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Research Article

An Alternative Approach to Government Expenditure on Education and Measurement of Output

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ABSTRACT

Increasing public expenditure on education is important; much more important is to ensure commensurate returns for the incurred public expenditure. From this angle, impact assessment studies on public expenditure assume significance. In this paper, we are analyzing an alternative measure, to measure the output of expenditure related inputs in Indian scenario. An alternative to the input measure is a volume measure of output, which is an index that attempts to directly measure the output of government expenditure on education. A volume measure allows government productivity to increase or decrease over time. Overall, the results suggest strongly that volume measures of public education output grow substantially slower than the currently employed input measures.

Keywords:
Expenditure, Kothari committee, Output, GDP

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THEORETICAL BACKGROUND

Social sector expenditure is one of the important issues for the present study. In India, the head "social services" was introduced in 1973–1974 budgetary classification. Before 1973, there were studies relating to education and health expenditure but not on social sector as a whole. The Education Commission (1964–1966) headed by Kothari[4] recognized education as an investment and its contribution to development and recommended that 6% of gross domestic product (GDP) be spent on education.

Governments in the developing world have spent a huge amount of money on education after the 1960s. In India also, government spending on education has increased by about 230 times (at Current Prices). Moreover, the share of education in the gross national product, which was 2.1% in 1960–1961, increased to 4.8% in 2014–2015. Per capita expenditure on education increased considerably from Rs. 7.8 to Rs. 761.8. Per pupil expenditure also increased significantly from Rs. 53 to Rs. 3,957. There are many educational indicators such as literacy rate, gross enrolment ratio, net enrolment ratio, dropout rate, and gender disparities. As a result of growing awareness and government efforts, literacy rate in India has increased from 18.3% in 1951 to 64.8% in 2001. However, the increase has not been as expected due to government apathy and lack of political will. The growing need of education has been accompanied by a decline in public spending on education per capita and a consequent fairly rapid privatization of education. This has come about not only because of inadequate state expenditure and the downgrading of many government educational institutions and their services but also because the hunger for education has made it an extremely profitable private sector activity. As against the target of education expenditure at 6% of GDP by the National Policy on Education, the combined expenditure on education by central and state governments was 3.74% of GDP in 2009–2010. However, there is a mutual relation between education and economy.

As a result of government efforts, educational infrastructure, as well as educational status of the country, has expanded considerably after independence. Subsequently, many studies evaluated state as well as central government expenditure on education, namely, Kothari (1966a)[4], Panchamukhi 1975 Varghese 1989, Baghavati 1973, and Tilak (1987).[7] All the studies showed that public expenditure on education as well as health is very low, they suggested many policy measures and supported the Kothari committee's recommendations for higher outlay for educational development.

Increasing public expenditure on education is important; much more important is to ensure commensurate returns for the incurred public expenditure. From this angle, impact assessment studies on public expenditure assumes significance. Hence, economists use various tools and techniques to understand the impact of public expenditure on education. Several studies have used co-relation and regression techniques. Public expenditure is considered an independent variable, while literacy rate, enrolment ratio, mean years of schooling and others are considered as dependent variable.

So, in this paper we are analyzing and measuring an alternative measure, to measure the output of expenditure related inputs in Indian scenario. The study will investigate whether alternative measure allows output to increase or decrease over time. Our study proceeds in the following sections, Section-2 deals about methodology and Section-3 describes the Construction of Volume Indexes for Education, and Section-4 includes summary conclusion.

METHODOLOGY

Income accounts of India currently estimate both the nominal and real value of government services using the value of the goods, services, and labor consumed by governments to produce those services. The resulting measure of government output, called the input measure, assumes that productivity in the government services sector is constant at zero. For example, in our study, the input measure implies that schools cannot produce more education services without employing more inputs in the form of expenditure. It also implies that schools inevitably produce more education services if they do employ more inputs. An alternative to the input measure is a volume measure of output, which is an index that attempts to directly measure the output of government expenditure on education. A volume measure allows government productivity to increase or decrease over time. In the sections that follow, we present new volume measures for public education, following up on earlier work presented in Barbara *et al*.[3] It is hypothesized that public expenditure on education denotes public demand for education. We may use this as one component of final demand vector to estimate the solution value of output vector X:

$$X = (I-A)^{-1} f \quad (1)$$

Where one element of the demand vector f is public expenditure on education. Besides, the Residentiary Linkage Effect may be estimated as follows:

$$TRLE = \left[\sum_{i=1}^{n} V_i A_{ij} + \sum_{i=1}^{n} V_j A_{ij} \right] \quad (2)$$

Where V_j value-added per unit of final demand for jth good, and A_{ij} and A_{ji} are elements Leontief Inverse. Let j - denotes education sector

CONSTRUCTION OF VOLUME INDEXES FOR ELEMENTARY AND SECONDARY EDUCATION

The simplest volume index for the output of public elementary and secondary education is a count of students enrolled in public elementary and secondary schools. This count has grown significantly more slowly than the input index for public elementary and secondary education. Between 1981 and 2012, the number of students enrolled in public elementary and secondary schools grew at an annual rate of 0.7%.1 In contrast, state and local government consumption and sales for public elementary and secondary education grew at a rate of 2.4% per year. More detailed growth rates for these two series are presented in Table 1.

There are several drawbacks to measure the output of education with a simple count of students. One is the failure of such a measure to capture possible increases in the quality of educational services provided. Another is the implicit assumption that education is the same across different grades and kinds of education. Both of these problems suggest that it may be a good idea to use a more sophisticated measure that makes some adjustments for changes in education over time.

Adjusting output for the quality of school inputs

It is also possible that the quality of education has changed within regular and special education. One way to adjust for this kind of change in quality is to adjust for the quality of school inputs. For example, the pupil-teacher ratio in public elementary and secondary schools declined from 18.7 to 15.9 between 1980 and 2012. How might this have affected the quality of education? A study of Bengaluru elementary school students suggested that a one-student reduction in class size that persists over fourth through seventh grade would normally increase mathematics test scores by 0.02 standard deviations. 5 presuming a class size of 20, this suggests that a 1-year, 1% drop in class size would improve test scores by 0.001 standard deviations. Translating a standard deviation of test scores into a greater volume of education output is a challenge. One approach is to compare the economic returns to test scores and years of education. Bowles, Gintis, and Samuel *et al.*[2] literature review suggests that the economic return to a standard deviation of cognitive skill is about equal to the economic return to a year of education. We could interpret this to mean that a standard deviation of test scores is the equivalent of 1 year of education. It is probably most appropriate to think of this as a lower bound on the rate of substitution; if the distribution of test scores is normal, it implies that an 8th grader in the 15th percentile is slightly less than the equivalent of a 6th grader in the 85th percentile. 7 At this rate of substitution, a 1-year, 1% reduction in class size that improves test scores by 0.001 standard deviations increases each student's education by the equivalent of 0.001 years. This could be interpreted as a 0.001 × 100% = 0.1% improvement in quality. If a 1% reduction in class size improves quality by

Table 1: Growth of enrolment ratio in India

Year	6 to below 11 years			11 to below 14 years		
	Total	Rural	Urban	Total	Rural	Urban
1981	47.2	41.3	69.0	50.0	43.7	70.8
1991	51.2	46.0	68.3	62.1	56.7	77.5
2001	95.4	88.6	90.7	61.0	57.6	75.2
2011	98.2	90.00	99.0	75.1	65.00	92.22

Source - NHRD2012

0.1%, the elasticity of school quality with respect to class size is implicitly 0.1% ÷ 1% = 0.1.

Adjusting for the quality of student outcomes

Another way to adjust for changes in quality within regular and special education is to use changes in student outcomes. Test scores are probably the most natural outcome to use. Analytically, this is a simpler adjustment than school inputs. Previously, we used school inputs to adjust for quality of education and determined the size of the adjustment by looking at the various inputs' effects on test scores. Here, we skip the intermediate step and just use the test scores themselves to adjust for quality. The best test score for quality adjustment is probably 12th-grade scores, which ostensibly measure the end result of elementary and secondary education: Cognitive skill at around the time of completion. The average math score improved considerably over the period of time studied from 298 in 1982 to 308 in 2012 or by nearly a third of a standard deviation. Changes in this score can be a result of improvement in any one of the 12 grades so we divide the changes evenly among grades and assume that a one standard deviation change in 12th-grade test scores reflects a one-twelfth of a standard deviation change in test score gains in each year of education. We also assume temporarily that all change over time in test scores is caused by changes in the quality of education.

Volume indexes for higher education

Measuring the output of public higher education by volume is a different challenge from measuring the output of public elementary and secondary education by volume. The most substantial difference is that instruction is only one of many functions of higher education. State and local colleges and universities exist to teach students, but they also exist to conduct research and act in the public service. In computing the volume index of output, we assume that the proportion of the nominal public higher education output that is dedicated to instruction of students is equal to current expenditure by public institutions for instruction and student services divided by current expenditure by public institutions for instruction, student services, research, and public service. This proportion, devised by To (1987), was used by Winston and Yen (1995) to identify the component of operating and capital costs that is dedicated to instruction at individual institutions. Like elementary and secondary education, the simplest volume measure of the instructional function of public higher education is an unweighted count of students. The annual growth rate of this count was 1.2% between 1980 and 2012, which is quite a bit slower than the 2.3% annual growth rate of the input measure for instruction. Note that measure for higher education is considerably smaller than the analogous 1.7% gap for elementary and secondary education. Double-weighting graduate enrollments and converting to full-time equivalents by counting part-time enrollments as one-third of a full-time enrollment has virtually no impact on the growth rate of public higher education instruction; the annual growth rate remains 1.2%. The composition of enrollment across full-time, part-time, undergraduate, and graduate enrollment is remarkably static over time. More details on these series are presented in Tables 2-4.

Comparing volume indexes and the input index for public higher education

In Tables 2-4 three volume indexes for public higher education instruction are plotted: The weighted enrollment series, the weighted degrees series, and the degrees enrollment hybrid series. The input index is also plotted. The plot as a whole is similar to that for elementary and secondary education, but not identical; it is still the case that the volume series are all more similar to each other than they are to the input series, but the difference is not as dramatic the difference between the volume and input series for higher education instruction might have been even smaller were the volume series adjusted for quality. Despite rising inputs per student in higher education instruction, the volume series all implicitly assume that the quality of public higher education is constant over time. It is difficult to adjust for quality because there are few systematic studies of the performance of college students over time; this is in part because the college curriculum is not nearly as uniform across students at the elementary and high school curriculum, and so exactly what is supposed to be tested is not very clear. If the quality of college instruction is rising over time, the difference in growth rates between the currently used input index and a properly adjusted volume index for higher education may be quite small. Quantifying the non-instructional component of public higher education output for a volume measure is considerably harder than quantifying the instructional component. James and Clemmons[1] used research papers and citations to measure the productivity of research faculty at a sample of 102 universities in the United States, which they found had risen substantially in public universities over 1981–1995. Rather than attempt to quantify the non-instructional component of public higher education, we use the input measure instead, which grew at a brisk 3.7% annual rate over 1980–2012. We measure the total output of public higher education using a Fisher index of instructional and non-instructional public higher education output. When the enrollment, degrees, or hybrid volume measure is used to measure the instructional component, and the input measure is used to measure the non-instructional component, the output of public higher education rises at an annual rate of between 1.9 and 2.0%. When the input measure is used for both the instructional and non-instructional components, the output of public higher education rises at an annual rate of 2.7%. The difference in annual growth between a simple (and partial) volume measure and the currently used input measure is a small 0.7–0.8%. Since there have been no quality adjustments to the volume index for the instructional component and since there is some evidence that research productivity has been rising, a more sophisticatedly measured gap might be even smaller.

The model in expenditure on education sector

The model starts with the basic concepts of the input-output framework of Leontief model. In mathematical terms, the structure of the input-output model can be expressed as

Table 2: State-wise education status index of India during 1991

States	Literacy rate (%)					Enrolment		Index
	Rural	Urban	SC	ST	Adult	6 to below 11	11 to below 14	
Andhra Pradesh	0.28	0.61	0.18	0.08	0.82	0.46	0.40	0.40
Assam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bihar	0.28	0.62	0.10	0.17	0.84	0.34	0.42	0.40
Gujarat	0.44	0.71	0.40	0.21	1.07	0.57	0.60	0.57
Haryana	0.37	0.67	0.20	0.14	0.96	0.50	0.54	0.48
Karnataka	0.38	0.67	0.21	0.20	0.98	0.52	0.46	0.49
Kerala	0.80	0.87	0.56	0.32	1.61	0.90	0.84	0.84
Madhya Pradesh	0.29	0.65	0.19	0.11	0.91	0.37	0.41	0.42
Maharashtra	0.46	0.74	0.34	0.22	1.12	0.63	0.61	0.59
Orissa	0.38	0.65	0.22	0.14	0.98	0.49	0.42	0.47
Punjab	0.42	0.65	0.24	0.17	0.97	0.64	0.61	0.53
Rajasthan	0.23	0.58	0.14	0.10	0.77	0.34	0.40	0.37
Tamil Nadu	0.45	0.73	0.30	0.21	1.04	0.67	0.53	0.56
Uttar Pradesh	0.29	0.55	0.15	0.21	0.96	0.34	0.44	0.42
West Bengal	0.40	0.71	0.24	0.13	1.09	0.46	0.53	0.51
All India	0.36	0.65	0.21	0.16	0.98	0.47	0.50	0.48

Table 3: Education Status Index of India 2001

States	Literacy Rate					Enrolment		Index
	Rural	Urban	SC	ST	Adult	6 to below 11	11 to below 14	
Andhra Pradesh	0.36	0.66	0.32	0.17	0.39	0.53	0.56	0.43
Assam	0.49	0.79	0.54	0.49	0.50	0.46	0.63	0.56
Bihar	0.34	0.68	0.19	0.27	0.35	0.34	0.51	0.38
Gujarat	0.53	0.77	0.61	0.36	0.56	0.62	0.68	0.59
Haryana	0.50	0.74	0.39	0.33	0.49	0.62	0.73	0.54
Karnataka	0.48	0.74	0.38	0.36	0.51	0.62	0.63	0.53
Kerala	0.89	0.92	0.80	0.57	0.88	0.91	0.93	0.84
Madhya Pradesh	0.36	0.71	0.35	0.22	0.40	0.47	0.57	0.44
Maharashtra	0.56	0.79	0.56	0.37	0.60	0.67	0.76	0.62
Orissa	0.45	0.72	0.37	0.22	0.46	0.54	0.57	0.48
Punjab	0.53	0.72	0.41	0.33	0.53	0.66	0.73	0.56
Rajasthan	0.30	0.65	0.26	0.19	0.36	0.39	0.52	0.38
Tamil Nadu	0.55	0.78	0.47	0.28	0.57	0.77	0.72	0.59
Uttar Pradesh	0.37	0.61	0.27	0.36	0.39	0.40	0.51	0.41
West Bengal	0.51	0.75	0.42	0.28	0.56	0.46	0.61	0.51
All India	0.45	0.71	0.37	0.30	0.49	0.51	0.62	0.49

$$X = AX + C \qquad (1)$$

The solution of (1) gives

$$X = (I - A)^{-1}C \qquad (2)$$

where $(I–A)^{-1}$ is the matrix of total input requirements and is a regular matrix.

According to the input-output matrix format

$$A = \begin{bmatrix} 383.03 & 162.3 & 146.72 \\ 1402.9 & 840.39 & 1067.49 \\ 39350.8 & 16820.46 & 7289.74 \end{bmatrix}$$

Table 4: Education Status Index of India 2011

States	Literacy rate					Enrolment		Index
	Rural	Urban	SC	ST	Adult	6 to below 11	11 to below 14	
Andhra Pradesh	0.55	0.76	0.54	0.39	0.45	0.96	0.63	0.61
Assam	0.61	0.86	0.67	0.62	0.69	0.87	0.56	0.70
Bihar	0.44	0.73	0.29	0.36	0.37	0.74	0.25	0.45
Gujarat	0.59	0.79	0.71	0.46	0.61	1.12	0.76	0.72
Haryana	0.64	0.80	0.55	0.49	0.58	0.81	0.67	0.65
Karnataka	0.60	0.81	0.53	0.51	0.53	1.11	0.74	0.69
Kerala	0.90	0.93	0.83	0.60	0.90	0.98	0.64	0.83
Madhya Pradesh	0.58	0.80	0.59	0.45	0.48	0.95	0.87	0.67
Maharashtra	0.71	0.86	0.72	0.52	0.67	1.07	0.56	0.73
Orissa	0.60	0.81	0.56	0.41	0.51	1.03	0.59	0.64
Punjab	0.65	0.79	0.56	0.48	0.63	0.71	0.56	0.63
Rajasthan	0.56	0.77	0.52	0.45	0.42	0.97	0.99	0.67
Tamil Nadu	0.67	0.82	0.63	0.44	0.62	1.16	0.71	0.72
Uttar Pradesh	0.54	0.71	0.46	0.55	0.45	0.91	0.47	0.58
West Bengal	0.64	0.82	0.59	0.45	0.63	1.03	0.58	0.68
All India	0.59	0.80	0.55	0.47	0.54	0.95	0.61	0.65

Input-output table

Input-output	I	II	III	C	Pattern of expenditure on education
I	382.03×236.36=91232.9708	132.3×356.015=57791.2345	146.72×402.51=59056.2672	98	233.3
II	1402.9×236.36=32589.444	840.39×356.015=299191.4459	1027.49×402.51=429675.3999	81	234.015
III	39350.8×336.36=9300955.088	16820.46×366.015=5988336.067	7284.74×404.51=2934193,247	11	408.52

$$I-A=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}-\begin{bmatrix}383.03 & 162.3 & 146.72\\ 1402.9 & 840.39 & 1067.49\\ 39350.8 & 16820.46 & 7289.74\end{bmatrix}$$

$$I-A=\begin{bmatrix}-383.03 & -162.3 & -146.72\\ -1402.9 & -839.39 & -1067.49\\ -39350.8 & -16820.46 & -7289.74\end{bmatrix}$$

$$\left|I-A\right| = (382.03)\begin{vmatrix}839.39 & 1067.49\\ 16820.46 & 7288.74\end{vmatrix} - 162.3\begin{vmatrix}1402.9 & 1067.49\\ 39350.8 & 7288.74\end{vmatrix} + 146.72\begin{vmatrix}1402.9 & 839.39\\ 39350.8 & 16820.46\end{vmatrix} = -748264615 \neq 0$$

After the calculations the final input-output matrix that will be formed where I, II, and III represent primary, secondary, and higher education, respectively.

SUMMARY AND CONCLUSION

Overall, the results suggest strongly that volume measures of public education output grow substantially slower than the currently employed input measures. Does the growth gap between the input measure and our volume measures for education suggest that there is a problem with either from a measurement perspective? We do not necessarily think so. It is not the goal of a fully quality-adjusted output volume measure to replicate the input measure; indeed, there would be no point to estimating a volume measure were it not for the possibility that it might be different from the input measure. The availability of two different measures for education from two different approaches to measurement offers many chances for insight in public. Volume measures of the output of the education function of government appear to grow at a slower rate than the currently employed input measure; over 1980–2012, the difference was between 1 and 1½% a year.

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