Volume Measurement and Price Index of Tertiary Education Services

Takashi Yamashita, U.S. Bureau of Economic Analysis

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Motivation

• How best to measure output of the education sector accurately?

• The SNA recommends measuring non-market services by output volume (chapter 15).
  – For education services, it could be the number of students educated and the number of credit hours produced/consumed.
• Three methods have been proposed:
  
  – Cost Method (Kendrick)
    • Closest to the current NIPA method of the public sector and NPISH output but includes opportunity cost of time spent on education.
  
  – Human Capital Approach (Jorgenson & Fraumeni)
    • Measures education as investment but captures factors far broader than “education.”
  
  – Output Volume Measurement (SNA, OECD, Eurostat)
    • Measurement by physical units; straight-forward but quality adjustment is difficult.
What I Do Today

• Present volume output of education services by credit hours and the number of students.

• Compare the estimates to the NIPA’s quantity index of higher education – i.e. table 2.5.5U for household consumption expenditures (HCE).

• Consider why these two series differ and compare price indices used to deflate education services.
International Standard Classification of Education (ISCED) 2011 provides guidelines for classifying education systems for international comparison.

ISCED divides post-secondary education into five levels:

- Level 4 – Post-secondary non-tertiary education (vocational and terminal programs that prepare for the labor market)
- Level 5 – Short-cycle (at least two years) tertiary education (designed to prepare for employment or for transfer into higher levels)
- Level 6 – Bachelor’s or equivalent level
- Level 7 – Master’s or equivalent level
- Level 8 – Doctoral or equivalent level

In this project, I define “tertiary education” as educational institutions in the ISCED levels 5 (mostly community colleges, some vocational programs) to 8 (doctoral programs, Carnegie Research/Doctoral institutions).
US Tertiary Education System

• The United States has a unique system of higher education.
  – Private system of accreditation
    • Considerably less government control of “what is a college/university?” than other OECD countries.
    • A greater extent of vocational training in “colleges.”
  – A large government sector with different levels of governmental control
  – Large presence of not-for-profit institutions that act like for-profit institutions
    • Many charge “economically significant price” and respond to market situations
  – Small but growing for-profit sector.

• Carnegie Classification of Institutions of Higher Education
  – A framework of classifying universities and colleges to group roughly comparable institutions.
I use data from Integrated Postsecondary Education Data System (IPEDS) for academic years 1998/1999~2014/15.

- Data harmonized and compiled by Delta Cost Project supplemented by original data from IPEDS.

All institutions that receive Title IV Federal grants are required to file.

- Includes about 7~8,000 institutions a year
  - Comprehensive coverage of degree granting public and nonprofit institutions.
  - The largest category is “private, not-for-profit 4-year” (1,500+) followed by “private, for-profit, less than 2 years” (1,200~1,500) institutions.
  - Smaller for-profit institutions move in and out of the data set frequently.
  - Different campuses of the same university system count as separate institutions
Constructing Quantity Index

• I construct chained Fisher Quantity Indices for total credit hours and full-time equivalent (FTE) student count.
• Fisher index is the geometric mean of Laspeyres and Paasche indices:

  Laspeyres Index: \( L_{t,t-1} = \frac{\sum P_{t-1}Q_t}{\sum P_{t-1}Q_{t-1}} \)

  Paasche Index: \( P_{t,t-1} = \frac{\sum P_tQ_t}{\sum P_tQ_{t-1}} \)

  Fisher Index: \( F_{t,t-1} = \left( L_{t,t-1}P_{t,t-1} \right)^{1/2} \)

• I then create a chained index:

\[
I_{t,0} = \prod_{i=1}^{i=t} F_{i,i-1}
\]
Quality Adjustment

• I do not attempt quality adjustments.
• What is “quality” in higher education?
• Usual metrics of quality (e.g. student-teacher ratio, completion rate, instructor qualification) are used to adjust quality of education over time at a single institution but variation in such measures is also observable in cross-section of institutions.
  – Do we make judgements about “quality of instruction” between institution A and institution B?
    • This is what “value added” research in education does (e.g., Hoxby 2015, Brookings 2015)
IPEDS Credit Hour Index vs NIPA HCE Quantity Index by Sector
What do we want to measure?

• If we want to measure education services that colleges and universities produce (as service producer), physical measures are better metrics since they are directly observable and directly comparable across time.

• Except a few commodities (crude oil, electricity), the NIPA measures “quantity” (Q) by deflating “expenditures” (PxQ) with a price index (P).
  
  — Are we measuring “price” correctly?
Price Indices from IPEDS vs PCE Deflator

- IPEDS Net Tuition per Credit Hours
- IPEDS Net Tuition per FTE Student
- NIPA PCE Deflator - Higher Education
- NIPA PCE Deflator - Services
NB: The NIPA assumes that prices of public institutions and NPISH schools follow the same trend thus the two series overlap.
What is the right “price”?

• The NIPAs count grants and scholarships awarded to students as both household income and consumption expenditures.
  – Household consumption expenditures do not measure “out of pocket” expenses of households.

• What is the relevant price for education services?
  – Universities engage in price discrimination (institutional grants) and households respond to price offered.
  – Tuitions are non-linearly priced.
  – Cost of producing education services differs substantially by type of institution.
  – Government transfers benefit both students and schools.
Differences between Two Measures

• NIPAs
  – “Higher education” depends on NCES’s definition, may possibly include vocational institutions that do not have a Carnegie Classification.
  – Household consumption expenditures for higher education, measured in dollars, include payments regardless of source of funding.
  – Quantity measure is $ amount deflated by PCE deflators.
  – PCE deflator follows CPI for higher education, $/student/semester.
  – PCE deflator assumes the trend is the same for the public and NPISH sectors.

• This Paper
  – Tertiary education as defined before.
  – Volume is measured with physical units (the number of hours and students).
  – Net tuition measures out-of-pocket expenses of students after grants.
  – Price indices is $/unit of credit or $/FTE student/calendar year.
Differences between Two Measures

• CPI
  – CPI is based on probability-based area sampling.
  – CPI is $/term/student, sampled every 2~4 months.
  – BLS tries to take out non-tuition related expenses (e.g., room and board) from financial aids.
  – Students with full-ride scholarships are excluded.
  – Students with small out-of-pocket payments are excluded.

• This Paper
  – IPEDS includes all institutions receiving Title IV Federal grants.
  – Net tuition measures out-of-pocket expenses of students after grants.
  – Price indices are $/unit of credit or $/FTE student/calendar year.
  – Net tuition figures from IPEDS cannot distinguish grants that are used for non-academic purposes (but money is fungible!)
  – Price is the average of all students.
  – Only when the net tuition is negative, the figure is replaced with zero to calculate the index (again, money is fungible!).
Conclusions

- Constructing volume indices for higher education, measured in terms of credit hours earned or FTE students, is feasible with IPEDS.
  - OECD and SNA recommend this method for nonmarket production of certain services.
- Volume measures show different growth pictures from what one gets from the NIPA’s quantity and real indices.
- Price indices created from IPEDS show slower inflation rate of college tuition.
- Inflation rates of tuitions and fees differ by type of institutional control.