

Literacy and Numeracy Production and Education Sector Reform: Evidence from Ghana[†]

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Abstract:

Few, if any, previous studies of the determinants of literacy and numeracy in Ghana and elsewhere have examined the impact of education reform on literacy and numeracy production and have mostly also been limited to considering the proficiency in only one language and numeracy and to considering only skills impacts from more traditional types of education. Examining the impact of traditional schooling, technical-vocational education and training, and adult literacy programs on literacy and numeracy in Ghana, this paper addresses all three issues. A comparison of outcomes before and after the 1987 Education Sector Reform indicates that, consistent with the objective of the Reform, the productivity of primary education in terms of literacy and numeracy increased, while the productivity of other levels and types of education decreased. Additionally, large skills differentials in Ghana related to gender, ethnicity, rural/urban location and region of residence are established. The results indicate that future education policy in Ghana should focus on strengthening the quality of both traditional education above the primary level and other types of education, including adult literacy programs.

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1. Introduction

Literacy and numeracy unarguably are at the heart of human and economic development. Partly as a result of this, literacy and numeracy have received widespread attention across the social sciences. Yet, there are many issues related to the creation of literacy and numeracy that have only received limited attention and, therefore, are still poorly understood.

One issue is the interplay of different types and levels of education in creating skills. Here, types of education might distinguish between technical-vocational education and more traditional education, as well as between child and youth education and adult education, where the latter would include adult literacy programs. At the very least adult literacy course participation, say, should be included as a control variable in empirical analyses, due to being a potentially important input into literacy and numeracy production. This is especially true for populations with low levels of human capital, where such programs may provide much needed skills, despite being frequently of relatively low intensity (meeting, say, a couple of times a week for a couple of hours) and receiving only moderate amounts of resources relative to the more traditional education system. Levels of education might distinguish among primary, middle, and secondary and above. Here, knowledge about the relative productivity of the different levels of education help inform policy makers in terms of how most efficiently to allocate resources so as to generate a given skills stock in the economy.

Another issue is the effect of policy reform on literacy and numeracy creation. Presumably education sector reforms aim at improving the quality of education with the ultimate goal of improving education outcomes such as literacy and numeracy. But do these reforms work as intended? There are several reasons why they might not. The actual policy measures undertaken may simply be ineffective in and of themselves, so that there is no impact of the

policy change at all. For example, there may be no behavioral response in terms of enrollment to a change in school subsidies. Alternatively, the distribution of public expenditures may be inefficient due to corruption or wasting, (Ye and Canagarajah, 2002). Alas, in many cases the net effect of policy reforms has not been examined, leaving policy makers with little information as to whether reforms actually worked as intended.

This paper addresses these twin issues of the interplay of different types and levels of education in creating literacy and numeracy and of the possible effects from policy reform for the case of Ghana. Ghana experienced a substantial education reform in 1987, specifically targeted at improving primary education by redirecting funds from other areas of the education system. This provides an opportunity to examine the impact of this policy intervention on literacy and numeracy production, in particular to examine whether there were differential impacts from different levels of education. Additionally, previous studies have generally been limited to examining impacts on numeracy and English reading ability, only, not considering English writing ability nor reading or writing ability in other languages. Yet, this extension is important: in Ghana, as in many other countries, while English may be one of the main languages of oral communication, English writing ability and reading and writing ability in other languages may also be important.

To examine these issues, this paper estimates linear probability and Multiple Indicator Multiple Cause (MIMIC) models for literacy and numeracy before and after the Reform and compares the changes in the relative productivity of different levels and types of education, as well as more formally tests for structural breaks in skills production before and after the Reform. Three main research questions are explored. First, did the relative productivity of different levels of more traditional education change following the Reform? Here, I expect a shift in the relative

productivity from higher to lower levels of education following the Education Sector Reform. Second, was the change in productivity higher for English or Ghanaian literacy? Here, due to the increasing importance of English as a language of instruction, as well as increased tourism, globalization, and so on, I expect this productivity shift to be greater for English than for Ghanaian literacy skills. Third, as a result of these two points, did skills levels increase, as well? Here, I expect the skills levels to have increased, as well, following the Reform, but more so for English than for Ghanaian literacy.

The remainder of this paper is structured as follows. The next section provides a brief description of the main elements of the 1987 Education Sector Reform in Ghana. Section 3 provides the conceptual framework and reviews the previous literature on literacy and numeracy production. The data and related issues are presented and discussed in Section 4. The analysis of literacy and numeracy determinants and the impact of the 1987 Education Sector Reform follows in Section 5. Section 6 concludes, discusses policy implications and provides suggestions for further research.

2. The 1987 Education Sector Reform

At one time, Ghana had one of the most highly developed education systems in West Africa; however, after 1975 it declined together with the rest of the economy (EIU, 2001: 13). In the late 1980s, the deterioration reached the point where primary school completers in many remote areas – especially in the Northern part – were completely illiterate (World Bank, 1989: 27). Possible explanations for this breakdown include a lack of funds for basic materials such as textbooks (Glewwe, 1999a : 101) as well as large numbers of trained and highly qualified teachers leaving the country and being replaced by untrained teachers, especially in primary and

middle schools (World Bank, 1989: 27).

In response to these developments the Education Sector Reform was launched in collaboration with bilateral and international agencies, including the World Bank, in 1987 by the Ghanaian government. From the outset, the emphasis was on basic education – as Chao and Alper (1998: 1) note “The Education Sector Reform program gave priority to basic education with substantially increased resource inputs [...] the share of the education budget in the government’s discretionary recurrent budget rose from 17 percent in 1981 to 41 percent in 1993, with the share for basic education reaching over 60 percent of the total allocation for education.” The shift in expenditures particularly favored primary education, increasing from 24.5 percent of total education expenditures in 1975 to 29.2 percent in 1990, whereas the shares of total education expenditures for other levels of education decreased over the same period (UNESCO, 1999). Indeed, among the main official goals of the Reform were (1) expanding the access to basic education (defined as the first nine years), (2) improving the quality of basic education, and (3) making education more relevant to Ghana’s socioeconomic needs (MOE, 1994: 13, MOE, 1996: 4-8).

To achieve these goals, the main elements of the Reform included the following. Most importantly, new curricula – explicitly designed to be more relevant to the needs of the labor market across all educational levels – were introduced. Entry requirements for teacher trainees were also raised. A program to replace unqualified teachers was introduced, as was in-service teacher training. Further, local community participation in the provision of basic education was strengthened. The Reform also involved training and retraining of basic education head teachers and construction of as many as 10,977 classrooms for the 1,983 least endowed primary schools (MOE, 1996).

Additionally, the reform substantially changed educational finance to make the system more equitable and sustainable (Cobbe, 1991: 106). These financial changes included reducing subsidies and enhancing so-called “cost recovery,” i.e., direct contributions by students, their families, their communities or all three towards the costs of education. For example, feeding and boarding subsidies in secondary schools and at universities were cut back or eliminated, and local communities were encouraged and in some cases required to provide capital and equipment, particularly to the junior secondary schools. Private costs, including (tuition) fees and expenditures on books, uniforms and transportation, were also increased. Part of the reform addressed public sector (including teachers’) salaries, which had been steadily eroded by inflation (Blunch, 2006). As a result of the Reform, the duration of pre-university education was reduced from 17 to 12 years, and restructured into a 6-3-3 system, that is, 6 years of primary, 3 years of junior secondary and 3 years of senior secondary education.

In summary, while the Reform had elements that targeted all levels and types of education, there was a relatively greater weight towards the first nine years of education in its implementation. In the empirical analyses in this paper, I will examine whether this change in emphasis was accompanied by a change in the output of schooling in terms of literacy and numeracy, and in particular whether skills productivity also shifted towards earlier years of education. Additionally, due to the increased focus on English, both due to supply, from becoming ever more important as a language of instruction in schools, and due to demand, with increased tourism, globalization and so on, it is expected that the greatest shift in both skills levels and educational productivity would pertain to English reading and writing skills.

3. Conceptual Framework and Previous Research

A large literature examines the production of literacy and numeracy skills. Considering first how skills are produced, there may be at least three routes to achieving literacy and numeracy skills. First, literacy and numeracy may be obtained from schooling during childhood. In particular, one would expect lower levels of childhood education, say through primary or early secondary school, to mainly be productive in terms of basic literacy and numeracy skills, whereas higher levels of education might be expected to provide more advanced literacy and numeracy skills. Second, literacy and numeracy may be obtained from participation in adult literacy programs and other programs. In Ghana, in particular, adult literacy programs have a long history in providing basic literacy and numeracy skills to people who have never or only briefly attended the more traditional education system (Blunch and Pörtner, 2005). Third, literacy and numeracy may be obtained from the home. This may range from parents helping with homework, reinforcing material taught in school, to regular home schooling (Behrman, Foster, Rosenzweig and Vashishtha, 1999).

Moving next to the literature on literacy and numeracy production, starting with the international evidence, the evidence for impacts from school quality is mixed. Reviewing the evidence from 277 studies relating school inputs to student performance (mostly in the form of test scores) Hanushek (1996) stated “the primary resources for schools are not consistently related to student performance” (p. 16). However, many of the reviewed studies are based on fairly aggregated data, thus estimating school, district or even state production functions. Alas, other (micro based) studies have found significant positive impacts on basic skills achievement from improved school quality. For example, Moll (1998) found an inverse relationship between skills acquisition and pupil-classroom ratios. The picture is more clear for school supply and school access, with longer distances affecting achievement negatively (Moll, 1998). Also,

educational attainment has been found to positively affect skills outcomes (Boissere, Knight and Sabot, 1985; Lavy, Spratt, and Leboucher, 1995; Alderman, Behrman, Khan, Ross and Sabot, 1996, 1997; Moll, 1998; McIntosh and Vignoles, 2001). The same has been found for the length of school in days (Fishback and Baskin, 1991).

Moving to the smaller literature for Ghana, findings are largely comparable to the international evidence. Teacher education, availability of blackboards and libraries, non-leaking classrooms, the number of books per classroom and private vs. public schools have proved to be important determinants for English reading and numeracy skills of Ghanaian children and youth (Glewwe and Jacoby, 1994; Glewwe, 1999a). When examining adults, however, it becomes harder to control for school quality due to the lack of information that pertains to the relevant time when the adults in a given survey were attending school. As an alternative approach, more proximate measures of school quality have been applied. For example, Glewwe (1996) examined the determinants of English reading skills and numeracy skills for adults and included age, years of schooling, regions and their interactions to proxy for temporal and spatial school quality variation. The findings of substantially and statistically significant impacts for the age-years of schooling and region-years of schooling interactions was interpreted as evidence of school quality differing over time and across regions. In particular, it was suggested that these findings were consistent with claims of school quality declining substantially in Ghana during the 1970s and early 1980s (World Bank, 1989).

Summing up, the empirical evidence from the literature on literacy and numeracy determinants in Ghana and elsewhere indicates that school quality and school supply have proved important for skills production. Additionally, the review gives rise to some suggestions for potential improvements. First, the studies generally do not consider the impact of education

sector reforms on skills production. Yet, as previously discussed, such reforms potentially affect school quality and therefore also skills production. Examination of the effectiveness of these reforms therefore is something which should be interesting for researchers and policymakers alike. Second, these studies consider only English reading and numeracy skills. However, for most Sub-Saharan African countries, Ghana included, these would only be part of the relevant “literacies”: in most of these countries, while the “official” government language remains that of the respective former colonial powers, indigenous language skills have become increasingly important after the countries’ independence, as also reflected in the contents of post-colony school curricula. There is a case, therefore, to consider the wider spectrum of indigenous and “foreign” literacy as well as numeracy skills.

In the light of the previous discussion, this article subsequently explores three main research questions. First, did the relative productivity of different levels of schooling change following the Reform? Here, I expect a shift in the relative productivity from higher to lower levels of education following the Education Sector Reform. Second, was the change in productivity higher for English or Ghanaian literacy? Here, due to the increasing importance of English as a language of instruction, as well as increased tourism, globalization, and so on, I expect this productivity shift to be greater for English than for Ghanaian literacy skills. Third, as a result of these two points, did skills levels increase, as well? Here, I expect the skills levels to have increased, as well, following the Reform, but more so for English than for Ghanaian literacy.

4. Data and Descriptive Analysis

The empirical analyses of this paper examine data from the Ghana Living Standards Survey

(GLSS), a series of four independent nationally representative, cross-section household surveys, carried out in 1987/88, 1988/89, 1991/92 and 1998/99. The most recent round of these (GLSS 4) is used for the analyses in this paper. The household survey contains information on literacy and numeracy, educational attainment, participation in adult literacy courses, as well as information on background variables such as age, gender, tribal association/ethnicity and region, which are also important factors in analyses of human capital processes.

Literacy and numeracy

Five different literacy and numeracy variables from the GLSS 4 are examined in this paper. The information on literacy skills from the GLSS 4 include Ghanaian reading and writing proficiency and English reading and writing proficiency, while numeracy measures the ability to do written calculations. The question on English reading (writing) skills is: “Can (NAME) read (write) a letter in English?” while the question on Ghanaian reading (writing) skills is: “In what Ghanaian language can (NAME) write a letter?” The question on written calculations is: “Can (NAME) do written calculations?” The respondent in the survey is either the head of household or a knowledgeable adult member. The subjective nature of these questions and the use of indirect reports are sources of concern.

As a rough check of the quality of the data, educational attainment and literacy and numeracy proficiency for adults are tabulated in Table 1 below.

[Table 1 about here]

Three findings from Table 1 give some measure of confidence in the data. First, the literacy and numeracy skill incidence does not appear heavily inflated. Second, literacy and numeracy rates increase with the level of education completed. Third, few literates have not

attended school (some of these may be genuine, though, resulting from home-schooling or participation in adult literacy programs).

Education variables

Educational attainment is measured as the highest level completed, ranging from “never attended school” through “university” and also includes technical/vocational training. I consider a set of five binary variables, corresponding to the completion of some education (kindergarten and/or primary incomplete), primary school, middle and junior secondary school, secondary school and above, and technical/vocational training.¹ In terms of the interpretation of subsequent results, it should be noted that this implies that the base category consists of individuals who never attended school.

In addition to educational attainment in terms of more traditional education, there is also information available on participation in adult literacy programs. I construct a binary measure, indicating whether an individual ever attended an adult literacy course program. A problem with this measure, of course, is that the time of participation is unknown. An individual may just have started attending a class, for example, in which case the impact from the program will not have taken full effect. This would lead to a downward bias in the estimated impact. Also, the quality and content of adult literacy programs may vary across time or across areas, since these programs are – and for a long time have been – offered by many different providers, including several different NGOs and the government. There is only information on whether or not an individual participated, however, and not on whom the provider or what the content was. Finally, the intensity of participation is unknown.

¹ Nine individuals in the full sample report having completed “other education.” These are dropped since it is not clear what “other education” is.

Other explanatory variables relevant for literacy and numeracy production

The economic, school quality and school supply variables that are directly relevant for school attendance and achievement are not available from the GLSS. To control for these conditions, I instead include geographical variables for rural-urban location and region of residence. Here, I expect literacy and numeracy to be positively associated with urban location and with the relatively more prosperous regions, such as the Greater Accra region.

Demographic variables for these analyses include gender, birth cohort and ethnicity/tribal association. Cultural and contextual factors are also captured by the variables for rural/urban location and region of residence.

Analysis samples

To examine the possibility of the Education Sector Reform of 1987 affecting skills outcomes, I consider two distinct sub-samples. The first (the pre-reform cohort) includes individuals, who were born prior to 1977 and the second includes individuals, who were born in 1977 or later. The reason for this is that those born in the second (the post-reform, or similarly, “treatment”) group should not be “too old” in 1987, that is, they should still be of school attending age. Being 10 years of age in 1987 appears to be a reasonable cut-off for inclusion in the post-reform sample, since then there would still be a couple of more years left before completing primary school, which may be taken to be the most important in terms of basic literacy and numeracy acquisition.

Sample restrictions

Moving to the sample restrictions, the first thing that restricts the sample is that individuals

should have had a chance to complete at least primary schooling, while at the same time being eligible for participation in adult literacy programs (the lower age limit). Also, individuals should not be “too old,” since measurement issues then start to become more important (upper age limit). As a result of this, the initial sample is restricted to individuals between 15 and 54 (both included) years of age. Additionally, explanatory variables are missing for some observations, which cause a further drop in the sample sizes. Lastly, I exclude a small number of individuals who report completing “other” education, since it is not obvious exactly what “other” education is. The total drop in sample size when moving from the initial to the final estimation sample is less than 0.3 percent, however, so that the final estimation sample should still be representative for the overall population of Ghana. The final estimation samples are 8,420 (pre-reform) and 3,555 (post-reform), respectively, yielding a total of 11,975 observations.

Descriptive analysis

To get an initial grasp of the data and the potential effects on skills production and education demand from the education reform, I first examine educational attainment and literacy and numeracy outcomes for the pre- and post reform cohorts. The possibility of the (childhood and youth) schooling of the younger part of the sample not being completed may be an issue. While in the regression analyses this will be dealt with by controlling for age, the descriptive analyses account for this by cutting off the sample at as high an age as possible. Optimally, I would like to cut the sample at 25 years of age or older, since then it is very likely that everybody has completed at least their childhood and youth schooling (adult literacy programs are, in principle, open for adults at any age) but this would drastically reduce the post-reform sample. I therefore choose 20 years of age as the cut-off instead, which also appears fairly reasonable: at 20 years of

age, a person should have completed child and youth education.

The means of schooling and skills incidence for the pre reform and restricted post reform samples are provided in columns two and three of Table 2, with the means for the unrestricted post reform sample provided for comparison in the last column of the table.

[Table 2 about here]

From Table 2, while educational attainment increased overall this was unevenly distributed across the different levels of education. For the full sample, for example, primary school completion increased by 1.7 percentage points, while middle school/junior secondary school completion increased by about 10 percentage-points and secondary and above increased by 4.4 percentage-points. These increases in school attainment mainly come from a decrease of the “no education” group, although technical-vocational completion dropped a bit, by about 1.7 percentage-points.

So how did literacy and numeracy attainment fare in comparison? The results from Table 2 indicate that literacy and numeracy increased by more than 10 percentage-points in most cases, sometimes much more, from the pre- to the post-reform period. These results are fairly consistent across both the restricted and the unrestricted post reform samples.

Overall, the descriptive analyses reveal large increases in skills levels for all five skills between the pre- and post-reform samples. Also, the levels of literacy increased relatively more for English reading and writing than for Ghanaian writing and writing, thus confirming the expectation of a relative shift from Ghanaian to English literacy skills. Further, the increases in literacy and numeracy do not appear to be driven by similar increases in educational attainment, except possibly for middle school and junior secondary school. Combined, these results are consistent with the productivity of schooling increasing due to the 1987 Education Sector

Reform. To examine whether and to what extent this is the case – including how different levels of education and types of skills were affected by the Reform – I now turn to the estimation of multivariate regression models of literacy and numeracy for the pre- and post-reform samples.

5. Results

In this section reduced form estimates of literacy and numeracy determinants will be presented and discussed. The emphasis is on the results for childhood and youth education, since it is not possible to distinguish between pre- and post reform adult literacy course participation (since individuals may have participated at any time after becoming adults).² I will start by motivating the estimation methods and then present the results pertaining to the differences before and after the 1987 Education Sector Reform in the relative productivity of different levels and types of education.

The dependent variable is one of the five literacy/numeracy measures discussed previously, while the explanatory variables include childhood and youth schooling, adult literacy course participation, gender, birth cohort, tribal association/ethnicity, rural/urban location and region of residence. Estimations are carried out using the linear probability model,³ estimating models separately for the five different literacy/numeracy measures and separately for the pre and post reform cohort, yielding a total of ten models to be estimated. Further, so as to allow for arbitrary heteroskedasticity, the estimations will be carried out using Huber-White standard errors (Huber,

² Since adult literacy course participation enters as an input into literacy and numeracy skills production, however, it is still very important to include as a control variable, even though the estimated coefficient cannot be interpreted in terms of the 1987 Education Sector Reform.

³ There may be some concern about using the linear probability model, when the dependent variable is binary. For example, predicted probabilities may fall outside the (0,1)-range and heteroskedasticity also is present by default. However, it can be argued that the LPM approximates the response probability well, especially if (1) the main purpose is to estimate the partial effect of a given regressor on the response probability, averaged across the distribution of the other regressors, (2) most of the regressors are discrete and take on only a few values and/or (3) heteroskedasticity-robust standard errors are used in place of regular standard errors (Wooldridge, 2002). All three factors seem to work in favor of the LPM for the purposes of the application here.

1967; White, 1980). Additionally, so as to allow for the possibility that observations are correlated within communities the standard errors are also adjusted for within-cluster correlation (Froot, 1989; Williams, 2000).

Should the LPM be estimated by means of ordinary least squares or by means of two-stage least squares? While one may treat educational attainment as pre-determined statistically, there is a possibility that it may be endogenous, thus potentially favoring 2SLS over OLS. While simultaneity is unlikely, except possibly for adult literacy programs,⁴ omitted variables are a possible source of bias. For example, ability is unobserved and at the same time also a key determinant of both an individual's educational attainment and her productivity in literacy and numeracy production. Pursuing a 2SLS estimation strategy – using as identifying instruments interactions of birth cohort and region of birth⁵ – indicate that childhood and youth educational attainment and adult literacy course participation are exogenous to skills for the pre-estimation sample (results not shown, available upon request). OLS is therefore consistent and also efficient relative to 2SLS. For the post-reform sample the null hypothesis of exogeneity is rejected in several cases. At the same time the instruments are much weaker for this sample, however, and are frequently not jointly statistically significant in the first-stage regression; in turn, this might give rise to the “weak instruments problem” (Bound, Jaeger, and Baker, 1995). The post-reform sample is also much smaller than the pre-reform sample, which might help explain these differences. As a result of this, OLS is preferred to 2SLS.

As an alternative means of estimation, essentially serving as a robustness check to corroborate the findings of the LPM, I also estimate the literacy and numeracy production

⁴ Since the timing of adult literacy course participation potentially is “close”, if not ongoing, to current literacy and numeracy of the individual. In contrast, childhood and youth educational attainment may be treated as predetermined to skills outcomes.

⁵ These are similar in spirit to the instruments applied in Angrist and Krueger (1991) and Duflo (2001).

functions using Multiple Indicator Multiple Cause (MIMIC) models. Conceptually, the MIMIC framework is relevant in this application, since the central idea behind the MIMIC approach is that the multiple outcomes that we observe – Ghanaian and English reading and writing literacy and numeracy – all originate from a single, underlying latent variable (Jöreskog and Goldberger, 1975). Here, this variable might be thought of as “functional literacy.” The MIMIC models are estimated using maximum likelihood.

Table 3 presents the estimated associations between schooling and literacy and numeracy skills for the LPM. The table is organized with increasing levels of childhood and youth education moving down in the first column and with Ghanaian reading and writing, English reading and writing, and numeracy moving to the right in the table. For each of the five skills, results are given first for the pre- and then for the post-reform sample.

[Table 3 about here]

From the table, several results stand out. Most strikingly, the productivity of primary education is larger for the post-reform sample than for the pre-reform sample, with statistically significant impact estimates for all skills. For childhood and youth schooling other than primary the impact for the pre-reform sample are mostly about the same, sometimes even slightly decreasing. Together, this supports my first main hypothesis, namely the expectation of a relative shift in productivity from higher to lower levels of education following the Education Sector Reform. Also, the impacts are generally larger for English reading and writing skills than for Ghanaian reading and writing skills, thus supporting my second main hypothesis of a relative shift in skills production from Ghanaian to English literacy. The productivity of primary schooling in terms of Ghanaian writing skills, for example, increases about 12 percentage-points, from 27.6 percentage-points to 40.3 percentage-points. This contrasts with an almost 33

percentage-points increase in the productivity of primary schooling in terms of English writing skills.

Again, while the results for adult literacy course participation cannot be interpreted in terms of the 1987 Education Sector Reform due to the timing issues related to participation described earlier, it is still possible to interpret the results for adult literacy course participation more generally, that is as an overall average effect. Keeping this caveat in mind, there appears to be a positive and statistically significant association between adult literacy course participation and Ghanaian reading and writing skills and numeracy. While the size of this association may not appear particularly impressive, indicating less than 10 percent of learners becoming proficient, it should be taken into account that most programs have a duration of only about 2 years (the national, public program has a duration of 21 months) and meet only a few times a week for just a couple of hours. Still, there is definitely room for improvement. The estimated negative association between adult literacy course participation and English reading and writing skills of course does not mean that attending an adult literacy course decreases English reading and writing skills but rather reflects the fact that until recently, the majority of adult literacy programs in Ghana have been concerned with teaching Ghanaian literacy skills. The results may therefore simply reflect that participants are less likely to be proficient in English due to not learning these skills in the programs (at least at the time covered by this dataset, where most adult literacy courses were explicitly focuses on Ghanaian languages and numeracy, only; more recently, instruction in English literacy have become more widespread).

Again, the literacy and numeracy production functions were also estimated using the MIMIC framework (Jöreskog and Goldberger, 1975). The results from the MIMIC specification are shown in Table 4. Similar to the LPM results in Table 3, the results are presented with the

different levels of education moving from the top to the bottom in the first column, and also presented separately for the pre- and post reform estimation samples. In contrast to the LPM, however, the observations are pooled across the five different skills measures, so that only one model is estimated for each of the two pre- and post reform regimes.⁶ The results are consistent with those of the LPM overall. First, the largest increases in skills productivity are found at the lower levels of education, namely some education and primary education completed. For example, the productivity (or marginal probability) of some education increases from 6.6 percentage-points pre-reform to 15.4 percentage-points post-reform, i.e. more than doubles, overall.⁷ This provides additional support to the relative shift in skills productivity towards lower levels of education, which also was found for the LPM specification. Second, since the factor loadings (the λ s) have increased more for English than for Ghanaian literacy (the λ parameter for Ghanaian reading has been normalized to one), this supports the prior expectation of a relative shift in skills productivity from Ghanaian literacy towards English literacy, which also was found for the LPM specification. Lastly, since the factor loadings are higher for English than for Ghanaian literacy overall, i.e., pre *and* post reform alike, the MIMIC specification yields the additional result that the threshold for English literacy proficiency is higher than that for Ghanaian literacy proficiency. This accord well with prior expectations, since individuals would seem to be exposed more to Ghanaian language(s) in their daily lives than to English.

To formally examine whether the differences in pre and post reform productivity of schooling are statistically significant, I also estimated fully interacted versions of the LPM – that

⁶ Again, one may interpret the MIMIC approach as essentially estimating a latent measure of functional literacy, by combining all four literacy measures and the numeracy measure into a composite functional skills measure.

⁷ Again, these overall skills productivities are multiplied by the relevant factor loadings, the λ s, to give the specific skill productivities.

is, models where the pre-and post reform samples are pooled into one estimation sample, and where a variable for being in the post-reform sample as well as interactions of this variable with all other variables are also included.

Testing, first, whether all education interactions *except* those for “some education” and “primary” are jointly zero reveals that this cannot be rejected: p-values are well above 10 percent, except for written calculations (p-value: 9 percent). In other words, as a whole, the skills productivity of other education than some education (primary incomplete) and primary education does not differ between the pre and post reform samples. Testing, second, whether *all* education interactions are jointly zero, i.e. adding now some education (primary incomplete) and primary education, reveals that this can be rejected: all p-values are 0.1 percent or less. In turn, this confirms that only the coefficients for “some education” and “primary” differ statistically between the pre- and post-reform sample, being larger for the post-reform than for the pre-reform sample. Combined with the large substantive differences in skills productivity of less than primary and primary established earlier, one may safely argue that there indeed was a substantial structural shift in the skills productivity favoring lower levels of childhood and youth education in Ghana following the 1987 Education Sector Reform.

6. Conclusion

This paper compared literacy and numeracy outcomes and education demand before and after the 1987 Education Sector Reform in Ghana. The analyses allowed for different types and levels of education in the production of literacy and numeracy.

The descriptive results revealed a large increase in the skills stock in Ghana between the pre-and post-reform samples. Surprisingly, this increase in the skills stock was not accompanied

by an increase in school enrollment to the same degree, hinting at “something else going on.” This something else, it was suggested, could well be changes in school quality due to the 1987 Education Sector Reform.

This possibility was further explored in the multivariate analysis of skills production, estimating both linear probability and Multiple Indicator Multiple Cause (MIMIC) models and controlling for a host of other factors, which might also affect skills production – such as gender, age, rural-urban location and region of residence. Large differentials were found between different types and levels of education. The skills productivity of primary education stood out by improving considerably, while the skills productivity of middle and junior secondary, secondary and above, technical-vocational and adult education remained constant or even decreased, except in a few cases. Linking back with the descriptive analysis, the finding that only the skills productivity of primary education increased dramatically, while primary school enrollment did not, indicates that the overall increase in literacy and numeracy to a large extent was driven by the increase in the quality of primary schooling following the Educational Sector Reform.

Since primary education was the main target of these reforms, this on one hand indicates that the reforms worked as intended, at least for primary education. On the other hand, the results also hint at the possible danger of policy makers losing the overall view when focusing too intensively on a specific area when carrying out reforms; an increased focus on one type or level of education with a resultant flow of resources to that type or level of education may very well be at the expense of other types or levels of education (Birdsall, 1996; Lauglo, 1996). On the demand side, Ghanaians only partially acted rationally on this shift in skills productivity following the Educational Sector Reform: primary school enrollment only increased modestly,

relative to the large increase in literacy and numeracy productivity of primary education.⁸

Future education reforms in Ghana and elsewhere, therefore, might try to maintain more of a balance between different types and levels of education when allocating resources, while policy makers at the same time ensure that information regarding intended and undergoing educational reforms reach the public. A caveat here, of course, is that to really assess whether the 1987 Education Sector Reform in Ghana was “good or bad,” one must quantify the welfare implications of the Reform. Since this paper is strictly concerned with the change in literacy and numeracy outcomes and schooling following the Reform, this is beyond the scope of the present analysis, however. The question of the desirability or otherwise of the consequences of the Reform is therefore left for future research.

Future research may also want to extend these analyses further in other directions, by examining the possible impact from education sector reforms on skills production for other countries. Again, a crucial issue here is that of timing: how to define the pre- and post-reform samples, while ensuring that there is no contamination between the pre- (control) and post-reform (treatment) groups? While I argued in this study that the groups were adequately demarcated, it would clearly be preferable if future studies would be able to examine data that were purposely collected for impact evaluation, preferably collecting also test scores rather than self-assessed literacy and numeracy measures.

⁸ There are of course other education outcomes than literacy and numeracy, which are also part and parcel of people’s educational decisions. For studies examining the same dataset used here in the context of wages and child health, see Blunch (2006).

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Table 1. Distribution of Self-reported Skills, Full Sample and across Highest Educational Level Completed

	<i>Ghanaian reading</i>	<i>Ghanaian writing</i>	<i>English reading</i>	<i>English writing</i>	<i>Written Calculations</i>
Full sample	0.449	0.413	0.523	0.506	0.641
Never attended school	0.020	0.014	0.005	0.005	0.044
Some education (primary incomplete)	0.140	0.113	0.128	0.111	0.365
Primary school	0.422	0.370	0.464	0.429	0.762
Middle/junior secondary school	0.720	0.670	0.874	0.847	0.963
Secondary and above	0.878	0.843	0.999	0.998	0.998
Technical/Vocational	0.747	0.686	0.998	0.995	0.992

Notes: Sample contains the pooled, full sample from the estimations, i.e. pooling the pre-and post reform samples, yielding a total of 11,975 observations.

Source: Ghana Living Standards Survey (Round 4, 1998/99).

Table 2. Means for Schooling, Literacy, and Numeracy Variables, Pre- and Post Reform Samples

	<i>Pre-reform</i>	<i>Post-reform, restricted (20 years and older)</i>	<i>Post-reform, unrestricted (15 years and older)</i>
<i>Schooling:</i>			
Never attended school (ref.)	0.288	0.174	0.129
Some education	0.104	0.074	0.149
Primary	0.127	0.144	0.266
Middle / JSS	0.337	0.436	0.382
Secondary and above	0.112	0.156	0.068
Technical/Vocational	0.033	0.016	0.005
Literacy course	0.080	0.025	0.013
<i>Literacy and numeracy :</i>			
Ghanaian reading	0.432	0.509	0.492
Ghanaian writing	0.393	0.482	0.462
English reading	0.479	0.624	0.630
English writing	0.463	0.602	0.609
Written calculations	0.592	0.731	0.762
N	8420	900	3555

Notes: Estimations incorporate survey weights.

Source: Ghana Living Standards Survey (Round 4, 1998/99).

Table 3. Traditional Schooling and Adult Literacy Course Participation Coefficients from OLS Literacy and Numeracy Regressions

	<i>Ghanaian reading</i>		<i>Ghanaian writing</i>		<i>English reading</i>		<i>English writing</i>		<i>Written calculations</i>	
	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Pre-Reform</i>	<i>Post-reform</i>	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Pre-reform</i>	<i>Post-reform</i>
Some education	0.065*** [0.017]	0.143*** [0.030]	0.048*** [0.014]	0.117*** [0.029]	0.050*** [0.013]	0.195*** [0.035]	0.039*** [0.011]	0.168*** [0.035]	0.217*** [0.028]	0.444*** [0.034]
Primary	0.328*** [0.025]	0.438*** [0.031]	0.276*** [0.020]	0.403*** [0.033]	0.280*** [0.019]	0.608*** [0.031]	0.245*** [0.018]	0.573*** [0.031]	0.590*** [0.025]	0.806*** [0.020]
Middle/JSS	0.683*** [0.020]	0.655*** [0.031]	0.633*** [0.019]	0.627*** [0.032]	0.833*** [0.013]	0.858*** [0.024]	0.805*** [0.013]	0.833*** [0.025]	0.881*** [0.013]	0.902*** [0.018]
Secondary and above	0.845*** [0.021]	0.858*** [0.029]	0.812*** [0.021]	0.837*** [0.032]	0.948*** [0.009]	0.965*** [0.023]	0.951*** [0.009]	0.950*** [0.024]	0.904*** [0.015]	0.936*** [0.019]
Technical/Vocational	0.733*** [0.031]	0.613*** [0.114]	0.683*** [0.033]	0.516*** [0.112]	0.934*** [0.012]	0.965*** [0.031]	0.936*** [0.012]	0.954*** [0.032]	0.893*** [0.017]	0.942*** [0.022]
Literacy course	0.091*** [0.018]	0.074 [0.062]	0.061*** [0.016]	0.065 [0.053]	-0.023** [0.010]	-0.098*** [0.034]	-0.017* [0.010]	-0.087** [0.036]	0.056** [0.022]	-0.051 [0.055]
R ²	0.50	0.31	0.47	0.30	0.72	0.50	0.70	0.49	0.70	0.57

Notes: The number of observations for the pre- and post-reform samples are 8420 and 3555, respectively. “Never attended school” is the reference category for educational attainment. Estimations incorporate survey weights and clustering. Robust Huber-White (Huber, 1967; White, 1980) standard errors, adjusted for within-community correlation/clustering (Froot, 1989; Williams, 2000), in brackets under parameter estimates. *: statistically significant at 10 percent; **: statistically significant at 5 percent; ***: statistically significant at 1 percent.

Source: Ghana Living Standards Survey (Round 4, 1998/99).

Table 4. Traditional Schooling and Adult Literacy Course Participation Marginal Effects from Maximum-Likelihood MIMIC Regression

	<i>Pre-reform</i>	<i>Post-reform</i>
Some education	0.046*** [0.006]	0.154*** [0.015]
Primary	0.237*** [0.011]	0.466*** [0.015]
Middle/JSS	0.679*** [0.008]	0.656*** [0.013]
Secondary and above	0.784*** [0.008]	0.746*** [0.014]
Technical/Vocational	0.766*** [0.009]	0.729*** [0.020]
Literacy course	-0.008 [0.008]	-0.061** [0.023]
$\lambda_{\text{Ghanaian writing}}$	0.936*** [0.005]	0.950*** [0.006]
$\lambda_{\text{English reading}}$	1.224*** [0.010]	1.307*** [0.017]
$\lambda_{\text{English writing}}$	1.198*** [0.011]	1.280*** [0.017]
$\lambda_{\text{Written calculations}}$	1.246*** [0.010]	1.334*** [0.017]
Log-Likelihood:	-5323.9974	-4568.0344

Notes: The number of observations for the pre- and post-reform samples are 8420 and 3555, respectively. “Never attended school” is the reference category for educational attainment. Factor loadings (the λ s) are relative to the base category, Ghanaian reading. Estimations incorporate survey weights. Robust Huber-White (Huber, 1967; White, 1980) standard errors in brackets under parameter estimates. *: statistically significant at 10 percent; **: statistically significant at 5 percent; ***: statistically significant at 1 percent.

Source: Ghana Living Standards Survey (Round 4, 1998/99).