – On the Input Side, a 15% Decrease in the Pupil-Teacher Ratio Leads to a 15% Increase in Inputs under CRS and the Share of Labor Inputs in the Total Constant
Initial Productivity Estimates
Non-labor Inputs

• Rising Share of Non-Labor Inputs in the Total
  – Non-labor Input Share Rose From 27% in 1980 to 33% in 2001
  – Current Output Methodology Only Adjusts for Output Impact of Labor Inputs: Teachers & Students
    • Teaching Staff Composition
    • Pupil-Teacher Ratio
Impact of Special Students: A Topic Under Investigation

- 1987-2000 Pupil-Teacher Ratios in Schools Completely Devoted to:
  - Special Education, Approx. 6-7
  - Vocational Education, Approx. 13
  - Alternative Education, Approx. 15-16
- Regular Schools, Approx. 17-18
Impact of Special Students: A Topic Under Investigation

• Hanushek and Rivkin (1997) Study Covering Public Elementary & Secondary Education From 1980-1990, Attributes to Special Education
  – 18% of the Increase in Expenditures
  – One-Third of the Fall in Pupil-teacher Ratios
    • Proportion of Special Ed Students in Total Students Increased (Impact of 1975 Law)
    • Pupil-teacher Ratio in % Terms Dropped by More in Special Ed Classes than in Regular Classes
Special Students
A Topic Under Investigation

- Mainstreaming and/or Special Classes
- Pupil-Teacher Ratio in “Regular” Classes

- Just Beginning to Investigate This Line of Research
Conclusion
Research, Research, & More Research

• Non-Labor Inputs
• Unmeasured Changes in Teacher Quality
• Higher Ed, Libraries, & Other
• Primary & Secondary Ed
  – High School Completion Factors
  – Special Classes & Teaching Specialists
  – Scope of School-related Activities
  – Composition of the Student Body
• Outcomes Measures with Non-school Factors Stripped
• Exciting Area With Many Challenges