

A Methodology to Estimate Education Attainment and Indirect Fertility Effects of Policies, Programmes, and Projects of the Education Sector

Introduction

METHODOLOGIES to project implications of changes in population growth rates in a country for the rate of economic development and to forecast required quantities of such items as food grains, houses, health clinics, and schools are now well-established.¹ There is also a widespread interest in understanding the role and relative importance of such factors as female education in influencing fertility behaviour. Numerous studies have attempted to quantify the relationship between education and fertility.² These and other studies suggest that fertility behaviour of couples in developing countries depend upon, among other things, their education attainment. Many issues remain to be explored before the education and fertility relationship is fully understood. At the same time there is a need to develop a methodology that can be used to estimate potential fertility implications of policies, programmes, and projects in the edu-

1- See for example : Coale and Hoover (1958) for implications of different rates of population growth for general economic development of India and Mexico; and Chau (1972) and Jones (1975) for implications of changes in rate of population growth for education planning in developing countries such as Colombia, Sri Lanka, Singapore, Tanzania, Thailand, and Tunisia .

2 for example, CochRne, 1979; Hermalin and Mason, 1981; and Jain, 1981. .

cation sector. Such a methodology is required to incorporate fertility implications of the education sector programmes in educational planning, and to assess the feasibility of advancements in female education as an approach to fertility reduction.

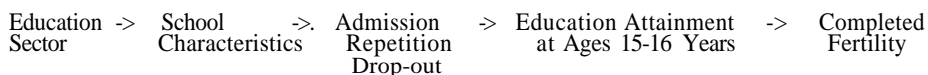
The purpose of this paper is to develop a methodology to estimate the impact of policies, programmes, and projects of the education sector in terms of their direct effects on education attainment as well as the implied work load and cost, and in terms of their indirect effects on the average fertility level of a cohort of women. The methodology consists of two components: (1) an analytical framework which specifies major links between policies, programmes, and projects of the education sector on the one hand, and changes in fertility levels, on the other; and (2) a simple projection model which quantifies the anticipated direct and indirect effects of alternative approaches in the education sector. The input parameters of the model are estimated by using data from India. Three hypothetical approaches are then compared to illustrate the application of this methodology.

Analytical Framework

General Overview. Methodologies to project implications of changes in rates of population growth are primarily based on accounting procedures. The same tradition is followed here. The future total population and its distribution by age and sex are projected under different assumptions about future trends of mortality, fertility, and migration. These projections are then used to estimate various requirements for the population. In the present case, the education distribution of female children born in a particular period is projected. This distribution is then utilized to estimate the anticipated average fertility for the entire cohort. Thus, the analytical framework developed in this paper is based on a cohort approach. It considers children born in a particular period (e.g. 1975), follows them through their school going years (1980-95) and then through their child-bearing period (1990-2020).

Let us start with policies, programmes, and projects in the education sector. They primarily affect such factors as location of schools, teaching personnel, and the classroom size. These in turn can influence one of the three primary determinants of education attainment: (1) admission rate, (2) repetition rate, and (3) drop-out rate. Children in a birth cohort can be exposed to different combinations of these three determinants and, thus could have different educational composition by the time they enter their childbearing period (about age 15-19 years). With the same education-specific fertility behaviour, children of the same cohort can be expected to have different average completed fertility, be-

cause of the differences in their education composition. This simple formulation ignores any interaction between education composition and education-specific fertility behaviour. It does not incorporate effects of non-formal education and effects of population education through formal and non-formal channels. This simple set of relationships is presented below.



Another way to consider these relationships is to start backward from completed fertility of a cohort of women which is a mathematical function of: (1) education-specific fertility levels and (2) education distribution of women around the time they enter their child-bearing period. The education distribution of girls by the time they are about 15 years of age is determined by: (1) the proportion of girls who entered school at age 5 (admission rate), (2) the proportion who repeated the same grade (repetition rate), and (3) the proportion who dropped out of the school system (drop-out rate).³ These three determinants can be influenced by school characteristics which in turn are influenced by policies, programmes, and projects in the education sector.

There are other important links which need to be mentioned. The three primary determinants of education attainment—admission, repetition, and drop-out rates—are not only influenced by school characteristics but also by (a) the individual child's characteristics and (6) the child's family background. These two sets of characteristics could be influenced by policies, programmes, and projects of other sectors. The average fertility for a group of women is in outcome of a set of four important intermediate or proximate variables: marriage, breastfeeding, use of contraception, and abortion (see Bongaarts, 1978). But the individual behaviour with respect to these factors might be guided by a more complex set of relationships between supply and demand factors or cost and benefits of children and thus the education-specific fertility behaviour might be influenced by factors other than the education attainment of the individual woman. A more complete set of relationships is schematically presented in Figure 1.

These relationships imply three main steps in specifying the anticipated effects of a particular programme in the education sector on fertility. These are :

3. Children may repeat the same grade because they are not allowed to take the final examination due to low attendance or poor performance. Transfers among schools are not considered drop outs in the school system.

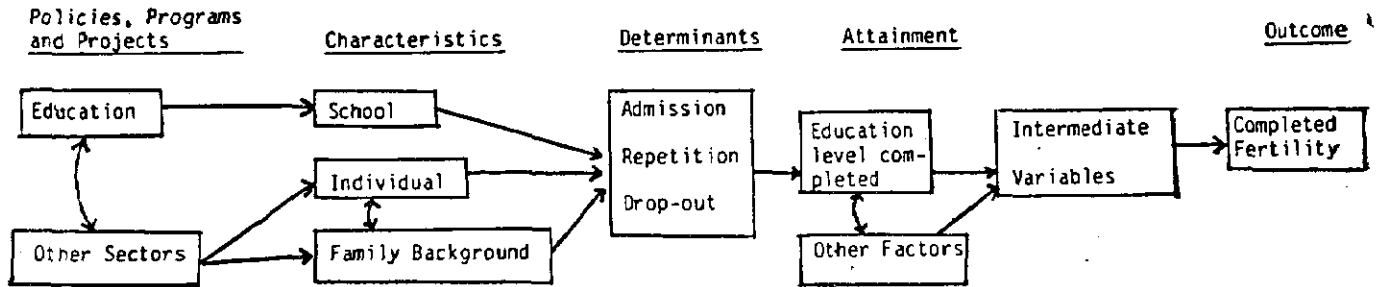


Fig 1. Schematic Presentation of Education-Fertility Relationship.

1. To specify the anticipated effects of the specific programme *in* the education sector on three primary determinants of education attainment: admission, repetition, and drop-out rates.
2. To project the education distribution of a cohort of girls exposed to the estimated values of these three parameters.
3. To estimate the average fertility of the entire cohort by using the projected education distribution and anticipated education-specific fertility levels.

Specifications mentioned in Step 1 would be country-specific and would require an extensive review of the existing literature and involvement of professionals from the education sector. No such attempt has been made here. Instead some of the items that might be relevant in such a review are specified. A simple model is constructed to project the education distribution and to estimate the average fertility mentioned in steps 2 and 3. The parameters used in this model would be country-specific and might vary over time within a country but the methodology is likely to be of general use.

As mentioned earlier, policies, programmes or projects of the education sector are likely to influence one or more of the three primary determinants of education attainment mainly by influencing school characteristics and to some extent by influencing relevant individual characteristics and the family background of an individual student. Some of the policies, programmes, and projects of the education and other sectors; some of the school characteristics; and the characteristics and the family background of the individual students which might be included in the literature review to specify their effects on the three primary determinants of education attainment are specified below.

Specification of Policies, Programmes, and Projects. The relevant policies in the *education sector* might include :

- Resource allocation for education, for example, the percent of Gross National Product allocated for education or the average per capita expenditure on education.
- Resource allocation *within* the education sector but *between* (i) Levels of education—primary, elementary, secondary, higher; (ii) Geographic areas—rural vs. urban or different states; and (iii) Activities, for example, new schools, teacher's training, salaries, library facilities, dormitories, mid-day meals at school.
- Subsidy, i.e. cost of education not to be recovered from students/parents.

- Curricula, for example, type of education, textbook, etc.
- Criterion for promotion from one grade to the next.

The programmes and projects will refer to a more specific activity designed to carry out policies set within any of the above mentioned categories. Relevant programmes in *other sectors* might include :

- Nutrition and health-related programmes.
- Employment and income-generating programmes for parents of the children.
- Transportation-related programmes,
- Child labour-related programmes and policies.

Specification of Characteristics. The *School Characteristics* that are primarily influenced by policies and programmes of the education sector and that, in turn, influence the three determinants of schooling (admission, repetition, and drop-out) might include: Accessibility of schools, i.e., location/distance of school from home, availability of transport, and availability of dormitories; Content of education; Accessibility to learning materials, for example, text books, stationary, library facilities; Characteristics of teaching personnel, for example, sex (male / female), training, salary, contract, experience, motivation; Workload, i.e., classroom size, or number of pupils per teacher; Single/Double sessions; Examination/Promotion criterion; School Timings, i.e., academic years, as well as timings of the day.

Important among the characteristics of individual students are: (a) learning ability, (b) motivation, and (c) morbidity and malnutrition. A lack of learning ability and the extent of morbidity and malnutrition might be influenced by the family background. But these are primarily influenced by programmes of other sectors and the extent to which individual's needs are met by the school system.

Important factors in *the family background* might include: Economic condition of the family: Ability or inability to pay the direct cost of education such as school fees, cost of uniforms, textbooks, stationary, transport, mid-day meals, and ability or inability to absorb the indirect or the opportunity costs of education, which determine the need for the child to work; Social condition, such as education of the parents which might affect parents' motivation to educate their children; Demographic, i.e. sex of the child, number of siblings and the birth order of the child,

The policies, programmes, and projects of the education sector and of other sectors; the characteristics of the school system, of individual students, and their family backgrounds can affect their education attainment *only* by influencing one

of the three primary determinants: admission, repetition, and drop-out rates.

Let us specify some of these anticipated changes by way of illustration. A decision to recover a part of the cost of education from students/parents would influence parent's ability to pay direct cost of education and thus would influence whether or not a child goes to school, and whether and how long he/she stays in school. Similarly, employment and income generating programmes for adults are likely to increase parents' ability to bear the direct and indirect cost of education and would enhance the chances that their children go to and stay in school. Location of schools, transportation facilities, and dormitories are likely to influence the accessibility of schools. Characteristics of the teaching personnel are likely to be affected by the decisions regarding resource allocation within the education sector and these characteristics in turn are likely to influence the repetition and drop-out rates.

The relative importance of admission, repetition, and drop-out rates for education attainment is likely to be country, period and grade specific. For this reason* the relative importance of school characteristics versus family background and that of programmes of the education sector versus other sectors are also likely to be country, period and grade specific. For example, in areas without any access to schools, programmes of the education sector obviously are important for providing school facilities. The extent to which school facilities are used, i.e., children go to and stay in school, might be influenced by school characteristics, individual child's learning ability, and family background.

The relative importance of these three groups of characteristics, in developing countries for education attainment is not known. There are few studies which address this issue.⁴ This review indicates that those factors which can be influenced by policies of the education sector have smaller influence than students' socio-economic background on their academic achievement at all levels of schooling except the higher secondary grades. Most of the studies reviewed, however, were concerned with cognitive achievement of students and thus are not informative about the determinants of, for example, drop-out rates.

Changes in the three determinants, caused by changes in any one or more of the preceding factors, can be compensatory and therefore, the education attainment might remain unchanged. For example, a rapid expansion of the education system through new schools might increase the initial admission rate. At the same time it might also increase the repetition and drop-out rates, if pupils with varying degrees of motivation and ability to learn are admitted in the school system without adequate preparation and training of the staff in dealing with a

4. See Alexander and Simmons, 1975, for a review.

very diverse group. Consequently, the education attainment of the population may not increase as much or as fast as would be expected on the basis of an increase in the admission rate alone. Similarly, changes in promotion criteria would not only affect the repetition rate but might also affect the drop-out rates. There are indications that countries with high repetition rates also have high drop-out rates (Levy, 1971). The extent to which the same relationship exists within a country at the aggregate or an individual level is not known. However, it is quite likely that changes in the preceding factors affect one or more of the determinants of education attainment. Thus, in order to estimate the effect of, for example, a programme in the education sector on the education attainment, one has to estimate its effects separately on all the three determinants—admission rate, repetition rate, and drop-out rate. These effects are likely to be country-specific and have to be estimated in the country programme context.

Projection Model

Description. It is a simple projection model; this model can be used to compare two or more policies, programmes, or projects of the education sector in terms of their direct effects on education attainment, the implied workload and cost, and in terms of their indirect effect on the average fertility levels of a cohort of women. It follows a cohort of children born in a specified year who become eligible to enter school, for example, at 5 years of age. These children are exposed to a set of annual admission rates, gradespecific annual repetition, and drop-out rates—the three primary determinants of education attainment. This model projects the distribution by completed grades for these children at each successive age until each child either drops out of the school or completes secondary education. Thus, this model projects the education distribution of a cohort of girls by the time they enter their child-bearing period. It also projects other indicators such as enrollment ratios and cost of education. The projected education distribution and the expected education-specific fertility levels are used to estimate the average completed family size for the entire cohort. This section describes the assumptions of the model, various steps involved in the estimation of the input parameters, the projection technique, and the output indicators.

Assumptions

1. All children remain in grade 0 until they complete 5 years of age i.e., pre-school, nursery, and kindergarten is treated as grade 0
2. P_{01}^5 percent of children at age 5 are admitted to Grade 1. PO_{01} percent of

the remaining enter school at age 6, p_{01} percent of the remaining enter school at age 7, and the remaining never go to school.

At the end of the first school year, R_{11} remain in Grade 1, D_{12} drop out of school after completing Grade 1, and P_{12} are promoted to Grade 2. More generally at the end of each school year R_{ii} remain in Grade i , $D_{i i+1}$ drop out of school after completing Grade i , and $P_{i i+1}$ are promoted to the next grade ($i + 1$). Here

$$R_{ii} + D_{i, i+1} + P_{i, i+1} = 1.$$

4. Each student is allowed a maximum of two repetitions throughout the school during grades 0-11. Each student can repeat the same grade two additional years thus spending three years in a grade or he/she can repeat two different grades for one additional year each.
5. Repeaters are exposed to the same promotion, repetition, and drop-out rates as the non-repeaters. However, after completing two repetitions, fifty percent of them are promoted to the next grade and the remaining fifty percent are forced to drop out of school.
- 6- The grade-specific promotion, repetition, and drop-out rates are assumed to remain constant for the entire school experience of the cohort.
7. The drop-outs are not allowed to re-enter the school system.

These assumptions are likely to be country and period specific. Assumption 1 fixes the minimum age at entry to the school system. The effect of assumption 2 is to limit the maximum age at entry to the school system. Assumptions four and five are used to assign some meaningful limits to the experience of repetition. Assumptions 5, 6, and 7 are used to keep the model simple. Some of these assumptions can be modified to adapt this model to situations prevalent in other settings. For example, the minimum age at entry can be changed from 5 to 6 years or the total number of repetitions allowed in a school system can be changed.

Estimation of Input Parameters

The model requires estimates of the following input parameters.

1. Grade-specific promotion, repetition, and drop-out rates.
2. Initial admission rate: $P_{51} \cdot P_{01}^6$
3. Cost of one year of education by level of education.
4. Education-specific fertility rates.

The estimation of these parameters follows.

Repetition, Drop-out, and Promotion Rates. The grade-specific annual repetition, drop-out, and promotion rates can be estimated from school records or special sample surveys. The sum of these three rates for any one grade is equal to one and, therefore, we need to estimate any two of them. The estimation procedure would depend on the availability of information. For India, we used a procedure described by Levy (1971). Let

E_i^t = enrollment in grade i in year t , and

R_i^t = repeaters, i.e., children enrolled in grade i in year t who were enrolled in the same grade in the previous year or who will be enrolled in the same grade next year.

$D_{i,t,t+1}^i$ = drop-outs between t and $(t + 1)$ years after completing grade i .

= (Enrolled in grade i in Year t) - (Promoted to and enrolled in grade $i + 1$ in Year $t + 1$) - (Repeating grade i in Year $t + 1$)

= $E_i^t - (E_{i+1}^{t+1} - R_{i+1}^{t+1}) - R_i^{t+1}$

= $(E_i^t - R_i^{t+1}) - (E_{i+1}^{t+1} - R_{i+1}^{t+1})$

= (Col. 5 - Col. 6) = Col. (7) of Table 1.

Drop-out rate = $D_{i,t,t+1}^i/E_i^t$ = (Col. 7/Col. 1) = Col. (8) of Table 1.

Promotion rate = 1 - Drop-out rate - Repetition rate

= 1 - Col. (3) - Col. (8) = Col. (9) of Table 1.

To estimate grade-specific promotion and drop-out rates, we need to know grade-specific repetition rates and the number of children enrolled in each grade for two consecutive years. The procedure described in Table 1 refers to girls in India. The number of girls enrolled in 1970/71 and 1971/72 in grades 1-13 is shown in columns (1) and (2), respectively. These numbers are taken from annual publications of the Ministry of Education. The repetition rates, shown

TABLE 1-ESTIMATION OF REPETITION, DROP-OUT, AND PROMOTION RATES FOR GIRLS BY GRADES IN INDIA

Grades (0)	Number of Girls		Repetition Rate	Estimated Number of Repeaters	Number of Promotees		Number of Drop-outs	Drop-out Rate	Promotion Rate	Survival Rates from Grade 1 to the Speci- fied Grade	
	70/71	71/72			Potential EI-R1	Actual E _{i+1} - R _{i+1}				(5) = (1) -<<<	(6) = (2) -(4)
	(1)	(2)	(3)	(4) = (2) X (3)	(5) = (1) -<<<	(6) = (2) -(4)	(7) = (5) -(6)	(8) = (7) -(1)	(10) = 1 - (3)-(8)	(10)	(11)
1	7924508	8213094	.26	2135404	5789104	3864762	1924342	.2428	.4972	—	—
2	4725426	4830953	.20	966191	3759235	3066897	692338	.1465	.6535	.4972	.677
3	3635682	3786292	.19	719395	2916287	2409540	506747	.1394	.6706	.3249	.567
4	2836167	2938463	.18	528923	2307244	1879962	427282	.1506	.6694	.2179	.481
5	2184437	2265014	.17	385052	1799385	1359292	440093	.2015	.6285	.1459	.411
6	1559878	1618205	.16	258913	1300965	1133718	167247	-.1072	.7328	.0917	
7	1287103	1333786	.15	200068	1087035	937864	149171	.1159	.7341	.0672	
8	1042492	3090540	.14	152676	889816	745694	144122	.1382	.7218	.0493	
9	799995	857119	.13	111425	688570	580223	108347	.1354	.7346	.0356	
10	619021	659344	.12	79121	539900	288522	251378	.4061	.4739	.0262	
11	272657	324182	.11	35660	237027	44260	192767	.7069	.1831	.0124	
12	15579	49178	.10	4918	10661	985	9676	.6211	.2789	.0023	
13	795	1082	.09	97	698						

*Entries in column 6 are shifted by one row. The entry in row 1 of column 6 is obtained from entries in row 2 of columns 2 and 4.

SOURCES :

Col. (1)—Ministry of Education, 1970/71

Col. (2)—Ministry of Education, 1971/72

Col. (3)—UNESCO Year Book (1977) for grades 1-5 and assumed rates for grades 6 and onwards.

Col. (11)-World Bank (1980)

in column (3), for grades 1-5 refer to 1975 and are taken from the 1977 Unesco Year Book. The repetition rates for grade 6 and onwards are assumed to decrease by one point per grade. This is not an unrealistic assumption, because the estimates of percent stagnation at primary (grades 1-5) and middle (grades 6-8) stage for 1970/71 were 20.9 and 15.6 percents, respectively (Batra, 1977). Similar figures for the higher secondary stage are not known.

The estimated number of repeaters, shown in column (4), is obtained by multiplying columns (2) and (3). The estimated number of potential promotees from one grade to the next, shown in column (5) is obtained by subtracting column (4) from column (1). Column (6) is obtained by subtracting column (4) from column (2), but entry in each row is shifted upward. Thus the entry in row 1 of column (6) is obtained from entries in row 2 of columns (2) and (4) and so on. The difference between columns (5) and (6), shown in column (7), represent the estimated number of drop-outs between two consecutive years from each grade. The estimated grade-specific drop-out rates, shown in column (8), are estimated from the ratio of column (7) and column (1). The estimated grade-specific promotion rates, shown in column (9), are obtained by subtracting the sum of columns (3) and (8) from one. Thus, out of 7.9 million girls enrolled in Grade 1 in 1970/71, about 26 percent repeated the same grade in 1971/72, 24 percent dropped out of school after completing Grade 1 and 50 percent were promoted to and were enrolled in Grade 2 in 1971/72. Children can drop out any time during the school year. But for simplicity, we assumed that they drop out at the end of the school year after completing the grade in which they were enrolled (see assumption 3).

The survival rates, i.e., the probability of reaching (or enrolling) $i + 1$ grades in exactly i years are shown in column (10). If a cohort of girls who enter Grade 1 are exposed to the grade-specific promotion rates shown in column (9) then the probability of reaching $(i + 1)$ grades in exactly i years is shown in column (10). Thus out of 1,000 girls who enter Grade one, 497 would be enrolled in the second grade after one year in school; 325 girls would be enrolled in Grade 3 after 2 years; and so on, only 146 would be enrolled in Grade 5 after four years. The proportion of those girls who enter Grade 1 and actually reach Grade 5 will be higher than .1459 shown in row (5) of column (10), because a certain proportion of those who repeat earlier grades would also reach Grade 5 but they would do so in more than 4 years.

Survival rates for a cohort of children can also be estimated from grade-specific enrollments of children in consecutive years. For example, the probability of reaching grade i can be estimated from the ratio of children enrolled in Grade i in year $(t + i - 1)$, and children enrolled in Grade 1 in year t .

$$\text{Survival rate from grade 1 to grade } i = \frac{E_i^{t+t-1}}{E_1^t}$$

The estimated survival rates from Grades 2 to 5 using this procedure are shown in column (11). These estimates are taken from the Education Sector Policy Paper of the World Bank (1980). They are much higher than those shown in column (10), because they are not adjusted for the repetition and drop-out rates. The survival rates for a period (1970/71 to 1971/72) can be estimated from columns (1) and (2). But these estimates also would not be adjusted for the repetition and drop-out rates and, thus would be higher than those shown in column (10).

Admission Rate. The admission rate can be estimated from the age distribution of all children and of those who are enrolled in Grade 1. Let

$$e_i = \frac{\text{children of age/years enrolled in Grade I}}{\text{all children of age } j \text{ years}} \quad /- 5, 6, 7$$

$$P_{01}^j = \frac{\text{children who enter Grade 1 at age } j \text{ years}}{\text{all children of age } j \text{ years}}$$

R_{11} = Repetition rate for Grade 1

Then:

$$e_5 = P_{01}^5 \quad (1)$$

$$e_6 = (1 - P_{01}^5) P_{01}^6 R_{11} \quad (2)$$

$$e_7 = (1 - P_{01}^5) (1 - P_{01}^6) P_{01}^7 + (1 - P_{01}^5) P_{01}^6 R_{11} + P_{01}^5 R_{11} R_{11} \quad (3)$$

Equations 1-3 can be rearranged as follows:

$$P_{01}^5 = e_5 \quad (4)$$

$$P_{01}^6 = \frac{e_6 - e_5 R_{11}}{1 - e_5} \quad (5)$$

$$P_{01}^7 = \frac{e_7 - (1 - e_5) P_{01}^6 R_{11} - e_5 R_{11} R_{11}}{(1 - e_5) (1 - P_{01}^6)} \quad (6)$$

For India, the values of e_{5t} , e_K and e_7 are estimated from the age distribution of girls enrolled in Grade 1 in 1970/71 and the age distribution of all girls according to the 1971 census. The estimation procedure is explained in Table 2.

TABLE 2—ESTIMATION OF ADMISSION RATE BY AGE FOR GIRLS, INDIA

Age (Years')	Girls Enrolled in Grade 1		Number of All		Ratio of Girls Enrolled in		
	Observed		Estimated		Grade 1 to All Girls		
	Number	%	Number	ing to 1971 Census	Observed	Estimated	
	(1)	(2)	(3)	(4)	(3)	(0) = (1) + (5)	(7) = (4) 4- (5)
< 5	72571	.92					
5	2111673	26.65	32.92	2608871	8845342	.2387	.2942
6	2671042	33.71	41.64	3300002	8606878	.3103	.3834
7	1632047	20.59	25.44	2015635	7417041	.2200	.2718
8	846189	10.68			8952585	.0945	
9	367037	4.63			5974329	.0614	
10	143864	1.82			9435240	.0152	
11 +	80085	1.00					
Total	7924508	100.00	100.00	7924508	49231415		

SOURCES :

Col. (1)—Ministry of Education, 1971/72

Col. (5)—Registrar General, 1971

Column 1 shows the number of girls enrolled in Grade 1 and column 2 shows the percent distribution of these girls. Single year age reporting is not accurate in India but the age distribution of girls enrolled in Grade 1 shows that 81% of these girls were of ages 5, 6, and 7; and about 3 percent were of ages 10 or more years. Since girls of age 5 or more years are enrolled in Grade 1, the ratio of all girls enrolled in Grade 1 and the number of girls of age 5 years will grossly overestimate the admission rate among 5 year old children. In India, this ratio was about .8959 (= 7924598 + 8845342) for girls in 1970/71.

According to assumption 2 of the model, girls can enter Grade I at 5,6, and 7. This assumption is not too far off since 81% of those enrolled in Grade 1 are of ages 5, 6, and 7. In order to be consistent with the assumption, we first adjusted percentages and number of girls of ages 5, 6, and 7 enrolled in Grade 1 so that the total of percentages adds up to 100 and the total of those enrolled in Grade 1 at ages 5, 6, and 7 adds up to 7,924,508.

Column 5 shows the number of girls according to the 1971 census. Columns 6 and 7 show the age-specific ratio of girls enrolled in Grade 1 to all girls. The estimated values of e_5 , e_6 , and e_7 from column 7 are then substituted in equations 4, 5, and 6 to obtain the values of P_{01} for ages 5, 6, and 7. These values are shown below:

$$P_{01}^6 = .2949, P_{01}^6 = .4350, P_{01}^7 = .4320$$

In many cases the age distribution of all girls or those enrolled in Grade 1 may not be available. For this reason we have used two other options.

OPTION II: $P_{01}^5 = 2P_{01}^6 = 4P_{01}^7$

OR $P_{01}^5 = \frac{1}{2}P_{01}^6$,

and $P_{01}^7 = \frac{1}{2}P_{01}^6$.

OPTION III: $P_{01}^5 = P_{01}^6 = P_{01}^7$

Option II assumes that the probability of entering Grade 1 decreases with age, and option III assumes that it remains constant between ages 5, 6, and 7. Different values to P_{01}^5 can then be given to obtain various estimates of selected output indicators. These outputs of the model can then be compared with the corresponding estimates obtained from external sources to select that estimate of admission rate which is internally consistent with estimates of repetition and drop-out rates and with the assumptions of the model. In the present case we assigned values to P_{01}^5 between 0.1 and 0.9 with an increment of 0.1 for options II and III and beyond the observed value of 0.29 for option I. Using these various values of admission rates, and values of repetition and drop-out rates shown in Table 1, we projected the following:

1. The distribution of females aged 15-19 years by completed number of grades, and
2. The enrollment ratios for grades 1-5, and grades 6-11.

These projected values are then compared with the observed education distribution of females aged 15-19 years obtained from the 1971 census, and with

the corresponding enrollment ratios for 1975 obtained from the 1977 Unesco year book. These comparisons, shown in Table 3, indicate that the projected

TABLE 3—OBSERVED AND ESTIMATED ENROLLMENT RATIOS AND DISTRIBUTION OF FEMALES AGED 15-19 YEARS BY NUMBER OF GRADES COMPLETED, INDIA

Completed Grades	Estimated: Option No.									Observed
	I			II			III			
	Admission rate			Admission rate			Admission Rate			
	0.29	0.50	0.60	0.4	0.6	0.9	0.4	0.6	0.9	
Percent Distribution										
0	22.6	7.4	0.1	43.2	23.8	4.3	21.6	6.4	0.1	68.6
1-4	52.2	61.9	66.6	37.4	49.9	62.1	52.5	61.9	64.9	
5-7	12.4	14.9	16.1	9.3	12.5	15.8	12.6	15.2	16.5	13.8
8-9	7.4	8.9	9.6	5.5	7.4	9.4	7.5	9.1	9.8	11.4
10+	5.4	6.9	7.6	4.6	6.4	8.4	5.8	7.4	8.7	6.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Enrollment Ratio										
Grades (1-5)	52.0	63.9	69.7	40.9	55.7	71.9	54.0	66.6	74.7	62.0
Grades (6-11)	11.4	14.3	15.7	9.3	12.8	16.7	12.0	15.1	17.3	18.8

Observed distribution refers to 1971 Census and the observed enrollment ratios refer to 1975.

$$\text{Enrollment ratio for grades 1-5} = \frac{\text{Pupils enrolled in grades 1-5}}{\text{Children aged 5-9 years}} \times 100$$

$$\text{Enrollment ratio for grades 6-11} = \frac{\text{Pupils enrolled in grades 6-11}}{\text{Children aged 10-15 years}} \times 100$$

values are in good agreement with the observed values for an admission rate of 0.6 under option III (Col. 8 vs. Col. 10). The projected percentage of females with less than four grades of schooling is 68.3 percent which is about the same as 68.6 percent classified by the census in illiterate and literate categories. Similarly, the agreement between the two values is fairly good for the other three categories of education. The model slightly overestimates the enrollment ratio for grades 1-5 and underestimates it for grades 6-11. Some of the differences between the observed and the projected values might reflect the diffe-

fences in definitions of education categories and differences due to bias in the single year age distribution used to project these values.

The comparisons presented above indicate that the estimated values of the admission, repetition, and drop-out rates may not be precise but are internally consistent with each other and with the assumptions of the model. The results based on these estimates and the model may not be accurate in absolute values but can be used with some degree of confidence to compare the outcome of various approaches within the education system.

Cost Per Year. According to the annual publication of the Ministry of Education, the average annual cost per pupil for 1974/75 was estimated to be Rs. 83, Rs. 127, and Rs. 236 for primary school (grades 1-5), middle school (grades 6-8), and high school (grades 9 onwards) education. These cost estimates do not include 'indirect' expenditure on such items as direction and inspection, buildings, scholarships, and hostel charges. A small proportion of these estimated annual costs is recovered from students in the form of tuition fees and other charges.

Education-Specific Fertility Levels. In many developing countries, the average number of children born has been found to decrease with advancement in female education. Many important issues remain to be explored before the education and fertility relationship is fully understood. For example, the observed association between education and fertility does not necessarily imply causation; the relationship between the two is not perfect; its magnitude differs from country to country; and mechanisms through which education is likely to influence fertility are not completely understood. For these reasons, the observed association may not accurately predict the future fertility behaviour of an individual woman. But we are not interested in the fertility of each individual woman. The interest is in predicting the aggregate fertility of women with the same level of education. The degree of uncertainty in predicting the aggregate fertility is far less than that involved in predicting the fertility of an individual woman because advancement in female education has also been found to be associated with an increase in age at marriage, a reduction in the duration of breastfeeding, an increase in the use of contraception, and a reduction in the desired family size. Thus, it can be assumed that the average fertility of women depends upon, among other factors, their education attainment.

We are next interested in quantifying this relationship for women in India. The information about education-specific fertility levels is quite limited at the all India level. A survey conducted in 1972 by the Office of the Registrar

General provided estimates of education-specific marital fertility rates separately for the rural and urban areas. These estimates are combined to obtain estimates of education-specific marital fertility rates at the all India level. In this survey, women were classified into three education groups : Illiterate (grades 0-4), Literate (grades 5-9), and Matric (grades 10+). The estimated total marital fertility rate per woman for these three education categories were 6.8, 6.2, and 4.6 children, respectively. It is obvious that these estimates of marital fertility rates observed in 1972 cannot accurately predict the education-specific fertility levels of children who would enter their child-bearing period in 1990. These fertility differences between education groups might not reflect the effect of education alone but might also include the effect of some other factors. If so, the current differentials would overestimate the potential fertility effect of education. At the same time, these estimates of marital fertility would underestimate the potential effect of education on total fertility because marital fertility does not include the fertility effect of increase in age at marriage associated with advancement in female education and because there are some indications that improvements in the education attainment of the entire cohort might also interact with the fertility behaviour of women with no education. We have used these estimated education-specific marital fertility rates to illustrate the application of the model. Obviously, other estimates of various fertility indicators can be used for sensitivity analyses.

Projection Technique

The model projects the distribution of children at each age by completed number of grades. The main part of the model involves a sequential multiplication of transition matrices which start with children aged 5 and generate the distribution of these children at the end of each year until age 20 years. The output vector at the end of each year becomes the input vector for the next year. These calculations are explained in Table 4. Transition matrix is divided into two parts : promotion and drop-out. Transition matrix shows the probability of repeating the same grade, moving from one grade to the next, and dropping out of school. By definition, the sum of these probabilities in each row is equal to one. Fifteen steps are involved. Since only two repetitions are allowed (assumption 4), each grade appears only in three steps. For example, Grade 0 appears in steps 1-3, Grade 1 in steps 2-4, Grade 2 in steps 3-5, and so on. The probability of moving from Grade 0 to Grade 1 for each of the three steps 1-3 depend upon the selected option (I or II or III) for admission rates. For option I these probabilities will be .2949, .4350, and .4320,

TABLE 4-TRANSITION MATRIX AND OUTPUT VECTOR TO ESTIMATE DISTRIBUTION BY COMPLETED GRADE AND EACH AGE

Age	Step No.	Transition Matrix						Output Vector							
		Annual Probability of			Dropping from School			Enrolled in Specific Grade			Drop-out After Specified Grade				
		1			2										
5	1	0	1					0	1						
		0	.4	.6				.4	.6						
6	2	0	1	2	1			0	1	2	1				
		0	.4	.6				.16	-.3960	.2983	.1457				
		1	0	.26	.4972	.2428									
7	3	0	1	2	3	0	1	3	0	1	2				
		0	.6			.4									
		1	.26	.4972		.2428		.1990	.2566	.1950	.0640	.0961	.0437		
		2		.20	.6535		.1465								
8	4	1	2	3	4	1	2	3	2	3	4	1	2	3	
		1	.6272			.3728			.1761	.2047	.1306	.0742	.0376	.0272	
		2	.20	.6535			.1465								
		3		.19	.6706		.1394								
9	5	2	3	4	5	2	3	4	3	4	5	2	3	4	
		2	.7535			.2465			.1716	.1608	.0875	-.0434	.0235	.0197	
		3	.19	.6706			.1394								
		4		.18	.6694		.1506								
10	6	3	4	5	6	3	4	5	4	5	6	3	4	5	
		3	.7656			.2344			.1603	.1225	.0550	-.0402	.0242	.0176	
		4	.18	.6694			.1506								
		5		.17	.6285		.2015								

		1						2					
11		5	6	7	4	5	6	5	6	7	4	5	6
	7	4 .7594			.2406								
		5 .17	.6285			.2015		.1425	.0858	.0403	.0386	.0247	.0059
		6	.16	.7328			.1072						
12		6	7	8	5	6	7	6	7	8	6	7	
	8	5 .7135			.2865								
		6 .16	.7328			.1072		.1154	.0689	.0296	.0408	.0092	.0047
		7	.15	.7341			.1159						
13		7	8	9	6	7	8	7	8	9	6	7	8
	9	6 .8128"	"		.1872								
		7 -15	.7341			.1159		.1042	.0547	.0214	.0216	.0080	.0041
		8	.14	.7218			.1382						
14		8	9	10	7	8	9	8	9	10	7	8	9
	10	7 .8091			.1909								
		8 .14	.7218			-1382		.0919	.0423	.0157	.0199	.0076	.0029
		9	.13	.7346			.1354						
15		9	10	11	8	9	10	9	10	11	8	9	10
	11	8 .7918			.2082								
		9 .13	-.7346			.1354		.0783	.0329	.0074	.0192	.0057	.0064
		10	.12	.4739			.4061						
.6		10	11	12	9	10	11	10	11	12	9	10	11
	12	9 .7996			2004"								
		10 .12	.4739			.4061		.0665	.0164	.0014	.0157	.0134	.0053
		11	-.11	.1831			.7069						

17		<u>11</u>	<u>12</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>11 12</u>	<u>10</u>	<u>11</u>	<u>12</u>
	13	10 .5339		.4661						
		11 .11	.1831		.7069		.0373	.0031	.0310	.0116
		12 .10			.90					.0013
<hr/>										
18		<u>11</u>	<u>12</u>	<u>11</u>	<u>12</u>	<u>12</u>	<u>11</u>	<u>12</u>		
	14	11 .2381		.7619			.0092		.0284	.0028
		12 .10			.90					
<hr/>										
19		<u>13"</u>	<u>12</u>	<u>12</u>	<u>13*</u>	<u>12</u>				
	15	12 .05		.95		.0005			.0087	

•For consistency, 50 percent of repeaters are promoted to Grade 13. Thus, completing Grade 12. The total pupils completing Grade 12 is obtained by adding .0005 and .0087.

respectively. Under option II they will decrease and for option III these probabilities will remain the same. In the present case they are equal to 0.6. The probability of repeating Grade 0, therefore, is 0.4.

For grades one and onwards, the probability of moving to the next grade, repeating the same grade, or dropping out of school are taken from Table 1. These probabilities are assumed to remain constant for the first two steps (for example steps 2 and 3 for Grade 1). For the third step (step 4 for Grade 1), one-half of the repetition rate (0.13 for Grade 1) is added to the probability of moving to the next grade and the remaining one-half of the repetition rate is added to the probability of dropping out of school. This means that half of the repeaters, after two repetitions, are promoted to the next grade and the other half are forced to drop out of school (assumptions 4, 5, and 6).

At the end of each year some children are promoted to the next grade, i.e., they are enrolled in grade $(j-j-1)$ and some drop out of school after completing grade t . Thus, the output vector has two parts: enrolled and drop-out. Only the enrolled part of the output vector becomes the input vector for the next year because according to assumption 7 of the model, the drop-outs are not allowed to re-enter the school system. At the end of step 1, the proportion of children enrolled in grades 0 and I would be .4 and .6, respectively. This vector becomes the input vector at step 2 which is then multiplied by the transition matrix to obtain the output vector.

Input Vector *Transition Matrix* *Output Vector*

$$(4.6)x \quad [0 \quad .26 \quad .4972 \quad .24812 \quad = (.16.3960.2983.1457)]$$

This process is repeated for each step until step 15.

Estimation of Output Indicators

The primary purpose of policies and programmes of the education sector is to enhance the education attainment of children in the country. The output indicators of this model are oriented to estimate education attainment and cost related to a specific policy, programme, or project of the education sector. Since, changes in education attainment of children are also likely to influence their future fertility levels, the average fertility for a cohort of women is also estimated.

Indicators of Attainment. In India, there are differences between states in the"

number of grades included in the primary, elementary, and secondary school education. In some states, students get a high school certificate after completing ten grades and in others they get a higher secondary certificate after completing eleven or even twelve grades. For uniformity, primary, elementary, and secondary levels are defined as completing grades 5, 8, and 10, respectively. Since age five is assumed to be the starting age, 12 grades constitute the schooling period and a maximum of two repetitions are permitted, all children would complete schooling by age 19 years. Thus, the projected distribution of children at age 19 years by number of completed grades is used to estimate the following three indices of attainment.

1. The proportion of children aged 5 years who would complete at least primary education (Grade 5 or more) by age 19 years.
2. The proportion of children aged 5 years who would complete at least elementary education (Grades 8 or more) by age 19 years.
3. The proportion of children aged 5 years who would complete at least secondary education (Grades 10 or more) by age 19 years.

The above indices are estimated from the numbers shown under the output vector in Table 4. Those children who are shown in Table 4 to be enrolled in grade $(i + 1)$, by definition, have completed Grade i . The distribution of children by completed grades at any specified age, therefore, is obtained by adding three components : (1) those who dropped out of school at earlier ages, (2) those who drop out at the end of the specified age (school year), and (3) those who are enrolled in the next grade. Thus at the end of step 2, the children will complete age 7 and their distribution by completed grades 0, and 1 would be .5560 (.16 + .3960) and .444 (.1457 + .2983). At the end of step 3, the children will complete age 8 and their distribution by completed grades 0, 1, and 2, would be .263 (.064 + .199), .4984 (.1457 + .0961 + .2566), and .2387 (.0437 + .1950). The total of these three numbers is one except, for the rounding errors.

Using this procedure, the percent distributions of children by completed grades at ages 15, 16, 17, 18, and 19 are obtained from the output vectors shown in Table 4. These distributions are shown in Table 5. The percent distribution of females of ages 15-19 years is obtained by combining five distributions shown in columns 1-5 according to the weights also shown in Table 5. Percent females of specified age who completed primary school (at least grade 5) is obtained by adding entries shown against grades 5 to-12. Similarly, percent Who completed elementary school (at least grade 8) is obtained by adding

TABLE 5—ESTIMATED DISTRIBUTION OF FEMALES BY COMPLETED GRADES AT AGES 15, 16,.... 19 YEARS

<i>Completed Grade by Specified Age</i>	<i>Distribution of Females at Age (Completed Years)</i>					
	<i>15</i>	<i>16</i>	<i>17</i>	<i>18</i>	<i>19</i>	<i>75-79</i>
0	.0640	.0640	.0640	.0640	.0640	.0640
1	.3160	.3160	.3160	.3160	.3160	.3160
2	.1247	.1247	.1247	.1247	.1247	.1247
3	.0959	.0959	.0959	.0959	.0959	.0959
4	.0825	.0825	.0825	.0825	.0825	.0825
5	.0832	.0832	.0832	.0832	.0832	.0832
6	.0367	.0367	.0367	.0367	.0367	.0367
7	.0325	.0325	.0325	.0325	.0325	.0325
8	.1091	.0308	.0308	.0308	.0308	.0482
9	.0416	.0909	.0243	.0243	.0243	.0425
10	.0138	.0362	.0881	.0508	.0508	.0464
11	—	.0066	.0200	.0545	.0453	.0242
12	—	—	.0012	.0041	.0133	.0031
Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Weights*	.2223	.2163	.1864	.2249	.1501	1.0000
Percent Completing :						
Primary + (5-12)	.3168	.3168	.3168	.3168	.3168	.3168
Elementary + (8-12)	.1645	.1645	.1645	.1645	.1645	.1644
Secondary + (10-12)	.0138	.0428	.1093	.1094	.1094	.0737

*Weights are obtained from the number of girls counted at ages 5-9 in 1971 Census.

SOURCES : Columns (1)-(5) are obtained from Table 4

Column (6) is the weighted sums of Columns (1)-(5)

grades 8-12 and percent who completed at least high school (at least grade 10) is obtained by adding grades 10, 11, and 12. Thus, if female children of age 5 years are exposed to the admission, repetition, and drop-out rates shown in

Table 4, than about 32 percent of these children would complete at least primary school, 16.4 percent would complete at least elementary school and **11 percent** would complete at least high school level education by the time they are 19 years of age.

Enrollment Ratios. The computations of enrollment ratios are shown in Table 6. Columns 1 and 5 show the proportion of girls of specified ages enrolled in grades 1-5 and 6-11, respectively. These proportions are obtained from the enrollment part of the output vector for each single year of age (see Table 4).

TABLE 6—ESTIMATION OF ENROLLMENT RATIOS FOR A COHORT OF GIRLS ENTERING SCHOOL AT AGE 5 YEARS

Age	Enrolled in Grades 1-5	No. of Children (000)	Weights	Enrollment Ratio for Grades 1-5	%Enrolled in Grades 6-11	Weights	Enrollment Ratio for Grades 6-11
(1)	(2)	(3)	(4) = (1) x (3)	(5)	(6)	(7) = (5) x (6)	
5	.6	8845	.2223	.1334			
6	.6943	8607	.2162	.1501			
7	.6506	7417	.1864	.1213			
8	.5115	8953	.2250	.1151			
9	.4199	5974	.1501	.0630			
10	.2828	9435	.2370	.0670	.0550	.2509	.0138
11	.1425	4614	.1159	.0165	.1261	.1226	.0155
12		7954			.2139	.2115	.0452
13		4802			.1803	.1277	.0230
14		5470			.1499	.1455	.0218
15		5336			.1186	.1418	.0168
16		5105			.0829	.1357	.0113
17		3068			.0373	.0816	.0031
Total				.6664			.1505

The numbers in Columns (1) and (5) are obtained from Table 4; and in Col. (2) are taken from the 1971 census.

Column (3) : Number of children of specified age/number of children aged 5-9 years,

Column (6) : Number of children of specified age/number of children aged 10-15 years.

Column 2 shows the number of female children by single years of age. These are taken from the 1971 Census. Using columns 1, 2, and 5, the enrollment ratios are estimated as follows.

Let

m_i = The proportion of children age i years enrolled in grades 1-5; $i = 5, 6, \dots, 11$.

k_j = The proportion of children age j years enrolled in grades 6-11; $j = 10, 11, \dots, 17$.

$$M_i = \frac{\text{Number of children age } i \text{ years}}{\text{Number of children age 5-9 years}}$$

$$K_j = \frac{\text{Number of children age } j \text{ years}}{\text{Number of children age 10-15 years}}$$

Enrollment ratio for grades 1-5

$$= \frac{\text{Pupils enrolled in grades 1-5}}{\text{Children aged 5-9 years}} \times 100$$

$$= 100 \times \sum_i \frac{\text{Children aged } i \text{ years} \times \text{proportion of aged } i \text{ years enrolled in grades 1-5}}{\text{Children aged 5-9 years}}$$

$$= 100 \times \sum_i M_i \times m_i = 100 \times \text{Col. (1)} \times \text{Col. (3)}$$

$$= 100 \times \Sigma \text{Col. 4} = 100 \times (0.6664) = 66.64.$$

Enrollment ratio for grades 6-11

$$= \frac{\text{Pupils enrolled in grades 6-11}}{\text{Children aged 10-15 years}} \times 100$$

$$= 100 \times \sum_j K_j \times k_j$$

$$= 100 \times \Sigma \text{Col. (5)} \times \text{Col. (6)}$$

$$= 100 \times \Sigma \text{Col. (7)} = 100 \times (.1505) = 15.05.$$

Number of School Years and Cost. The following indices are used to estimate the average number of school years and the average cost per graduate.

1. Average number of years in school per graduate from:

$$a. \text{ Primary school} = \frac{\text{Total number of years in primary school}}{\text{Graduates from primary school}}$$

$$b. \text{ Elementary school} = \frac{\text{Total number of years in primary and elementary school}}{\text{Graduates from elementary school}}$$

$$c. \text{ Secondary school} = \frac{\text{Total number of years in primary and elementary and secondary school}}{\text{Graduates from secondary school}}$$

2. Average cost per graduate from:

$$a. \text{ Primary school} = \frac{\text{Years in primary school} \times \text{cost per year in primary school}}{\text{Graduates from primary schools}}$$

$$b. \text{ Elementary school} = \frac{(\text{Years in primary school} \times \text{cost per year in primary school}) + (\text{Years in elementary school} \times \text{cost per year in elementary school})}{\text{Graduates from elementary school}}$$

$$c. \text{ Secondary school} = \frac{(\text{Years in primary school} \times \text{cost per year in primary school}) + (\text{Years in elementary school} \times \text{cost per year in elementary school}) + (\text{Years in secondary school} \times \text{cost per year in secondary school})}{\text{Graduates from secondary school}}$$

Table 7 shows the estimated distribution of females at age 19 years by number of completed grades and by number of years spent in school. This table is obtained from drop-out part of the output vector shown in Table 4. For example, in Step 2 of Table 4, .1457 is shown as the proportion of children who completed Grade 1 in one year. This number is entered in Table 7 in row 2 and column 2. In step 6 of Table 4, .0402 is shown under completed Grade 3. This number is entered in Table 7 in row 6 and column 4. It shows the proportion of children who completed Grade 3 in five years. Similarly, other entries are transformed from Table 4 to Table 7. The entries in the top diagonal of Table 7 shows the proportion of children who completed each specified grade without any repetition. The second diagonal shows the proportion of

TABLE 7—ESTIMATED DISTRIBUTION OF FEMALES BY COMPLETED GRADES AT AGE 19 YEARS AND BY NUMBER OF YEARS IN SCHOOL

<i>No. of Years in School</i>	<i>Number of Grades Completed by Age 19 Years</i>													
	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>Total</i>
0	.0640													.0640
1	.1457													.1457
2	.0961	.0437												.1398
3	.0742	.0376	.0272											.1390
4		.0434	.0285	.0197										.0916
5			.0402	.0242	.0176									.0820
6				.0386	.0247	.0059								.0692
7					.0408	.0092	.0047							.0547
8						.0216	.0080	.0041						.0337
9							.0199	.0076	.0029					.0304
10								.0192	.0057	.0064				.0313
11									.0157	.0134	.0053			.0344
12										.0310	.0116	.0013		.0439
13											.0284	.0028		.0312
14												.0092		.0092
Total Students	.0640	.3160	.1247	.0959	.0825	.0831	.0367	.0326	.0309	.0243	.0508	.0453	.0133	1.0001
Years ^a	0	.5605	.3738	.3966	.4314	.5218	.2726	.2760	.2932	.2558	.5834	.5667	.1808	4.7126

The numbers in the inside matrix are obtained from Table 4. The marginals are obtained by adding the respective rows and columns.

^aweighted sums for each column.

children who completed each specified grade with only one repetition and the bottom diagonal shows the corresponding proportions with two repetitions.

Total for each column in Table 7 shows the percent of females who completed each specified grade by age 19 years. Total number of years for each column are obtained by multiplying each entry in the column by the corresponding number of school years and then adding these products. Thus,

$$.5605 = 1 \times .1457 + 2 \times .0961 + 3 \times .0742.$$

Entries in each of the last two rows of Table 7 are added separately for grades 1-5, 6-8, and 9-12. These numbers are shown against total years and students in Table 8 under columns 1-3. Column 4 is the total of columns 1, 2 and 3.

TABLE 8—ESTIMATED TOTAL COST (RS.) AND TOTAL NUMBER OF YEARS SPENT IN SCHOOL BY A COHORT OF ONE GIRL STARTING SCHOOL AT AGE 5, INDIA

Type of School	No. of Years Spent by Those Who Completed Grades :			Total Years (4) = (1) + (2) + (3)	Cost/Year ^a (5)	Total Cost (6) = (4) × (5)
	1-5 (1)	6-8 (2)	9-12 (3)			
Primary School	2.2841	.5010	.6685	3.4536	83	286.6488
Middle School		.3408	.4011	.7419	127	94.2213
High School			.5171	.5171	236	122.0356
Total : Years ^b	2.2841	.8418	1.5867	4.7126		502.9057
Students ^b	.7022	.1002	.1337	.9361		

^a Ministry of Education, 1974/75.

^b From Table 7.

School years spent in primary school has three components : (a) years spent in primary school by those who did not go beyond Grade 5 (= 2.2841 years by .7022 students), (b) years spent in primary school by those who went to the middle school but did not go beyond Grade 8 (.1002 students × 5 years per student = .5010), and (c) years spent in primary school by those who went to the high school (.1337 students × 5 years per student = .6685). Similarly, years spent in middle school has two components: (a) years spent by those (.1002 students) who did not go beyond the middle school (.3408 = .8418 - .5010

and (b) years spent by those (.1337) who went to high school (.1337 X 3 = .4011). Years spent in high school has only one component and it shows the number of years spent in high school by those (.1337) who went beyond Grade 8 (.5171 = 1.5867 - .6685 - .4011).

The average cost per year per student in school is shown in column 5. The total cost is shown in column 6, which is obtained by multiplying column 4 with column 5. Sum of entries in column 6 gives the total cost of school education for the entire cohort of children expressed in term of per child in the cohort including those who did not go to school.

In Table 9 we show computations of average number of school years and average cost per graduate from each type of school. Columns (1) and (2) are

TABLE 9-ESTIMATED AVERAGE NUMBER OF YEARS IN SCHOOL AND AVERAGE COST (Rs.) PER GRADUATE, FOR GIRLS, INDIA

<i>Type of School</i>	<i>No. of Years</i>	<i>Total Cost</i>	<i>Graduates</i>	<i>Years Per Graduate</i>	<i>Cost Per Graduate</i>
	(1)	(2)	(3)	(4) = (1) ÷ (3)	(5) = (2) ÷ (3)
Primary	3.4536	286.6488	.3168	10.90	904.83
Primary + Middle	4.1955	380.8701	.1645	25.50	2315.32
Primary + Middle + High	4.7126	502.9057	.1094	43.08	4596.94

SOURCES : Col. (1) from Col. (4) of Table 8.
 Col. (2) from Col. (6) of Table 8.
 Col. (3) from Col. (5) of Table 5.

the same as columns (4) and (6), respectively of Table 8. Column (3) is taken from Table 5. Column (4) shows the average number of school years per graduate and is obtained by taking the ratio of column (1) and column (3). These numbers show that 100 children in a cohort exposed to the current policies and programs of the education sector would spend 345 years in primary schools but since only about 32 will complete primary school education, the average number of years per graduate would be about 11 years. In the absence of wastage and stagnation in the school system, this number should have been, close to 5 years. The cost per graduate from primary school would be about Rs. 905 instead of Rs. 415 (83 X 5). Evidently any improvement in the school system, i.e., the reduction in repetition and drop-out rates would result in considerable savings in terms of the number of school years and the cost per graduate. The extent of savings would depend upon the cost of special programmes

that might be required to reduce drop-out and repetition rates and the effectiveness of these programmes. This methodology can thus be used to compare the relative cost-effectiveness of various programmes or various options.

Average Fertility. Average fertility of the entire cohort of women depends, among other factors, upon education distribution of these women and their expected education-specific fertility rates. Table 10 shows the computation of

TABLE 10— ESTIMATED AVERAGE MARITAL FERTILITY PER WOMAN FOR A COHORT OF GIRLS ELIGIBLE TO ENTER SCHOOL AT AGE 5, INDIA

Completed Grades	Proportion of Females age. 19 Years	Marital Fertility Rate per Woman', all India	Expected marital fertility
	(1)	(2)	(3)=(1)×(2)
0	.0640	6.8	.4352
1	.3160	6.8	2.1488
2	.1247	6.8	.8480
3	.0959	6.8	.6521
4	.0825	6.8	.5610
5	.0832	6.2	.5158
6	.0367	6.2	.2275
7	.0325	6.2	.2015
8	.0308	6.2	.1910
9	.0243	6.2	.1507
10	.0508	4.6	.2337
11	.0453	4.6	.2084
12	.0133	4.6	.0612
Total	1.0001		6.4349

SOURCES : Col. (1)—Table 5

Col. (2)—Based on data from Registrar general (1972).

average marital fertility for the entire cohort. Column (1) shows the proportion of females by completed grades and is taken from Table 5. Column 2 shows education specific marital rates; Column (3) is the product of columns (1)

and (2), The sum of column (3) shows the average marital fertility per woman expected for the cohort of children who are exposed to the current policies of the education sector and who would enter child-bearing period at age 15. Let

N_i = Number of women with education level of completed grade i .

F_i = Fertility level of women with education level of completed grade i .

$$\begin{aligned} \text{Average marital fertility} &= \frac{\sum_{i=1}^n N_i F_i}{\sum_{i=1}^n N_i} \\ &= \text{Col. (1)} \times \text{Col. (2)} = \text{S Col. (3)} \\ &= 6.4349 \end{aligned}$$

Illustrative Application of the Model

Using the methodology presented above, we can estimate direct and indirect effects of any policy or programme of the education sector and thus, can compare two or more options in terms of their direct effects on education attainment, implied per capita cost, work-load, average number of school years per graduate, average cost per graduate, and finally in terms of their indirect implications for fertility levels. This is done in Table ! 1 for three hypothetical alternatives to illustrate the application of the model.

Three alternatives are: (1) alternative I assumes no change in the current policies and programmes of the education sector, (2) alternative II assumes that the education sector policies eliminate repetition of grades up to Grade 4 and achieve a fifty percent reduction in drop-out rates up to Grade 4, and (3) alternative III assumes that the education sector policies increase admission rate at age 5 by fifty percent, eliminate repetition of grades up to Grade 9, and decrease drop-out rates by fifty percent up to Grade 9. The result for these three alternatives are shown in columns (I), (2), and (3), respectively. Columns (4) and (5) show percent changes in output of alternative II and III in comparison to alternative I. Each of the two alternatives II and III will increase the workload and the implied cost of school education for a cohort of children but they will also increase education attainment of children. More importantly, the average number of school years and average cost per graduate will decrease. Since the national objective is to increase the education attainment up to primary level, i.e., to provide functional literacy to people, alternative II is better than alternative III. However, if a substantial increase in graduates from secondary schools becomes the objective, alternative III would be better than alternative II. Both of these alternatives would have additional indirect and unintended benefits

TABLE 11-COMPARISON OF THREE HYPOTHETICAL ALTERNATIVES IN TERMS OF THEIR DIRECT AND INDIRECT EFFECTS

Output Indicator	Alternatives			Percent change from I	
	I	II	III	II	III
	(1)	(2)	(3)	(4)	(5)
Attainment :					
Percent women Completing					
At Least primary	31.7	65.6	70.0	107	121
At Least Elementary	16.5	35.9	56.1	118	240
At Least High School	10.9	24.5	48.7	125	347
Work Load :					
Enrollment Ratio					
Grades 1-5	66.6	80.1	83.8	20	26
Grades 6-11	15.1	35.0	53.0	132	251
Average Number of Years in School Per Graduate from :					
Primary School	10.9	6.3	6.0	-42	-45
Elementary School	25.5	15.6	10.7	-39	-58
High School	43.1	27.1	15.4	-37	-64
Average Cost Per Graduate from :					
Primary School	905	522	497	-42	-45
Elementary School	2315	1472	1026	-36	-56
High School	4597	3161	1911	-31	-57
Implied Cost per child	502.9	774.8	929.9	54	85
Implied marital fertility per woman	6.43	6.01	5.60	-7	-13

NOTE : Alternative I assumes no change

II assumes no repetition and 50% reduction in drop-out rates up to Grade 4.

III assumes 50% increase in admission rate at age 5 years and no repetition and 50% reduction in drop-out rates up to Grade 9,

to the society in terms of anticipated reduction in the marital fertility of these cohorts,

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