

# **The Impact of Education Reforms on Household Adult Welfare Outcomes in Ethiopia: The 1994 Free Primary Education (FPE) Reform<sup>1</sup>**

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## **Abstract**

This study examines the effect of free primary education reform on years of schooling and on various indicators of welfare in Ethiopia. Welfare is measured using multiple poverty indicators, including per adult equivalent consumption expenditure, relative deprivation in terms of consumption expenditure, and poverty gap. Using variation in individuals' dates of birth at the time of the reform as a source of exogenous variation in education, cohorts of age 14 and younger in 1994, who were either in pre-school or primary school, are presumed to be exposed to the reform, whereas those above age 14 are presumed not to be exposed. I used both difference-in-differences (DID) and instrumental variable estimation strategies to estimate the impact of the reform on education, and the causal impact of education on adult welfare outcomes. Preliminary results show that the reform led to an increase in years of schooling of 0.80 years (without controls) and 0.77 years (with controls), and increased the welfare of individuals who were age 8 or younger in 1994. Therefore, in general the reform increased the education and welfare outcomes of individuals age 8 or younger in 1994, who were likely to be in preschool or in the first cycle of primary school when the reform started.

**Keywords:** Free primary education, Ethiopia, Educational attainment, Welfare Outcomes, Poverty measures

**JEL Classification:** O55, I25, I26, I31, I32

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<sup>1</sup> Working Paper: This is a draft with preliminary results and not the final version.

## **1. Introduction**

Levels of education have increased sharply across sub-Saharan Africa in the last few decades (World Bank, 2012). This rise stems from policies designed to achieve universal primary education and gender parity in primary and secondary education (Goal #2, Millennium Development Goals). The elimination of school fees in many recent primary education reforms is one specific policy that has contributed to this achievement. Many sub-Saharan African countries have implemented free primary education policies including Kenya and Nigeria in the 1970's, Zimbabwe and Tanzania in the 1980's, and Ethiopia, Malawi, and Uganda in the 1990. More recently, more countries joined the campaign to implement free primary education (Deininger, 2003; Kattan and Burnett, 2004; Oumer, 2009; World Bank, 2009). According to UNESCO, countries that fulfilled this reform (Lesotho, Mozambique, Ghana, Kenya, Ethiopia, Tanzania, Cameroon, Malawi, and Uganda) saw a surge in primary school enrollments in the following years (UNESCO, 2007; Oumer, 2009).

Despite this success, many questions persist about the quality, and therefore the economic return of this education. Recent studies have examined the progress and challenges of free primary education reforms (Oumer, 2009), and its effect on different factors such as school enrolment and quality of education (Deininger, 2003; Nishemura et al., 2008; Grogan, 2009; Lucas and Mbiti, 2012a; Chicoine, 2016a, 2016b; Snilstvert et al., 2016;), fertility (Fort et al., 2016), HIV health outcomes (Behrman, 2015), and gender equality (Lucas and Mbiti, 2012b). However, the connection between increased school enrolment, and the welfare gains of the people is still an open question. With these considerations in mind, this paper informs the discourse by examining the degree to which free primary education affects the welfare of individuals.

This paper focuses on Ethiopia whose impact of free primary education was very remarkable because the country has had a long history of low primary school enrolment and wide disparities in education across and within the regions (Oumer, 2009). Yet, there are relatively few published studies of the impacts of free primary education in Ethiopia. The current study examines the 1994 Ethiopia free primary education

reform to evaluate the effect of this reform on individual's education and welfare outcomes using three waves of a nationally representative panel data set (the World Bank's Living Standards and Measurement Survey – Integrated Surveys on Agriculture (LSMS-ISA) survey for Ethiopia). Specifically, the paper performs two tasks: first, it estimates the impact of free primary education on individuals' completed years of schooling, and second, it estimates the impact of this increase in years of schooling on the welfare of individual households. **This, then, answers the question: what is the economic return to primary schooling in Ethiopia?**

Ethiopia's Sustainable Development and Poverty Reduction Program envisioned education as playing a major role in poverty reduction through universal primary education, and by creating a workforce with the required human capital skills essential for competitiveness in the global economy. This led to the inclusion of free primary education in the Ethiopia's PRSP<sup>2</sup> in 2002 (World Bank, 2005, 2009; Oumer, 2009). However, the question of whether free primary education reduces poverty or otherwise increases welfare is still of concern to economists and policymakers, since the impact of this policy on poverty is unclear. In regard to this, the present paper follows the approach of Darko et al., (2018), who measure welfare using a variety of different indicators.

The welfare measures examined include annual per adult equivalent consumption expenditure, relative deprivation in terms of consumption expenditure, and poverty gap. The measure of relative deprivation simply compares the consumption expenditure of a given household to that of the mean consumption expenditure of all households that are better off than the given household in question (Stark and Taylor, 1989). Poverty gap measures how far a given household is from the poverty line of a country (Foster et al., 1984).

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<sup>2</sup> Poverty Reduction Strategy Paper.

The identification strategy in this study is based on the fact that exposure to the reform varies by date of birth. The population age 14 and younger in 1994 were either in pre-school or primary school (or had not yet started school) at the time of the reform, and so they were exposed to the reform, whereas those above age 14 in 1994 were not exposed to the reform. More specifically, individuals aged eight and below were almost certainly strongly affected by the reform, while those age nine to 14 were likely to be only weakly affected. This study uses difference-in-differences (DID) and instrumental variable (IV) identification strategies to estimate the impact of the reform. It draws methodological insight from Duflo (2001), who used a similar approach to evaluate the impact of a school building program on education and earnings in Indonesia. The same identification strategy is employed in this paper to estimate the returns to education in Ethiopia, by using this exogenous variation in education by virtue of the reform to evaluate the causal effect of years of schooling on various measures of welfare.

There is an extensive literature on the returns to education in developing countries (Psacharopoulos, 1989, 1994a, 1994b; Card and Krueger, 1992; Glewwe, 1996; Psacharopoulos and Patrinos, 2004; Peet et al., 2015) and developed countries (Card, 2001), of which this paper contributes to the developing country literature. In terms of previous research on free primary education reform in Ethiopia, Chicoine (2016b) examined the effect of the reform on schooling and fertility. This paper extends this literature by estimating the impact of free primary education on years of schooling, and its impact on various welfare outcomes. Also, the study is relevant to the fourth Sustainable Development Goal (SDG); ensuring that all girls and boys have complete free, equitable, and quality primary and secondary education, leading to relevant and effective learning outcomes for all by 2030 (United Nations, 2015).

Several studies have also estimated the causal effect of education in labor markets using instrumental variable methods (Angrist and Krueger, 1991a; Butcher and Case, 1994; Kane and Rouse, 1993; Card, 1993, 1995; Duflo, 2001, 2004) and fixed effect methods (Angrist and Newey, 1991; Ashenfelter and

Krueger, 1994) estimators, as well as the conventional ordinary least squares (OLS) estimation (Glewwe 1996; Peet et al, 2015). However, few studies have examined the relationship between years of schooling and various measures of welfare in extant literature using instrumental variable. This paper estimates the impact of education on various measures of welfare using instrumental variables to avoid bias due to endogenous variation in education.

Preliminary results from this study indicate that the reform led to an increase in years of schooling by 0.80 years (without controls) and 0.77 years (with controls), and improved the welfare of individuals aged eight and below in 1994. However, the cohort of age nine to 14, who presumably were weakly affected by the reform, were not affected. This suggests that cohorts in pre-school or in the early stages of primary school at the time of the reform were the most or only affected cohorts.

The remainder of this paper is organized as follows. Section 2 describes the relevant history of, and education reform in Ethiopia. The empirical framework in Section 3 discusses the identification strategy and the empirical strategy. Section 4 provides a description of the data and summary statistics. Section 5 reports the results and discussion, and session 6 concludes.

## **2. History and Education Reform in Ethiopia**

Between 1974 and 1991, Ethiopia was governed under two very different political systems: military (monarchy) and communism. Then in 1991, a major political and economic transition took place that replaced the communist rule with a federal political system that divided the country into nine regions and two city administrations (Ofcansky and Berry, 1993; World Bank, 2009; Oumer, 2009). Following the new decentralized political order in Ethiopia, the government made some important revisions to the previous education policy. The first change, issued by Proclamation No. 41 in 1993, authorized the decentralization of primary and secondary education to each of the nine regions and two city administrations (Negash, 1996; UNESCO, 2007; Tewfik, 2010). The second official change was the 1994 Education and Training Policy (ETP) which eliminated school fees for students in Grades 1 to 10 in order to reduce the financial burden on parents. Additionally, the policy reduced cost of school fees for students in Grade 11 and 12, and in higher (Transitional Government of Ethiopia, 1993; UNESCO, 2007; Oumer, 2009). The ETP declaration in 1994 was implemented in these nine regions in 1995, prior to the beginning of the 1995 school year.

The education system used a 6-2-4 structure from 1962 to 1994, so that six years primary school were followed by two years of junior secondary school, and four years of senior secondary school. Following the 1994 ETP, the primary school official entrance age remained at seven, but the government created a new education structure of 4-4-2-2. This structure consists of two cycles of primary education, basic education (grades 1-4) and general primary education (grades 5-8), two years of general secondary education (grades 9 and 10), and two years of preparatory secondary education (grades 11 and 12). Unlike the old structure, where national examinations were taken at the end of each cycle to determine selection

of students into the next cycle, the new structure has national examinations taken only at the end of grade eight and grade ten (World Bank, 2005; World Bank, 2009, Oumer 2009).

The identification strategy for this paper focuses on the elimination of school fees in Grades one through eight, and an accompanying law that made primary education compulsory. These changes were followed by a substantial increase in primary school enrollment, with the largest increase in Grade 1 (World Bank, 2009). Figure 1 confirms that the improvement in grade one enrollment was large compared to other grades. As seen in Figure 1, enrollment fell in the late 1970s, when Mengistu Haile Mariam took power after the overthrow of Haile Selassie in 1974. The sharp decline in enrollment in the mid-1980s was likely due to the severe famine, which caused roughly one million deaths and left many more millions destitute. Similarly, there was another fall in enrollment in the early 1990's, which may reflect the overthrow of Mengistu regime in 1991 (World Bank, 2005). After 1993, which are the years after the two reforms, there was a sharp increase in enrolment, as depicted in Figure 1. In terms of the additional enrollment and percent growth (45%; 28%), the largest increase in Grade 1 enrollment is in the 1993/1994 and 1995/1996 school years.

Despite these gains in enrollment, schools in Ethiopia experienced many problems. Pupil-teacher ratios increased by 40 percent between 1992 and 1995, and by 60 percent through 1996. The number of students per school also grew, by 75 percent between 1992 and 1995, and by 90 percent in 1996 (Ministry of Education, 1995, 1996, 2000). This resulted in overcrowded classrooms. Other problems associated with the reforms were less qualified teachers and less government budget (World Bank, 2009). These reforms were implemented without proper planning and adequate financial resources, which likely reduced the quality and efficiency of education (Oumer, 2009).

Chicoine (2016a) claims that the two reforms increased students' time in school by more than one full year, raised the rate of passing grade eight exams, and increased the literacy rate by almost ten percent. Unlike Chicoine (2016a, b) and the other few studies that have examined the impacts of these reforms, this study will focus only on the ETP reform, specifically the elimination of primary school fees for Grades 1 to 8.

The removal of school fees took place in all primary schools across the country, and hence there is no geographic variation in the implementation of this reform. This paper exploits only the timing variation of the reform, while Chicoine (2016a, b) focuses on both timing and geographic variation of the reform. Therefore, this paper draws methodological inspiration from Duflo (2001, 2004), where the INPRES program was geared towards regional development with the number of schools constructed per region (district) clearly defined. Duflo (2001, 2004) explains the plausibility of using both temporal and geographic variation.

Chicoine (2016a, b) estimated the effect of the reform geographically, and accounted for the regional timing variation using predicted data from pre-reform regional enrolment data. Nonetheless, there is no concrete information on the geographic and regional timing variation of the reform, though the first reform focuses on regional decentralization. This could result in measurement error which may produce imprecise estimates. This is why this study focuses only on ETP, in spite of the latter reform being influenced by the former.



### 3. Empirical Framework

#### 3.1. Identification Strategy

This paper explores how exogenous variation in education caused by the 1994 free primary education reform in Ethiopia can be used to create instrumental variables to estimate the causal impact of education on welfare. Under certain assumptions, this solves the endogeneity problem that leads to bias when estimating the impact of education on welfare. Using three waves (2011/2012, 2013/2014, 2015/2016) of a nationally representative panel survey from Ethiopia, I construct dummy variables that indicate which cohorts of individuals were affected by the reform. More specifically, individuals' ages (date of birth) were used to determine whether an individual was exposed to the reform. An individual born in 1990 or before was 4 years or older when the reform was implemented in 1994. This corresponds to the individual being 22 or older in 2012, 24 or older in 2014, and 26 or older in 2016. Table 1 describes the reform dummies using the age of an individual born in 1990 or later through to 1980. This is then matched to the corresponding age in 1994, 2012, 2014, and 2016.

The official entry age for primary school in Ethiopia is age seven, and primary education lasts for eight years (grades 1-8). Grade repetition and delayed school entry are major factors contributing to children being older than the expected age for their grade in school in most sub-Saharan African countries. This leads to wide variation in age for a given grade among enrolled children in primary school (Glewwe and Jacoby, 1995; Grant and Behrman, 2010; UNESCO, 2012).

Table 2 presents information on enrolment, based on the 2007 E.C (2014/2025) Education Statistics Annual Abstract, for Grades 1 to 8, and for Grade 1 only, and the population age of seven through 14 years in Ethiopia (Ministry of Education, 2016), which is the age range associated with Grades 1-8. The Apparent Intake Rate (AIR)<sup>3</sup> for Grade 1 for Ethiopia as a whole is 158.4%, implying there are many children who

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<sup>3</sup> The Apparent Intake Rate (AIR) is the percentage of new entrants irrespective of their age examined in contrast with the population age of school admission age in Ethiopia.

are not age seven but are enrolled in Grade 1. This could be due to grade repetition or to students starting primary school later than age seven. The Gross Enrolment Ratio (GER)<sup>4</sup> for Grades 1-8 is 101%, indicating the number of students that have chance to attend primary school reach the target and are in the population age of seven to 14 years (Ministry of Education, 2016). Tables 3a and 3b present the distribution of age and educational attainment in Ethiopia for individuals age 7-14, as reported in the 1994 Ethiopia Census. Tables 2, 3a, and 3b are used to set the age cutoff used in constructing the reform dummies.

In order to rule out measurement error, the paper selects an extensive possible age cutoff<sup>5</sup> from age four and below through age 14. The official age for preschool in Ethiopia is four to six. Any individual in this age in 1994 is expected to be fully exposed to the reform. In contrast, individuals of age 15 and older in 1994, based on Tables 3a and 3b, are considered to be too old to have been exposed to the reform. The age cutoff in 1994 were then matched to the age of the individual households in the three-wave nationally represented panel data (2011/2012, 2013/2014, 2015/2016). In summary, individuals of age 14 and below in 1994 were partially or fully exposed to the reform, whereas those above age 14 in 1994 were not exposed to the reform.

More specifically, three categories of reform dummy variables were constructed.

*Category 1:* Individuals who were eight or younger in 1994, who were strongly affected by the reform because those individuals were either in pre-school or in early stages (first cycle) of primary school when the reform was implemented in 1994. Possibly, some of these individuals were also infants.

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<sup>4</sup> The Gross Enrolment Ratio (GER) shows the total number of children enrolled in grade 1-8 irrespective of their age as a proportion of the school age population in Ethiopia.

<sup>5</sup> Age (years) in 1994: 4 and below, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14.

*Category 2:* Individuals in the age range of nine to 14 in 1994 are likely to have been only partially affected by the reform, since these individuals were either finished with the first cycle or in the second cycle of primary school in 1994.

*Category 3:* Individuals age 15 and older in 1994, who had little or no exposure to the reform since at that age range an individual were either finishing up or no longer in primary school in 1994.

The paper uses both difference-in-differences (DID) and instrumental variable (IV) estimators. DID is used to estimate the impact of the reform on education, and IV is used to estimate the impact of education on household welfare<sup>6</sup>. The treatment reform dummy variables in Table 1 were used as instrumental variables to provide exogenous variation in years of schooling, and thus exogenous variation was used to estimate the causal effect of years of schooling on welfare. The identification assumptions underlying this strategy are the different assumptions stated in the three categories of dummy variables above. Justification for the exclusion restriction and instrument condition are explained in Section 6.

Thus, Table 3 presents a rough tabulation of the DID estimator explaining the identification strategy and assumptions. However, these results are imprecise and uncertain, and so the rest of this paper explains a more detailed and precise regression estimation. The results of the weakly affected is likely to be caused by the sharp decline in enrolment in the mid 1980's, and perhaps this was due to the severe famine that occurred in Ethiopia between 1983-1985.

### **3.2. Empirical Strategy**

In order to estimate the effect of the reform on education and individual welfare in Ethiopia, I conduct difference-in-differences (DID) estimation in a regression framework. The DID estimator is used to predict

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<sup>6</sup> Reform dummies were used as treatment variable in the DID estimation, not as IV, and these treatment dummies were used as IV in estimating the impact of education on welfare. See Duflo (2001) pages 797-802 for more details on method.

the impact of the reform on education; and is then used as the first stage equation in a two-stage least squares (2SLS) estimation of the return to education.

The structural model (OLS) estimating the direct linkage between welfare and education is written as;

$$\mathbf{W}_{ij} = \beta_0 + \beta_1 S_{ij} + \boldsymbol{\delta} \mathbf{X}_{ij} + \mu_{ij}. \quad (1)$$

Where  $\mathbf{W}_{ij}$  is various measures of welfare of individual  $i$  in cohort  $j$ ;  $\beta$ 's,  $\boldsymbol{\delta}$  are coefficients,  $\mathbf{X}_{ij}$  is a vector of time invariant control variables of individual  $i$  in cohort  $j$ ;  $S_{ij}$  is the years of schooling of individual  $i$  in cohort  $j$ ;  $\mu_{ij}$  is the residual.

### 3.2.1. Effect of Free Primary Education Reform on Years of Schooling

Two models of DID (first stage equations) were used to estimate the impact of the reform on years of endogenous schooling. The first is a restricted estimation, and the second is an unrestricted estimation. Restricted estimation categorizes strongly (age 4 and below to age 8 in 1994) and weakly (age 9 to 14 in 1994) affected cohorts separately into two different treatment dummies; whereas the unrestricted uses individual-specific reform dummies (ages: 4 and below, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14) as a set of treatment dummy variables without imposing any groupings. The latter is to disentangle the individual-specific effect of the reform dummies on years of schooling and welfare.

#### *Restricted estimation*

I estimate the first stage equation by imposing a group restriction on the reform dummies, stated as;

$$S_{ij} = \alpha_0 + age_i + \alpha_1 agesq_i + \gamma_1 T_{1i} + \gamma_2 T_{2i} + \boldsymbol{\theta} \mathbf{X}_{ij} + \varepsilon_{ij}. \quad (2)$$

Where  $T_{1i}$  is a “treatment dummy” indicating whether an individual belongs to the strongly affected cohort (age 4 and below to 8 in 1994);  $T_{2i}$  “treatment dummy” indicates whether the individual belongs to the weakly affected cohort (age 9 to 14 in 1994);  $age_i$  and  $agesq_i$  account for long term trends in the determinants of years of schooling.  $age_i$  is the age of individual households between the ages of 20 to 60;

$agesq_i$  is the squared of  $age_i$  that explains the non-linear component of the trend;  $\varepsilon_{ij}$  is the residual of individual  $i$  in cohort  $j$ ; and  $\gamma_1, \gamma_2, \alpha$ 's,  $\theta$  are coefficients. The comparison (control) group for this estimation is the unaffected cohorts (age above 14 in 1994). The assumption for the first stage equation is  $E[T_1, X_{ij}] \neq 0$   $E[T_2, X_{ij}] \neq 0$

Second, I estimate the reduced form equation as;

$$W_{ij} = \pi_0 + age_i + \pi_1 agesq_i + \pi_3 T_{1i} + \pi_4 T_{2i} + \theta X_{ij} + \omega_{ij}. \quad (3)$$

Where  $\pi$ 's,  $\theta$  are coefficients and  $\omega_{ij}$  is the residual of individual  $i$  in cohort  $j$ . The strongly affected treatment dummy has a full treatment effect whereas the weakly affected has a partial treatment effect.

### ***Unrestricted estimation***

Here, the first stage equation is specified as the relationship between years of schooling of an individual  $i$  born in year  $k$ , and their respective degree of exposure to the reform.

$$S_{ij} = \alpha_0 + age_i + \alpha_1 agesq_i + \sum_{k=<4}^{14} \gamma_{1k} T_{ik} + \theta X_{ij} + \varepsilon_{ij}. \quad (4)$$

Where  $T_{ik}$  is a set of treatment dummy variables indicating whether individual  $i$  is of age  $k$  in 1994,  $k = <4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14$ ;  $\gamma_{1k}$  is the coefficient of treatment dummy which estimates the impact of the reform on a given cohort. The same omitted group as the restricted estimation is used (unaffected cohorts, age above 14 in 1994). This estimates the impact of each of the reform dummies (created in Table 1) on education.

The reduced form equation is estimated as;

$$W_{ij} = \pi_0 + age_i + \pi_1 agesq_i + \sum_{k=<4}^{14} \pi_{3k} T_{ik} + \theta X_{ij} + \omega_{ij}. \quad (5)$$

Unlike the restricted estimation, there are 5 full treatment ( $<4, 5, 6, 7, 8$ ) effects and 6 partial treatment (9, 10, 11, 12, 13, 14) effects of each reform dummy.

### **3.2.2. Effect of Free Primary Education Reform on Welfare (2SLS of Returns to Education)**

The returns to education are estimated for both the restricted and unrestricted models using 2SLS.

### ***Restricted estimation***

The 2SLS restricted estimation of return to education is expressed as;

$$W_{ij} = \pi_{10} + age_i + \pi_{11}agesq_i + \pi_{13}\hat{S}_{ij} + \sigma X_{ij} + \rho_{ij}. \quad (6)$$

Where  $\hat{S}_{ij}$  is the predicted years of schooling from equation (2);  $\rho_{ij}$  is the residual;  $\pi's$ ,  $\sigma$  are coefficients.

This model estimates the impact of the predicted years of schooling on poverty measures of welfare

### ***Unrestricted estimation***

Finally, I replaced the predicted years of schooling in equation (6) with that of equation (4) to estimate the 2SLS returns to education for the unrestricted model. The model specification is the same as the restricted except for the different predicted years in schooling.

$$W_{ij} = \pi_{10} + age_i + \pi_{11}agesq_i + \pi_{13}\hat{S}_{ij} + \sigma X_{ij} + \rho_{ij}. \quad (7)$$

### **3.2.3. Choice of Estimation**

The most relevant estimations are the first stage equation that estimates the impact of the reform on education, and the 2SLS estimating the returns to education. The reduced form equations are for robustness check of the 2SLS and OLS estimation.

## **4. Data and Descriptive Statistics**

### **4.1. Data**

I used data from the World Bank Living Standards and Measurement Survey – Integrated Surveys on Agriculture (LSMS-ISA) for Ethiopia. The data is a three-wave nationally represented panel data collected in 2011/2012, 2013/2014, and 2015/2016. The first wave survey refers to the Ethiopian Rural Socioeconomic Survey (ERSS)<sup>7</sup>, which was collected and documented in collaboration with the Central Statistics Agency of Ethiopia (CSA) and the World Bank LSMS-ISA team. The survey was collected in

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<sup>7</sup> ERSS is generally collected in rural areas and is implemented in 290 rural and 43 small town enumeration areas (EAs). It collects data on rural and small-town households, their characteristics, welfare and their agricultural activities.

three rounds of visits to each household; first (September-October 2011), second (November-December 2011), and third (January-March 2012). The household survey which is the main part of the data used for this study was collected in the third round. The total number of households interviewed is 3,969 with a response rate of 99.3 percent. Consumption expenditure aggregate data was constructed from food, non-food, and education expenses as a separate data.

The second wave, the Ethiopia Socioeconomic Survey (ESS) collects and documents the same information as the first wave. The Ethiopia Socioeconomic Survey first began with only rural areas and then expanded it to include all urban areas. This increased the number of survey areas from 333 (3,776 households) to 433 (5,262 households). The total sample for both waves is 5,262 (433 EAs), out of which 290 were rural, 43 were small towns and 100 were urban EAs. The mode of survey collection and documentation is the same for the third wave. Though data were collected in different years, the time (month) frame in each year was the same across all the three waves.

The household and consumption aggregate data were employed for the current study with a focus on intra-households. After thorough data management of the three-wave panel data, a total sample of 4,192 individuals from age 20 to 60 years was utilized for the analysis. The key variables used from the panel data were age, years of schooling, consumption expenditure, gender, religion, and region of birth.

#### **4.1.2. Measures of Welfare**

Welfare is measured in terms of poverty as in Darko et al., (2018). These measures include per adult equivalent consumption expenditure, relative deprivation in terms of per adult equivalent consumption expenditure, and poverty gap. The total annual consumption expenditure is the aggregate expenditure consisting of expenditure on food, non-food, and education; including 25 separates food items<sup>8</sup> commonly

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<sup>8</sup> (Teff; wheat; barley; maize; sorghum; millet; horse beans; chick pea; field pea; lentils; haricot beans; Niger seed; linseed; onion; banana; potato; kocho and bula; meat; milk; cheese; eggs; sugar; salt; coffee; and chat/Kat)

consumed in Ethiopia. The non-food<sup>9</sup> expenditure component consists of expenditure on 11 basic household goods over the past one month, and 12 other<sup>10</sup> expenditure categories over the past 12 months.

Nominal per adult equivalent consumption expenditure is calculated as a variable in the consumption aggregate data. Real per adult equivalent consumption expenditure is not included in the data; but using the provided price index in the data I deflate the nominal value into real terms. Relative deprivation (RD) in terms of consumption expenditure is measured using the index as defined by Stark and Taylor (1989):

$$RD = AD(y_i) * P(y_i). \quad (8)$$

Where  $AD(y_i)$  is the mean per adult equivalent consumption (real value) of household in a reference group that are richer than the household  $i$ ;  $P(y_i)$  is the proportion represented by these households. The reference group for this study is the total sample size of each wave data, since free primary education is a national reform, hence the need to estimate a universal representative effect. The larger the RD index for a given household, the more deprived the household is relative to other households in terms of real per adult equivalent consumption expenditure.

The Foster-Greer-Thorbeckie index (Foster et al., 1984) is used to measure the poverty gap and severity of poverty. Mathematically is specified as;

$$FGT_{\alpha} = \left(\frac{1}{n}\right) \sum_{i=1}^h \left(\frac{Z-y_i}{Z}\right)^{\alpha}. \quad (9)$$

Where  $y_i$  is the real per adult equivalent consumption of household  $i$ ; and  $Z$  is the Ethiopia national poverty line. Three poverty lines are constructed for each wave using the set national poverty line (Birr 3781 per year per adult person) based on the 2010/2011 Household Income and Consumption Expenditure Survey

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<sup>9</sup> (matches; batteries; candles and incense; laundry soap, omo, endod, and besana leaves; hand soap; other personal care goods; charcoal; firewood; kerosene; cigarettes, tobacco, suret, and gaya; and transport)

<sup>10</sup> (clothes/shoes/fabric for men; clothes/shoes/fabric for women; clothes/shoes/fabric for boys; clothes/shoes/fabric for girls; kitchen equipment; linens; furniture; lamp and torch; ceremonial expenses; contributions to IDDIR; donations to the church; and taxes and levies)



(HICE). The poverty line for 2011/2012, 2013/2014, and 2015/2016 were obtained by applying their respective annual GDP deflator<sup>11</sup> to the national set poverty line in 2010/2011 (NPC, 2017).

Table 4 displays the poverty lines for the three waves. Usually, FGT is a summary statistic but it is agreeable for use in a regression model by creating a household specific version of the index using the expression within the summation (Mason and Smale, 2013).  $FGT_1$  and  $FGT_2$  ( $\alpha = 1, 2$ ) denote poverty gap and severity of poverty where the latter is the squared of the former. The poverty gap and severity both take values of zero for non-poor households and a fraction for poor households. Thus,  $\{FGT_1 = [0,1]; FGT_2 = [0,1]\}$ . This paper focuses only on the poverty gap.

## 4.2. Descriptive Statistics

Table 5 describes the variables used in obtaining the estimates of the analysis. The dependent variables are real per adult equivalent consumption expenditure, relative deprivation in terms of per adult equivalent consumption expenditure, and poverty gap. I used time invariant covariates including gender, region of birth, and religion; and I included the treatment dummy variables for cohorts who are weakly and strongly affected by the reform. Tables 6a, 6b, and Figure 2 reports the descriptive and summary statistics. Summary statistics of all the variables are presented in Table 6a, separately for each wave data and the pooled data. Statistics for the pooled data differs slightly from that of the wave-specific data.

Table 6b reports the frequencies and percent values of the time invariant covariates for the pooled data. Slightly more than half of the population used are female; and Oromia, Amhara and SNNP regions have the highest number of households for this study. More than 50 percent of the households belongs to an orthodox church. Figure 2 displays a graphical representation of the reform effect on years of schooling, and obviously years of schooling is higher for the strongly exposed (age 30 and below) cohorts in contrast to the weakly exposed (age 30 to 36). Also, some cohorts outside the age cut off (above age 36) may have

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<sup>11</sup> Provided by the Ministry of Finance and Economic Cooperation (MOFEC 2011-2016) of Ethiopia.

more years of education than the weakly affected, which validates the mean difference conclusion of less marginal gain for the weakly exposed in Table 3.

The regression fitted line<sup>12</sup> indicates that younger cohorts are more educated than older cohorts owing to the reform exposure. This, then partly justifies the assumption of cohorts aged 8 and below in 1994 being strongly exposed to the reform. Finally, this may imply that those who were in second cycle or later stages of primary school when the reform was implemented benefited less or none.

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<sup>12</sup> Regression line corresponds to the first stage restricted reduced form equation (6).

## 5. Results and Discussion

### 5.1. Restricted estimation

#### 5.1.1. Effect of reform on education (DID estimation) and welfare outcomes

Table 7 show the coefficient estimates of the reduced form restricted models for education and all poverty measures. Coefficients for the strongly exposed treatment dummy were significantly greater than zero for education, and consumption expenditure<sup>13</sup>; whereas that of relative deprivation and poverty gap produce significant negative estimates. This means the reform is expected to increase years of schooling (79.5%, 77%)<sup>14</sup> and log consumption expenditure (37.2%, 37%) of individuals that are strongly exposed to the reform; and reduce the levels of relative deprivation (13.5%, 13.3%) and poverty gap (12.8%, 12.6%). The first stage equation (2) coefficients for consumption expenditure and relative deprivation are the same due to the same sample size. Simply put, educational achievement of the strongly exposed cohorts' increases by 77% and 79.5% with and without covariates, and similar explanation applies to the various welfare measures.

The treatment dummy for the weakly exposed produces insignificant negative estimates for education, and significant estimates for consumption expenditure, relative deprivation, and poverty gap. This suggest the weakly exposed cohorts are possibly unaffected by the reform since the insignificant estimates reduces educational level. Regardless of this, it decreases relative deprivation and poverty gap; and increases consumption expenditure. Thus, weakly affected cohorts are either better off in the absence of the reform or not affected by it. In summary, the results of the reduced form restricted estimations justify the findings of the mean difference in Table 3 and the graphical representation in Figure 2. The first stage reduced form

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<sup>13</sup> Consumption expenditure and relative deprivation are all logged.

<sup>14</sup> First percent value is without covariates and second is with covariates, this represent first stage equation estimates for consumption expenditure and relative deprivation first stage.

confirms the reform does affect years of schooling of individuals who are age eight and younger (category 1 in section 4.1).

As a robustness check I dropped the treatment dummy variable for the weakly affected and constructed a new reduced form restricted model with only the strongly exposed treatment dummy variable. The omitted group is now formed of individuals aged nine and above in 1994. The coefficient estimates reported in Table 8 were robust and consistent with the direction of the strongly exposed treatment estimates in equation (2) and (3), and are more highly significant than the estimates in equation (2) and (3). However, the predicted values differ from the first estimation with larger estimates for education, and smaller estimates for consumption expenditure, relative deprivation, and poverty gap. This may imply the implementation of the reform affected the population age of eight and younger who were either in pre-school (or possibly infants) or in the first cycle of primary school at the time of the reform. Overall, the results of the DID and reduced form for the restricted estimation satisfies the identification assumptions described in section 4.

#### **5.1.2. Returns to education of welfare outcomes**

The direction of the coefficients of OLS and 2SLS is the same as that of the reduced form equation (3) that estimates the direct relationship between the two restricted treatment dummies and the various measures of welfare. The reduced form equation serves as a robustness check for the OLS and 2SLS. Similarly, the estimates on returns to education for both OLS and 2SLS were significantly greater than 0 for consumption expenditure, while negatively significant for the OLS estimates of relative deprivation and poverty gap. However, the magnitude of the 2SLS estimates were larger than the OLS estimates; and the robust standard errors for the 2SLS were slightly larger than the OLS standard errors. Table 9 presents these estimates. The relatively high explanatory power of the instruments as explained by the F-statistics in the first stage estimation confirms the validity of these instruments. Therefore, the OLS estimates may be biased downwards possibly due to measurement errors and reverse causality. 2SLS estimator may be

better in explaining the causal relationship between education and welfare outcomes, only if perhaps the weakly exposed treatment dummy is dropped as an instrument or is redefined. This is because it may be correlated with the error term or the strongly exposed treatment variable due to its poor explanatory power in the first stage which can make 2SLS estimates biased towards the OLS.

The OLS minimize the estimate of the variance of errors, so is expected to have smaller standard errors than the 2SLS. Further, the 2SLS estimates with only one instrument (strongly exposed treatment dummy) produce very similar estimates as the former but slightly larger estimates as display in Table 10, and all estimates were significant unlike the former. This method maybe more precise since the weakly exposed instrument explain the exogenous variation in education poorly and is likely to be wrongly defined. The larger F-statistic of the model with only strongly exposed instrument explain the overall significance of using only the strongly exposed treatment dummy variable.

The restricted instruments used were tested for its strength using Montiel Olea and Pflueger (2013) robust test for weak instrument; and shows the worst-case bias in the estimator is less than the critical value at 5% (tau) leading to a rejection<sup>15</sup> of the null hypothesis of weak instrument. Hence the instruments are strong in all estimations. The validity of the instruments is tested based on the relevance and exogeneity condition. The relevance condition holds in the case of consumption expenditure and relative deprivation since all the endogeneity tests show years of schooling is indeed an endogenous regressor, but fails in the case of poverty gap. However, dropping the weakly exposed treatment variable corrected it. Also, the OLS estimates not being the same as the 2SLS estimates validates the relevance condition.

The test for over-identifying restriction fails in most cases which could possibly be due to either a misspecification of the model or correlation of instruments with the error term, probably the weakly exposed treatment dummy variable. Nonetheless, most studies (Angrist and Pischke, 2009; Parente and

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<sup>15</sup> Since F statistics was greater than the critical values of worst-case bias.

Santos Silva, 2012) indicates this test gives minimal information on whether instruments are correlated with the errors in case validity holds or not. The exogeneity condition cannot be tested but it holds based on the assumption that the instruments constructed are uncorrelated with the error term, strictly only when the weakly exposed treatment instrument is dropped or redefined since it may not be orthogonal.

In general, the results agree with most previous studies (Card, 1993, 1995, 1999; Butcher and case, 1994; Ashenfelter and Zimmerman, 1997) finding that IV estimates are larger than OLS estimates.

## **5.2. Unrestricted estimation**

### **5.2.1. Effect of reform on education (DID estimation) and welfare outcomes**

Table 11 reports the reduced form unrestricted coefficient estimates. Estimates of the first stage produce statistically strong significance for cohorts aged five and six. The reduced form unrestricted models generate inconsistent estimates, since at the worst case of no significant effect on education, almost all the estimates on welfare measures were strongly significant. The results here may not be precise and is not consistent with the restricted estimation results. The purpose of the unrestricted estimation is to disentangle the individual-specific effect of the reform dummies on years of schooling and welfare. However, using this approach produces unstable and unreliable estimates of years of schooling and welfare measures. Also, the low F-statistic explain the very poor explanatory power of this estimation.

### **5.2.2. Returns to education of welfare outcomes**

Table 12 presents the coefficient estimates of OLS and 2SLS for the unrestricted estimation. The OLS estimates is smaller than the 2SLS estimates. The 2SLS estimates maybe imprecise and inconsistent possibly due to potential sample bias, measurement error, and simultaneity bias. This makes the 2SLS bias towards the OLS which leads to upward bias estimation. Potential sample and simultaneity bias may be due to the use of many weakly correlated instruments since the test for weak instruments failed in this estimation. Using the same test of Montiel Olea and Pflueger (2013) led to the failure to reject the null hypothesis of weak instrument implying the instruments are not strong. However, the endogeneity test

holds in all cases. The assumption for the exclusion restriction (exogeneity) may not hold in this case because it is possible the instruments are correlated with the error term due to the nature of the results generated. In short, the instruments used in the unrestricted estimation might not be valid leading to bias and imprecise results. Therefore, the restricted estimation is likely to be the best approach for this study with the caveat of using only the strongly exposed dummy as a treatment variable.

The estimates on log consumption expenditure means the reform positively impact on education which produces a gain in the welfare of individuals. Whereas, the estimates on log relative deprivation and poverty gap implies the reform increased years of schooling and improved welfare via the reduction of poverty.

## 6. Conclusion

This article examines the impact of free primary education reform on years of schooling, and then estimates the effect on various welfare outcomes. Welfare outcomes are measured in terms of poverty using per adult equivalent consumption expenditure, relative deprivation, and poverty gap. The results indicate that the reform increased primary school enrolment, which in turn improved the welfare of households. Thus, the study provides evidence that free primary education positively impacts the welfare of households in Ethiopia. Also, the assumption that cohorts aged eight and below in 1994 are strongly affected by the reform is justified by the results of this study.

The positive estimates of education on strongly exposed cohorts aged eight and younger in 1994, indicates the reform affects younger individuals in pre-school (or possibly infants) or in early stages of the first cycle of primary education. The findings on the weakly exposed cohorts aged nine to 14 could also mean such individuals are either not affected or weakly affected by the reform. This suggests cohorts in the second cycle or late stages of primary school at the time of the reform maybe comparable to unaffected cohorts above age 14 in 1994 (likely not in primary school). The result of the weakly affected individuals is also likely to be caused by the severe famine<sup>16</sup> that occurred in Ethiopia in 1983-1985. The estimates of the economic returns to education on the poverty measures indicates the welfare of individuals affected by the reform improved. This then suggests that free primary education reform led to welfare gains for people of Ethiopia.

The paper presents an identification strategy using a national level data to estimate the extent of free primary education on years of schooling and welfare gains in Ethiopia. The estimates generated indicates reform led to increase primary school enrolment and welfare gains of the people of Ethiopia. However, I

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<sup>16</sup> Therefore, I need to control for the severe famine using weather and political instability data, since the famine was mostly ascribed to drought, climatic phenomena, and political instability. I am still working on these confounders using weather data from NOAA and conflict data from UCDP/PRIO Armed Conflict dataset. The approach I am using to capture the weather on all individuals is “weather shock approach” as by Maccini and Yang (2009). The final paper will contain modified results with the confounders included.



examined this study using only temporal variation, future extension of this work can consider using both temporal and geographic variation. Extending the study to other SSA countries with free primary education will also be a good idea for future studies. Policy makers, economist, and Ethiopia Ministry of education may consider these results as a guide in decision making, and implementing or amending future education reforms.

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## Appendix

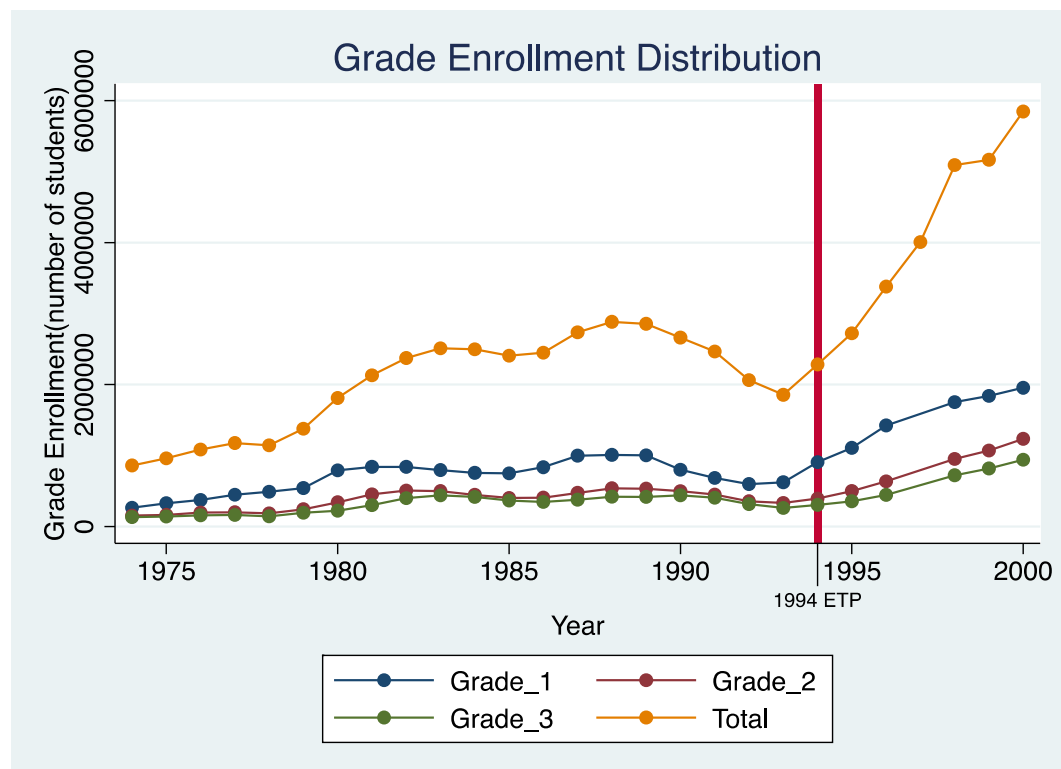


Figure 1. Grade 1 enrolment compared to other grades and total enrolment. 1994 ETP refers to the Education and Training Policy implemented in 1994. Increase in grade 1 enrolment was greater than the increase in other grades and before the ETP implementation.  
Source: UNESCO Institute for Statistics.

## Effect of FPE reform on years of schooling (Pooled)

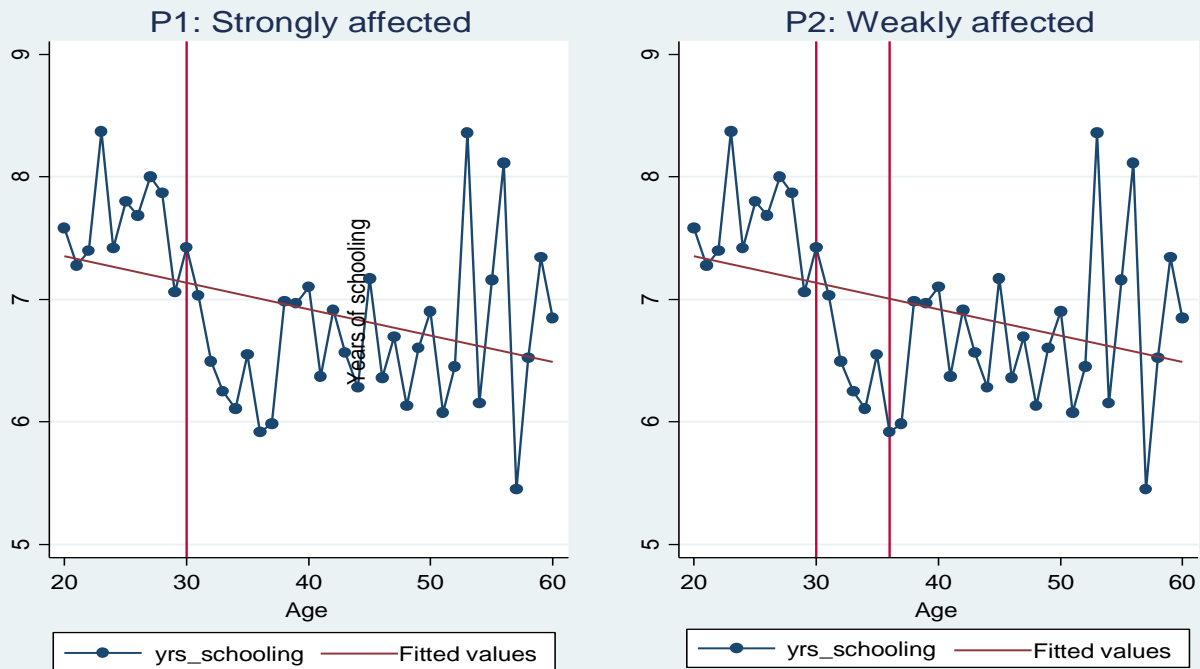


Figure 2. Individuals age 30 and below are strongly affected by the reform compared to those between age 30 and 36 that are weakly affected by the reform. The fitted line shows years of education increase with decreasing age. Weakly affected is comparable to the unaffected individuals.  
 Source: LSMS-ISA data

**Table 1: FPE Reform dummy variables in 1994 matched with age in wave data**

| <b>Birth Year</b> | <b>Age (1994)</b> | <b>Age (2012)</b> | <b>Age (2014)</b> | <b>Age (2016)</b> | <b>Degree of FPE Effect</b> |
|-------------------|-------------------|-------------------|-------------------|-------------------|-----------------------------|
| >=1990            | <=4               | <=22              | <=24              | <=26              | Strong                      |
| 1989              | 5                 | 23                | 25                | 27                | Strong                      |
| 1988              | 6                 | 24                | 26                | 28                | Strong                      |
| 1987              | 7                 | 25                | 27                | 29                | Strong                      |
| 1986              | 8                 | 26                | 28                | 30                | Strong                      |
| 1985              | 9                 | 27                | 29                | 31                | Weak                        |
| 1984              | 10                | 28                | 30                | 32                | Weak                        |
| 1983              | 11                | 29                | 31                | 33                | Weak                        |
| 1982              | 12                | 30                | 32                | 34                | Weak                        |
| 1981              | 13                | 31                | 33                | 35                | Weak                        |
| 1980              | 14                | 32                | 34                | 36                | Weak                        |
| >1980             | >14               | >32               | >34               | >36               | No effect                   |

Notes: Age is measured in years. Cohorts in age range <4 to 8 are strongly affected whereas those in the 9 to 14 range are weakly exposed to the reform. Cohorts above age 14 are not affected by the reform



**Table 2: Apparent intake rate (AIR) and gross enrolment ratio (GER) of school population age and grade enrolment**

| Region                  | Grade 1-8 Enrolment          |                              |              | Grade 1 Enrolment |                  |              |
|-------------------------|------------------------------|------------------------------|--------------|-------------------|------------------|--------------|
|                         | School Age Population (7-14) | Enrolment First cycle (G1-8) | GER%         | Population Age 7  | Enrolment to G1  | AIR %        |
| Tigray                  | 996,976                      | 1,102,593                    | 110.6        | 123,342           | 181,339          | 147.0        |
| Afar                    | 288,288                      | 218,963                      | 76.0         | 42,923            | 33,409           | 77.8         |
| Amhara                  | 3,883,527                    | 4,282,146                    | 110.3        | 531,981           | 747,830          | 140.6        |
| Oromiya                 | 7,384,614                    | 6,841,930                    | 92.7         | 943,455           | 1,528,032        | 162.0        |
| Somali                  | 882,125                      | 711,941                      | 80.7         | 155,050           | 266,560          | 171.9        |
| SNNP                    | 3,990,378                    | 4,273,580                    | 107.1        | 487,899           | 897,385          | 183.9        |
| Benishangul-Gumuz       | 206,002                      | 214,877                      | 104.3        | 26,875            | 43,359           | 161.3        |
| Gambella                | 75,077                       | 104,327                      | 139.0        | 9,571             | 18,574           | 194.1        |
| Harari                  | 40,618                       | 41,336                       | 101.8        | 5,176             | 9,158            | 176.9        |
| Addis Ababa             | 342,525                      | 505,914                      | 147.7        | 50,511            | 46,484           | 92.0         |
| Dire Dawa               | 101,170                      | 67,068                       | 66.3         | 11,086            | 9,327            | 84.1         |
| <b>National (Total)</b> | <b>18,191,299</b>            | <b>18,364,675</b>            | <b>101.0</b> | <b>2,387,870</b>  | <b>3,781,457</b> | <b>158.4</b> |

Source: Education Statistics Annual Abstract 2007 E.C. (2014/2015), Technical Report in Addis Ababa, Ethiopia

Notes: There more students of other age in grade 1 aside the official entry age of 7, and the grade 1 to 8 enrolment constitute the primary school age population of 7 to 14.

**Table 3a: Weighted Distribution of Age and Educational Attainment of Individuals in Ethiopia**

| Education level in 1994      | Age in 1994 (years) |         |           |         |           |         |           |         |           |         |           |         |
|------------------------------|---------------------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|
|                              | 5                   |         | 6         |         | 7         |         | 8         |         | 9         |         | 10        |         |
|                              | Frequency           | Percent | Frequency | Percent | Frequency | Percent | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| no education                 | 211,508             | 45.90%  | 175,499   | 33.30%  | 201,078   | 24.90%  | 185,130   | 16.40%  | 149,352   | 12.90%  | 178,381   | 10.20%  |
| literate or literacy program | 8,038               | 1.70%   | 13,853    | 2.60%   | 21,394    | 2.60%   | 25,569    | 2.30%   | 22,868    | 2.00%   | 30,771    | 1.80%   |
| non-regular education        | 7,243               | 1.60%   | 14,259    | 2.70%   | 15,214    | 1.90%   | 15,402    | 1.40%   | 10,183    | 0.90%   | 15,820    | 0.90%   |
| pre-school                   | 224,684             | 48.80%  | 273,037   | 51.80%  | 326,318   | 40.40%  | 248,852   | 22.00%  | 168,727   | 14.60%  | 176,641   | 10.10%  |
| basic education, grade 1     | 6,871               | 1.50%   | 45,650    | 8.70%   | 210,767   | 26.10%  | 453,743   | 40.20%  | 366,932   | 31.70%  | 443,227   | 25.30%  |
| basic education, grade 2     | 231                 | 0.10%   | 3,554     | 0.70%   | 27,512    | 3.40%   | 167,333   | 14.80%  | 302,045   | 26.10%  | 419,283   | 23.90%  |
| basic education, grade 3     | 0                   | 0.00%   | 10        | 0.00%   | 3,720     | 0.50%   | 28,803    | 2.50%   | 108,564   | 9.40%   | 316,368   | 18.10%  |
| basic education, grade 4     | 0                   | 0.00%   | 0         | 0.00%   | 20        | 0.00%   | 3,873     | 0.30%   | 25,030    | 2.20%   | 129,251   | 7.40%   |
| basic education, grade 5     | 0                   | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 3,481     | 0.30%   | 34,544    | 2.00%   |
| basic education, grade 6     | 0                   | 0.00%   | 10        | 0.00%   | 0         | 0.00%   | 10        | 0.00%   | 10        | 0.00%   | 5,795     | 0.30%   |
| basic education, grade 7     | 0                   | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 450       | 0.00%   |
| basic education, grade 8     | 0                   | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 120       | 0.00%   |
| basic education, grade 9     | 10                  | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 10        | 0.00%   | 100       | 0.00%   |
| basic education, grade 10    | 0                   | 0.00%   | 0         | 0.00%   | 20        | 0.00%   | 10        | 0.00%   | 0         | 0.00%   | 0         | 0.00%   |
| basic education, grade 11    | 0                   | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 60        | 0.00%   |
| basic education, grade 12    | 10                  | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 40        | 0.00%   |
| certificate or diploma       | 0                   | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 10        | 0.00%   | 0         | 0.00%   | 50        | 0.00%   |
| bachelor, incomplete         | 0                   | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 10        | 0.00%   | 10        | 0.00%   |
| bachelor, complete           | 0                   | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   |
| graduate, incomplete         | 0                   | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   |
| graduate, masters            | 0                   | 0.00%   | 0         | 0.00%   | 10        | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 10        | 0.00%   |
| graduate, doctorate          | 0                   | 0.00%   | 10        | 0.00%   | 10        | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 10        | 0.00%   |
| unknown                      | 1,732               | 0.40%   | 1,344     | 0.30%   | 1,534     | 0.20%   | 1,262     | 0.10%   | 908       | 0.10%   | 980       | 0.10%   |
| Total weight                 | 460,327             | 100.00% | 527,226   | 100.00% | 807,597   | 100.00% | 1,129,996 | 100.00% | 1,158,120 | 100.00% | 1,751,911 | 100.00% |
| Obs (actual)                 | 27,588              |         | 30,187    |         | 44,500    |         | 58,521    |         | 60,619    |         | 91,466    |         |

Notes: Frequency and percent values were adjusted with the household weight in the data. Source: IPUMS International, 1994 Ethiopian Census

**Table 3b: Weighted Distribution of Age and Educational Attainment of Individuals in Ethiopia (Cont'd of Table 3a)**

| Education level in 1994      | Age in 1994 (years) |         |           |         |           |         |           |         | Weighted Value Total |         | Actual Obs. |
|------------------------------|---------------------|---------|-----------|---------|-----------|---------|-----------|---------|----------------------|---------|-------------|
|                              | 11                  |         | 12        |         | 13        |         | 14        |         |                      |         |             |
|                              | Frequency           | Percent | Frequency | Percent | Frequency | Percent | Frequency | Percent | Frequency            | Percent |             |
| no education                 | 69,729              | 7.30%   | 124,035   | 6.80%   | 70,691    | 5.50%   | 65,025    | 4.90%   | 1,430,428            | 12.70%  | 144,550     |
| literate or literacy program | 14,342              | 1.50%   | 30,069    | 1.70%   | 19,356    | 1.50%   | 19,339    | 1.40%   | 205,598              | 1.80%   | 20,114      |
| non-regular education        | 7,552               | 0.80%   | 14,707    | 0.80%   | 9,233     | 0.70%   | 9,697     | 0.70%   | 119,310              | 1.10%   | 9,285       |
| pre-school                   | 59,587              | 6.20%   | 97,230    | 5.40%   | 44,841    | 3.50%   | 36,563    | 2.70%   | 1,656,481            | 14.70%  | 30,831      |
| basic education, grade 1     | 185,974             | 19.40%  | 316,132   | 17.40%  | 165,804   | 12.80%  | 139,124   | 10.40%  | 2,334,224            | 20.80%  | 121,588     |
| basic education, grade 2     | 208,179             | 21.70%  | 354,187   | 19.50%  | 216,040   | 16.70%  | 182,775   | 13.60%  | 1,881,139            | 16.70%  | 88,209      |
| basic education, grade 3     | 183,770             | 19.10%  | 311,437   | 17.20%  | 204,204   | 15.70%  | 184,074   | 13.70%  | 1,340,950            | 11.90%  | 64,833      |
| basic education, grade 4     | 144,141             | 15.00%  | 254,738   | 14.00%  | 183,705   | 14.20%  | 175,401   | 13.10%  | 916,160              | 8.10%   | 46,380      |
| basic education, grade 5     | 64,191              | 6.70%   | 195,937   | 10.80%  | 165,674   | 12.80%  | 171,565   | 12.80%  | 635,392              | 5.70%   | 34,959      |
| basic education, grade 6     | 18,742              | 2.00%   | 87,305    | 4.80%   | 134,050   | 10.30%  | 157,659   | 11.80%  | 403,581              | 3.60%   | 23,052      |
| basic education, grade 7     | 3,170               | 0.30%   | 24,382    | 1.30%   | 64,719    | 5.00%   | 126,577   | 9.50%   | 219,298              | 2.00%   | 14,269      |
| basic education, grade 8     | 90                  | 0.00%   | 3,362     | 0.20%   | 16,100    | 1.20%   | 55,403    | 4.10%   | 75,075               | 0.70%   | 5,999       |
| basic education, grade 9     | 50                  | 0.00%   | 50        | 0.00%   | 1,712     | 0.10%   | 13,802    | 1.00%   | 15,734               | 0.10%   | 1,667       |
| basic education, grade 10    | 10                  | 0.00%   | 20        | 0.00%   | 10        | 0.00%   | 1,958     | 0.10%   | 2,028                | 0.00%   | 221         |
| basic education, grade 11    | 20                  | 0.00%   | 30        | 0.00%   | 0         | 0.00%   | 50        | 0.00%   | 160                  | 0.00%   | 16          |
| basic education, grade 12    | 20                  | 0.00%   | 40        | 0.00%   | 10        | 0.00%   | 10        | 0.00%   | 130                  | 0.00%   | 13          |
| certificate or diploma       | 30                  | 0.00%   | 10        | 0.00%   | 20        | 0.00%   | 0         | 0.00%   | 120                  | 0.00%   | 12          |
| bachelor, incomplete         | 30                  | 0.00%   | 10        | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 60                   | 0.00%   | 6           |
| bachelor, complete           | 10                  | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 10                   | 0.00%   | 1           |
| graduate, incomplete         | 30                  | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 10        | 0.00%   | 40                   | 0.00%   | 4           |
| graduate, masters            | 0                   | 0.00%   | 10        | 0.00%   | 10        | 0.00%   | 10        | 0.00%   | 50                   | 0.00%   | 5           |
| graduate, doctorate          | 20                  | 0.00%   | 30        | 0.00%   | 0         | 0.00%   | 0         | 0.00%   | 80                   | 0.00%   | 8           |
| unknown                      | 390                 | 0.00%   | 544       | 0.00%   | 362       | 0.00%   | 250       | 0.00%   | 9,306                | 0.10%   | 922         |
| Total weight                 | 960,077             | 100.00% | 1,814,266 | 100.00% | 1,296,539 | 100.00% | 1,339,292 | 100.00% | 11,245,352           | 100.00% | 606,944     |
| Obs (actual)                 | 52,030              |         | 96,838    |         | 71,331    |         | 73,864    |         | 606,944              |         |             |

Notes: Frequency and percent values were adjusted with the household weight in the data. Source: IPUMS International, 1994 Ethiopian Census



**Table 4: Poverty lines (Birr per year per adult person)**

| <b>Year</b> | <b>GDP Deflator index</b> | <b>Poverty line (Birr/year/adult)</b> |
|-------------|---------------------------|---------------------------------------|
| 2011/2012   | 1.34 (2012)               | 5067                                  |
| 2013/2014   | 1.6 (2014)                | 6050                                  |
| 2015/2016   | 1.9 (2016)                | 7184                                  |

GDP deflator of each year is multiplied by the Ethiopia national poverty line (Birr 3781/year/adult) set in 2010/2011

Source: National Planning Commission, (2017) report for Ethiopia

**Table 5: Definition of variables in the models**

| <b>Variables</b>   | <b>Definition</b>  |
|--|--|
| <i>Dependent variables (Poverty Measures of Welfare)</i> |  |
| Real per adult equivalent consumption expenditure        | Expenditure on food and non-food consumption (birr) adjusted to real terms |
| Relative deprivation in terms of consumption expenditure | Stark and Taylor's 1989 index (birr)                                       |
| Poverty gap  | Foster-Greer-Thorbecke (FGT) 1984 index [0,1]                              |
| <i>Covariates</i>  |  |
| Education (Highest grade)                                | Years of schooling   |
| Age  | Age of individual (years)  |
| Age squared  | Squared of the age of individual in household                              |
| Gender   | Female = 2 and male = 1  |
| Region of birth  | Region in which individual was born  |
| Religion   | Main religion of individual  |
| Treatment dummy (strongly affected)                      | Individuals of 8 years old and younger in 1994 = 1, otherwise = 0          |
| Treatment dummy (weakly affected)                        | Individuals in age range 9 to 14 years in 1994 = 1, otherwise = 0          |

Notes: Age in data is used but it corresponds to age in 1994

**Table 6a: Descriptive Statistics of dependent variables and covariates**

| <b>Variables</b>   | <b>Wave 3: 2015/2016</b> |               |           | <b>Wave 2: 2013/2014</b> |               |           | <b>Wave 1: 2011/2012</b> |               |           | <b>Pooled</b> |
|--|--------------------------|---------------|-----------|--------------------------|---------------|-----------|--------------------------|---------------|-----------|---------------|
|  | <b>Mean</b>              | <b>Median</b> | <b>SD</b> | <b>Mean</b>              | <b>Median</b> | <b>SD</b> | <b>Mean</b>              | <b>Median</b> | <b>SD</b> | <b>Mean</b>   |
| <i>Dependent variables (Poverty Measures of Welfare)</i> |                          |               |           |                          |               |           |                          |               |           |               |
| Real Per adult equivalent consumption expenditure        | 7,964                    | 7,964         | 7,181     | 6,905                    | 6,905         | 5,325     | 5,965                    | 5,965         | 5,469     | 6,218         |
| Relative Deprivation in terms of consumption expenditure | 5,491                    | 5,491         | 1,512     | 4,605                    | 4,605         | 1,466     | 3,944                    | 3,944         | 1,128     | 5,905         |
| Poverty gap  | 0.229                    | 0.229         | 0.259     | 0.201                    | 0.201         | 0.240     | 0.198                    | 0.198         | 0.238     | 0.291         |
| <i>Covariates</i>  |                          |               |           |                          |               |           |                          |               |           |               |
| Age(years)   | 34.90                    | 34.90         | 10.97     | 33.90                    | 33.90         | 10.82     | 30.35                    | 30.35         | 9.209     | 35.84         |
| Education (Highest grade)                                | 8.382                    | 8.382         | 4.706     | 8.340                    | 8.340         | 4.643     | 8.143                    | 8.143         | 3.907     | 7.026         |
| Age squared  | 1,339                    | 1,339         | 834.6     | 1,266                    | 1,266         | 815.1     | 1,006                    | 1,006         | 646.7     | 1,407         |
| Age in 1994  | 13.05                    | 13.05         | 10.78     | 13.90                    | 13.90         | 10.82     | 12.35                    | 12.35         | 9.209     | 14.03         |
| Treatment 1 (strong)                                     |                          |               |           |                          |               |           |                          |               |           | 0.393         |
| Treatment 2 (weak)                                       |                          |               |           |                          |               |           |                          |               |           | 0.160         |
| <i>Observations</i>                                      | 5,636                    | 5,636         | 5,636     | 5,808                    | 5,808         | 5,808     | 2,758                    | 2,758         | 2,758     | 4,192         |

**Table 6b: Pooled distribution of covariates**

| <b>Variables</b>       | <b>Frequency</b> | <b>Percent</b> |
|------------------------|------------------|----------------|
| <i>Gender</i>          |                  |                |
| Male                   | 1,959            | 46.77          |
| Female                 | 2,230            | 53.23          |
| <i>Region of birth</i> |                  |                |
| Tigray                 | 434              | 10.66          |
| Afar                   | 111              | 2.73           |
| Amhara                 | 891              | 21.88          |
| Oromia                 | 932              | 22.89          |
| Somalie                | 155              | 3.81           |
| Benshagul Gumuz        | 70               | 1.72           |
| SNNP                   | 1,174            | 28.83          |
| Gambella               | 99               | 2.43           |
| Harari                 | 86               | 2.11           |
| Addis Ababa            | 4                | 0.1            |
| Diredawa               | 109              | 2.68           |
| Outside of Ethiopia    | 7                | 0.17           |
| <i>Religion</i>        |                  |                |
| Orthodox               | 1,778            | 43.74          |
| Catholic               | 59               | 1.45           |
| Protestant             | 988              | 24.31          |
| Muslim                 | 1,205            | 29.64          |
| Traditional            | 10               | 0.25           |
| Pegan                  | 8                | 0.2            |
| Wakefeta               | 5                | 0.12           |
| Other                  | 12               | 0.3            |



**Table 7: Effect of Free Primary Education Reform on Education and Welfare (Reduced form restricted models)**

|                      | Education (1st stage for CE and RD) |                      | Log consumption expenditure (CE) |                      | Log relative deprivation (RD) |                      | Education (1st stage for PG) |                      | Poverty gap (PG)     |                      |
|----------------------|-------------------------------------|----------------------|----------------------------------|----------------------|-------------------------------|----------------------|------------------------------|----------------------|----------------------|----------------------|
| Variables            | (1)                                 | (2)                  | (3)                              | (4)                  | (5)                           | (6)                  | (7)                          | (8)                  | (9)                  | (10)                 |
| Age(years)           | -0.038<br>(0.059)                   | -0.030<br>(0.060)    | 0.033***<br>(0.010)              | 0.035***<br>(0.010)  | -0.012***<br>(0.004)          | -0.013***<br>(0.004) | -0.038<br>(0.058)            | -0.029<br>(0.059)    | -0.013***<br>(0.004) | -0.014***<br>(0.004) |
| Age squared          | 0.001<br>(0.001)                    | 0.000<br>(0.001)     | -0.000***<br>(0.000)             | -0.000***<br>(0.000) | 0.000***<br>(0.000)           | 0.000***<br>(0.000)  | 0.000<br>(0.001)             | 0.000<br>(0.001)     | 0.000***<br>(0.000)  | 0.000***<br>(0.000)  |
| age <=4 to 8 in 1994 | 0.795**<br>(0.360)                  | 0.770**<br>(0.364)   | 0.372***<br>(0.062)              | 0.370***<br>(0.062)  | -0.135***<br>(0.027)          | -0.133***<br>(0.027) | 0.660*<br>(0.352)            | 0.615*<br>(0.356)    | -0.128***<br>(0.025) | -0.126***<br>(0.025) |
| age 9 to 14 in 1994  | -0.304<br>(0.240)                   | -0.328<br>(0.242)    | 0.207***<br>(0.039)              | 0.191***<br>(0.039)  | -0.076***<br>(0.017)          | -0.069***<br>(0.017) | -0.340<br>(0.234)            | -0.372<br>(0.236)    | -0.069***<br>(0.017) | -0.067***<br>(0.017) |
| Constant             | 9.994***<br>(1.368)                 | 11.118***<br>(1.416) | 7.910***<br>(0.235)              | 7.933***<br>(0.243)  | 8.511***<br>(0.107)           | 8.494***<br>(0.111)  | 10.158***<br>(1.341)         | 11.443***<br>(1.388) | 0.519***<br>(0.093)  | 0.509***<br>(0.096)  |
| Year FE              | Yes                                 | Yes                  | Yes                              | Yes                  | Yes                           | Yes                  | Yes                          | Yes                  | Yes                  | Yes                  |
| Control              | No                                  | Yes                  | No                               | Yes                  | No                            | Yes                  | No                           | Yes                  | No                   | Yes                  |
| Observations         | 3,954                               | 3,833                | 3,954                            | 3,833                | 3,954                         | 3,833                | 4,192                        | 4,065                | 4,192                | 4,065                |
| R-squared            | 0.028                               | 0.039                | 0.024                            | 0.032                | 0.096                         | 0.095                | 0.027                        | 0.038                | 0.016                | 0.021                |
| F-statistic          | 22.83                               | 19.54                |                                  |                      |                               |                      | 22.92                        | 20.12                |                      |                      |
| P-value              | 0                                   | 0                    |                                  |                      |                               |                      | 0                            | 0                    |                      |                      |

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1; Standard errors in parenthesis. Welfare is measured in terms of poverty. F-statistics test the overall significance of the first stage equation

**Table 8: Effect of Free Primary Education Reform on Education and Welfare (Reduced form restricted models (strongly exposed instrument))**

|                      | Education (1st stage for CE and RD) |                      | Log consumption expenditure (CE) |                     | Log relative deprivation (RD) |                      | Education (1st stage for PG) |                      | Poverty gap (PG)     |                      |
|----------------------|-------------------------------------|----------------------|----------------------------------|---------------------|-------------------------------|----------------------|------------------------------|----------------------|----------------------|----------------------|
| Variables            | (1)                                 | (2)                  | (3)                              | (4)                 | (5)                           | (6)                  | (7)                          | (8)                  | (9)                  | (10)                 |
| Age(years)           | -0.018<br>(0.057)                   | -0.007<br>(0.058)    | 0.020**<br>(0.009)               | 0.022**<br>(0.010)  | -0.007*<br>(0.004)            | -0.008**<br>(0.004)  | -0.015<br>(0.056)            | -0.003<br>(0.057)    | -0.009**<br>(0.004)  | -0.009**<br>(0.004)  |
| Age squared          | 0.000<br>(0.001)                    | 0.000<br>(0.001)     | -0.000**<br>(0.000)              | -0.000**<br>(0.000) | 0.000**<br>(0.000)            | 0.000**<br>(0.000)   | 0.000<br>(0.001)             | 0.000<br>(0.001)     | 0.000**<br>(0.000)   | 0.000**<br>(0.000)   |
| age <=4 to 8 in 1994 | 1.096***<br>(0.270)                 | 1.095***<br>(0.273)  | 0.167***<br>(0.047)              | 0.180***<br>(0.047) | -0.060***<br>(0.021)          | -0.064***<br>(0.021) | 0.999***<br>(0.263)          | 0.988***<br>(0.266)  | -0.059***<br>(0.018) | -0.059***<br>(0.018) |
| Constant             | 9.277***<br>(1.245)                 | 10.327***<br>(1.290) | 8.397***<br>(0.214)              | 8.394***<br>(0.221) | 8.333***<br>(0.098)           | 8.327***<br>(0.103)  | 9.349***<br>(1.220)          | 10.534***<br>(1.263) | 0.355***<br>(0.084)  | 0.345***<br>(0.087)  |
| Year FE              | Yes                                 | Yes                  | Yes                              | Yes                 | Yes                           | Yes                  | Yes                          | Yes                  | Yes                  | Yes                  |
| Control              | No                                  | Yes                  | No                               | Yes                 | No                            | Yes                  | No                           | Yes                  | No                   | Yes                  |
| Observations         | 3,954                               | 3,833                | 3,954                            | 3,833               | 3,954                         | 3,833                | 4,192                        | 4,065                | 4,192                | 4,065                |
| R-squared            | 0.028                               | 0.039                | 0.017                            | 0.026               | 0.091                         | 0.091                | 0.026                        | 0.038                | 0.012                | 0.017                |
| F-statistic          | 28.13                               | 22.06                |                                  |                     |                               |                      | 28.11                        | 22.63                |                      |                      |
| P-value              | 0                                   | 0                    |                                  |                     |                               |                      | 0                            | 0                    |                      |                      |

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1; Standard errors in parenthesis. Strongly exposed cohorts reform dummy is the only instrument used. F-statistics test the overall significance of the first stage equation

**Table 9: Effect of Education on Welfare Outcomes (OLS and restricted 2SLS estimations)**

| Variables    | Log consumption expenditure (CE) |                     |                     |                     | Log relative deprivation (RD) |                      |                     |                     | Poverty gap (PG)     |                      |                    |                   |
|--------------|----------------------------------|---------------------|---------------------|---------------------|-------------------------------|----------------------|---------------------|---------------------|----------------------|----------------------|--------------------|-------------------|
|              | OLS                              | OLS                 | 2SLS                | 2SLS                | OLS                           | OLS                  | 2SLS                | 2SLS                | OLS                  | OLS                  | 2SLS               | 2SLS              |
| Education    | 0.036***<br>(0.003)              | 0.035***<br>(0.003) | 0.079**<br>(0.039)  | 0.089**<br>(0.040)  | -0.016***<br>(0.001)          | -0.016***<br>(0.001) | -0.014<br>(0.018)   | -0.031*<br>(0.016)  | -0.012***<br>(0.001) | -0.011***<br>(0.001) | -0.025<br>(0.017)  | -0.024<br>(0.017) |
| Age(years)   |                                  |                     | 0.009<br>(0.010)    | 0.010<br>(0.010)    |                               |                      | 0.001<br>(0.004)    | -0.004<br>(0.004)   |                      |                      | -0.004<br>(0.004)  | -0.003<br>(0.004) |
| Age squared  |                                  |                     | -0.000<br>(0.000)   | -0.000<br>(0.000)   |                               |                      | 0.000<br>(0.000)    | 0.000<br>(0.000)    |                      |                      | 0.000<br>(0.000)   | 0.000<br>(0.000)  |
| Constant     | 8.487***<br>(0.077)              | 8.510***<br>(0.093) | 7.962***<br>(0.535) | 7.784***<br>(0.585) | 8.332***<br>(0.045)           | 8.322***<br>(0.051)  | 8.692***<br>(0.198) | 8.536***<br>(0.241) | 0.279***<br>(0.026)  | 0.275***<br>(0.032)  | 0.470**<br>(0.230) | 0.460*<br>(0.252) |
| Year FE      | Yes                              | Yes                 | Yes                 | Yes                 | Yes                           | Yes                  | Yes                 | Yes                 | Yes                  | Yes                  | Yes                | Yes               |
| Control      | No                               | Yes                 | No                  | Yes                 | No                            | Yes                  | No                  | Yes                 | No                   | Yes                  | No                 | Yes               |
| Observations | 3,954                            | 3,833               | 3,954               | 3,833               | 3,954                         | 3,833                | 3,954               | 3,833               | 4,192                | 4,065                | 4,192              | 4,065             |
| R-squared    | 0.055                            | 0.060               |                     |                     | 0.13                          | 0.130                | 0.071               | 0.090               | 0.035                | 0.037                |                    | 0.008             |

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1; Standard errors in parenthesis. Welfare is measured in terms of poverty.

**Table 10: Effect of Education on Welfare Outcomes (OLS and restricted 2SLS estimations (strongly exposed instrument))**

| Variables    | Log consumption expenditure (CE) |                     |                     |                     | Log relative deprivation (RD) |                      |                     |                      | Poverty gap (PG)     |                      |                      |                      |
|--------------|----------------------------------|---------------------|---------------------|---------------------|-------------------------------|----------------------|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|              | OLS                              | OLS                 | 2SLS                | 2SLS                | OLS                           | OLS                  | 2SLS                | 2SLS                 | OLS                  | OLS                  | 2SLS                 | 2SLS                 |
| Education    | 0.036***<br>(0.003)              | 0.035***<br>(0.003) | 0.152***<br>(0.049) | 0.165***<br>(0.051) | -0.016***<br>(0.001)          | -0.016***<br>(0.001) | -0.045**<br>(0.020) | -0.058***<br>(0.020) | -0.012***<br>(0.001) | -0.011***<br>(0.001) | -0.059***<br>(0.022) | -0.060***<br>(0.023) |
| Age(years)   |                                  |                     | 0.022*<br>(0.012)   | 0.023*<br>(0.012)   |                               |                      | -0.005<br>(0.005)   | -0.009*<br>(0.005)   |                      |                      | -0.010*<br>(0.005)   | -0.009*<br>(0.005)   |
| Age squared  |                                  |                     | -0.000**<br>(0.000) | -0.000**<br>(0.000) |                               |                      | 0.000<br>(0.000)    | 0.000**<br>(0.000)   |                      |                      | 0.000**<br>(0.000)   | 0.000**<br>(0.000)   |
| Constant     | 8.487***<br>(0.077)              | 8.510***<br>(0.093) | 6.986***<br>(0.667) | 6.693***<br>(0.754) | 8.332***<br>(0.045)           | 8.322***<br>(0.051)  | 9.027***<br>(0.225) | 8.931***<br>(0.293)  | 0.279***<br>(0.026)  | 0.275***<br>(0.032)  | 0.905***<br>(0.293)  | 0.979***<br>(0.330)  |
| Year FE      | Yes                              | Yes                 | Yes                 | Yes                 | Yes                           | Yes                  | Yes                 | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Control      | No                               | Yes                 | No                  | Yes                 | No                            | Yes                  | No                  | Yes                  | No                   | Yes                  | No                   | Yes                  |
| Observations | 3,954                            | 3,833               | 3,954               | 3,833               | 3,954                         | 3,833                | 3,954               | 3,833                | 4,192                | 4,065                | 4,192                | 4,065                |
| R-squared    | 0.055                            | 0.060               |                     |                     | 0.130                         | 0.130                |                     |                      | 0.035                | 0.037                |                      |                      |

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1; Standard errors in parenthesis. Used only strongly exposed cohorts instrument.

**Table 11: Effect of Free Primary Education Reform on Education and Welfare (Reduced form unrestricted models)**

| Variables    | Education (1st stage for CE and RD) |                      | Log consumption expenditure (CE) |                     | Log relative deprivation (RD) |                      | Education (1st stage for PG) |                      | Poverty gap (PG)     |                      |
|--------------|-------------------------------------|----------------------|----------------------------------|---------------------|-------------------------------|----------------------|------------------------------|----------------------|----------------------|----------------------|
|              | (1)                                 | (2)                  | (3)                              | (4)                 | (5)                           | (6)                  | (7)                          | (8)                  | (9)                  | (10)                 |
| Age(years)   | -0.039<br>(0.099)                   | -0.014<br>(0.102)    | 0.028*<br>(0.016)                | 0.028*<br>(0.016)   | -0.005<br>(0.007)             | -0.006<br>(0.007)    | -0.051<br>(0.098)            | -0.035<br>(0.100)    | -0.014**<br>(0.007)  | -0.014**<br>(0.007)  |
| Age squared  | 0.001<br>(0.001)                    | 0.000<br>(0.001)     | -0.000<br>(0.000)                | -0.000<br>(0.000)   | 0.000<br>(0.000)              | 0.000<br>(0.000)     | 0.001<br>(0.001)             | 0.000<br>(0.001)     | 0.000*<br>(0.000)    | 0.000*<br>(0.000)    |
| age 4/below  | 0.761<br>(0.658)                    | 0.843<br>(0.671)     | 0.328***<br>(0.108)              | 0.315***<br>(0.108) | -0.083*<br>(0.045)            | -0.078*<br>(0.045)   | 0.545<br>(0.645)             | 0.541<br>(0.658)     | -0.130***<br>(0.045) | -0.128***<br>(0.046) |
| age 5        | 1.252**<br>(0.568)                  | 1.499***<br>(0.580)  | 0.475***<br>(0.093)              | 0.484***<br>(0.092) | -0.158***<br>(0.041)          | -0.156***<br>(0.041) | 1.030*<br>(0.559)            | 1.213**<br>(0.570)   | -0.183***<br>(0.038) | -0.188***<br>(0.038) |
| age 6        | 1.183**<br>(0.530)                  | 1.230**<br>(0.536)   | 0.377***<br>(0.093)              | 0.382***<br>(0.093) | -0.138***<br>(0.039)          | -0.139***<br>(0.040) | 1.087**<br>(0.518)           | 1.103**<br>(0.525)   | -0.132***<br>(0.037) | -0.137***<br>(0.037) |
| age 7        | 0.368<br>(0.523)                    | 0.328<br>(0.530)     | 0.434***<br>(0.092)              | 0.434***<br>(0.093) | -0.129***<br>(0.039)          | -0.130***<br>(0.039) | 0.181<br>(0.508)             | 0.099<br>(0.515)     | -0.151***<br>(0.035) | -0.151***<br>(0.035) |
| age 8        | 0.811*<br>(0.442)                   | 0.773*<br>(0.446)    | 0.312***<br>(0.074)              | 0.286***<br>(0.073) | -0.108***<br>(0.032)          | -0.098***<br>(0.032) | 0.650<br>(0.433)             | 0.563<br>(0.438)     | -0.111***<br>(0.030) | -0.103***<br>(0.031) |
| age 9        | 0.853<br>(0.566)                    | 0.918<br>(0.566)     | 0.300***<br>(0.102)              | 0.305***<br>(0.102) | -0.141***<br>(0.045)          | -0.142***<br>(0.045) | 0.419<br>(0.551)             | 0.426<br>(0.552)     | -0.112***<br>(0.041) | -0.114***<br>(0.041) |
| age 10       | -0.309<br>(0.408)                   | -0.326<br>(0.415)    | 0.314***<br>(0.073)              | 0.249***<br>(0.069) | -0.105***<br>(0.030)          | -0.082***<br>(0.029) | -0.217<br>(0.400)            | -0.257<br>(0.407)    | -0.099***<br>(0.028) | -0.090***<br>(0.029) |
| age 11       | -0.376<br>(0.505)                   | -0.348<br>(0.510)    | 0.169**<br>(0.083)               | 0.153*<br>(0.085)   | -0.055<br>(0.037)             | -0.047<br>(0.037)    | -0.358<br>(0.480)            | -0.352<br>(0.484)    | -0.080**<br>(0.034)  | -0.077**<br>(0.035)  |
| age 12       | -0.527<br>(0.445)                   | -0.420<br>(0.446)    | 0.123*<br>(0.067)                | 0.123*<br>(0.067)   | -0.023<br>(0.029)             | -0.025<br>(0.029)    | -0.632<br>(0.438)            | -0.557<br>(0.439)    | -0.041<br>(0.030)    | -0.039<br>(0.030)    |
| age 13       | -0.245<br>(0.380)                   | -0.243<br>(0.381)    | 0.154***<br>(0.056)              | 0.156***<br>(0.056) | -0.028<br>(0.025)             | -0.029<br>(0.025)    | -0.324<br>(0.371)            | -0.337<br>(0.372)    | -0.062**<br>(0.025)  | -0.063**<br>(0.025)  |
| age 14       | -0.814*<br>(0.446)                  | -0.962**<br>(0.457)  | 0.113<br>(0.078)                 | 0.100<br>(0.076)    | -0.052<br>(0.033)             | -0.042<br>(0.033)    | -0.845**<br>(0.429)          | -0.991**<br>(0.439)  | -0.037<br>(0.031)    | -0.038<br>(0.031)    |
| Constant     | 9.917***<br>(2.294)                 | 10.595***<br>(2.361) | 8.012***<br>(0.376)              | 8.063***<br>(0.381) | 8.360***<br>(0.162)           | 8.335***<br>(0.164)  | 10.353***<br>(2.253)         | 11.416***<br>(2.319) | 0.543***<br>(0.157)  | 0.537***<br>(0.161)  |
| Year FE      | Yes                                 | Yes                  | Yes                              | Yes                 | Yes                           | Yes                  | Yes                          | Yes                  | Yes                  | Yes                  |
| Control      | No                                  | Yes                  | No                               | Yes                 | No                            | Yes                  | No                           | Yes                  | No                   | Yes                  |
| Observations | 3,954                               | 3,833                | 3,954                            | 3,833               | 3,954                         | 3,833                | 4,192                        | 4,065                | 4,192                | 4,065                |
| R-squared    | 0.031                               | 0.043                | 0.029                            | 0.037               | 0.102                         | 0.101                | 0.029                        | 0.041                | 0.019                | 0.024                |
| F-statistic  | 9.05                                | 10.15                |                                  |                     |                               |                      | 8.949                        | 10.28                |                      |                      |
| P-value      | 0                                   | 0                    |                                  |                     |                               |                      | 0                            | 0                    |                      |                      |

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1; Standard errors in parenthesis. Welfare is measured in terms of poverty. F-statistics test the overall significance of the first stage equation

**Table 12: Effect of Education on Welfare Outcomes (OLS and unrestricted 2SLS estimations)**

| Variables    | Log consumption expenditure (CE) |                     |                     |                     | Log relative deprivation (RD) |                      |                      |                      | Poverty gap (PG)     |                      |                     |                     |
|--------------|----------------------------------|---------------------|---------------------|---------------------|-------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|
|              | OLS                              | OLS                 | 2SLS                | 2SLS                | OLS                           | OLS                  | 2SLS                 | 2SLS                 | OLS                  | OLS                  | 2SLS                | 2SLS                |
| Education    | 0.036***<br>(0.003)              | 0.035***<br>(0.003) | 0.087***<br>(0.031) | 0.095***<br>(0.029) | -0.016***<br>(0.001)          | -0.016***<br>(0.001) | -0.054***<br>(0.014) | -0.043***<br>(0.013) | -0.012***<br>(0.001) | -0.011***<br>(0.001) | -0.033**<br>(0.014) | -0.033**<br>(0.013) |
| Age(years)   |                                  |                     | 0.010<br>(0.009)    | 0.011<br>(0.008)    |                               |                      | -0.007*<br>(0.004)   | -0.006*<br>(0.004)   |                      |                      | -0.005<br>(0.004)   | -0.005<br>(0.003)   |
| Age squared  |                                  |                     | -0.000<br>(0.000)   | -0.000<br>(0.000)   |                               |                      | 0.000**<br>(0.000)   | 0.000**<br>(0.000)   |                      |                      | 0.000*<br>(0.000)   | 0.000<br>(0.000)    |
| Constant     | 8.487***<br>(0.077)              | 8.510***<br>(0.093) | 7.851***<br>(0.425) | 7.689***<br>(0.443) | 8.332***<br>(0.045)           | 8.322***<br>(0.051)  | 9.128***<br>(0.161)  | 8.710***<br>(0.189)  | 0.279***<br>(0.026)  | 0.275***<br>(0.032)  | 0.569***<br>(0.188) | 0.598***<br>(0.196) |
| Year FE      | Yes                              | Yes                 | Yes                 | Yes                 | Yes                           | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                 | Yes                 |
| Control      | No                               | Yes                 | No                  | Yes                 | No                            | Yes                  | No                   | Yes                  | No                   | Yes                  | No                  | Yes                 |
| Observations | 3,954                            | 3,833               | 3,954               | 3,833               | 3,954                         | 3,833                | 3,954                | 3,833                | 4,192                | 4,065                | 4,192               | 4,065               |
| R-squared    | 0.055                            | 0.060               |                     |                     | 0.130                         | 0.130                |                      | 0.006                | 0.035                | 0.037                |                     |                     |

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1; Standard errors in parenthesis. Welfare is measured in terms of poverty.