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**Scope for Efficiency Gains Resulting from
Reduction in Repetition and Dropout**

A Simulation Exercise

by

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CONTENTS

I	Introduction	1
II.	Measuring the Effects of Repetition and Dropout on Internal Efficiency .	6
III.	Simulation of the Impact of Changes in Repetition and Dropout on Internal Efficiency	10
	A. Scenario 1: Reduction of Repetition by Ten Percent	12
	B. Scenario 2: Reduction of Dropout by Ten Percent	13
	C. Scenario 3: Reduction in Both Repetition and Dropout by Ten Percent	14
IV.	Cost Savings and Additional Expenditures of Reducing Repetition and Dropout Rates	16
	APPENDIX	23
	REFERENCES	25
	NOTES	26

Tables

Table 1:	Promotion, Repetition and Dropout Rates by Grade in Primary Education. <u>Mozambique</u> , 1986-87. Percentages. (Both Sexes)	8
Table 2:	Repetition and Dropout Rates Used for Simulation Under the Three Scenarios	11
Table 3:	Changes in the Internal Efficiency of Primary Education Resulting from a Ten Percent Reduction in Repetition and Dropout	11
Table 4:	Cost Changes Under a Constant Budget	18
Table 5:	Cost Changes Under No Additional Per-Pupil Expenditure	18
Table 6:	Cost Changes Under a Strategy that Increases Expenditures in Teaching Materials by 3.5%	20
Table 7:	Cost Changes Under a Strategy that Increases Per-Pupil Expenditures in Teaching Materials by 3.5%	21
Table 8:	Sensitivity Analysis of the Impact of Reducing Repetition and Dropout Rates on Internal Efficiency and on Cost Per-Graduate	22



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Table IA:	Changes in the Number of Pupil-Years Spent by the Cohort in Each Grade as a Consequence of Ten Percent Reduction in Repetition and Dropout Rates	23
Table 2A:	Changes in the Number of Students Reaching the Next Grade as a Consequence of a Ten Percent Reduction in Repetition and Dropout	24
Table 3A:	Changes in the Number of Students Repeating Each Grade as a Consequence of a Ten Percent Reduction in Repetition and Dropout	24
Table 4A:	Changes in the Number of Students Dropping-Out as a Consequence of a Ten Percent Reduction in Repetition and Dropout	24

Figures

Figure 1:	Hypothetical Flow of the 1986 Cohort Through Primary Education in <u>Mozambique</u> , 1986 (Both Sexes)	
Figure 2:	Description of the Stationary State for a System Operating Under the Flow Rates Observed for <u>Mozambique</u> in 1986 .	10
Figure 3:	Summary Description of Scenario 1	13
Figure 4:	Summary Description of Scenario 2	14
Figure 5:	Summary Description of Scenario 3	15



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I. Introduction

Most Bank education staff work in countries whose ability to provide quality education to a rapidly increasing population of school age is severely hampered by constraints on public budgets. Often this results in distributing available resources more and more thinly on an ever increasing number of students, thus causing further deterioration in the already low quality of learning.

A key objective of Bank lending operations for such countries is to support policies and investments designed to promote more efficient use of education resources. The strategies proposed to attain this objective normally include a combination of different interventions. Reducing repetition and dropout figures prominently among these strategies. The supporting argument for this proposal is that reducing the high levels of repetition and dropout found in most developing countries offers considerable scope for more efficient use of available resources¹. In addition, goals such as universal primary education clearly cannot be attained if pupils drop out before they have acquired basic literacy and numeracy skills.

Why, and to what extent, repetition and dropout represent waste of resources will not be discussed in detail in this paper². Suffice it to say that dropout is considered wasteful because investments (public and private) have been made in pupils who fail to attain the minimum objectives of the cycle of education in which they are enrolled. This waste is perhaps most obvious for students who drop out from primary education before they have acquired permanent literacy and numeracy skills.

Repetition involves an element of waste since repeaters stay in school longer than the normal duration of the cycle, thus increasing cost per graduate, and leading either to more crowded classrooms or to a reduction in the intake capacity of the corresponding grades. Thus, the benefits those repeating a grade may derive from spending an extra year in a grade must be weighted against the increased costs, the fact that overcrowded classes may reduce the



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effectiveness of the learning process for everybody including those who do not repeat, and the fact that repeaters may prevent non-enrolled children from being admitted to school. Moreover, studies show that repetition tends to increase the probability of dropout.

For these and other reasons more fully reviewed in the literature in this area, many Bank projects aim at reducing repetition and dropout. Because repetition and dropout are governed by a number of school and non-school factors, and because it is generally difficult to establish the relative strength of the different causal effects and how amendable they are to policy interventions, project documents often lack precision as to how this reduction could be achieved. However, most people will probably agree that improvements in the present low quality of learning outcomes -- a serious concern regardless of efficiency considerations -- would be a key ingredient in any effort to reduce repetition and dropout. This is why projects supporting policies to reduce repetition and dropout generally rely on quality-improvement measures as their main instrument for achieving such reductions³.

Most quality-improvement measures require investments. Of particular interest in this connection is research indicating that marginal increases in some educational inputs (or mix of inputs), such as inservice teacher training and textbooks, are likely to be more cost-effective (i.e., result in a higher increase in output per dollar invested) than increases in other inputs, such as reduction in class size below 40 students or introducing computers in the classroom⁴. Therefore, to promote more output per dollar invested, projects often support increased spending on inputs considered to be the most cost-effective in the country considered (e.g., relatively less for salaries and more for pedagogical materials).

Increasing expenditures on this type of inputs can be obtained either through a shift of existing resources in favor of the inputs considered to be the most cost-effective ones in a given national situation, or by providing additional resources through the projects to help finance inputs of the more "cost-effective" type. Normally, a combination of the two approaches is adopted: priority in allocating additional resources is given to the most cost-effective inputs, resulting in a shift over time in the share of total resources allocated to such inputs.

To sum up, investments to improve availability of cost-effective inputs are likely to improve student achievement which, in turn, will generate reduction in the cost per graduate through a reduction in repetition and dropout. Although it is difficult to assess the strength of the causal relationships determining the impact of :

- (a) quality improvement investments on student achievements,
- (b) improvements in student achievement on the propensity of students to repeat or dropout, and
- (c) reduction in repetition and dropout on total education expenditures and on cost per graduate,



there is quite solid evidence from a number of countries suggesting that the impacts in all three areas may be fairly strong⁵. In the present resource-constrained situation, this gives rise to a very interesting question: to what extent can the cost associated with investments in improvements in quality of learning outcomes be recuperated through efficiency gains derived from reduction in repetition and dropout?

The purpose of this paper is to shed light on this question. This will be done by presenting a set of simulation exercises that will help us to better understand:

- (a) how reduction in repetition and dropout effects the total costs of providing for a cohort of students,
- (b) how reduction in repetition and dropout effects differently total costs and unit costs, i.e., the cost of producing a graduate,⁶
- (c) the magnitude of potential efficiency gains resulting from reduction in repetition and dropout as compared to the amount of resources required to make adequate provision of pedagogical materials. This particular type of impact was selected for this comparison since investment in pedagogical materials has been shown to be very cost-effective in most developing country settings.

The paper is organized as follows. Section II explains how the Reconstructed Cohort Method can be used to analyze the impact of repetition and dropout on cost per graduate and on total cost of providing primary education to a cohort of pupils. Section III uses this method to simulate the impact of reduction in repetition and dropout on cost per graduate and on total expenditures. Finally, Section IV compares the cost of reducing repetition and dropout with efficiency gains generated from the operation of a more efficient system.

II. Measuring The Effects of Repetition and Dropout on Internal Efficiency.

Before analyzing the quantitative impact of repetition and dropout on the inputs and outputs of a cycle of education, a few caveats are required as regards the extent to which repetition and dropout should be considered inefficient use of resources.

This paper uses the Reconstructed Cohort Method to assess the impact of repetition and dropout on education efficiency. As will be explained further below, this method is used to estimate the progression of a group of students who all start school the same year (a cohort) through a cycle of education. According to this method, a 100% efficient system is one where there is no repetition or dropout (i.e. all pupils graduate without repetition) and where all entering students acquire the skills specified in the curriculum. The input/output ratio is the indicator used to gauge how close to the 100% mark an educational system is. Before defining this indicator, we shall briefly discuss how input and output are measured when using this method.



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The output indicator used by the Reconstructed Cohort Method is the number of pupils graduating from a cycle. The inputs are measured by the numbering of pupil-years used by the cohort. The latter is a summary indicator of the two main factors determining the amount of resources consumed by this cohort: (a) the number of pupils enrolled in each grade of the system (or cycle) every year; and (b) the supplies and services (i.e. teachers, curriculum, learning materials, buildings, etc) used to educate these pupils. One student staying one year in the system would use resources equivalent to one pupil-year. A student who repeats a grade once will use inputs equivalent to two pupil-years to complete one grade. Therefore, the concept of pupil-years summarizes both the student's personal efforts in each grade and the educational resources used during his/her stay in the system.

The Reconstructed Cohort Method assumes that all resources used by repeaters are wasted. Naturally, this is contrary to the view held by those who believe that repetition is an effective measure of helping students who, for various reasons, are not judged ready for promotion to the next grade. There is no consensus about how effective repeating a grade is in helping slow learners as compared to other educational options⁷. Proponents of repetition argue that repeating a grade helps slow learners to attain instructional objectives and prevent students from dropping out prematurely. For example, a recent study in Burundi (Schwille, 1990) shows that repetition in the last grade of primary education, which is more a function of limited intake capacity in the first grade of secondary education than of student academic performance, results in positive learning gains. On the other side, Haddad (1979), Holmes (1989), and Grisson and Shepard (1989), among many others, argue that repetition has potentially harmful effects on students' self-esteem and attitudes toward schooling and that holding children back increases the likelihood of dropping out of school.

It seems safe to conclude that repetition is unlikely to be an absolute waste of resources in all cases. However, since repetition increases cost, reduces the intake capacity of the system and diminishes the quality of education through overcrowding, the real question is whether this is the most cost-effective way of helping slow learners. While the type of analysis presented in this study cannot answer this question, the results will illustrate the magnitude of resources that can be freed through reduction in repetition and made available for other and possible more effective uses.

Is dropout a total waste? The output indicator used in studies of educational wastage (number of graduates) assumes this is the case. This is, of course, an extreme assumption. Learning is a continuous process, and we certainly cannot say that students dropping out after, e.g., completion of the fifth grade, have not learned anything and, therefore, the effort invested in them is a total waste. But what about student leaving after one or two years of schooling? How much of the basic skills (reading, writing, arithmetic) and knowledge can we expect them to have acquired on a permanent basis in such a short period of time? How much human capital would students have acquired before dropping out? There is no clear-cut answer to this question.⁸



From a purely quantitative perspective, repetition and dropout affect the internal efficiency of the system because they influence both the amount of educational inputs used by the system and the total level of outputs generated by it. Yet, how does repetition, which is something that happens to the students once they are in the system and is a consequence of factors such as their learning abilities, quality of instruction, and rules and regulations, effect the amount of inputs per student used by the educational system? We shall devote a good part of this paper to analyzing this question. In general terms, repetition affects the inputs used by the educational system because it increases the time a student remains in the system before dropping out, moving to the next grade, or graduating. The longer a student is enrolled beyond the minimum time required, the more teacher time, classroom space, textbooks and other teaching materials and educational services will be needed, and the more it will cost the family to keep the student at school. A similar argument can be presented for the influence of dropout on educational inputs and outputs. Because dropout affects the number of students that stay in the system, it has a direct impact on both the amount of resources needed to educate the cohort, and on the number who graduate, i.e., on the level of output.

To illustrate how the Reconstructed Cohort Method can be used to study how repetition and dropout influence (a) the number of pupil-years a cohort of students consumes during its stay in a cycle of education, and (b) the proportion of students who graduate, we shall reconstruct the flow of the students who started primary education in Mozambique in 1986 through the primary cycle. We have selected this country because in 1986 it had a four-grade cycle. This facilitates the analysis and presentation of the results.

Table 1: Promotion, Repetition and Dropout Rates by Grade in Primary Education. Mozambique, 1986-87. Percentages. (Both Sexes)

	Grade 1	Grade 2	Grade 3	Grade 4
Promotion Rates	50.4	51.8	50.0	81.5*
Repetition Rates	26.0	26.6	27.2	18.5
Dropout Rates	23.6	21.6	22.8	0.0

Source: UNESCO Office of Statistics

* This rate pertains to everybody leaving the grade whether or not they had completed the cycle successfully.



Employing the Reconstructed Cohort Method⁹ and the flow rates shown in Table 1, the student flow diagram presented in Figure 1 may be established. The diagram shows that only 681 of the initial cohort of 1000 students eventually reached Grade 2 (bottom row). The rest dropped out. But these 681 students did not move to Grade 2 at the same pace. Some of them (177)¹⁰ spent more than one year in Grade 1 before moving on, which means that they used more than one year of school resources to complete that grade. By counting the number of students who were still enrolled in the first grade after 1986 we get a count of the number of pupil-years or pupil-places occupied by repeaters in first grade. In this example, the number of pupil years occupied by the 260 pupils who repeated Grade 1 in 1987 is equal to 351 which were used by the 177 students who eventually were promoted to Grade 2 in 1987 or the following years ($131 + 34 + 9 + 2 + 1$) as well as by the 83 students who eventually dropped out after one or more repetition ($62 + 15 + 4 + 2$). Thus, assuming that all dropout take place at the end of the year, the original 1000 students spent 1000 pupil-years during the first academic year, producing 504 promotees, 236 dropouts and 260 repeaters.

During the second academic year, the 260 repeaters in Grade 1 spent another full year in the system using 260 pupil-years. And so on, we can continue down the column for Grade 1 counting, inside each box, the number of pupil-years used by repeaters each year. The final count tells us that it took 1351 pupil-years to get 681 students from Grade 1 to Grade 2. Thus, because of a 26.0 percent repetition rate, this system will need 1351 places in Grade 1 to accommodate 1000 new entrants¹¹

To assess the impact of dropout we compare the number of students reaching a given grade with the number of students starting the previous grade. The indicator used for this comparison is the survival rate between grades. In this example, the survival rate between Grade 1 and 2 is equal to 68.1% (i.e. $681/1000$). Thus, the system loses more than 30% of the students between the first and second grades.

In summary, repetition in the first grade increases the total amount of input used (at constant per-pupil cost) by keeping students longer in that grade. In the absence of repetition, these resources could have been used to cater for new entrants in countries where lack of capacity limits admission, or freed for other purposes including quality improvements. Dropout diminishes the efficiency of the system by reducing the number of students moving to the next grade and thus the number who eventually complete the cycle, and by the use of resources on pupils who do not attain the objectives of the system.

Let us now move on to Grade 2 to examine what happened to the 681¹² students who eventually reached that grade. First, the pupil-years row in Figure 1 shows that these students spent 927 pupil-years in Grade 2, of which 246 were used on repetition ($138+70+28+10+3+1$). Thus, due to repetition, the system needed 927 places to accommodate 681 new students in Grade 2. Second, only 480 of these 681 students eventually moved on to Grade 3, which gives a



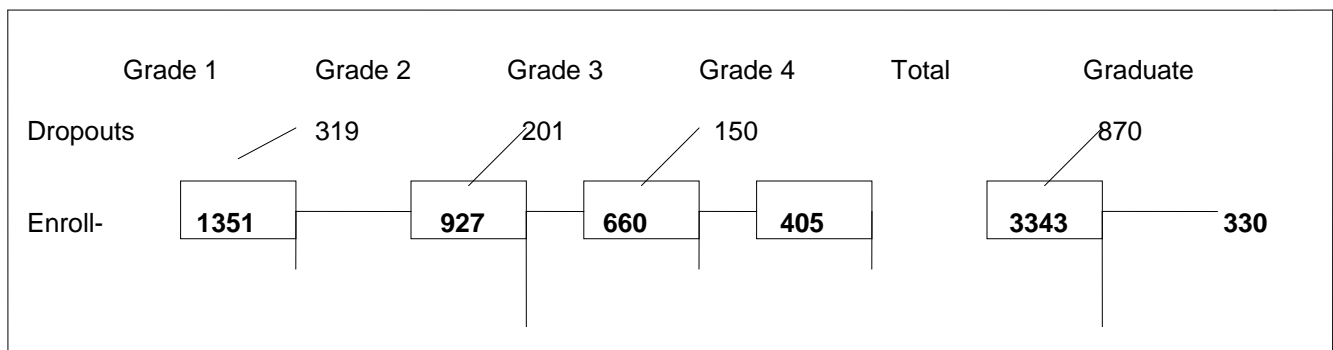
survival rate between Grades 2 and 3 equal to 70.5%. (480/681). In other words, almost 30% of the students who reached Grade 2 dropped before Grade 3.

The 480 students reaching Grade 3 spent a total of 660 pupil-years in that grade, of which 180¹³ were spent on repetition (by pupils who eventually were promoted to Grade 4 and by pupils who dropped out), 150¹⁴ on dropout and the rest, i.e. 330, were used by promotees. The survival rate between Grade 3 and 4 equals 68.8%. Thus, more than 30% of the students reaching Grade 3 left the system before Grade 4.

Finally, the 330 students reaching Grade 4 spent a total of 405 pupil-years in that grade, of which 75 were used on repetition. Since data on graduates were not available, it has been assumed that there was no dropout from this grade and that all students graduate.

Another way to describe the consequences of a given set of repetition and dropout rates on the internal efficiency of the system is to use the analogy of the stationary state, i.e. the state reached by a system when enrollment by grade does not change over time. As indicated above, under stationary conditions, the number of pupil-years spent by the cohort in each grade also represents the total enrollment by grade generated in a system where 1000 new students are admitted each year and where the flow rates remain unchanged over time. Figure 2 summarizes how such a system would look if it operates with the flow rates given in Table 1 for Mozambique. Under these conditions, 1000 annual new entrants to Grade I of this four-grade cycle would generate, annually a total enrollment of 3343 students, distributed by grade as shown in Figure 2. Of these 3343 students, a total of 852 are repeaters. At the end of each school year, 670 of these pupils will have dropped out (i.e. 319 from Grade 1, 201 from Grade 2 and 150 from Grade 3) and 330 will graduate.

Figure 2: Description of the Stationary State for a System Operating Under the Flow Rates Observed for Mozambique In 1988





ment

Repeaters

351

246

180

75

852

Finally, we turn to the type of indicators that can be derived from Figure 1. As a consequence of repetition and dropout in Mozambique, for every 1,000 students entering the first grade, only 330 graduate. To produce these 330 graduates the system needs an amount of resources equivalent to 3,343 pupil-years, of which 852 (i.e. 25.5%) are used by repeaters. In terms of inputs, this means that the Mozambique school system needs 10.13 pupil-years (3,343/330) for each graduate, which is equivalent to 2.53 times the minimum of four years required, had there been no repetition and dropout. (The slight difference with the figures shown in Figure 1, i.e., 10.14 pupil-years and 2.54 for the input-output ratio, is due to rounding.)

III. Simulation of the Impact of Changes in Repetition and Dropout on Internal Efficiency.

We shall now use the method explained above to study how changes in repetition and dropout rates affect internal efficiency of a cycle of education. To throw light on this question we shall simulate the effect of the following three scenarios:

- (1) Reduction of repetition rates by ten percent.
- (2) Reduction of dropout rates by ten percent.
- (3) Reduction of both repetition and dropout rates by ten percent.

In all three cases we shall simulate how a reduction in the level of repetition and/or dropout by ten percent¹⁵ in each grade affects: (i) total costs, i.e., the total number of pupil-years required to cater for the full stay in the cycle of a cohort of 1000 students; (ii) the ability of the system to accommodate new students; and (iii) the total number of graduates originating from this cohort. Table 2 presents the repetition and dropout rates implied for each of these scenarios for Mozambique (see Table 1).

Table 2: Repetition and Dropout Rates Used for the Simulation Under the Three Scenarios.

	Repetition (%)	Dropout (%)
	Grades	Grades



Scenario	1	2	3	4	1	2	3	4
Initial	26.0	26.6	27.2	18.5	23.6	21.6	22.8	0.0
1	23.4	23.9	24.5	16.7	23.6	21.6	22.8	0.0
2	26.0	26.6	27.2	18.5	21.2	19.5	20.5	0.0
3	23.4	23.9	24.5	16.7	21.2	19.5	20.5	0.0

Table 3 summarizes the results of the three simulations. Column (1) shows the overall level of inputs used by the cohort, column (3) the number of students completing the cycle (outputs), Column (5) the average number of pupil-years per graduate and Columns (7) shows the input/output ratio¹⁶. We will analyze these results separate for each of the three scenarios.

Table 3: Changes In the internal Efficiency of Primary Education Resulting from a Ten Percent Reduction In Repetition and/or Dropout¹⁷

	Pupil-Years (Input)	% Change Input	Graduates (Output)	% Change Output	No. of Years per Graduate	% Change Yr./Grd.	Input/Output	% Change
Scenario	1	2	3	4	5	6	7	8
Initial	3341		330		10.13		2.53	
1	3285	-1.7	345	4.5	9.52	-6.1	2.38	-6.3
2	3502	4.8	376	13.9	9.31	-8.2	2.33	-8.3
3	3437	2.8	391	18.5	8.79	-13.3	2.20	-13.4

As expected, to reduce repetition and dropout rates leads to a more efficient system. In all three scenarios the input-output ratio decreases, meaning that, on average, it takes less input to graduate a student. The largest efficiency gain is achieved by the mixed strategy of reducing both repetition and dropout (Scenario 3). The second Largest gain is derived by reducing dropout rates alone (Scenario 2). Note however that Scenarios 2 and 3 would require a higher total input than



in the initial case. That is, if unit cost remains constant, total cost of providing for the cohort would, under these alternatives, be higher than in the initial situation. However, as noted above, output would increase more than total costs, i.e., unit cost per graduate would decrease.

To get a better understanding of how these efficiency gains are achieved we shall explore, separately for each of the three scenarios, how the reduced repetition and/or dropout impact on: (i) how students move through the system; (ii) how they survive from grade to grade; and (iii) how many cohort members complete the cycle.

A. Scenario 1: Reduction of Repetition by Ten Percent.

As Table 3 indicates, one of the consequences of reducing repetition by ten percent is that the system needs fewer pupil-years (-1.7%) to produce more graduates (4.5%). Thus, in this case, we can obtain more output for less input. This result depends on two crucial factors which will be discussed further in Section IV. First, to achieve a ten percent reduction in repetition may require investments. These have not been considered in this simulation. Second, to translate a reduction in repetition into less resource use may be difficult. For example, in a class with 50 pupils of which 10 are repeaters (i.e., 20% repetition), a ten percent reduction in the repetition rate would mean only one pupil less in the class. While this would permit savings on supplies and training materials, it may not permit savings on teacher salaries.

The overall reduction in input is explained mainly by reductions in the number of pupil-years needed by the system to move students between Grades 1, 2 and 3¹⁸. The reduction in total inputs resulting from the gains obtained in these lower grades is, however, lessened by increases in the number of pupil-years needed in Grade 4 to graduate the comparatively higher number of students who now reach this grade. If these efficiency gains can actually be translated into less resource use, the resources thus freed can be used to expand the system, or to finance the current effort to improve quality and support further reduction of repetition, or to a combination of both expansion and quality improvements.

For a system that has not yet achieved universal access to primary education, to decrease the number of pupil-years required by the cohort in the first grade means that coverage can be expanded at little or no cost. In the case of Mozambique, a 10% reduction in repetition could lead to a 3.4%¹⁹ increase in intake to primary education provided that class size is kept unchanged. The only cost associated with this expansion will be the expenditures incurred in implementing the program that will bring down repetition. Naturally, whether or not it is possible in practice to use this liberated capacity to increase new intake would depend on a number of practical and organizational factors, including the extent to which the capacity thus freed are in areas where lack of capacity is an effective constraint on new admission.

The reduction of pupil years used by this cohort in the second and third grades will have no immediate impact on the expansion of the intake capacity, unless new students are allowed to

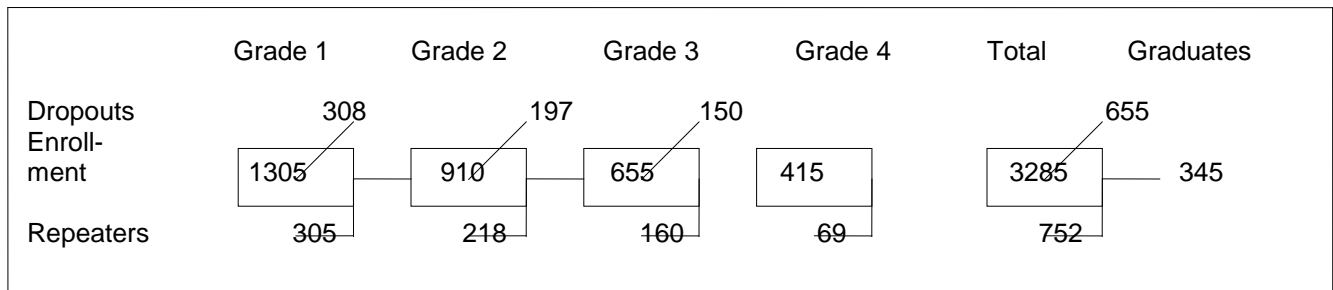


join the system in these grades. However, it will liberate some resources that can be: (i) used to support the repetition reduction strategy-, (ii) reallocated to the fourth grade to make up for the additional resources demanded for enrollment expansion in that grade; (iii) reallocated to first grade to support the expansion of the system; or (iv) used in subsequent years in Grades 2 and 3 to cater to enrollment increase resulting from increased intake.

The increase in the number of pupil-years in Grade 4 is a consequence of two factors: (i) the reduction of repetition in the lower grades led to increased survival in the cycle; and (ii) as both the repetition rate and the enrollment in Grade 4 are lower than in Grades 2 and 3 (see Table 1), a 10% reduction in repetition in this grade freed comparatively less places that could be used for the increased number of promotees. This effect can be seen in Tables A1 and A3 of the appendix which show that the number of students reaching higher grades increases in each grade while the number of students dropping out declines. Thus, the increased enrollment in Grade 4 is a direct consequence of the increased survival. Other things equal, more resources will be required to cater to this increase in enrollment.

Figure 3 summarizes what would happen annually in a stationary system operating under the flow rates assumed in Scenario 1.

Figure 3: Summary Description of Scenario 1



A comparison of the results presented in Figure 3 with those given in Figure 2 shows that a 10% reduction in repetition rates means a reduction of 1.7% in the total annual enrollment (from 3343 to 3285), and a decrease of 11.4% in the number of repeaters (from 852 to 752). The number of graduates produced by the system annually will increase by 4.5% (from 330 to 345) and the number of dropouts will decrease by 2.4% (from 670 to 655).

B. Scenario 2: Reduction of Dropout by Ten Percent.

Table 3 shows that, compared to the initial case, this scenario leads to an increase in both the number of graduates generated and the amount of inputs used by the system. A higher level of inputs is required to provide for a higher enrollment (of repeaters as well as non-repeaters)



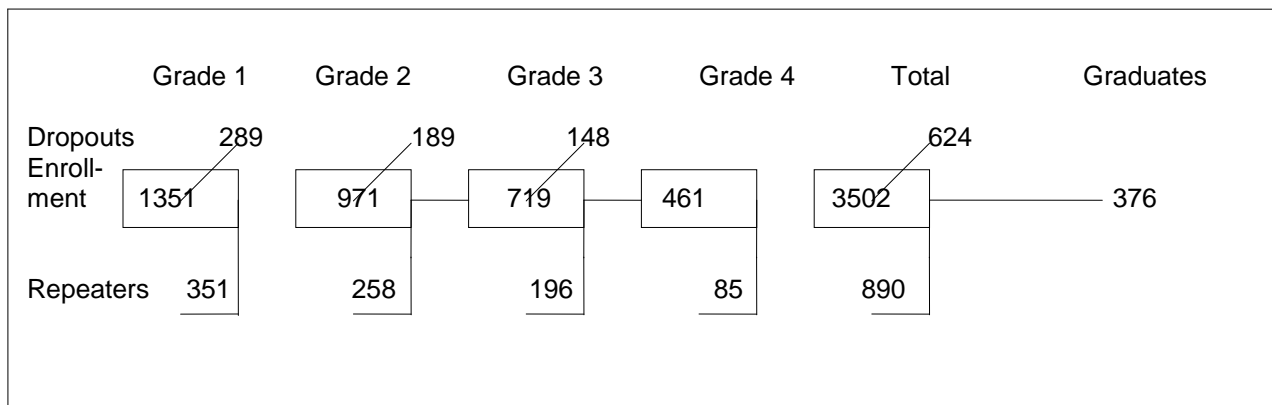
resulting from the decrease in dropout. This is further illustrated by the data presented in Tables 1A and 3A of the Appendix As these tables show, the number of pupil-years in Grade 1 does not change because both the number of new entrants (1000) and the number of repeaters are unchanged. In Grades 2, 3 and 4 the number of pupil-years increase because, as less students drop out, more students reach successive grades, each adding one more year to the total level of input for each additional year they stay in the system. However, the increased survival also leads to an increase in the number of graduates, and this increase in output is larger than the increase in inputs, causing a decline in the input/output ratio and, therefore, a more efficient system.

Since reducing dropout in Grade 1 has no effect on the number of pupil-years used by students in this grade²⁰, a reduction in the dropout rate in this grade has no effect on the capacity of the system to accommodate new students.

As illustrated by this simulation, a policy that aims at reducing dropout will, other things equal, result in an increase in the number of pupil-years needed to provide for the cohort. If available resources are already fully utilized, this policy will demand additional resources. If not matched by additional resources in a situation where available resources are already insufficient to cater adequately to those already enrolled, this could lead to the deterioration of teaching conditions. In turn, this might lead to a resurgence of higher dropout levels. However, if the system also has a higher than desired level of repetition, then we may provide for some of the increase enrollment resulting from lower dropout by liberating capacity used by repeaters. The effect of a combined reduction in repetition and dropout will be analyzed in the neid section.

Figure 4 summarizes what would happen annually in a stationary system operating under the flow rates assumed under Scenario 2.

Figure 4: Summary Description of Scenario 2



A comparison between Figures 4 and 2 shows that a 10% reduction in dropout rates in a system such as that of Mozambique will lead to a 4.8% increase in the total annual enrollment



(from 3343 to 3502), and also an increase of 4.5% in the total number of repeaters (from 852 to 890). The number of graduates produced by the system annually will increase by 14.0% (from 330 to 376) and the number of dropouts will decrease by 6.9% (from 670 to 624).

C. Scenario 3: Reduction in Both Repetition and Dropout by Ten Percent.

Table 3 shows that the combined effect of a simultaneous reduction of ten percent in repetition and dropout produces a large increases in the number of students graduating from the primary cycle (18.5%), which is accompanied by a moderate increase in the number of pupil-years necessary to produce these extra graduates (2.8%). Thus, other things equal, a substantial part of the 4.8% additional pupil-years required to cater to the additional enrollment resulting from the reduction in dropout can be provided through a corresponding reduction in repetition²¹. Note however that the additional cost of this strategy will be higher than 2.8% in case implementing the changes needed to reduce repetition and dropout (Scenario 2) require additional investment. We shall return to that question in Section IV below.

As expected, the reduction in repetition generates a decrease in the number of pupil-years used by the cohort in Grade 1 (see Table 1A in the Appendix), thus liberating resources which can be used to expand new admission or decrease class size. In Grades 2 and 3, however, the increase in the number of pupil-years required to cater to the reduction in dropout is tempered by the decrease in the number of repeaters (see Table 3A in the Appendix). This combined effect of more student reaching the grade and less students being retained through repetition explains why the number of pupil-years spent by the cohort in Grades 2 and 3 is lower for a strategy that simultaneously reduces repetition and dropout than for one which only reduces dropout.

Figure 5: Summary Description of Scenario 3

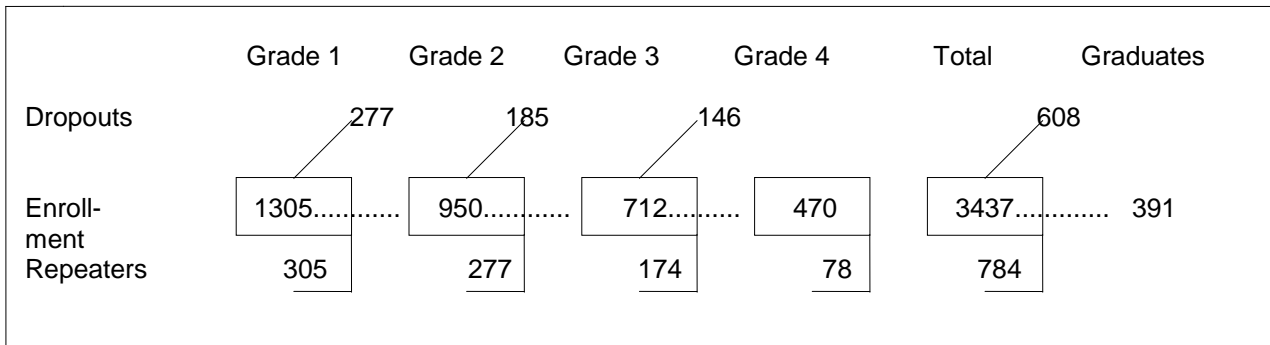


Figure 5 summarizes what happens annual in a stationary system operating under the flow rates assumed for Scenario 3. A comparison of Figures 3, 4 and 5 shows that a simultaneous 10%



reduction in repetition and dropout will produce a system with higher enrollment than if only repetition is reduced, but a system with lower enrollment than if only dropout is reduced. In other words, the total input (in pupil-years) required to cater to a cohort of 1000 pupils during their stay in this four year cycle is highest when only dropout is reduced (because more pupils stay on in the system), less high if both dropout and repetition is reduced (since in this case repeaters free capacity that can be used by students who stay on instead of dropping out), and lowest in the case where only repetition is reduced (since there is no increase in enrollment generated by reduced dropout). However, when we consider the impact on pupil-years per graduate instead of on total pupil years, the case where both repetition and dropout is reduced is by far the most efficient strategy and the case where only repetition is reduced is the least efficient of the three strategies (although it results in a decrease in total studentyears).

In summary, the main effects of reducing repetition on internal efficiency are to: (i) decrease the total costs (i.e., the number of pupil-years) needed to graduate a cohort of students; (ii) free student-places in the first grade that can be used to accommodate new students or to reduce class size; (iii) increase the number of graduates; and (iv) decrease the required input per graduate. The main effects of reducing dropout are to: (i) increase the number of pupil-years necessary to provide for the cohort; (ii) increase the number of graduates; and (iii) decrease the required amount of inputs per graduate. A mixture of these two strategies will reinforce both the increase in the number of graduates and the decrease in the pupil-years per graduate. What will happen to the overall costs, i.e., the total number of pupil-years required by the cohort, will depend on the relative magnitude of the repetition and dropout rates as well as on the comparative magnitude of the decrease in these rates.

Another way to look at the results of the simulations is to say that a reduction in dropout rates will increase the time spent by the cohort in the system, since it will allow some pupils who previously dropped out to progress further in the cycle. This will require more resources, but will also yield higher output. Thus, this increase in input is an effective use of resources in the sense that it contributes directly to increased output. A reduction in repetition will increase the speed at which a cohort of students move through the system and thus reduce the amount of time used inefficiently. As a consequence of this, a reduction in repetition does not only decrease the cost to the system of educating a given cohort of students but also will reduce the private cost of education because of less foregone income and lower school related expenditures for parents. The lower private cost represented by lower levels of repetition might also decrease the probabilities of dropping out.

IV. Cost Savings and Additional Expenditures of Reducing Repetition and Dropout Rates.

So far we have analyzed the impact of reducing repetition and dropout on: (i) the total amount of inputs (measured in pupil-years) used to cater for a cohort of 1000 students throughout



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their stay in a four-year cycle of education; (ii) the number of students completing the cycle (graduates); and (iii) the amount of input per graduate. We have neither examined the extent to which investments are required to reduce repetition and dropout, nor what the cost of such investments might be as compared to the savings resulting from the improved level of internal efficiency. In other words, we have not examined the "cost of transition". A particular interesting question in this connection is the extent to which the costs of the investments required to achieve a given reduction in repetition and/or dropout actually can be "recuperated" over time through the efficiency gains resulting from such an improved internal efficiency.

To assess the costs associated with a given improvement in internal efficiency, we would ideally rate different measures designed to reduce repetition and dropout according to their effectiveness and cost and select those that promise to yield the highest benefits per unit cost. This approach requires empirical knowledge about the impact of different interventions on the propensity for pupils to repeat and/or drop out. Unfortunately, while a number of studies exist showing the relative cost-effectiveness of different such interventions in specific national settings, this knowledge cannot easily be generalized to arrive at statements such as "reducing repetition by X% will require a Y% increase in investments". Therefore, we can not really quantify in any precise manner the "cost of transition" .

In the absence of the above type of information, we shall use a much more approximate and less ambitious approach to try to shed some light on how the magnitude of the savings generated through reduction in repetition and dropout may compare to the costs of some key quality improvement measures often provided through World Bank projects. To do this, we shall use the Reconstructed Cohort Method to simulate the cost implications of reducing repetition and dropout. The simulation would be based on assumptions about how the interventions required to bring down repetition and dropout would affect total cost and cost per-pupil; that is, based on different ways of costing the interventions.

In this section we examine four strategies for attributing costs to interventions aimed at reducing repetition and dropout. Each strategy consists of different ways of combining changes in total and per-pupil costs. First, we assume that the intervention does not change the current level of total costs while unit costs change with changes in the level of inputs. Second, we assume that the intervention has no impact on unit costs and that total costs are adjusted so as to reflect the changes in inputs resulting from reduction of repetition and/or dropout. In the third case we assume that the intervention results in increases in the level of total expenditures and also in changes in unit cost. Specifically, this case assumes a 3.5% increase in total recurrent cost, which is the average share of the primary education budget that low income countries spend on teaching materials. In the fourth case we examine the implications of implementing a program that increases the cost per student by 3.5% which, in turn, increases total costs. This increase in unit cost is the equivalent of what was spent in Brazil (US\$5) in a quality improvement intervention which improved reading scores of children participating in the program by 27% in comparison to children not participating in it²² .



The first strategy to assess the impact of reducing repetition and dropout consists of assuming that the intervention does not change the current level of recurrent expenditures, i.e. it will be "cost-neutral" in terms of total recurrent expenditures. Examples of this type of "cost-neutral" measures include: (a) more adequate examination standards; (b) administrative controls on the number of time a student can repeat; (c) automatic promotion and; (d) redistribution of more qualified teachers to entrance grades²³. In all these cases we assume that the reduction in repetition and dropout could be achieved without extra costs. However, we are not assuming that unit cost is constant since, for example, it is difficult to think that it would be possible to change the availability of teachers and classrooms proportionally to the number of pupil enrolled. In this case, while total costs remain the same, costs per student would change in a direction opposite to that of total inputs, while costs per graduate would change in the same direction as the average number of years necessary to produce a graduate.

The results of this type of "cost-neutral" strategy are presented in Table 4, which shows that reducing repetition by ten percent (Scenario 1) generates a 1.8% increase in annual unit costs (i.e., cost per pupil-year produced), but a 4.3% reduction in cost per graduate. The increase in costs per pupil-year is the result of the assumption that total recurrent expenditures is kept constant, which means that the savings resulting from a decline in the number of pupil-years used by this cohort during its stay in the cycle (from 3343 to 3285, or by 1.7%) are kept in the system. Reducing dropout by ten percent (Scenario 2) reduces both costs per pupil-year and cost per graduate (by 4.5% and 12.2%, respectively). Finally, a simultaneous reduction in repetition and dropout by ten percent brings down cost per pupil-year by 2.7% and cost per graduate by 15.6%.

A main weakness of this "cost-neutral" strategy is that total recurrent expenditure does not change. If the number of students in the system increases but total recurrent expenditure is kept the same, as in Scenarios 2 and 3, then teaching conditions could deteriorate through lack of educational resources and, bring about, once again, high repetition and drop out rates.

Table 4: Cost Changes Under a Constant Budget (1)

Scenario	Annual unit Cost	Nº of Graduates (output)	Pupil-Years (Input)	Total Cost	% Change	Cost Per Graduate	% Change
Initial	100.0	330	3343	334300		1013	
1	101.8	345	3285	334300	0.0	969	-4.3
2	95.5	376	3502	334300	0.0	889	-12.2



3 97.3 391 3437 334300 0.0 855 -15.6

(1) The different scenarios have been defined in Section III.

The second strategy, which assumes that the intervention to reduce repetition and dropout would have no impact on cost per pupil-year, implying that marginal cost per pupil-year equals average cost. This would be the case in a system where, first, a given decrease in enrollment brings about a proportional decline in total cost and, second, where repetition and dropout can be reduced without extra investments. The former would imply that a given decline in enrollment brings about a proportional decline in education inputs such as teachers, classrooms and teaching materials. In this case, the changes in total cost and cost per graduate brought about by a reduction of repetition and dropout will be equivalent to changes observed in, respectively, the number of pupil-years and the average number of years required to produce a graduate. Hence, this case is equal to that studied for the three scenarios presented in Section III. Table 5 illustrates the impact of this strategy.

Table 5: Cost Changes Under No Additional Per-Pupil Expenditure

Scenario	Annual Unit Cost	Nº. of Graduates (Output)	Pupil-Years (Input)	Total Cost	% Change	Cost Per Graduate	% Change
Initial	100	330	3343	334300		10.13	
1	100	345	3285	328500	-1.7	9.52	-6.2
2	100	376	3502	350200	4.8	9.31	-8.1
3	100	391	3437	343700	2.8	8.79	-13.4

The table shows that under this strategy of unchanged costs per pupil-year the costs per graduate will decline in the three scenarios by 6.2%, 8.1% and 13.4%, respectively. Total costs will decrease (by 1.7%) when repetition is reduced by ten percent (Scenario 1). In the case of Scenario 2 (ten percent reduction in dropout), or Scenario 3 (simultaneous reduction in repetition and dropout by ten percent), total costs will go up, by 4.8% and 2.8% respectively. Keeping cost per pupil-year constant assumes that dropout and repetition can be reduced through measures that



do not require additional investments per pupil-year produced, i.e., it will be "cost-neutral" in terms of unit costs.

The third strategy to be studied assumes that the additional cost of the interventions required to reduce repetition and dropout will involve additional expenditures, for example, in the form of more non-salary inputs such as investment in: (i) more teacher books/guides, (ii) more and better textbooks, (iii) more writing materials, and possible (iv) inservice teacher training. For the sake of this illustration, we shall assume that the additional expenses necessary to implement this intervention will increase total recurrent expenditures in Mozambique by 3.5%. On average, low-income countries spend 3.5% of their primary education budget on teaching materials. Thus, assuming that this is presently the case in Mozambique, this hypothesis would imply doubling this amount. Under these assumptions, a reduction of repetition by ten percent, generated by the intervention, will cause cost per pupil-year to increase by 5.3% while cost per graduate will decrease by 1% (see Table 6). The 5.3% increase in cost per pupil-year is the result of reinvesting all savings generated by a reduction in the number of pupil years (1.7%). On the other hand, if the strategy only generates a reduction in dropout by ten percent (Scenario 2), the unit cost will decrease by 1.2% and cost per-graduate will go down by 9.2%. If the investment reduces both repetition and dropout by ten percent (Scenario 3), then unit cost will increase by 0.7% while cost per-graduate will decrease by 12.6%.

Table 6: Cost Changes Under a Strategy that Increases Total Expenditures in Teaching Materials by 3S%

Scenario	Annual Unit Cost	Nº of Graduates (Output)	Pupil-Years (Input)	Total Cost	% Change	Cost Per Graduate	% Change
Initial	100.0	330	3343	334300		1013	
1	105.3	345	3285	346001	3.5	1003	-1.0
2	98.8	376	3502	346001	3.5	920	-9.2
3	100.7	391	3437	346001	3.5	885	-12.6

A problem with this way of financing the intervention is that the initial reduction in repetition and dropout could result in an increase in the number of students in the system that offsets the previous increase in total expenditures and thus reduces per-pupil expenditures. Lower per-pupil expenditures may lead to a deterioration of teaching conditions and to increasing levels of repetition and dropout. Since this strategy does not contemplate increasing total recurrent



expenditures to adjust for the increase in the number of pupils enrolled in the system that results from lower repetition and dropout rates, it is somewhat similar to the first strategy presented above where total recurrent expenditure were fixed (i.e. cost neutral in terms of total expenditures). To prevent a deterioration in teaching conditions resulting from increasing enrollment, the fourth strategy assumes that achieving the objective of reducing repetition and dropout as proposed in each of the three scenarios will require an additional investment of 3.5% per-pupil in non-salary inputs. This means that the total cost of the intervention will be a function of the new level of per-pupil expenditures and of the changes in the number of pupil-years (inputs) resulting from the reduction in repetition and dropout. In other words, total cost will depend on how effectively the intervention reallocates existing resources and targets new investment in the most needed sectors so as to achieve substantial reductions in repetition and dropout levels.

The results of investing an additional 3.5% per pupil, presented in Table 7, suggest that if only repetition is reduced by ten percent, then total cost will increase by 1.7% but cost per-graduate would go down by 2.7%. If this per-pupil increase on no-salary inputs only impacts on dropout, reducing dropout rates by ten percent nonsalary, then total cost will increase by 8.4% and cost per graduate will decrease 4.8%. However, if this 3.5% increase in non-salary expenditures generates a reduction in both repetition and dropout by ten percent then total cost will increase by 6.4% with the benefit of a decrease of 10.2% in cost per-graduate. Therefore, from a costbenefit stand point, a simultaneous reduction in repetition and dropout is the most effective strategy to increase the number of graduates and the internal efficiency of the educational system while keeping total cost within limits.

Table 7: Cost Changes Under a Strategy that Increases Per Pupil Expenditures In Teaching Materials by 3.5%

Scenario	Annual Unit Cost	N°.of Graduates (Output)	Pupil-Years (Input)	Total Cost	% Change	Cost Per Graduate	%
Initial	100.0	330	3343	334300		1013	
1	103.5	345	3285	339998	1.7	986	-2.7
2	103.5	376	3502	362457	8.4	964	-4.8
3	103.5	391	3437	355730	6.4	910	-10.2



From the previous discussion we can conclude that the real challenge from a policy perspective is to find a strategy that has the right mix of reduction in repetition and dropout that could bring down cost per-graduate while keeping total cost within limits. Based on the previous results we can anticipate that this type of strategy will be country specific and will depend both on the actual patterns and levels of repetition and dropout observed in each country, and on how responsive repetition and dropout rates are to changes in the organization of the school system, current administrative practices and to additional investments in non-salary inputs.

Simulating scenarios as we have done in this section, is a useful analytic tool for sensitivity analysis. As shown, it can help to clarify the impact of different strategies for reducing repetition and dropout on total educational expenditures and on cost per graduate. Furthermore, it can help choose a combination of reduction in repetition and dropout that could keep total cost within limits and cost per graduate stable.

Table 8 shows the results of a sensitivity analysis simulating the impact of reducing repetition and dropout rates, from zero to one hundred percent, on the number of pupil-years (inputs), number of graduates (outputs) and costs per graduate in Mozambique²⁴. The first part of the table shows how gains in internal efficiency resulting from reduction in repetition and dropout generate reductions in the amount of resources (inputs) needed to produce a graduate (output). These gains are reflected in the reduction of the input/output ratio. The second part of the table shows how these efficiency gains result in a reduction of cost per-graduate.

As suggested by the results presented in Table 8, if additional per-pupil expenditures have no impact on repetition and dropout, cost per-graduate and total cost would increase in the same magnitude as those extra investment. For example, if investment per pupil increases by \$0.25 per pupil-year, and it takes 10.14 pupil-years to produce a graduate, cost per graduate will increase by \$2.54, or from \$334 to \$337 (after rounding, see column 1 of Table 8). However, if repetition and dropout rates decrease, cost per graduate would also decrease. How much will depend on how effectively the intervention brings down repetition and dropout. Because reducing repetition and dropout also increases the number of students in the system, total cost will increase. For example, if increasing per-pupil expenditure by US\$1.50 has no impact on repetition and dropout, cost per graduate will go up by 4.8% (from US\$334 to US\$350) and total cost would increase by 4.5%. If this intervention reduces repetition and dropout by 40%, then cost per-graduate would go down by 34.4% (from US\$334 to US\$ 216) and total cost would increase by 15%²⁵. Finally, if this additional US\$1.50 completely eliminates repetition and dropout then cost per-graduate would be reduced by 58.7% (from US\$334 to US\$138) but total cost would increase by 25%²⁶. On the other hand, if we assumed that US\$5.0 in additional educational resources per-pupil are needed to reduce repetition and dropout by 40% (as opposed to US\$1.50)



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then cost per-graduate would decrease by only 29% (from US\$334 to US\$237) and total cost would increase by 27%²⁷.

Table 8 Sensitivity Analysis of the Impact of Reducing Repetition and Dropout Rates on Internal Efficiency and on Cost Per-Graduate

Changes in	% Simultaneous <u>Reduction in Repetition</u> and Dropout Rates										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Input	3345	3438	3525	3605	3679	3746	3807	3863	3914	3959	4000
Output	330	392	456	522	589	657	725	794	863	932	1000
Input/output	2.53	2.19	1.93	1.73	1.56	1.43	1.31	1.22	1.13	1.06	1.00

Investment Per pupil	COST PER - GRADUATE										
	%Reduction in Repetition and Dropout Rates										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
\$0.00	\$334	\$290	\$255	\$228	\$206	\$188	\$173	\$161	\$150	\$140	\$132
\$0.25	\$337	\$292	\$257	\$230	\$208	\$190	\$175	\$162	\$151	\$141	\$133
\$0.50	\$339	\$294	\$259	\$231	\$209	\$191	\$176	\$163	\$152	\$142	\$134
\$0.75	\$342	\$296	\$261	\$233	\$211	\$192	\$177	\$164	\$153	\$143	\$135
\$1.00	\$344	\$298	\$263	\$235	\$212	\$194	\$178	\$165	\$154	\$144	\$136



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Initial	1351		927		660		405		3343	
1	1305	-3.4	910	-1.9	655	-0.8	415	2.4	3285	-1.7
2	1351	0.0	971	4.7	719	8.9	461	14.0	3502	4.8
3	1305	-3.4	950	2.5	712	7.9	470	16.1	3437	2.8

Table 2A. Changes In the Number of Students Reaching the Next Grade as a Consequence of a Ten Percent Reduction in Repetition and Dropout.

Scenari 0	Initial Cohort	Grade 2	% Change	Grade 3	% Change	Grade 4	% Change	Grad.	% Change
Initial	1000	681		480		330		330	
1	1000	692	1.6	495	3.1	345	4.5	345	4.5
2	1000	713	4.7	719	9.2	376	13.9	376	13.9
3	1000	723	6.2	712	12.1	391	18.5	391	18.5

Table 3A. Chan in the Number of Students Repeating Each Grade as a Consequence of a Ten Percent Reduction in Repetition and Dropout.

Scenario	Grade 1	% Change	Grade 2	% Change	Grade 3	% Change	Grade 4	% Change	% Total Change
Initial	351		246		180		75		852
1	305	-13.1	218	-11.4	160	-11.1	69	-8.0	752
2	351	0.0	258	4.9	196	8.9	85	13.3	890
3	305	-13.1	227	-7.7	174	-33	78	4.0	794

Table 4A. Changes In the Number of Students Dropping-Out as a Consequence of a Ten Percent Reduction In Repetition and Dropout.



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Scenario	Grade 1	% Change	Grade 2	% Change	Grade 3	% Change	Total	% Change
Initial	319		201		150		670	
1	308	-3.5	197	-2.0	149	-0.7	655	-2.4
2	287	-10.0	189	-6.0	148	-1.3	624	-6.9
3	277	-13.2	185	-8.0	146	-2.7	609	-9.1

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NOTES

- 1 For example, 25 out of the 34 Sub-Saharan African countries for which data were available for a recent year had more than 15% repeaters in primary education, and nine had more than 30%. Similarly, 19 of 33 countries had more than 15% repeaters in general secondary education, and five had more than 30%. About 40% of those who start Grade 1 in Sub-Saharan Africa drop out prior to reaching the final grade of the primary cycle.
- 2 For a review of the literature in this area, readers are referred to Haddad (1979) and UNESCO (1980).
- 3 Recent examples of Bank's education sector work presenting this argument can be found in the latest reports for Rwanda (1989), Zaire (1990), Turkey (1990), Lesotho (1991), Kenya (1991), El Salvador (1991), Ecuador (1991) and Mexico (1991).
- 4 See for example Fuller (1987), Harbison and Hanushek (1989), and Lockheed and Verspoor (1990).
- 5 See, for example, Harbison and Hanushek (1989) and Carlson (1991).
- 6 For example, other things equal, a reduction in dropout will reduce cost per graduate, but will increase total costs as more pupils need to be provided for. However, if repetition and dropout can be reduced simultaneously, less repetition will liberate capacity which can be used to cater for increased retention of students. Thus, savings generated through reduction in repetition may be used both to provide for increased enrollment generated by reduced dropout, and to finance investments required to obtain the improvements in learning conditions needed to reduce repetition and dropout.
- 7 For a discussion of the effect of repetition and dropout see Haddad (1979), Shepard (1989), Schulle (1990).
- 8 For example, Berstecher (1970) proposes to break down total output (human capital of a cohort) between final output (graduates) and intermediary output (dropouts). According to this approach, the contribution of a graduate to the total output is equal to unity while the contribution of a dropout is always less than unity. In a four grade system, for example, a student dropping out after the first grade would have contributed one fourth to total output, a second grade dropout would have contributed one half and a third grade dropout three quarters. This weighting, of course, is arbitrary and might not reflect real learning gains. It is, however, a practical way to account for the quantitative contribution of dropout to educational outputs.
- 9 The Hypothesis behind this method and how to employ it has been explained in Fredriksen (1991) and will not be repeated here.
- 10 That is: $131 + 34 + 9 + 2 + 1$
- 11 As will be explained further bellow, the 1351 figure represents the total enrollment in the first grade generated by a system that operates under "stationary" conditions, i.e., a situation where the flow rates remain unchanged over time and 1000 new students are admitted each year. In the present case, such a system would produce an annual enrollment of 1351 students in Grade 1 (1000 new entrants and 351 repeaters), 319



Grade 1 students would drop out at the end of each year and 681 would be promoted to second grade.

12 That is: $504+131+34+9+2+1$

13 That is: $71+58+30+13+5+2+1$

14 That is: $60+47+27+11+4+1$

15 Note that Appraisal Reports often set this targets in terms of reduction in percentage points. For example, a reduction in a repetition rate from 20% to 15% represents a reduction of five percentage points. Expressed as a percentage of the initial rate, this reduction represents a 25% reduction. We have chosen to use the latter approach as it facilitates the interpretation of the results.

16 The input/output ratio equals the number of years per graduate (column 5) divided by the duration of the cycle, which in this example is 4 grades.

17 The figure presented in this table have been rounded. This is why percent changes calculated using these figures could yield results slightly different from those shown in the table. This situation applies to all the tables used in the three scenarios.

18 See Table 1A in the Appendix

19 See Table 1A in the Appendix

20 In part this is due to the assumption that dropouts are assumed to leave at the end of the school year.

21 Comparing the figures shown in Column I of Table 3 for the different scenarios show that a ten percent reduction in dropout results in an increase in the number of pupil-places required by 4.8% or by 159 (from 3,343 to 3,502). If repetition also is reduced by ten percent, then the number of pupil-places required is 3,437, which is only 94 more than in the initial situation. This means that 65 of the 159 pupil-places required to cater to the increased enrollment resulting from decreased dropout are secured through reduced repetition. Naturally these results are heavily influenced by the magnitude of repetition dropout rates in each grade.

22 See Harbison and Hanushek (1989), and Lockheed and Verspoor (1990).

23 Some of these measures are examined in Schiefelbein (1989).

24 Since we did not have per-pupil cost data for Mozambique, we assumed that per-pupil expenditures in this country was equal to US\$33, which corresponds to the weighted mean per-pupil expenditures in primary education in low income countries (Lockheed and Verspoor 1990).

25 Total cost would increase from US\$110319 to US\$126925.5 for a cohort of 1,000 students.

26 Total cost would increase from US\$110319 to US\$138000 for a cohort of 1,000 students.

27 Total cost would increase from US\$110319 to US\$139801 for a cohort of 1,000 students.