



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
 - Eurostat Recommendations (1995 & 2001) & Country Comparisons
 - 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

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- 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
 - Very Significant Source of Achievement Variation - Rivkin, Hanushek, & Kain (2001, 2004)
 - 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 (2003) - Krueger (2003) Debate
 - 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

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- 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



U.S. Exploratory Estimates - Table 2

% Annual Rates of Growth in Perspective Volume Indicator Quality-Adjusters

	1980- 2001	1980- 1990	1990- 2001
Teaching Staff Composition	0.13	0.49	-0.20
Pupil-teacher Ratio	-.77	-.83	-0.71
High School Drop-out Rate	-1.31	-1.52	-1.11
College Enrollment Rate	1.07	2.00	0.24



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 $2\times$ 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

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- 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
 - Sub-periods 1980-1990, 1990-2001
 - Period as a Whole 1980-2001

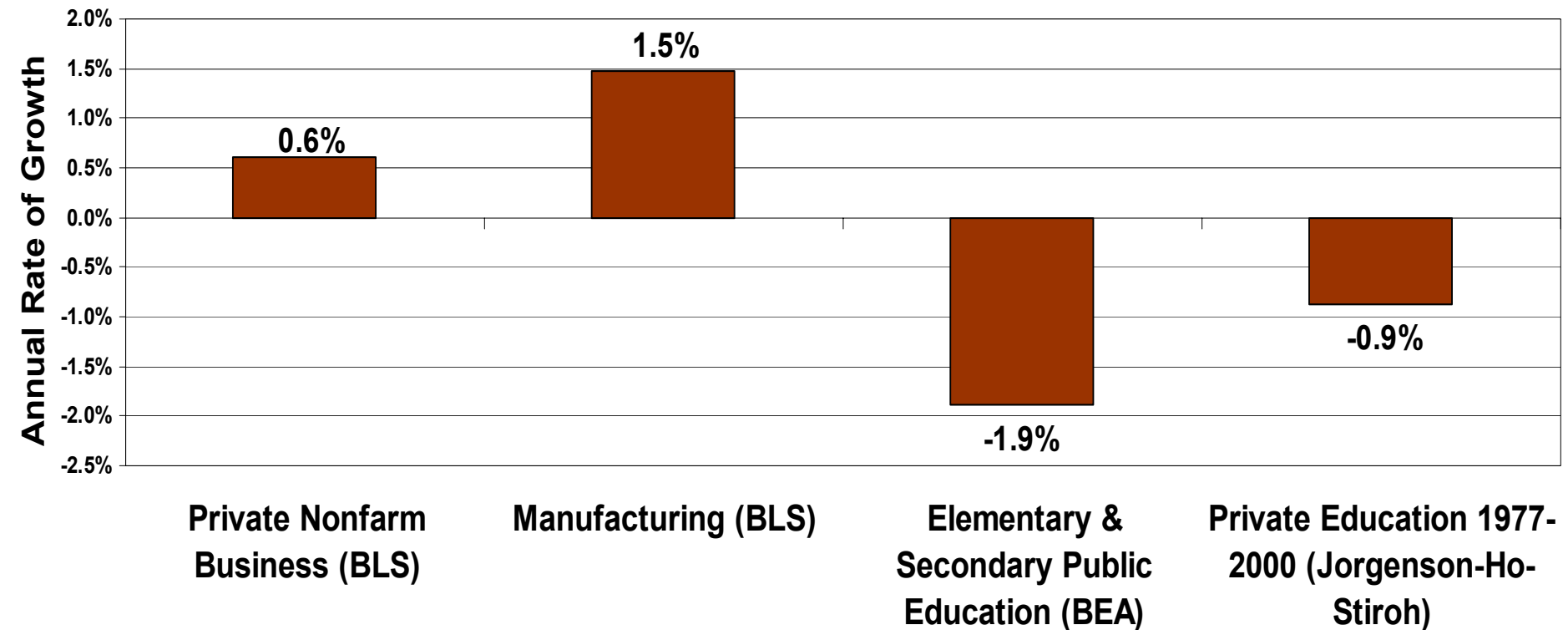


Empirical Productivity Results from Others

- 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





BUT, There Is More to the Story

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- 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
- Lazear (2001) in a Theoretical Paper Discusses the Impact of Disruptive Students, in General & On Class Sizes

- 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