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Cost Effectiveness in Primary Education: A Study of Pakistan

ZAFAR H. ISMAIL, HAFIZ A. PASHA and A. RAUF KHAN

1. INTRODUCTION

The Government of Pakistan prepared the second Perspective Plan in 1987-88 for the next fifteen years to set the long-term social and economic policy framework. The Plan identified that the long-term objectives could only be achieved if the education, skills, nutrition and health of the people were improved. These objectives have recently been operationalised in the donor supported Social Action Programme (SAP). However, there is general recognition of the resource constraint within which these objectives are to be achieved, especially given the low priority that has been attached traditionally to allocations to the social sectors. Therefore, the programme envisages the expansion of primary infrastructure through an accelerated school construction programme using cost-effective approaches to delivery including need-based criteria for school location and changes in the pattern of allocation of funds among sector inputs.

This paper examines cost-effectiveness of the primary education sector in Pakistan and attempts to establish implications for a possible future strategy. Section 2 presents the historical profile of the sector from 1973 to 1991. Section 3 sets out the theoretical framework for analysis. Sections 4 and 5 first estimate the costs and then identify the determinants of spatial and inter-temporal variation in these costs. Section 6 summarises the key conclusions.

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2. TRENDS IN PRIMARY EDUCATION

Estimates of enrollment published by the Central Bureau of Education of the Government of Pakistan indicate that it is increasing at a faster pace than the growth in population of the relevant age cohort (5–9 years) for each of the Provinces (see Table 1). In the largest province, Punjab, primary enrollment has increased at more than twice the growth rate in the relevant population cohort between 1973 and 1991. Starting from low base levels, female enrollments have shown an even faster growth rate generally (except in Balochistan). The differential in growth rates between enrollments and education inputs (Teachers and Schools) indicates that the average number of students per teacher has been increasing with the passage of time. Also the average school size, measured as students per school, has been increasing.

Table 1

Growth Rates in Enrollment, School Going Age Population and Inputs to Primary Education, 1972-73 to 1990-91

(Percentage)

	Punjab	Sindh	N.W.F.P	Balochistan
Cohort Population	2.2	3.5	3.5	3.5
Total Enrollment	4.7	4.2	5.9	9.1
Female Enrollment	5.6	4.5	5.9	8.0
Number of Schools	3.9	5.5	5.2	3.6
Number of Teachers	3.5	2.7	2.6	8.5

The higher growth rate in the number of schools in the three more relatively developed Provinces clearly shows the declining trend in the number of teachers per school. This tends to imply that the quality of education has been declining and that the share of capital costs in the provision of education at the primary stage has been increasing over the period.

3. THEORETICAL FRAMEWORK

Different approaches can be adopted for deriving the cost function for primary education of provincial governments. One approach is to view the provincial governments as engaging in a cost minimisation behaviour, given knowledge of the production function of enrollments with respect to inputs like schools, teachers, etc.

In this view unit costs are the minimum average costs for achieving a target enrollment ratio. However, this approach assumes rational behaviour with full knowledge of the production function, and no resource constraints such that targets can be fully met. These assumptions are generally not satisfied in practice.

A more realistic view of how provincial governments behave is that they generally operate in an overall resource constrained framework, both for recurring and development expenditures, and that given the overall quantum of resources available in the recurring budget and the ADP, funds are allocated to primary education on the basis of inter-sectoral priorities. According to this view then the actual choice of level of inputs need not correspond to the cost minimising combination. As such some inputs are likely to be overused while other remain at sub-optimal levels. Fox example, if development allocations for primary education are high, especially in recent years following the launching of the SAP, then too many schools may be built relative to teachers whose numbers may be constrained by lack of revenues to finance recurring expenditures.

We set up the theoretical framework which is consistent with the latter view. Accordingly the number of teachers, T_t, and the number of schools, S_t is given exogenously by the size of current recurring and development expenditure (past and present) allocations for primary schools.

The total cost of primary education to provincial governments is given by

$$C_t = W_t \overline{T}_t + v_t \overline{S} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (1)$$

where w_t is the average wage rate (at constant prices) of teachers. The wage rate includes overhead costs and cost of inputs (books, etc.), v_t is the rental price of capital and includes a depreciation component and a component for the opportunity cost of capital.

The production function of primary education is represented as

$$E_t = f_t(\overline{T}_t, \overline{S}_t, Z_t) \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (2)$$

where E_t = enrollments and Z_t a vector of variables on the demand side determining the rate of utilisation of education facilities.

Therefore, we have that the average cost, AC_t, in year t per enrollment as

$$AC_t = \frac{C_t}{E_t} = \frac{w_t \overline{T}_t + v_t \overline{S}_t}{f_t(T_t, S_t, Z_t)} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (3)$$

4. ESTIMATION OF COSTS

Information on public sector costs (both recurring and capital) of providing education are contained in the annual budget documents of the provincial governments.[1]

As the construction of schools is spread over a number of years, the data on development outlay would need to be lagged differently for each province. Because of data limitations a two-year lag for each of the Provinces has been used.

The cost of providing primary education to a particular student is the aggregate expenditure incurred over the five years he/she spends in school. Further, as these costs are incurred at different periods of time one needs to convert these into real terms.

The recurring expenditure series has been converted to real terms (at constant prices of 1990-91) by inflating the nominal values by the implicit deflator for the Public Administration and Defence sector of the economy. The nominal development expenditures have been adjusted to real terms using the implicit deflator for the Construction sector. The trend growth rate in these implicit deflators indicates that the former has been rising by 8.1 percent annually and the latter by 8.8 percent annually. This would imply that the construction of more schools in preference to the provision of more factor inputs may be less cost efficient.

In real terms N.W.F.P. has been increasing its recurring expenditure much more rapidly than the other Provinces. Sindh, however, outstrips the others in its annual increase in development expenditure. Inter-provincial differences in growth rates may be seen in Table 2. These clearly highlight the priority in the mix of expenditure for each of the provinces.

Table 2

Real Growth in Expenditures and in Unit Costs (1972-73 to 1990- 91)

(Percentage)

	Punjab	Sindh	N.W.F.P.	Balochistan
Recurring Expenditure	8.7	7.8	12.5	12.0
Development Expenditure	9.4	18.3	10.8	7.9
Recurring Cost per Teacher	5.2	5.1	10.0	3.5
Construction Cost per School	2.0	5.1	–2.5	2.2

[1]Indicates the share of provincial governments in provision.

An important conclusion by comparison of the growth rates in Tables 1 and 2 respectively is the fast increase in expenditure relative to the growth in physical inputs. This indicates that the unit cost, C_t, of constructing a school has been rising in real terms while the real recurring cost per teacher has also demonstrated some increase.

The output of the primary stage of education is the number of students completing the fifth year. As information on completions, successful or otherwise, is not available, the output at this stage has been equated to the enrollment in class 5. The recurring costs spent on a student produced by the system is the aggregate cost per enrollment over the five year span.

The value of the base stock of schools in 1973 has been derived by first estimating the average per school cost in real terms and then applying this to the base quantum. This however, underestimates the value of the base stock as it does not include the value of those primary level class-rooms available in the higher category of schools (middle and high). Information for this is not available. To this base year estimate each year's addition to the capital stock is added. This is then converted into an annualised stream by aggregating the opportunity cost of the stock of schools each year and the current year's depreciation. The opportunity cost has been assumed to be 12.5 percent (the long-term return on government bonds) of the value of the stock. The life-span of a primary shcool has been assumed to be 40 years. These have then been translated to the per student cost.

These province-wise estimates on a per student basis of primary education are presented in Table 3. Table 4 summarises the growth rates in enrollment and output costs.

It is also of some interest to note the inter-provincial variation in costs. As of 1990-91, output cost at Rs 16,196 are the highest in Balochistan, followed by Rs 15,985 in N.W.F.P., Rs 7,553 in Sindh and Rs 6,579 in the Punjab. Costs are relatively high in the former two provinces becuase of the high component of capital costs due largely to higher costs of constuction.

5. DETERMINANTS OF COSTS

The general specification of the average cost function (with respect to enrollment) of primary education for provincial governments is given by Equation (4). For econometric estimation we scale the number of schools by the school going age population in age group of five to nine years. The latter variable reflects potential demand. Similarly, the number of teachers is scaled by the number of schools, to yield the input mix. Also, since the impact on unit cost of $\overline{S}$ and $\overline{T}$ is ambiguous, these variables enter in a polynomial form in the cost function.

Table 3

Enrollment and Output Costs per Student in Primary Education (at 1990-91 Prices)

(In Rupees)

	Enrollment Costs	Output Costs	Enrollment Costs	Output Costs
	Punjab		**Sindh**	
1973	790		774	
1974	828		835	
1975	844		830	
1976	844		841	
1977	829	4,134	777	4,057
1978	904	4,249	883	4,166
1979	888	4,309	843	4,174
1980	906	4,371	883	4,,227
1981	927	4,454	906	4,292
1982	930	4,555	923	4,438
1983	1,037	4,688	1,032	4,587
1984	1,132	4,932	1,015	4,760
1985	1,112	5,138	1,114	4,991
1986	1,284	5,494	1,429	5,514
1987	1,324	5,888	1,615	6,206
1988	1,343	6,194	1,699	6,873
1989	1,340	6,402	1,562	7,419
1990	1,257	6,547	1,564	7,869
1991	1,316	6,579	1,447	7,887
	NWFP		**Balochistan**	
1973	1,862		2,422	
1974	1,944		2,331	
1975	1,924		2,366	
1976	1,924		2,400	
1977	1,908	9,561	2,296	11,815
1978	1,978	9,677	2,332	11,725
1979	2,008	9,742	2,426	11,820
1980	2,100	9,919	2,471	11,925
1981	2,196	10,191	2,583	12,108
1982	2,313	10,596	2,769	12,582
1983	2,557	11,175	2,901	13,150
1984	2,629	11,796	2,963	13,686
1985	2,757	12,453	2,959	14,175
1986	2,872	13,129	3,190	14,782
1987	3,096	13,911	3,376	15,389
1988	3,222	14,576	3,423	15,912
1989	3,237	15,184	3,231	16,180
1990	3,256	15,683	3,146	16,366
1991	3,175	15,985	3,020	16,196

Table 4

Real Growth in Enrollment and Output Costs of Primary Education

(Percentage)

	Punjab	Sindh	N.W.F.P.	Balochistan
Annual Cost per Enrollment	3.8	5.8	4.4	2.7
Output Cost	3.8	5.6	4.2	2.9

The resulting equation to be estimated is as follows:

$$AC_t = \beta_0 + \beta_1 \left[\frac{\bar{S}_t}{\bar{A}_t}\right] + \beta_2 \left[\frac{\bar{S}_t}{\bar{A}_t}\right]^2 + \beta_3 \left[\frac{\bar{S}_t}{\bar{A}_t}\right]^3 + \beta_4 \left[\frac{\bar{T}_t}{\bar{S}_t}\right]$$

$$+ \beta_5 \left[\frac{\bar{T}_t}{\bar{S}_t}\right]^2 + \beta_6 \left[\frac{\bar{T}_t}{\bar{S}_t}\right]^3 + \beta_7 Y_t + \beta_8 U_t + \beta_9 I_t + \varepsilon \quad \ldots \ldots \quad (4)$$

where

$\bar{A}_t$ = school going age population in year t;
Y_t = real per capita income;
U_t = extent of urbanisation; and
I_t = relative price index for wages to construction cost.

Y_t is included to capture the real wage effect (inclusive of labour into shcool construction) and a possible demand effect. U_t is a demand related variable. I_t derives the cost implications of a divergence between inflation in wages and construction costs.

The magnitudes of β_2 to β_6, are of special significance. These will help in identifying the presence of economies or diseconomies in the use of inputs.

Equation (4) is estimated on pooled time-series data for the four provinces for the period, 1976-77 to 1990-91. The results are given in Table 5. Intercept and slope dummies for the provinces have been used wherever significant. The estimated equation demonstrates that there are some significant inter-regional differences in these coefficients, with Punjab and Sindh falling into one group and N.W.F.P. and Balochistan into another group.

Table 5

Results of Regressions
Average Cost per Enrollment is the Dependent Variabl

Variable***	Coefficient	*t*-Ratio
$(\bar{S}_t/\breve{A}_t)$	− 658.885	− 4.019*
$(\bar{S}_t/\breve{A}_t)^2$	93.127	3.128*
$(\bar{S}_t/\breve{A}_t)^2$. DPS	− 44.367	− 2.276**
$(\bar{T}_t/\bar{S}_t)$	5742.927	6.941*
$(\bar{T}_t/\bar{S}_t)^2$	− 2355.522	− 4.956*
$(\bar{T}_t/\bar{S}_t)^3$	305.364	3.833*
U_t	− 3780.088	− 4.389*
Y_t	0.465	5.665*
I_t	− 1526.407	− 6.189*
DUMBAL	652.917	8.857*
R'^2	0.982	
F	361.821	
Degrees of Freedom 49		

* Significant at 1 percent level.

** Significant at 5 percent level.

*** The cubic term for $(S_t/\breve{A}_t)$ is not significant.

DUMBAL = 1 for Balochistan; zero otherwise.

DPS = 1 for Punjab and Sindh; zero otherwise.

For all provinces the equation indicates that the average cost falls initially and then rises subsequently with increase in $(\bar{S}_t/\breve{A}_t)$, the ratio of schools to school-going age population. Therefore, there exists for each province an optimal $(\bar{S}/\breve{A})$ which minimises unit costs. Any expansion in schools beyond this level raises the unit cost. With regard to teachers per school, we observe a rise in costs initially and then a fall with increase in $(\bar{T}/\bar{S})$ upto a level beyond which costs rise once again.

The estimated optimal cost minimising magnitudes of inputs for each province are given in Table 6. The optimal number of schools per 1000 school-going age population in Punjab and Sindh is 6.76. The former province was close to this level by 1990-91. For N.W.F.P. and Balochistan the corresponding optimal mag-

nitude is 3.54. N.W.F.P. is already above this magnitude. Therefore, in at least two provinces of the country, Punjab and N.W.F.P., the priority in allocation of resources has to shift from school building. This activity can perhaps only be justified on regional equity considerations in areas which are backward and have low levels of coverage.

Table 6

Actual (1990-91) and Optimal Number of Schools per 1000 School-going Age Population and Teachers per School by Province*

	Actual (1)	Optimal (2)	Difference (2–1)
	$(\overline{S}/\overset{*}{A})$		
Punjab	6.33	6.76	0.43
Sindh	5.96	6.76	0.80
N.W.F.P.	3.95	3.54	– 0.41
Balochistan	2.32	3.54	1.22
	$(\overline{T}/\overline{S})$		
Punjab	2.16	3.16	1.00
Sindh	2.16	3.16	1.00
N.W.F.P.	1.51	3.16	1.65
Balochistan	2.84	3.16	0.32

Table 6 also indicates there is underprovision generally of teachers. It appears that their role in raising quality and demand for primary education has not been fully recognised. Actual inputs of teachers per school are below cost minimising levels in all provinces, especially N.W.F.P. Overall we have the conclusion that the composition of expenditure budgets (with the possible exception of Balochistan) has to be dramatically altered. The recurring allocations for employing more teachers need to be raised and simultaneously development allocations scaled down. The same strategy is recommended for the Social Action Programme. However, the expansion in the number of primary school teachers raises issues of adequate training facilities, remuneration levels and decentralisation of management down to community level to increase accountability of teaching inputs.

6. CONCLUSIONS

This paper has examined the degree of cost effectiveness of the primary education sector of Pakistan. Annual enrollment and output costs have been estimated for each province for the period, 1976-77 to 1990-91. These have shown a rising trend generally because of the increase in real recurring costs per teacher, in costs of school contruction and because of the divergence in the physical level of use of education inputs, schools and teachers, from the cost minimising levels. In particular, the number of teachers is substantially below optimal levels. This indicates that cost effectiveness of provision of primary education can be significantly enhanced if the allocation of funds is shifted towards recurring expenditures for employment of more teachers away from development allocations for construction of new schools.

Comments on "Cost Effectiveness in Primary Education: A Study of Pakistan"

It is a pleasure to comment on the paper by Zafar H. Ismail, Hafiz A. Pasha and A. Rauf Khan.

In the paper the authors considered the issues of cost effectiveness of primary education and future strategy of resource allocation. They noted that for improvement of human capital stock, allocation of resources in the presence of resource constraint, has to shift from construction of new schools to employment of more teachers. I must acknowledge that it is an interesting and useful study. The issue of economic efficiency in relation to resource allocation is a priority area of the primary education element of the Social Action Programme which was launched by the Government in 1992-93. The conclusion drawn points to the right direction for planners and policy-makers. However, there are some problems in respect to data, methodology and specification of the cost function used in the study.

Under Section (2) "Trends in Primary Education", it is stated that over the period 1972–91 the student/teacher ratio is falling. However, based on the data provided in the Tables 1 and 2 inferences contrary to this can be drawn.

In designing the theoretical framework, it would be much more useful if a province-specific framework be designed. A typical school, location-specific to urban, semi-urban and rural is a case in point. Instead of historical cost data, cost reflecting both fixed as well as variable ones be estimated and then discounted to arrive at unit cost may be prescribed as the standard one for the allocation of resources. Needless to say that in view of the changing structure of inputs and associated prices, the standard unit cost would need revision in due course of time.

With reference to data, my two concerns are in regard to relevance of primary school data and selection and application of deflators. On the cost side, public expenditure data are used, whereas data on enrollment, number of schools and teachers seem to relate to both public and private sectors. Further in estimating the average capital cost of schools, it appears that cost is overestimated as shelterless schools constituting about 28 percent of total schools have not been taken care of. As for the selection of deflators, the authors have used the deflators of public

administration and defence and construction sectors respectively for deflating the recurrent and the development expenditures. These may not be quite relevant. As the composition of inputs of both the deflators are quite different and heavily biased towards inputs with low weights for wage components and construction inputs of schools. It may be appropriate that specific deflators of public expenditure for the education sector are calculated and used. As the time frame is the same and growth rates of both the implicit deflators are close, it may be useful, if methodology based on current prices, which is also valid, may be used.

At the end I must add that the study is useful as it highlights the current policy issues and serves well to contribute to our understanding of the resource allocation process in the primary education sector.

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