The Role of Fertility in Achieving Africa's Schooling MDGs
Early Evidence for sub-Saharan Africa

Sarah C. Giroux
Parfait M. Eloundou-Enyegue
(*Cornell University*)

ABSTRACT

In theory, declines in national fertility boost schooling by reducing age-dependency but questions remain about the size and catalysts of this dividend. We address these questions in sub-Saharan Africa by using a detailed framework and decomposition methods. Results about catalysts suggest that –beyond policy-- dividends depend on characteristics of fertility transitions and on changes in employment, economic performance and public commitment to education. Results about the size of Africa's schooling dividends are mixed. On the one hand, the schooling resource per child grew on average by $73 between 1990 and 2005, with a third of this growth tied to trends in age dependency. Yet despite these nominal gains, Africa lost ground relative to the world partly because age dependency declined even more in other regions. Only after 2105 (the MDG deadline) will Africa begin to narrow its gap vis-à-vis the world average. Also, dividends accrue earlier among countries that already had higher enrollments, suggesting that transitions might initially raise schooling inequality across sub-Saharan countries.

INTRODUCTION

A central question in the population-development debate is whether falling birth rates in high-fertility nations promote socioeconomic development and, within this debate, the "demographic dividend" has recently emerged as a new rationale. Contrary to the earlier emphasis on population growth or size, this argument sets age-dependency as the key mediating variable. As fertility declines, the proportion of workers to dependents rises mechanically, thus freeing resources that can be saved and invested in socioeconomic development (Bloom, Canning & Sevilla 2002; Mason & Lee 2005; Merrick 2002; Ross 2004). Studies have begun to estimate this dividend, but at least three gaps remain. First, studies have covered economic outcomes such as savings, investments, productivity, economic growth, and poverty reduction, but have paid less attention to dividends in the realm of schooling (Birdsall, Kelley, & Sinding, 2001; Crenshaw, Ameen & Christenson, 1997; Feyrer, 2008; Mason & Lee, 2005). Second, the catalysts of this dividend remain insufficiently understood. The conventional wisdom so far is that dividends are not automatic but contingent on national policy, i.e. countries reap a dividend only insofar as they also implement sound policies. Beyond policy however, we know little about other contextual influences (Birdsall et al., 2001; Bloom et al., 2002; Lee, Lee & Mason, 2008; Mason & Lee, 2005). Third, few studies have investigated dividends in sub-Saharan Africa (SSA), where transitions are recent (Bloom et al., 2007).

To fill these gaps, our study examines schooling dividends within SSA and their contextual variation. Previous studies of the link between fertility and schooling have mostly tested the resource "dilution" hypothesis, focusing at the micro-level (Cassen, 1994; Lloyd, 1994). Few so far have tested the "dividend argument" which is a complementary, macro-level pathway through which countries might secure schooling benefits from transitions. We ask three questions: (1) Under what societal circumstances are schooling dividends likely? (2) How large a schooling dividend can one expect from SSA's fertility transitions? (3) Can these dividends reduce SSA's schooling resource gap vis-à-vis the world?

We answer these questions by using a mix of conceptual detail and empirical focus. Conceptually, the idea is to describe the dividend argument in full, rather than short form. By specifying the logical chain of processes from fertility change to its presumed benefits, this fuller presentation clarifies how contextual forces might affect the overall process. After this conceptual detail however, the empirical analysis focuses on the argument's core clause, namely the impact of age structure on per capita schooling resources[ii]. There are several benefits to this two-pronged approach. The first prong, which addresses the conceptual aspect of our inquiry, permits a detailed analysis of the dividend-production process and the multiple ways this process can be amplified or stalled. The second prong, which addresses the empirical aspect of our analysis, ensures a more specific test of the dividend argument. Furthermore, it facilitates quantitative analysis by sidestepping difficult issues of causation and aggregation.

Contemporary Africa is a good case for studying schooling dividends, as the region is straining to reach ambitious Millennium goals in education such as universal primary education and gender parity in schooling (UN 2001). These targets set for 2015 will likely be missed by many countries unless progress is accelerated, and this in turn depends on new infusion of budget resources, increased efficiency, or the kind of opportunistic boost that a dividend could provide (Binder, 2009; Sahn & Stifel, 2003; UNDP, 2001; UNESCO, 2005). Furthermore, Africa's demographic diversity facilitates the study of contextual variation in dividends. Although the region has begun its fertility transition, countries vary greatly in the depth and steadiness of their declines. Forerunning countries are now below 4 births per woman but fertility levels remain above 6 in nearly half of the countries, and some transitions appear to be stalling (Bongaarts, 2006; Cohen, 1998; Tabutin & Schoumaker, 2004; World Bank, 2009). These declines in fertility have been led by urban families (Shapiro & Tambashe, 2001) and were sometimes accompanied by changes in marriage patterns, reversals in child mortality, rising AIDS-related mortality, reversals in economic fortunes, or changes in budget policies (Antoine & Nanitelamio, 1991; Bongaarts, 1996; UNICEF, 2008; World Bank, 2009). Such diversity in national experiences can help understand the sources of contextual variation in dividends.

The rest of the paper is organized as follows: First we review previous studies of the impact of fertility transitions on schooling outcomes, arguing that most address the "dilution" rather than "dividend" hypothesis. After presenting the dividend argument in detail, we describe an empirical approach focused on the core clause of this argument: the impact of age structure on per capita schooling resources. This approach is applied to analyze SSA's dividends at a time when this region is beginning its demographic transition. Finally, we present findings and discuss implications for Africa's prospects of securing a schooling dividend and for scientific debates about the effects of fertility transitions.

PREVIOUS STUDIES: DILUTION VERSUS DIVIDEND

The notion that fertility transitions impact schooling is rooted in both "dilution" and "dividend" theory. Dilution --the notion that higher fertility *at the family level* dilutes parental resources thereby compromising children's human capital-- has been the dominant argument so far. In this perspective, the benefits from transitions stem from smaller sibsize, and analyses therefore focus on micro-level relationships between sibsize and schooling (Anh et al., 1998; Bhat, 2002; Blake, 1981; Cassen, 1994; Downey, 1995; Lam & Marteleto, 2005; Lloyd, 1994; Lu & Treiman, 2005; Knodel, Havanon & Sittitrai, 1990)[iii].

A review of these studies shows historical advances in methods to deal with statistical issues of measurement, estimation, internal validity, and policy inference. Studies increasingly use large national surveys, and/or event-history analyses that address the dynamic nature of schooling and fertility events. Measurement has evolved from crude indicators of fertility, such as number of children ever born, to more precise and time-sensitive measures that finely capture children's sibsize experiences. The measurement of schooling has been similarly refined, from enrollment to annual odds of school dropout or school quality. Studies have also expanded the list of statistical controls and testing of pathways through which sibsize affects schooling outcomes (Downey, 1995; Eloundou-Enyegue & Williams, 2006; Lloyd ,1994; Lu & Treiman, 2005).

Still, most of these studies remain mired in causality debates, i.e., whether inverse relationships between sibsize and schooling reflect causal effects or parents' endogenous tradeoff between high fertility and child quality. To resolve this problem, researchers try to capture exogenous fertility by using natural policy experiments (e.g. sudden changes in birth control or abortion laws), random placement of family planning clinics, twin births, gender of first-borns, or reportedly unwanted fertility (Baez, 2008; Glick & Sahn, 1999; Montgomery & Lloyd, 1999; Rosenzweig & Wolpin, 1980), but none of these remedies are considered to be fully satisfactory. Beyond causation, one worries about two fallacies when relying on micro-studies to estimate the impacts of fertility transitions on national schooling. One stems from using cross-sectional evidence to infer historical change, a problem Thornton (2001) termed "reading history sideways." The other is reverse ecological fallacy, which occurs when micro-level findings are used to infer aggregate relationships (Bernard, 2000). Reverse ecological fallacy is a concern if the effects of sibsize are non-linear. In such cases, aggregate impacts will depend on whether or not national fertility declines occur evenly among both larger and smaller families. To infer the national-level effect of fertility declines, one thus needs information about the distribution of fertility change and the schooling differentials associated with various sibsizes. Knodel and colleagues (1990) address these problems by conceptualizing fertility transitions as changes in the proportion of children experiencing various sibsizes, then applying the corresponding schooling differentials. Even after this improvement, yet another concern is the questionable assumption that sibsize effects remain stable over time or that contemporary fertility transitions are one-dimensional, rather than dual transitions in both family size and structure. In spite of these caveats, previous studies have cumulatively built a reasonable case that smaller family size is associated with improved schooling outcomes through the concentration of resources at the family level.

In contrast, few studies have tested the hypothesis of a schooling dividend, i.e., the possibility that fertility transitions might also affect schooling through changes in age structure. Perhaps the oversight is temporary, since the argument itself is recent. More plausibly, the reason for oversight is conceptual, if schooling analysts view the dividend as a mere variant of the general dilution argument. The differences between dilution and dividend hypotheses therefore deserve comment. One difference is breadth, with the dividend argument being theoretically broader both at its right and left hand sides. On the predictor side, fertility declines are not the dividend's only trigger but adult mortality matters as well.

On the outcome side, dividends accrue in multiple forms, whether savings, investments opportunities, productivity, or children's human capital. Another difference between the dilution and dividend arguments lies in the level and nature of the mediating variable. While the intervening mechanism in the dilution argument depends on decision making that occurs at the individual level, the intervening mechanism in the dividend argument is a macro-level process. Individuals can therefore reap dividends regardless of their own fertility behavior. This macro-process depends on trends in relative cohort size, rather than sibsize as is the case with dilution, and the two trends need not be not simultaneous (Lam & Marteleto, 2005). Also, the dividend addresses supply factors and the corresponding public resources, while dilution is about demand factors and private resources. In all those respects, the "dividend" and "dilution" are complementary, and our study thus complements previous empirical tests of the dilution hypothesis. The question is whether in addition to family-level influences, fertility transitions also affect schooling through macro-level influences on age dependency. Our approach to answering this question is to combine detail (in the conceptual framework) and focus (in the empirical analysis).

CONCEPTUAL FRAMEWORK

The dilution and dividend arguments concur in concluding that national declines in fertility boost schooling. Yet their consensus on the bottom line obscures differences in process and detail. The detail in Figure 1 highlights the sequential nature of the dividend-production process. First, declines in fertility alter age dependency. Then, age dependency reduces *real* dependency, and the distinction between the two concepts is outlined below. The third step links real age dependency to resources. As dependency is lowered, the resources available per capita increase, but this boost also depends on trends in national resources and budget allocation. Finally, in step 4, resources are converted into schooling outcomes, a conversion that depends on a country's policy effectiveness in transforming resources into schooling outcomes.

Two remarks about this process are in order. First is the difference between age and real dependency. Although the two concepts seem synonymous, the first is purely demographic while the second has more socioeconomic meaning. Age dependency is the proportion of children 0-14 relative to working-age individuals (15-64). In real terms however, dependency is the ratio of dependent children to working adults. Dependent children are only a subset of all children, especially if child labor and child-headed households are common. Working adults are likewise a subset of the total population in the working ages. In addition to age structure, real dependency thus depends on norms about working ages and current employment, meaning that jobless growth for instance need not ease real dependency. The first point, then, is simply that age and real dependency ratios can be quite different. A second remark is with regards to the time lag between changes in fertility and changes in age structure. A 15-year lag is expected before birth cohorts can work their way through the age structure and fully alter the child dependent population. Since we study changes in age structure between 1990 and 2005, the relevant period for the changes in fertility is 1975-1990.

[**Figure 1 about here**]

The detail in Figure 1 offers three insights. The first is to reveal the contextual forces affecting each step in the process. Such forces include the levels of child and adult mortality (first step) but also the pace of fertility decline: declines that occur in fits and starts are unlikely to produce a clear window of opportunity during which age dependency is low. Other forces include the trends in child labor and adult unemployment (second step), the economic performance and public commitment to children (third step), and policy (fourth step). In sum, policy (narrowly understood here as the extent to which national governments transform resources into outcomes) is not the only obstacle to the dividend. Dividends also depend on normative and economic context as well as on the characteristics of fertility transitions, even though these other forces are often downplayed in earlier, black-box presentations of the dividend argument.

As a second insight, a detailed presentation clarifies why previous studies might have emphasized policy as a main condition. Conceptually, the four steps in Figure 1 represent two distinct sub-processes. The first sub-process (steps 1 through 3) relates to the *production* of a resource opportunity. Its end product is a "bonus" i.e., a resource opportunity, in the form of more public spending per child. The second sub-process (step 4) is about the *transformation* of opportunity into outcome, with the end product being the schooling "dividend," i.e., final outcomes such as enrollments or attainment. By equating "bonus" and "dividend," analyses will likely emphasize the last step (the transformation of the resource opportunity) and therefore miss the earlier steps. Missing these earlier steps logically implies missing contextual influences other than policy. Clearly, the transformation of the resource opportunity depends on policy, specifically policies affecting the efficient transformation of public resources into favorable schooling outcomes (Binder, 2009). However, the first sub-process (creating the resource bonus) depends on other factors that merit attention.

As a third insight, the presentation in Figure 1 helps identify the main limiting factor(s) in reaping a dividend. To do this, one can calculate a conversion coefficient for each step, i.e., how much change in one factor in the chain translates into change in the next. Conversion is efficient when improvements in the preceding variable are converted into large improvements in the following variable (i.e., a large conversion coefficient). Conversion is ineffective if improvements in the preceding variable are translated into very small improvements or setbacks in the subsequent variable (small or negative conversion coefficients). To illustrate, Zimbabwe experienced a 30% decline in fertility between 1975 and 1990. This translated, 15 years later, into an 18% reduction in age dependency, i.e., a conversion coefficient of .60. Because no objective threshold exists for distinguishing large from small coefficients, our analysis conservatively focuses on negative coefficients, i.e., situations where improvements in one variable are followed by regress in the next. This qualitative analysis helps identify country-specific bottlenecks (limiting factors), i.e., ineffective steps that impede the production of dividends. In multi-country studies such as ours, one can thus tally the most common bottlenecks.

EMPIRICAL APPROACH

While the full Figure 1 permits a qualitative inventory of contextual factors, one most focus on the crux of this argument in order to quantitatively estimate the size of the bonus. This crucial step is the penultimate step where age-dependency is converted into resources per child. This focus is of course narrow: its starting point is age-dependency, rather than fertility, and its endpoint is the schooling resource per child, rather than a final outcome such as enrollments or educational attainment. Yet this focused approach permits a more specific test of the dividend argument which, *sensu stricto*, is about added schooling resources, not whether these are judiciously used by policy to improve schooling outcomes. Additionally, it avoids some of the data problems associated with using enrollments (or attainment) as the dependent variable.[iv]

At the national level, the average schooling resources per pupil (*r*) depends on the total national resources (G), the share of these resources allotted to education (k), and the size of the school age population (n). Roughly r=Gk/n. Taking age dependency (p) as the proportion of children compared to the total working age (adult) population (n/N) then

$$r = gk / p \qquad (1)$$

where g is (G/N), the national income over the total adult population

The historical change in the schooling resources per capita thus depends on trends in age dependency, the economy and the public budget allocation to education (as reflected in p, g, and k respectively,). This change can be decomposed as follows.

$$\Delta r \cong \underbrace{-[\overline{(kg / p^2)} * \Delta p]}_{\text{Age dependency}} + \underbrace{[\overline{(k / p)} * \Delta g]}_{\text{Income effect}} + \underbrace{[\overline{(g / p)} * \Delta k\ ]}_{\text{Budget effect}} \qquad (2)$$

While the gain in (2) is measured in absolute terms, it can also be evaluated in relative terms, e.g., vis-à-vis the world average. The computations remain the same except all four parameters (r,k,p,and g) are calculated relative to world averages. Such comparisons show how various countries gain or lose ground vis-à-vis the world as a result of demographic transitions[v].

DATA

Our analyses require national indicators of fertility, age dependency, policy commitment to education, and economic performance. Relevant statistics are fortunately available (World Bank 2009) and the specific measures used were as follows. Fertility is indicated by total fertility rates. Age dependency was measured by the percentage between 0-14 to people in the 15-64 years age group. Real dependency was the number of children in the 0-14 age range divided by the number of employed adults. While a full account of real dependency must integrate the working status of children, we lacked data on economically active children in 1990. The resource commitment to children's education was measured by the share of Gross National Income (GNI) allocated to education. It averaged 4.7 percent for the whole of SSA in 1990 but declined to 3.8 percent by 2005. The national economic performance was indicated by total GNI divided by the adult population, and school enrollments were measured by the gross enrollments at the primary level. Although the World Bank database covers nearly five decades (1960-2008), we largely focused on years between 1990 and 2005 both because this period covers the early stage of African fertility decline and because of data availability. The only problematic variables included gross enrollments and share of education budgets for which data were missing on 11% and 15% of the countries, most of them small in size (see Tables 2 and 3).

FINDINGS

Favorable Contexts

Under what circumstances are dividends likely? Our first study question is partly answered with the conceptual framework in Figure 1. Based on this framework, contextual hindrances include trends in (a) **age structure**, e.g., falling infant mortality and rising adult mortality, (b) **life course patterns of employment**, e.g., rising child labor and adult unemployment, (c) **size of national education budget**, whether as a result of economic downturns or reduced policy commitments, or (d) **policy conversion of resources into outcomes**, itself contingent in part on the structure of spending. This first insight is important and we discuss later how it advances previous thinking. For now, the framework helps identify the main constraints to dividends for individual countries. The results of this analysis are presented in Table 1.

[**Table 1 about here**]

Table 1 is a numerical equivalent of Figure 1. While Figure 1 merely describes the successive steps of the dividend-production process, Table 1 quantifies these transitions. The table shows national data on total fertility rates, age dependency, real dependency, schooling resources per capita, and school enrollments. Most data are given for 1990 and 2005, but those on fertility are given for the 1975-90 period, because of the expected 15-year lag before changes in fertility translate into age dependency. To show how changes in one outcome translate into the next, we computed conversion coefficients (gray columns), measured as the ratio of the percent change in an outcome to the percent change in the preceding outcome. Again, as a general rule, high positive coefficients indicate efficient conversion; low and positive coefficients indicate less efficient conversion; negative coefficients indicate ineffective/counterproductive conversion[vi]. One can thus identify each country's specific constraints, i.e., step(s) where conversion is ineffective. One can likewise tally the constraints most frequently met across study countries.

Aggregate results for all study countries (bottom row) show an average fertility decline of about 10% between 1975 and 1990. This translated, fifteen years later, into a 10% fall in age dependency, a 9% decline in real dependency, a 60% gain in schooling resource per child, and a 41% growth in gross enrollments. In sum and from the standpoint of children resources, changes in these constitutive processes were positive across the board. As a result, none of the conversion steps was counterproductive: declines in TFR were associated with reduced age dependency (C_1=+1.02); reduced age dependency was accompanied by reduced real dependency (C_2=+0.89); reduced real dependency was accompanied by improved resource per child (C_3=6.58), which itself was accompanied by gains in enrollments (C_4=+0.68).

Although the entire conversion process worked effectively for sub-Saharan Africa as a whole, the same is not true for every country. A majority of study countries show at least one counter-productive step, the most common being step 3 (12 cases), followed by steps 1 and 4 (5 cases each) and step 2 (3 cases). Only one country, Somalia, had more than one problematic step. It is noteworthy that step 2 was often not problematic, despite evidence of high rates of unemployment in the region (DHS 2009). Perhaps growth in unemployment during that period was not large enough to offset the trends in real age dependency. Clearly, the fourth step (and its contextual dependency on policy) is not the most common problem, despite the attention it has received in previous studies of dividends. Most countries can convert additional resources into better schooling outcomes, albeit with varying efficiency. The third step is where many countries stumble and where countries differ most. When countries are ranked by magnitude of fertility decline, step 4 is more problematic only for countries in later transition stages. Thus, whether in chronology or frequency, step 4 is not the first to require attention.

Size of Bonus

After listing the limiting factors, we use equation (2) to estimate the change in schooling resource per child (*r*) for various African countries. Table 2 summarizes these results. The nominal changes are found in column 9. The table (bottom row) shows an average gain of

$72.8 per child between 1990 and 2005 for the entire sample[vii] but this average conceals substantial variation across countries. Gains in *r* approach or exceed $150 (i.e., roughly $10 per year) in seven countries, including Botswana ($961), Mauritius ($512), South Africa ($390), Namibia ($318), Swaziland ($240), Cape Verde ($239) and Lesotho ($148). Seventeen countries saw more modest gains (ranging between $4 to $33) while fourteen countries experienced some decline. The greatest losses in *r* occurred in Zimbabwe (-$96) the Congo (-$73), Togo (-$25), Cote d'Ivoire (-22), and Mauritania (-$21). These nominal changes are put in better perspective when expressed in percentage terms. In that light, even though Cape Verde's nominal change, for instance, is smaller than South Africa's, it is more impressive in percent terms (353% versus 86%). One can also put these changes in perspective by a) projecting future changes (since current declines in fertility are still modest), b) comparing Africa's gains to the world's, or c) comparing the bonus (i.e. the change stemming from trends in age structure) to change stemming from other influences. We begin with this last contrast.

Because the total change in *r* reflects the combined effects of age structure, economic performance and public commitment to children's education, it is useful to decompose these various contributions (columns 11 through 13). Results for the study sample show that about two-thirds (71%) of the gain in *r* was associated with improved economic performance, and about a quarter (25%) with changing age structure, and the rest (5%) with increased public commitment to education. In clear, while improved economic performance was the main reason for the aggregate gain in *r*, the change in age structure was an important factor as well. Age structure matters in our study sample but also for the weighted sub-Saharan Africa and world samples, where it accounts for 42% and 32%, respectively, of the change in *r* between 1990 and 2005. Again, large variations exist across countries. In countries experiencing large gains (~ $150 or more), the contributions of age dependency were all positive and substantial, ranging from 17% in Lesotho to 53% in South Africa. Similarly, in 13 of the 14 countries experiencing losses in *r*, age dependency braked the decline even though it was not sufficient to stem it. In sum, the trends in age dependency during this period generally worked to boost children's resources, even if the contribution was at times insufficient to overcome adverse trends in the economy or public commitment to education. In addition to age dependency and economic performance, Table 2 highlights the importance of social commitment to education. Countries that achieved the largest gains in *r* did so through balanced contributions of economic growth, reduced dependency, and improved public commitment to education. South Africa and Namibia are notable exceptions where *r* grew despite a declining public commitment to education. In countries where *r* declined, the culprits were economic downturns (e.g. Zimbabwe) or reduced public commitment (Congo, Togo, and Côte d'Ivoire) or both. The point here is that reductions in age dependency were an important factor in spurring growth or braking the decline in *r*, but economic growth and public commitment to education mattered as well.

[Table 2 about here]

Gains relative to the world

As some African countries raised their schooling resources per capita during the study period, the world average also improved, from $550 to $1,074. This warrants evaluating national gains against the global trend. The results of these analyses are summarized in Table 3. Columns 1 through 8 in this table show, for each country, the relative values of economic performance (g'), budget allocation (k'), age dependency (p'), and the resulting values for schooling resource per child (r') for the years 1990 and 2005, respectively. Values below 1 for these numbers indicate that African values are below the world average, while numbers above 1 suggest the opposite.

Looking at the numbers in columns 1,3, and 5, the clear sources of SSA's lower r values are higher dependency and lower economic performance: our sample countries, in 1990, experienced a level of economic productivity was that 82 percent lower than the world's average, while also saddled by an age dependency ratio that was 63 percent higher. Moreover, most African countries did not outspend the world on education, as a share of their national budgets: in 1990, SSA spent 16% less than the world average[viii]. When considering trends (column 9), SSA was not able to surpass global gains (.00), despite its nominal progress. Decomposition analysis (columns 10 through 12) is irrelevant for the entire sample of countries since the corresponding change is 0. If one takes the weighted values for sub-Saharan Africa as a whole however, the region lost a little ground -0.04 during that period, because of a mix of slower decline in age dependency (25%), slower economic growth (33%) and changes in budget commitment (42%). The information under columns 1 through 6 clarify this further: SSA fell further behind in terms of economic productivity (from 84 to 86% lower than the world's average), in age dependency (64% to 83% higher than the world average), and in educational spending (from 6% more to 13% less than the world average). Table 3 also shows large variations across countries. While most study countries lost ground, some did not, and a few did in fact gain ground relative to the world. Ground-gaining nations included Botswana (.62), Mauritius (.25), Cape Verde (.16), Swaziland (.11), Lesotho (.09), and Ghana (.01). Eight countries experienced no change relative to the world and twenty-four experienced relative declines, ranging from small (<.01

in such countries as Madagascar, Democratic Republic of Congo, Namibia, and Ghana) to large (>.05 in Cameroon, Togo, Mauritania, Cote d'Ivoire, the Congo, and Zimbabwe).

[Table 3 about here]

Future prospects

Because African fertility transitions are still in their early stages, the bonus observed thus far gives only a preliminary indication. As fertility continues to decline, can one expect larger gains in the future? In particular, how large a schooling bonus to expect by 2015, the end year for the MDGs? These questions require projecting future r values. Unfortunately, data projections exist for age dependency but not economic performance or public education budgets. With these data limitations, one can do a partial analysis based on age dependency only. Alternatively, one can simulate the bonus under hypothetical scenarios about future economic growth and public commitment to education.

Partial analysis: UN data on age dependency trends are shown on Figure 2, for sub-Saharan Africa. The data are shown in comparative terms, relative to 1990 figures and to the World average, respectively. They indicate that age dependency in Africa peaked in 1985-1990. From this 1990 peak, dependency is projected to decline steadily to reach 43 by the year 2050. Yet because world values also decline during that time, SSA will keep losing ground for some time. Compared to world values, Africa's age dependency will evolve from being 63% higher in 1990 to 90% higher in 2015. Interestingly, only after 2015 (the end-date of MDGs) will SSA begin to gain ground in relative terms. By 2050, Africa's age dependency will have returned to being only 39% higher than the world average.

[**Figure 2 about here**]

Simulation. To project future r values in the absence of future economic and budget data, we simulated three scenarios. The first, baseline, scenario assumes that individual countries maintain the growth and public spending on education experienced in the last decade, while age dependency evolves as projected by the UN. In addition, we simulate two optimistic scenarios about economic performance and education spending, respectively. "Economically optimistic" projections assume that each country henceforth grows at the average rate achieved by countries in the third quartile[ix] during the last decade (1995-2005). In clear, countries grow at an annual rate of 2.65 percent or the countries' actual growth rate, whichever is higher. "Budgetary optimistic" projections assume that each country's education spending (as a share of GNI) is henceforth as high as the share devoted on average during 1995-2005 by countries in the top quartile. In clear, countries spend 6.8 percent of their GNI or their actual value, whichever is higher. The value of all these simulations is to extend analysis to 2015 (the end period for the MDGs) and to examine outcomes under a few best-case scenarios.

The results of simulations are shown in Table 4. The first four columns show the actual 2005 values for (*p*), (*g*), (*k*), and (*r*). The second set of columns show the expected *r* values if countries maintained current growth rates and policy commitment. The expected gain for the whole region is $135 but some variations can be seen: a few countries (Burundi, Gambia, and Guinea) experience declines in r while others gain more than $500 (Angola, Botswana, Mauritius, and Namibia). Yet, compared to 1990-2005, much fewer countries experience a decline while more countries see sizeable growth. The third set of columns shows the economically optimistic scenario, and regionally we see a slight increase in the projected *r*, from $135 to $152, with no counties experiencing declines in *r*. The last set of columns shows the results of the budget-optimistic scenario. The regional average under this scenario soars to $ 268 per child. Under these assumptions, increased public commitment to educational spending generates the largest boost to *r* values.

[**Table 4 about here**]

Altogether, these simulations suggest that Africa's fertility transitions will induce sizeable gains in the schooling resource per child, if current trends are maintained. While these gains will initially be nominal only, they become relative gains after 2015, when age dependency begins to decline faster than the world average. Gains will be much larger if economic conditions or especially the public commitment to education improve. Gains could be twice as high in a budget-optimistic scenario as in the baseline projection. In clear, the prospect of a demographic dividend does not warrant divestment from education. Rather the dividend is magnified by increased public commitment to schooling.

CONCLUSIONS

This paper adds to a burgeoning literature on dividends from fertility transitions. While previous studies have covered economic outcomes such as savings, productivity, investments, poverty reduction, we extend analysis to schooling dividends and to sub-Saharan Africa, two domains that remain understudied so far. Our paper yields five main insights about schooling dividends. First, it expands the list of contextual influences that should be considered. Beyond sound policy, whether countries reap dividends depends on (1) characteristics of the transition itself, such as whether or not the declines in fertility occur in fits and starts and whether they are accompanied by changes in mortality; (2) changes in life-course patterns of employment; (3) changes in economic performance and public commitment to education. Second, our analyses identify the main bottlenecks in producing schooling dividends in contemporary SSA. Against conventional wisdom, policy is not the only or main limitation. Rather, the most common challenge is the translation of age dependency into improved resources, and it depends on concurrent trends in economic growth and budget allocation. A greater emphasis on this step is warranted. Third, most African countries where fertility fell before the 1990s saw clear gains in schooling resources per child, but these gains did not owe to demographic change alone. Economic performance or public commitment to schooling mattered as well. In clear, the bonus does not obviate the need for these other efforts. Fourth, despite nominal gains in resource per capita, most African countries barely kept ground the world average due to even faster improvements in non-African nations. Until 2015 at least, the gains in resources associated with declining age dependency will be smaller than those achieved by the world on average. Accordingly, most of SSA will lose ground in relative terms. After 2015 however, the gap may begin to narrow. In clear, the dividends may well make nominal contributions to expanding enrollments during the current time frame of MDGs but they could also make further contributions to improving the relative quality of schooling beyond 2015. Fifth, vanguard countries in reaping a schooling bonus appear, somewhat ironically, to be among the education frontrunners. In other words the early benefits of fertility transitions go to countries needing them least. This is not entirely surprising, given the importance of individual and mass education in promoting fertility declines (Bledsoe et al., 1999). What this implies however is a self-reinforcing cycle between rising schooling and declining fertility, and possible widening of schooling inequality within Africa, at least in the early phases of its fertility transitions.

Our conclusions are subject to several caveats. To begin, our empirical analysis of the dividend-production process is partial. It focuses narrowly on a sub-segment of the process that begins with age structure (not fertility) and ends with schooling resources (not schooling outcomes). We could extend our decomposition analysis to show how changes in age structure reflect changes in birth rates, child mortality, and adult mortality, respectively. At the other end, we could also extend analyses to clarify how additional resources contribute to various outcomes such as enrollments, retention, and schooling quality. Specifically, why are some African countries better in converting additional resources into improved outcomes? Our conversion coefficients already establish the *extent* of policy efficiency. What remains is to understand the reasons for this differential efficiency. Future research on this question can build on previous studies (e.g., Binder, 2009) but with a focus on Africa. One must also remember that our study of dividends focuses on schooling, not economic growth. Some conclusions about contextual influences (especially those affecting steps 3 and 4) are thus not directly applicable. Nonetheless, much of the logic used here can apply to other outcomes. Also, insofar as education fosters economic growth, schooling dividends represent one pathway to economic dividends. As a third caveat, our analyses address national public resources and they do not consider additional resources from private and international sources. Again, the dividends only complement these other resources. Transnational flows of resources and workers imply that the processes producing a dividend often spill over national boundaries. International migration for instance affects how fertility transitions reshape the age composition of national populations. Furthermore, the schooling dividends accrued by a nation could fuel economic growth in other countries, as a result of brain drain. Finally, while we argue that characteristics of fertility transitions are important, our analyses lack a thorough treatment of these influences. More thorough analyses must build on recent descriptions of the pace and dimensions of demographic change in SSA (Antoine & Nanitelamio, 1991; Bongaarts, 2006; Cohen, 1998; Kirk & Pillet, 1998).

These various caveats caution against over-generalization, and suggest areas of further research. For now however, our findings show the early evidence and prospects of a schooling dividend in SSA to be promising: A few vanguard countries have now seen sizeable gains in schooling resources per child (in excess of $10 per year), and more countries stand to do so by the year 2015. After 2015, global trends in age dependency favor Africa narrowing its gap in per-capita schooling resources vis-à-vis the rest of the world. It may seem ironic that these major gains would come after the MDGs deadline of 2015. It likewise seems ironic that the first beneficiaries of a bonus are precisely countries that already had higher levels of resources per child. Still, if age dependency continues to decline as projected by the UN, many sub-Saharan countries should enhance their schooling resource per capita in the coming decades and most might turn this resource bonus into a schooling dividend.

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NOTES

[i] The authors are at Cornell University (Department of Development Sociology). Please direct correspondence to pme7@cornell.edu. We acknowledge suggestions and insights from conference participants at Yaoundé University (June 2009), Korea University (July 2009), Brown University (November 2009), and Cornell University (January 2010). Research was supported in part by resources and grants from the Hewlett Foundation, the Spencer Foundation, and the Polson Institute for Global Development.

[ii] Our focus here on resources, not enrollments, facilitates international comparisons because resources may be a better indicator of the quality of education experience than mere enrollment would (World Bank, 2005).

[iii] The most basic approach to studying dividends is to rely on cross-country regressions of socioeconomic advances on age dependency. However, macro-level regressions have a slew of statistical limitations, including outliers, measurement error, omitted variables, data comparability, endogeneity, auto-correlation, regression to the mean. As a result, studies have focused on the micro-levels effects of sibsize on schooling (Cassen, 1994).

[iv] Enrollment data are often more readily available in gross rather than the preferred net form. Also, net enrollments have an upper bound of 100%, meaning that progress is hard to measure in countries nearing universal enrollment. Finally, enrollments say little about school quality, a growing concern at a time when the pursuit of MDGs via free public schooling can overwhelm school systems, leading some countries to achieve nominal gains in enrollment at the expense of quality (UNESCO, 2005). Focusing on schooling resources (rather than enrollments) thus improves international and historical comparison, if one is interested in quality of schooling.

[v]

More broadly, one can assess how global fertility transitions affect world inequality in schooling resources per child. For instance, if one takes the Mean Log Deviation (MLD) as a measure of inequality

$$I_R = \sum_j w_j \ln(1/r_j) \qquad [3]$$

where I=global inequality; w_j represent the populations of individual countries as shares of the world population.

In that case, the change in global inequality can be decomposed as in (4) below, a breakdown that isolates, among others, how age dependency in various world regions affect global inequality in children's schooling resources.

$$\Delta I_R \cong [\sum_j (\bar{r}_j - \overline{\ln r_j})\Delta w_j] - [\sum_j (\overline{w_j r_j} - \bar{w}_j)\Delta \ln(p_j)] + [\sum_j (\overline{w_j r_j} - \bar{w}_j)\Delta \ln(g_j)] + [\sum_j (\overline{w_j r_j} - \bar{w}_j)\Delta \ln(k_j)]$$

Pop size effect — Age dependency — Income effect — Allocation effect

[vi] This is not a hard and fast rule, however. A negative sign is problematic only when a positive change in an outcome is followed by negative change in the following outcomes. If the reverse is true (negative change followed by positive change), then there is less worry. Furthermore, the last step poses special problems when declines in gross enrollments (i.e., a priori a negative trend) can in fact be a positive development. For instance, countries with gross primary enrollment that exceed 100% can see their numbers decline as a result of declining repetition rates.

[vii] This value reflects the unweighted average for countries in the study sample. Note the difference with results for the weighted SSA average, which was a $13.8. That this increase was much smaller suggests some combination of sample selection and larger gains in r among small countries.

[viii] It is important to note here that, as an aggregate, the region had a public commitment to education 6% higher than the world average in 1990. This is likely due to the fact that large countries were able to allocate greater portions of their budgets during this period.

[ix] We chose the third rather than the top quartile since some countries in the top quartile had exceptionally high GNI growth during this period, e.g. Angola (21%) or Nigeria (12%).

Table 1. Prospects for a schooling dividend, various African countries

				Conversion 1				Conversion 2				Conversion 3				Conversion 4				
COUNTRY	Total Fertility rate			C1	Age dependency ratio			C2	Real dependency ratio			C3	$ Resources per child			C4	Primary school enrollment			Problematic Conversions
	1975* [1]	1990 [2]	% decline [3]	(6)/(3)	1990 [4]	2005 [5]	% decline [6]	(9)/(6)	1990 [7]	2005 [8]	% decline [9]	(12)/(9)	1990 [10]	2005 [11]	% increase [12]	(15)/(12)	1990 [13]	2005 [14]	%increase [15]	(bottlenecks)
South Africa	5.2	3.5	33%	0.82	67.2	49.3	27%	0.99	118.2	87.1	26%	3.28	453.1	843.3	86%	-0.04 ¶	106.7	103.2	-3%	**C4**
Zimbabwe	7.3	5.1	30%	0.59	90.3	74.2	18%	0.79	115.4	99.1	14%	-4.90 ¶	139.8	43.2	-69%	-0.01	100.7	101.2	0%	**C3**
Botswana	6.4	4.6	28%	1.18	85.9	57.3	33%	0.84	135.9	98.1	28%	11.25	307.4	1268.2	313%	0.01	104.2	106.7	2%	
Mauritius	3.1	2.3	26%	0.69	43.7	35.9	18%	0.96	67.1	55.7	17%	11.79	255.0	767.5	201%	-0.03 ¶	109.2	102.1	-7%	**C4**
Kenya	7.8	5.8	26%	0.88	101.2	78.5	22%	0.91	116.5	92.6	21%	3.54	45.0	77.7	73%	0.11	100.5	108.2	8%	
Cape Verde	6.9	5.2	25%	1.15	97.8	70.1	28%	0.91	146.9	108.8	26%	13.60	67.9	307.4	353%	-0.01 ¶	111.9	108.0	-4%	**C4**
Cote d'Ivoire	7.9	6.2	22%	0.55	85.1	75.0	12%	0.61	120.9	112.1	7%	-2.70 ¶	114.3	91.9	-20%	-0.33	66.2	70.6	7%	**C3**
Rwanda	8.2	6.7	18%	1.32	102.1	77.5	24%	0.73	111.6	92.0	18%	-1.44 ¶	25.9	19.3	-25%	-3.33	69.6	128.3	84%	**C3**
Ghana	6.8	5.6	18%	0.93	83.4	69.8	16%	0.96	107.3	90.4	16%	8.29	24.9	57.4	131%	0.17	70.9	86.8	22%	
Swaziland	6.8	5.6	18%	1.24	97.8	76.3	22%	0.70	129.4	109.4	15%	12.26	126.2	365.8	190%	0.07	93.9	105.9	13%	
Sao Tome and Principe	6.5	5.4	17%	1.13	95.2	76.9	19%	0.85	152.8	127.8	16%	---			---	---	136.3	128.1	-6%	
Congo, Rep.	6.3	5.3	16%	0.69	84.1	75.0	11%	0.90	112.4	101.5	10%	-5.16 ¶	145.5	72.2	-50%	0.27	123.0	106.6	-13%	**C3**
Lesotho	5.7	4.9	14%	1.27	88.6	72.9	18%	0.77	108.3	93.4	14%	19.63	55.0	203.3	270%	0.02	108.6	114.1	5%	
Togo	7.2	6.2	14%	1.25	90.2	74.6	17%	0.89	120.4	101.8	15%	-3.48 ¶	46.2	21.3	-54%	-0.22	89.0	99.4	12%	**C3**
Namibia	6.6	5.7	14%	1.32	82.6	67.7	18%	0.78	137.7	118.4	14%	6.65	342.6	661.2	93%	-0.14 ¶	121.2	105.4	-13%	**C4**
Zambia	7.4	6.4	14%	-0.14 ¶	88.6	90.3	-2%	0.85	120.3	122.2	-2%	-13.89	21.8	26.6	22%	0.99	94.0	114.6	22%	**C1**
Comoros	7	6.1	13%	2.18	91.1	65.6	28%	0.91	114.6	85.4	25%	1.71	48.7	69.9	44%	0.43	72.0	85.4	19%	
Madagascar	7.1	6.2	13%	0.15	85.7	84.1	2%	3.27	98.1	91.8	6%	7.27	11.9	17.4	47%	1.10	91.9	139.1	51%	
Mauritania	6.5	5.8	11%	1.42	84.5	71.6	15%	0.93	113.6	97.5	14%	-2.63 ¶	56.3	35.3	-37%	-2.72	49.2	99.1	101%	**C3**
Senegal	7.5	6.7	11%	0.89	92.3	83.6	9%	0.71	116.3	108.4	7%	---			---	---	55.2	79.7	44%	
Guinea-Bissau	6.6	5.9	11%	-0.49 ¶	74.7	78.6	-5%	0.85	98.9	103.3	-4%	---		10.6	---	---	..	..	---	**C1**
Sudan	6.6	5.9	11%	1.16	83.1	72.9	12%	1.14	155.9	134.1	14%	-2.08 ¶	19.7	14.0	-29%	-0.55	48.9	56.7	16%	**C3**
Malawi	7.5	6.9	8%	-0.12 ¶	92.4	93.2	-1%	0.10	112.7	112.8	0%	-525.33	10.6	16.0	50%	1.71	64.7	120.0	85%	**C1**
Cameroon	6.4	5.9	8%	1.81	88.7	76.1	14%	0.86	126.0	110.7	12%	0.56	58.7	62.7	7%	1.84	96.0	108.0	13%	
Tanzania	6.7	6.2	7%	0.66	89.5	85.1	5%	0.59	93.6	90.9	3%	44.97	8.3	19.3	131%	0.42	69.4	107.4	55%	
Burkina Faso	7.8	7.3	6%	1.10	94.6	87.9	7%	0.92	108.6	101.5	7%	12.59	20.0	36.4	82%	0.91	32.2	56.2	75%	
Somalia	7.2	6.8	6%	-0.08 ¶	84.5	84.9	0%	-0.23 ¶	114.0	113.9	0%	---			---	---	..	..	---	**C1,C2**
Sierra Leone	5.8	5.5	5%	0.01	77.2	77.2	0%	-11.32 ¶	112.0	112.7	-1%	-258.08	8.0	20.8	161%	---	57.6	..	---	**C2**
Eritrea	6.5	6.2	5%	3.74	90.7	75.1	17%	0.93	122.1	102.6	16%	---		23.8	---	---	20.8	66.3	219%	
Mozambique	6.5	6.2	5%	2.14	92.7	83.6	10%	0.73	102.2	94.8	7%	13.60	14.1	27.8	98%	0.64	62.9	102.0	62%	
Central African Republi	5.8	5.6	3%	1.89	81.4	76.1	7%	0.74	97.0	92.4	5%	-10.24 ¶	24.2	12.2	-49%	0.23	68.4	60.7	-11%	**C3**
Gambia, The	6.3	6.1	3%	0.07	79.0	78.8	0%	-3.62 ¶	96.6	97.4	-1%	56.78	24.2	13.0	-46%	-0.70	57.5	76.1	32%	**C2**
Burundi	6.8	6.6	3%	5.25	87.9	74.3	15%	0.92	91.6	78.6	14%	-0.73 ¶	14.4	13.0	-10%	-1.68	69.8	81.9	17%	**C3**
Guinea	6.9	6.7	3%	1.76	85.4	81.1	5%	0.79	94.8	90.9	4%	-0.77 ¶	16.6	16.1	-3%	-49.02	34.1	86.2	153%	**C3**
Nigeria	6.9	6.7	3%	3.56	89.2	80.0	10%	0.79	150.9	138.7	8%	21.44	5.0	13.8	174%	0.07	84.7	95.5	13%	
Mali	7.6	7.4	3%	0.99	86.2	84.0	3%	0.31	162.0	160.7	1%	138.77	16.3	34.7	113%	1.40	29.9	77.2	158%	
Niger	8.1	7.9	2%	0.36	100.7	99.8	1%	1.13	152.5	151.0	1%	-39.92 ¶	20.4	12.2	-41%	-2.11	26.8	49.7	85%	**C3**
Liberia	6.6	6.5	2%	4.30	87.0	81.4	7%	1.00	118.2	110.5	6%	---			---	---	..	..	---	
Benin	6.8	6.7	1%	5.41	89.4	82.3	8%	1.36	120.8	107.6	11%	5.97	27.3	45.0	65%	1.54	47.9	95.7	100%	
Angola	7.2	7.1	1%	3.94	95.3	90.1	5%	0.85	110.7	105.5	5%	9.27	71.6	102.5	43%	---	86.2	..	---	
Chad	6.7	6.7	0%		90.7	90.1	1%	7.68	121.3	114.7	5%	11.31	7.5	12.1	62%	0.87	49.3	75.6	53%	
Uganda	7.1	7.1	0%	¶	97.7	102.7	-5%	0.98	108.0	113.3	-5%	-9.53	17.2	25.4	48%	1.58	67.3	117.9	75%	**C1**
Gabon	5	5.1	-2%	-6.52	77.9	67.8	13%	0.65	96.7	88.5	9%	2.63	365.0	446.6	22%	-0.07 ¶	154.8	152.2	-2%	**C4**
Ethiopia	6.8	7	-3%	-0.21	86.5	86.0	1%	18.72	108.2	95.8	12%	-3.81 ¶	15.4	8.6	-44%	-3.04	33.4	78.0	134%	**C3**
Congo, Dem. Rep.	6.5	6.7	-3%	0.63	94.1	95.9	-2%	1.68	123.0	127.0	-3%	15.08	4.5	2.3	-49%	---	54.4	..	---	
Equatorial Guinea	5.7	5.9	-4%	3.75	68.4	77.4	-13%	0.91	96.6	108.2	-12%	---		186.1	---	---	172.9	122.0	-29%	
AVERAGE	6.7	6.0	10%	1.02	87.0	78.0	10%	0.89	116.5	105.5	9%	6.58	78.4	145.8	60%	0.68	78.2	96.9	41%	

Notes: * because of the expected time lag, the fertility decline considered is the one that occurred 15 years earlier

Table 2. Trends in Resources per Child in sub-Saharan Africa¶, 1990-2005.

COUNTRY/REGION	g		k		p*		r		Δ r	%Δ r	Age Dependency	Income	Social Commitment
	1990	*2005*	*1990*	*2005*	*1990*	*2005*	*1990*	*2005*	*1990-2005*	*1990-2005*			
	[1]	*[2]*	*[3]*	*[4]*	*[5]*	*[6]*	*[7]*	*[8]*	*[9]*	*[10]*	*[11]*	*[12]*	*[13]*
High resource gains													
Botswana	5148	8580	0.05	0.08	0.86	0.57	$ 307.4	$ 1,268.2	$ 960.8	313%	**34%**	**33%**	**33%**
Mauritius	3372	7348	0.03	0.04	0.44	0.36	$ 255.0	$ 767.5	$ 512.5	201%	**20%**	**68%**	**12%**
South Africa	5294	7892	0.06	0.05	0.67	0.49	$ 453.1	$ 843.3	$ 390.2	86%	**53%**	**62%**	**-14%**
Namibia	3183	6152	0.09	0.07	0.83	0.68	$ 342.7	$ 661.2	$ 318.5	93%	**32%**	**100%**	**-33%**
Swaziland	2760	4376	0.04	0.06	0.98	0.76	$ 126.2	$ 365.8	$ 239.6	190%	**26%**	**42%**	**32%**
Cape Verde	1988	3630	0.03	0.06	0.98	0.70	$ 67.9	$ 307.4	$ 239.5	353%	**27%**	**37%**	**36%**
Lesotho	1154	1539	0.04	0.10	0.89	0.73	$ 55.0	$ 203.3	$ 148.4	270%	**17%**	**23%**	**60%**
Medium resource gains													
Kenya	725	967	0.06	0.06	1.01	0.78	$ 45.0	$ 77.7	$ 32.7	73%	**48%**	**51%**	**1%**
Ghana	729	845	0.03	0.05	0.83	0.70	$ 24.9	$ 57.4	$ 32.5	131%	**23%**	**18%**	**59%**
Angola	1545	3120	0.04	0.03	0.95	0.90	$ 71.6	$ 102.5	$ 30.9	43%	**16%**	**206%**	**-123%**
Comoros	1128	1094	0.04	0.04	0.91	0.66	$ 48.7	$ 69.9	$ 21.2	44%	**91%**	**-8%**	**17%**
Mali	601	828	0.02	0.04	0.86	0.84	$ 16.3	$ 34.7	$ 18.4	113%	**4%**	**42%**	**54%**
Benin	740	1019	0.03	0.04	0.89	0.82	$ 27.3	$ 45.0	$ 17.7	65%	**17%**	**64%**	**19%**
Burkina Faso	697	745	0.03	0.04	0.95	0.88	$ 20.0	$ 36.4	$ 16.4	82%	**13%**	**11%**	**76%**
Mozambique	341	563	0.04	0.04	0.93	0.84	$ 14.1	$ 27.8	$ 13.8	98%	**16%**	**72%**	**12%**
Sierra Leone	259	412	0.02	0.04	0.77	0.77	$ 8.0	$ 20.8	$ 12.9	161%	**0%**	**49%**	**51%**
Tanzania	312	685	0.02	0.02	0.89	0.85	$ 8.3	$ 19.3	$ 10.9	131%	**6%**	**94%**	**0%**
Nigeria	528	1299	0.01	0.01	0.89	0.80	$ 5.0	$ 13.8	$ 8.8	174%	**12%**	**88%**	**0%**
Uganda	484	652	0.03	0.04	0.98	1.03	$ 17.2	$ 25.4	$ 8.2	48%	**-13%**	**76%**	**37%**
Madagascar	503	535	0.02	0.03	0.86	0.84	$ 11.9	$ 17.4	$ 5.5	47%	**5%**	**16%**	**79%**
Malawi	385	424	0.03	0.04	0.92	0.93	$ 10.6	$ 16.0	$ 5.3	50%	**-2%**	**24%**	**78%**
Zambia	738	1129	0.03	0.02	0.89	0.90	$ 21.8	$ 26.6	$ 4.8	22%	**-9%**	**214%**	**-105%**
Chad	556	936	0.01	0.01	0.91	0.90	$ 7.5	$ 12.1	$ 4.6	62%	**2%**	**109%**	**-10%**
Cameroon	1706	1655	0.03	0.03	0.89	0.76	$ 58.7	$ 62.7	$ 4.0	7%	**229%**	**-46%**	**-83%**
Negative resource gains													
Guinea	785	651	0.02	0.02	0.85	0.81	$ 16.6	$ 16.1	$ (0.5)	-3%	**-163%**	**585%**	**-322%**
Burundi	381	189	0.03	0.05	0.88	0.74	$ 14.4	$ 13.0	$ (1.5)	-10%	**-123%**	**549%**	**-326%**
Congo, Dem. Rep.	451	234	0.01	0.01	0.94	0.96	$ 4.5	$ 2.3	$ (2.2)	-49%	**3%**	**97%**	**0%**
Sudan	795	1175	0.02	0.01	0.83	0.73	$ 19.7	$ 14.0	$ (5.7)	-29%	**-35%**	**-113%**	**248%**
Rwanda	747	477	0.04	0.03	1.02	0.77	$ 25.9	$ 19.3	$ (6.6)	-25%	**-93%**	**153%**	**40%**
Ethiopia	478	315	0.03	0.02	0.87	0.86	$ 15.4	$ 8.6	$ (6.8)	-44%	**-1%**	**71%**	**30%**
Niger	634	522	0.03	0.02	1.01	1.00	$ 20.4	$ 12.2	$ (8.3)	-41%	**-2%**	**38%**	**64%**
Gambia, The	599	504	0.03	0.02	0.79	0.79	$ 24.2	$ 13.0	$ (11.1)	-46%	**0%**	**28%**	**72%**
Central African Republic	920	589	0.02	0.02	0.81	0.76	$ 24.2	$ 12.2	$ (11.9)	-49%	**-10%**	**65%**	**45%**
Mauritania	1049	1131	0.05	0.02	0.84	0.72	$ 56.3	$ 35.3	$ (21.0)	-37%	**-35%**	**-16%**	**151%**
Cote d'Ivoire	1389	1475	0.07	0.05	0.85	0.75	$ 114.3	$ 91.9	$ (22.4)	-20%	**-57%**	**-27%**	**184%**
Togo	799	625	0.05	0.03	0.90	0.75	$ 46.2	$ 21.3	$ (25.0)	-54%	**-25%**	**32%**	**93%**
Congo, Rep.	1818	2401	0.07	0.02	0.84	0.75	$ 145.5	$ 72.2	$ (73.3)	-50%	**-16%**	**-42%**	**159%**
Zimbabwe	1593	467	0.08	0.07	0.90	0.74	$ 139.8	$ 43.2	$ (96.5)	-69%	**-18%**	**105%**	**13%**
Sub-Saharan Africa (Weighted[1])	1072	1491	0.05	0.04	0.88	0.80	$ 56.6	$ 70.5	$ 13.8	24%	**42%**	**153%**	**-95%**
Sub-Saharan Africa (Sample[2])	1245	1768	0.04	0.04	0.88	0.78	$ 70.83	$ 143.60	$ 72.77	103%	**25%**	**71%**	**5%**
World	6734	10874	0.04	0.04	0.54	0.44	$ 549.9	$ 1,073.9	$ 524.0	95%	**32%**	**70%**	**-2%**

*¶Due to data limitations, excluded countires include Equatorial Guinea, Eritrea, Gabon, Guinea-Bissau, Liberia, Mayotte, Sao Tome and Principe, Senegal, Seychelles, and Somalia; *Values represent the number of children per 100 working adults. [1] These values are the reported aggregate values for sub-Saharan Africa from DHS and are weighted by population size. [2] These are the average values for the countires in our sample.*

Table 3. Trends in Relative Resources per Child in sub-Saharan Africa¶, 1990-2005.

COUNTRY/REGION	g' 1990 [1]	g' 2005 [2]	k' 1990 [3]	k' 2005 [4]	p' 1990 [5]	p' 2005 [6]	r' 1990 [7]	r' 2005 [8]	Δ r' 1990-2005 [9]	Age Dependency [10]	Income [11]	Social Commitment [12]
Relative gain												
Botswana	0.76	0.79	1.17	1.95	1.60	1.30	0.56	1.18	0.62	**29%**	**4%**	**67%**
Mauritius	0.50	0.68	0.75	0.86	0.81	0.82	0.46	0.71	0.25	**-1%**	**69%**	**32%**
Cape Verde	0.30	0.33	0.76	1.37	1.82	1.59	0.12	0.29	0.16	**17%**	**15%**	**68%**
Swaziland	0.41	0.40	1.02	1.47	1.82	1.73	0.23	0.34	0.11	**12%**	**-5%**	**92%**
Lesotho	0.17	0.14	0.96	2.21	1.65	1.66	0.10	0.19	0.09	**-1%**	**-32%**	**133%**
Ghana	0.11	0.08	0.65	1.09	1.55	1.58	0.05	0.05	0.01	**-13%**	**-204%**	**317%**
No relative change												
Sierra Leone	0.04	0.04	0.54	0.90	1.44	1.75	0.01	0.02	0.00	**-67%**	**-5%**	**172%**
Nigeria	0.08	0.12	0.19	0.20	1.66	1.82	0.01	0.01	0.00	**-27%**	**124%**	**3%**
Tanzania	0.05	0.06	0.54	0.55	1.66	1.93	0.02	0.02	0.00	**-88%**	**182%**	**6%**
Mali	0.09	0.08	0.53	0.81	1.60	1.91	0.03	0.03	0.00	**-183%**	**-169%**	**452%**
Mozambique	0.05	0.05	0.87	0.95	1.72	1.90	0.03	0.03	0.00	**-725%**	**162%**	**664%**
Chad	0.08	0.09	0.28	0.27	1.69	2.05	0.01	0.01	0.00	**102%**	**-22%**	**19%**
Burkina Faso	0.10	0.07	0.62	0.99	1.76	2.00	0.04	0.03	0.00	**222%**	**731%**	**-852%**
Malawi	0.06	0.04	0.58	0.81	1.72	2.12	0.02	0.01	0.00	**84%**	**150%**	**-133%**
Relative decline												
Madagascar	0.07	0.05	0.46	0.63	1.59	1.91	0.02	0.02	-0.01	**66%**	**151%**	**-117%**
Congo, Dem. Rep.	0.07	0.02	0.22	0.22	1.75	2.18	0.01	0.00	-0.01	**20%**	**81%**	**-1%**
Namibia	0.47	0.57	2.02	1.67	1.54	1.54	0.62	0.62	-0.01	**15%**	**-1505%**	**1590%**
Uganda	0.07	0.06	0.79	0.92	1.82	2.33	0.03	0.02	-0.01	**91%**	**64%**	**-54%**
Benin	0.11	0.09	0.75	0.84	1.66	1.87	0.05	0.04	-0.01	**70%**	**94%**	**-63%**
Kenya	0.11	0.09	1.43	1.45	1.88	1.78	0.08	0.07	-0.01	**-44%**	**156%**	**-12%**
Burundi	0.06	0.02	0.76	1.17	1.63	1.69	0.03	0.01	-0.01	**4%**	**162%**	**-66%**
Zambia	0.11	0.10	0.60	0.49	1.65	2.05	0.04	0.02	-0.01	**48%**	**11%**	**41%**
Guinea	0.12	0.06	0.41	0.46	1.59	1.84	0.03	0.01	-0.02	**23%**	**95%**	**-17%**
Ethiopia	0.07	0.03	0.63	0.54	1.61	1.95	0.03	0.01	-0.02	**18%**	**69%**	**13%**
Sudan	0.12	0.11	0.47	0.20	1.54	1.66	0.04	0.01	-0.02	**8%**	**9%**	**83%**
Comoros	0.17	0.10	0.89	0.96	1.69	1.49	0.09	0.07	-0.02	**-41%**	**165%**	**-24%**
Niger	0.09	0.05	0.74	0.53	1.87	2.27	0.04	0.01	-0.03	**18%**	**54%**	**27%**
Rwanda	0.11	0.04	0.81	0.72	1.90	1.76	0.05	0.02	-0.03	**-8%**	**96%**	**12%**
Gambia, The	0.09	0.05	0.73	0.47	1.47	1.79	0.04	0.01	-0.03	**18%**	**49%**	**34%**
Central African Republic	0.14	0.05	0.49	0.36	1.51	1.73	0.04	0.01	-0.03	**12%**	**66%**	**23%**
Angola	0.23	0.29	1.01	0.68	1.77	2.05	0.13	0.10	-0.03	**48%**	**-75%**	**127%**
South Africa	0.79	0.73	1.31	1.21	1.25	1.12	0.82	0.79	-0.04	**-229%**	**166%**	**162%**
Cameroon	0.25	0.15	0.70	0.66	1.65	1.73	0.11	0.06	-0.05	**8%**	**84%**	**8%**
Togo	0.12	0.06	1.19	0.58	1.68	1.69	0.08	0.02	-0.06	**1%**	**50%**	**49%**
Mauritania	0.16	0.10	1.03	0.51	1.57	1.63	0.10	0.03	-0.07	**3%**	**36%**	**61%**
Cote d'Ivoire	0.21	0.14	1.59	1.07	1.58	1.70	0.21	0.09	-0.12	**9%**	**47%**	**44%**
Congo, Rep.	0.27	0.22	1.53	0.52	1.56	1.70	0.26	0.07	-0.20	**7%**	**16%**	**77%**
Zimbabwe	0.24	0.04	1.80	1.58	1.68	1.69	0.25	0.04	-0.21	**0%**	**91%**	**9%**
Sub-Saharan Africa (Weighted[1])	0.16	0.14	1.06	0.87	1.64	1.83	0.10	0.07	-0.04	**25%**	**33%**	**42%**
Sub-Saharan Africa (Sample[2])	0.18	0.16	0.84	0.87	1.63	1.77	0.13	0.13	0.00	**NA**	**NA**	**NA**
World	6734	10874	0.04	0.04	0.54	0.44	$ 550	$ 1,074	$ 524			

*¶Due to data limitations, excluded countires include Equatorial Guinea, Eritrea, Gabon, Guinea-Bissau, Liberia, Mayotte, Sao Tome and Principe, Senegal, Seychelles, and Somalia; *Values represent the number of children per 100 working adults. 1 These values are the reported aggregate values for sub-Saharan Africa from DHS and are weighted by population size. 2 These are the average values for the countires in our sample.*

Table 4. Projections for Resources per Child in sub-Saharan Africa: 2005 -2015.

					Baseline scenario					Optimistic scenario 1					Optimistic scenario 2				
										Economically Optimistic					**Budgetary Optimistic**				
	2005				2015				2005-2015	2015				2005-2015	2015				2005-2015
COUNTRY	*p*	*g*	*k*	*r*	*p*	*g*	*k*	*r*	**Δ r**	*p*	*g*	*k*	*r*	**Δ r**	*p*	*g*	*k*	*r*	**Δ r**
Botswana	57	8580	0.08	$ 1,276	50	14689	0.08	$ 2,489	$ 1,214	50	14689	0.08	$ 2,489	$ 1,214	50	14689	0.08	$ 2,489	$ 1,214
South Africa	49	7892	0.05	$ 848	46	11521	0.05	$ 1,319	$ 471	46	12637	0.05	$ 1,447	$ 598	46	11521	0.07	$ 1,703	$ 855
Mauritius	36	7348	0.04	$ 766	29	10914	0.04	$ 1,413	$ 647	29	11765	0.04	$ 1,523	$ 757	29	10914	0.07	$ 2,559	$ 1,793
Namibia	68	6152	0.07	$ 658	56	10595	0.07	$ 1,377	$ 719	56	10595	0.07	$ 1,377	$ 719	56	10595	0.07	$ 1,377	$ 719
Swaziland	76	4376	0.06	$ 367	62	6120	0.06	$ 629	$ 262	62	7006	0.06	$ 721	$ 353	62	6120	0.07	$ 671	$ 304
Cape Verde	70	3630	0.06	$ 311	51	5577	0.06	$ 656	$ 345	51	5813	0.06	$ 684	$ 373	51	5577	0.07	$ 744	$ 433
Lesotho	73	1539	0.10	$ 203	63	1967	0.10	$ 300	$ 98	63	2465	0.10	$ 376	$ 174	63	1967	0.10	$ 300	$ 98
Angola	90	3120	0.03	$ 103	81	21232	0.03	$ 776	$ 673	81	21232	0.03	$ 776	$ 673	81	21232	0.07	$ 1,782	$ 1,680
Côte d'Ivoire	75	1475	0.05	$ 92	69	1857	0.05	$ 126	$ 34	69	2363	0.05	$ 160	$ 68	69	1857	0.07	$ 183	$ 91
Kenya	78	967	0.06	$ 78	77	1576	0.06	$ 129	$ 51	77	1576	0.06	$ 129	$ 51	77	1576	0.07	$ 139	$ 61
Congo	75	2401	0.02	$ 72	66	7743	0.02	$ 264	$ 192	66	7743	0.02	$ 264	$ 192	66	7743	0.07	$ 798	$ 726
Comoros	66	1094	0.04	$ 69	63	1409	0.04	$ 94	$ 24	63	1752	0.04	$ 116	$ 47	63	1409	0.07	$ 152	$ 83
Cameroon	76	1655	0.03	$ 65	71	2536	0.03	$ 107	$ 42	71	2650	0.03	$ 112	$ 47	71	2536	0.07	$ 243	$ 178
Ghana	70	845	0.05	$ 57	62	1214	0.05	$ 93	$ 36	62	1354	0.05	$ 103	$ 46	62	1214	0.07	$ 133	$ 76
Benin	82	1019	0.04	$ 45	77	1621	0.04	$ 77	$ 31	77	1631	0.04	$ 77	$ 32	77	1621	0.07	$ 143	$ 98
Zimbabwe	74	467	0.07	$ 43	62	613	0.07	$ 68	$ 25	62	748	0.07	$ 83	$ 40	62	613	0.07	$ 68	$ 25
Burkina Faso	88	745	0.04	$ 36	89	1286	0.04	$ 62	$ 26	89	1286	0.04	$ 62	$ 26	89	1286	0.07	$ 98	$ 62
Mauritania	72	1131	0.02	$ 35	64	1182	0.02	$ 41	$ 6	64	1811	0.02	$ 63	$ 28	64	1182	0.07	$ 126	$ 90
Mali	84	828	0.04	$ 35	80	1356	0.04	$ 60	$ 25	80	1356	0.04	$ 60	$ 25	80	1356	0.07	$ 115	$ 81
Mozambique	84	563	0.04	$ 28	79	1383	0.04	$ 72	$ 45	79	1383	0.04	$ 72	$ 45	79	1383	0.07	$ 119	$ 91
Zambia	90	1129	0.02	$ 27	88	2055	0.02	$ 50	$ 23	88	2055	0.02	$ 50	$ 23	88	2055	0.07	$ 159	$ 132
Uganda	103	652	0.04	$ 25	96	777	0.04	$ 32	$ 7	96	1044	0.04	$ 44	$ 18	96	777	0.07	$ 55	$ 30
Togo	75	625	0.03	$ 21	65	751	0.03	$ 29	$ 8	65	1001	0.03	$ 39	$ 18	65	751	0.07	$ 79	$ 57
Sierra Leone	77	412	0.04	$ 21	78	498	0.04	$ 25	$ 4	78	660	0.04	$ 33	$ 12	78	498	0.07	$ 43	$ 23
Rwanda	77	477	0.03	$ 19	77	491	0.03	$ 20	$ 1	77	763	0.03	$ 31	$ 12	77	491	0.07	$ 43	$ 24
Tanzania	85	685	0.02	$ 19	86	1463	0.02	$ 41	$ 21	86	1463	0.02	$ 41	$ 21	86	1463	0.07	$ 116	$ 96
Madagascar	84	535	0.03	$ 17	71	723	0.03	$ 28	$ 10	71	856	0.03	$ 33	$ 16	71	723	0.07	$ 69	$ 52
Guinea	81	651	0.02	$ 16	76	477	0.02	$ 13	$ (4)	76	1042	0.02	$ 27	$ 11	76	477	0.07	$ 43	$ 27
Central African Republic	76	589	0.02	$ 16	67	597	0.02	$ 18	$ 2	67	943	0.02	$ 28	$ 12	67	597	0.07	$ 61	$ 45
Malawi	93	424	0.04	$ 16	84	958	0.04	$ 40	$ 24	84	958	0.04	$ 40	$ 24	84	958	0.07	$ 78	$ 62
Sudan	73	1175	0.01	$ 14	61	2081	0.01	$ 30	$ 16	61	2081	0.01	$ 30	$ 16	61	2081	0.07	$ 232	$ 218
Nigeria	80	1299	0.01	$ 14	74	3958	0.01	$ 45	$ 32	74	3958	0.01	$ 45	$ 32	74	3958	0.07	$ 364	$ 350
Burundi	74	189	0.05	$ 13	62	119	0.05	$ 10	$ (3)	62	302	0.05	$ 25	$ 12	62	119	0.07	$ 13	$ 0
Gambia	79	504	0.02	$ 13	72	406	0.02	$ 11	$ (2)	72	806	0.02	$ 23	$ 10	72	406	0.07	$ 38	$ 25
Chad	90	936	0.01	$ 12	85	2580	0.01	$ 35	$ 23	85	2580	0.01	$ 35	$ 23	85	2580	0.07	$ 206	$ 194
Niger	100	522	0.02	$ 12	106	715	0.02	$ 16	$ 4	106	836	0.02	$ 18	$ 6	106	715	0.07	$ 46	$ 34
Ethiopia	86	315	0.02	$ 9	75	401	0.02	$ 13	$ 4	75	505	0.02	$ 16	$ 7	75	401	0.07	$ 36	$ 28
Democratic Republic of the Con	96	234	0.01	$ 2	85	272	0.01	$ 3	$ 1	85	374	0.01	$ 4	$ 2	85	272	0.07	$ 22	$ 19
Average Regional Gain									**$ 135**					**$ 152**					**$ 268**

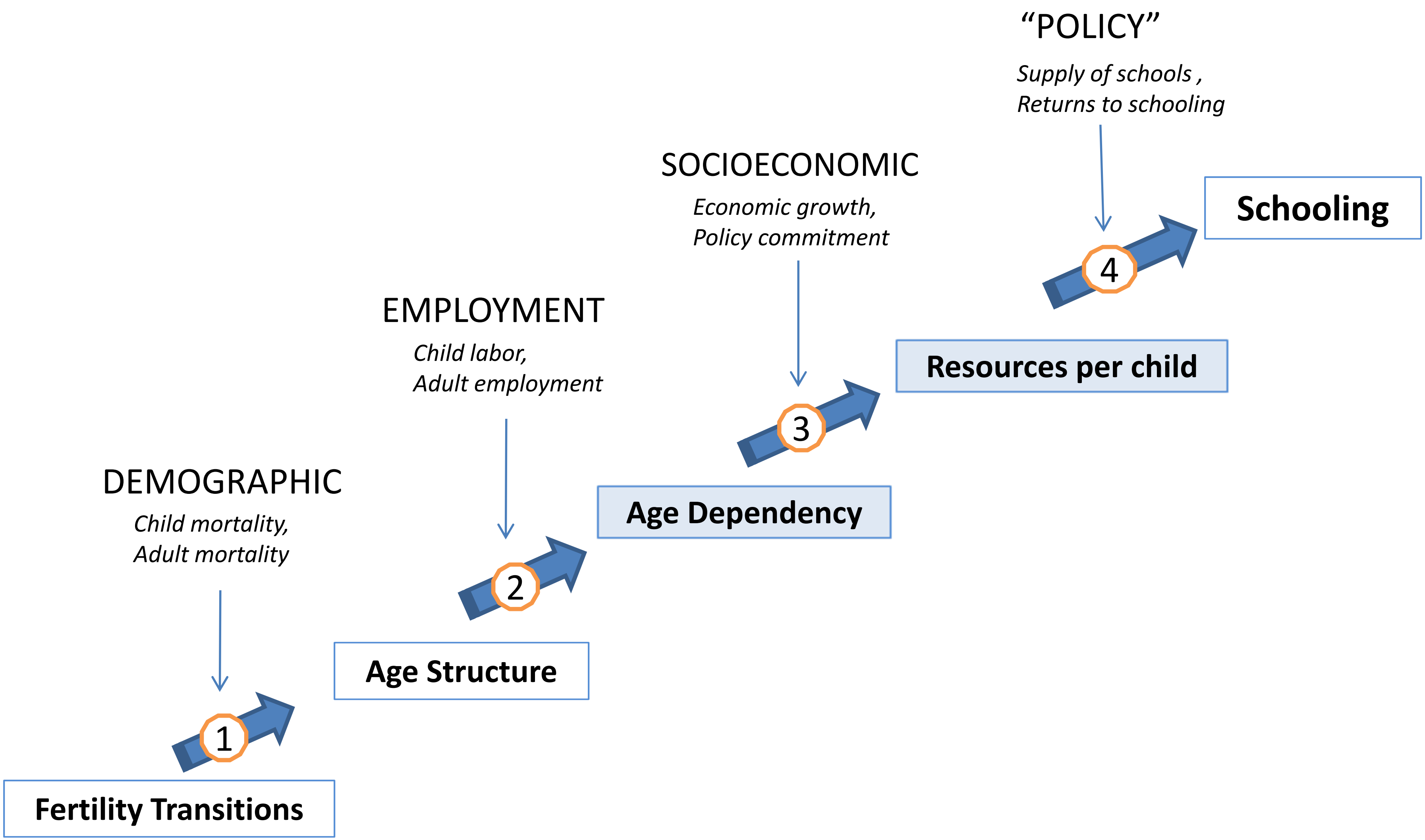
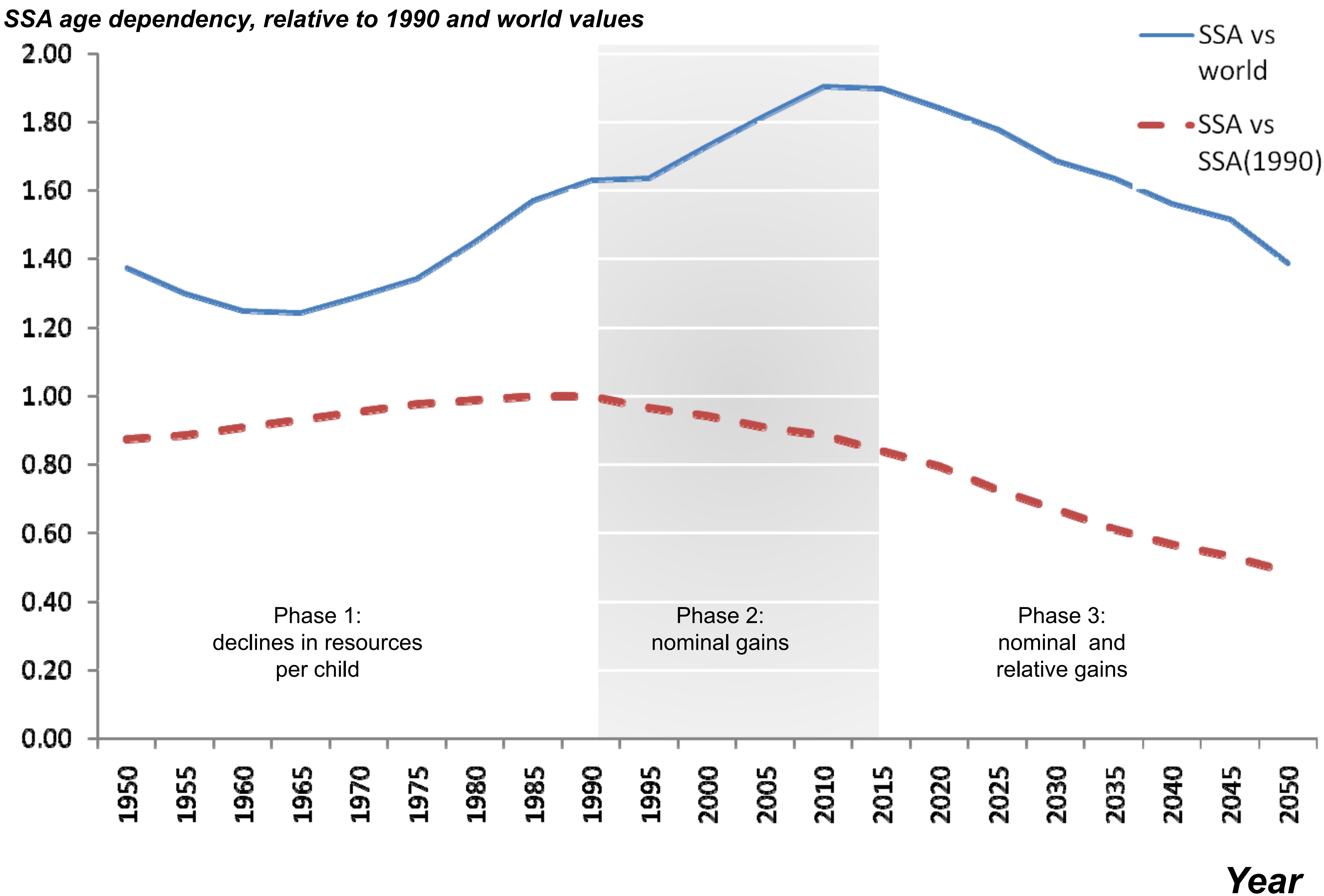


Figure 1. Detailed conceptual framework for the dividend argument

Figure 2. Past and projected age-dependency ratios for SSA, relative to 1990 and world values respectively



Source: computed from UN data (2009).