Crop Choice, School Participation and Child Labor in Developing Countries: Cotton Expansion in Burkina Faso

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Abstract

We estimate the effects of changes in cotton adoption on children's schooling and child labor in rural Burkina Faso. Using time and spatial variations, we find evidence that expansion of cotton farming has led to an increase in enrollment and to a reduction of participation in child labor for girls. There are, however, no detectable effects on boys. In theory, cotton adoption could increase household's income, leading to increased demand for schooling and reduced child labor. On the other hand, because children are productive on cotton farms, adoption of cotton could increase the opportunity cost of child time and the demand for child labor. We provide suggestive evidence showing that boys are more productive than girls on cotton farms. Taken together the results suggest that the income effect from cotton adoption might have been larger than the wage effect for girls, hence the overall positive impacts on school enrollment for girls.

Key words: Crop choice, School participation, Child labor, Burkina Faso.

Low levels of human capital, particularly those of education, health and nutrition, have direct welfare implications. In addition, inequality in human capital outcomes, apart from being of interest per se, has both direct and indirect impacts on income inequality. Education is crucial in augmenting individual earnings and improving the prospects of economic growth in general. Thus, a better understanding of how poor households make decisions about educating their children can provide useful insights into how poverty can be effectively addressed. Furthermore, to answer operational questions regarding the design of appropriate education policies, micro-level household responses to changes in the economic environment need to be well understood.

In addition to low education levels, gender inequality in educational attainment is a pressing issue. Over the past three decades, girls' education has received increasing attention in the developing world, primarily because of the relationship between female education and child health and nutrition at the micro level as well as the overall impact on economic growth (e.g., Klasen, 2002). This makes investing more in girls' education even more crucial in environments where the initial gender disparity in education is relatively large (Schultz, 2002).

Recently, efforts to increase enrollment and reduce the gender gap have taken different forms. Demand side interventions include school feeding and cash transfers among others. For example, school feeding programs have been designed to attract more girls to school. Kazianga et al. (2013) report such interventions in Burkina Faso, where girls receive a ration of food to take home. Similarly, conditional cash transfers can also be designed to provide higher incentives to increase the enrollment of girls (e.g., Akresh et al., 2013; Baird et al., 2011; Paul Schultz, 2004). Supply side interventions include the construction of "girl–friendly" schools, where the overall school environment is made more appealing to girls. Examples of these types of interventions include the National Policy for Education of Girls at the Elementary Level in India (e.g. Meller et al., 2014; Wu et al., 2007) and the "girl-friendly" schools in Burkina Faso (Kazianga et al., 2013).

In addition to these types of specific policy interventions, there is a growing body of evidence that documents how changes in the economic environment – either exogenous or not – have affected education and child labor (e.g., Beegle et al., 2006; Edmonds, 2006). Rosenzweig and Evenson (1977) found that the Green Revolution in India led to a reduction in child labor and an increase in school attendance. These initial findings have been supported by subsequent research (e.g., Foster and Rosenzweig, 1996, 2004). Because both agricultural policy and education play a central role in many development policies, understanding how they interact can provide useful insights into how resource-constrained households make decisions regarding educating their children, particularly in the context of a rapidly changing agricultural landscape.

We use micro data from Burkina Faso to ask whether and to what extent differences in the evolution of school enrollment and child labor across regions can be ascribed to changes in cotton adoption. The main contribution of this article is to document an agricultural policy with an unusually (and unintended) large effect on girls' enrollment in school in rural Burkina Faso. It exploits a unique feature of the policy reform (which varied across space and time) to credibly identify the effects of cotton expansion on school participation.

Cotton is by far the major cash crop in Burkina Faso, and the adoption of cotton is presumed to have a substantial impact on household income. Farmers who adopt cotton are more likely to enjoy a significant income increase, which in turn should lead to increased demand for education and reduced demand for family child labor (Basu and Van, 1998; Behrman and Knowles, 1999; Edmonds, 2005). These households, however, also face increased opportunity costs of child time because child labor is more productive in cotton farming than other crops (Collins and Margo, 2006; Levy, 1985).

The article is related to a strand of literature that documents the interaction between crop choice and agricultural technology on the one hand, and education and child labor on the other. In India, enrollment rates in primary school increased in areas that experienced a larger increase in agricultural yields during the Green Revolution (Foster and Rosenzweig, 1996). More specifically, the rise in enrollment was attributed to increased returns to primary education, following the introduction of new high yielding crop varieties. The overall result, however, suggested a pro-male bias: on average, investments in education were significantly larger for boys than for girls (Boserup, 1990). We contribute to this body of literature, by investigating the effects of a large-scale agricultural policy reform (in the form of cotton expansion) on girls' education and labor in rural Burkina Faso.

For the specific case of cash crops and cotton, Levy (1985) reports that children are better suited for cotton weeding and picking than tasks related to cultivating other crops, and child labor does not have a good enough substitute in cotton-related activities. As a result, in Egypt, the shift in cropping pattern away from cotton played a role in curbing child labor. Along the same lines, Collins and Margo (2006) argues that the emphasis on cotton in nineteenth-century southern United States partially explains the education gap between Blacks and Whites, given that child labor was more productive in the cotton fields in the South, rendering it less likely for children to attend school. Dammert (2008) found that, in Peru, children living in coca-growing regions, engaged more in market work after coca production shifted to Columbia. Schooling outcomes, however, were not affected by the increase in working hours.

We find that the cotton policy reform increased girls' participation in school and reduced girls' involvement in farm labor in the new cotton region relative to the non-cotton region. Using our preferred specifications, girls' enrollment rate increased by 3.9 percentage points and their number of years of education completed increased by 0.15 year in the new cotton region, relative to the non-cotton region. These percentage points correspond to 28.5 percent in enrollment and 30 percent in years of education completed compared to the pre-reform (i.e. 1994) outcomes. Girls' participation in farm labor decreased by 22.3 percentage points in the new cotton region relative to the non-cotton region. The findings hold for alternative specifications and for a number of robustness checks. Hence, the changes in education and child labor that we detect are unlikely due to other factors than the cotton policy reform.

The Policy Reform: Cotton Expansion

Cotton is one of the main economic resources of Burkina Faso and the main source of foreign exchange, accounting for 50 to 60 percent of exports. The country's share of world cotton exports has tripled since the mid-1990's. Cotton provides about 700,000 jobs – mainly for members of farmers' households – or about 17 percent of the population.

Cotton has been commercially grown in Burkina Faso since the 1920s (e.g., Hauchart, 2010)[1], and was a mandatory crop intended for export. The colonial administration imposed about 4 ha for 100 inhabitants. This policy intensified cotton production until the 1929 famine, which led to a severe food shortage in the then Upper Volta. As a result, cotton farming was given up.

Cotton farming was eventually revived owing to the establishment of the French Company for Textile Development (CFDT) in 1949. CFDT distributed inputs and supervised producers and played a central role in the improvement of farming techniques (e.g., Schwartz, 1993). CFDT was replaced by a new parastatal organization named SOFITEX (Société des Fibres Textiles) in 1979. SOFITEX was a joint venture between the government and CFDT. Hence, the basic state-led model remained unchanged (Kaminski et al., 2011).

SOFITEX operated as a monopoly in the cotton sector until the mid-1990's and was the only agency in charge of input distribution, output marketing, and extension services in the sector. The relationship between SOFITEX and cotton producers was akin to contract farming whereby SOFITEX provided services (e.g., improved seeds, farmer education, fertilizers, loans, and marketing services) to farmers against the exclusive rights to purchase cotton output. SOFITEX also managed to introduce new production techniques and high yield varieties.

The policy reform we focus on was implemented in two stages starting in the early 1990's. The first stage targeted farmers' organizations that undermined cotton production and lowered credit repayment rates. To improve farmers' social capital and production incentives, new legislation was passed to allow the formation of farmer organizations based on voluntary participation as opposed to farmer groups that are determined by residency in a given village. This reform concerned only the region that was already farming cotton (e.g. Government of Burkina Faso, 2007; Ministère de l'Agriculture et des Ressources Animales, 1996). We refer to this area as the old cotton region henceforth.

The second stage of the reform was initiated after the devaluation of the local currency (CFA Franc) in late 1993. New cotton companies were allowed to provide the same services as SOFITEX but in different regions of the country, namely in the central and eastern provinces. The stated objective was to extend cotton farming to new areas to reach a target of 300,000 tons. We refer to this region as the new cotton region. The expansion into this new region started around the 1995/96 farming season as documented by official reports from the government of Burkina Faso (e.g. Government of Burkina Faso, 2007; Ministère de l'Agriculture et des Ressources Animales, 1996)[2]. Thus, the 1994 household survey can serve as pre-reform (baseline) data for the new cotton and the non-cotton regions, but not for the old cotton region.

There are three reasons why the 1994 household survey cannot be used as pre-reform data for the old cotton region. First, as discussed above, the reform in the old cotton region started well before 1994 (e.g. Government of Burkina Faso, 2007; Ministère de l'Agriculture et des Ressources Animales, 1996; Kaminski et al., 2011). Second, because producers shifted away from cotton in the late 1980's and in the early 1990's (Kaminski and Serra, 2011), it is plausible that cotton expansion observed in this region is driven by these farmers shifting back to cotton. Third, it is not clear whether it is the first stage of the reform or the second stage that would be driving cotton expansion in that region. Hence, we focus primarily on the second stage of the reform, that is, the effect of cotton expansion on regions that did not grow cotton before the policy reform. For completeness, however, we will show results for the old cotton region as well.

From an agronomic perspective, cotton cultivation needs long frost-free periods and moderate annual rainfall of about 700–1300 millimeters (e.g., Krishna, 2014). In drier regions, precipitation of about 650 millimeters might support production in addition to irrigation techniques (e.g., Krishna, 2014). Cotton farming in Burkina Faso is essentially rainfed, and there is no evidence of irrigated cotton farms. Figure 1 provides a summary of rainfall distribution in Burkina Faso. From the figure, it is apparent that all the southern and southwestern regions and parts of the central, southeastern and eastern regions are suited for cotton farming. In contrast, the northern region, with less than 600 millimeters of annual rainfall, was never suited for cotton farming.

In summary, prior to the policy reform, the only cotton company was based in Bobo-Dioulasso (in the southern region). Prices and transportation costs at the time implied that it was not economically viable to expand into the central and eastern regions. As a result, cotton cultivation was mainly limited to the southern and the southwestern regions. The reform along with currency devaluation contributed to making the commercial farming of cotton a viable economic activity for residents in the central, eastern and southeastern regions where cotton was not commercially farmed before the second stage of the policy reform.

Survey and Descriptive Statistics

We use data from three rounds of the national priority surveys conducted in 1994, 1998, and 2003. The three surveys are similar in the scope of information collected, sampling design, and coverage. The surveys are closely related to the World Bank LSMS (e.g., Grosh and Glewwe, 2000) and are nationally representative. All three surveys use a two-stage stratified random sampling. The analysis focuses on rural households while the sub-sample of urban households is used for robustness checks.

The surveys collected information on household and individual characteristics, employment status, expenditures and income. Information on school enrollment status and participation in various activities was collected for school age children. Table 1A summarizes the data for the 1994 survey round, and table 1B summarizes the combined data of the 1998 and 2003 survey rounds. We report the rural sub-sample average at the child and the household level for the old cotton provinces (column 1), the new cotton provinces (column 2) and the non-cotton provinces (column 3). We also present the mean difference tests of the two first regions relative to the non-cotton region (column 4 and 5). In columns 6 and 7, we show the mean difference tests conditional on survey months.

In the pre-reform survey (i.e. 1994), child education levels are very low with sizable differences between boys and girls. Across the three regions, child total enrollment was 26.3 percent in the old cotton region, 20.3 percent in the new cotton region and 17.6 percent in the non-cotton region. The number of years of education completed was respectively 0.946, 0.718 and 0.630 year in the old, the new, and the non-cotton regions. Overall, among school-age children (7 to 15 years old), less than a quarter attended school at the time of the survey and they completed less than one year of education on average. In all three regions, boys were more likely to be enrolled in school, and they have, on average, completed more years of education than girls. Education levels, for both boys and girls, were higher in the old cotton regions than in the non-cotton region. There were no significant differences, however, between the new cotton region and the non-cotton region.

Child labor is roughly the same across the three regions. We do not observe any detectable difference both in the pre-reform and the post-reform surveys. In 1994, girls participated slightly more in child work than boys in both the old cotton region (42.4 percent vs. 40.4 percent) and the new cotton region (43.4 percent vs. 41.7 percent). In the non-cotton region, girls were less likely to participate in child labor than boys. These patterns hold when we restrict to farm labor only.

The post-reform descriptive statistics (the 1998 and 2003 surveys) are summarized in table 1B. Enrollment rates decreased slightly to 23.2 percent in the old cotton region, but increased slightly to 21.3 percent and 20.6 percent in the new and non-cotton regions, respectively. The trend in number of years of education completed mimics that of enrollment.

It declined slightly in the old cotton region but increased in both the new and the non-cotton region[3]. In each of the three regions, more than 50 percent of children reported participating in any form of labor (or in farm labor), a substantial increase from the pre-reform survey.

The changes in the old cotton region relative to the non-cotton region are obtained from subtracting column 4 in table 1A from column 4 in table 1B. The difference in boys' enrollment between the old and the non-cotton regions is 0.085 in 1994 (table 1A), and 0.016 in the post-reform survey (table 1B), implying a relative change of -0.069 in the old cotton region after the reform. The corresponding figure for girls is -0.055. Similar calculations imply relative changes in years of education of -0.143 years for boys and -0.352 years for girls in the old cotton region. Both boys and girls are relatively more likely to engage in farm labor in the old cotton region as well.

The difference between column 5 in tables 1B and 1A gives the relative change in the new cotton region with respect to the non-cotton region. The relative change in boys' enrollment is -0.033 whereas there was almost no change in girls' enrollment (-0.001). Relative to the non-cotton region, years of education in the new cotton region decreased -0.099 years for boys, but increased by 0.028 years for girls. Participation in child labor (boys and girls) increased compared to the non-cotton region.

The surveys were conducted in the course of several months, and different regions were surveyed in different months across the three rounds. In particular, some regions were surveyed in the summer months (when school is not in session) in some rounds[4]. It is plausible that responses to enrollment status and child labor participation vary whether the survey was fielded during the academic year or during the summer break. To control for these possible seasonal effects, we report mean differences between the old cotton (column 6) and the new cotton region (column 7) on the one hand and the non-cotton region on the other hand, conditional on survey month dummies[5]. The conditional differences are qualitatively the same as the unconditional ones with two noticeable exceptions. The relative change in girls' enrollment in the new cotton region remains small (0.002) but is now positive.

Moreover, the relative change in girls' participation in farm labor is now negative. Hence, the conditional differences suggest that, relative to the old cotton region, girls' education outcomes (enrollment and years of education completed) improved in the new cotton region and girls' participation in farm labor decreased.

Central to our identification strategy (discussed in more details below) is the adoption of cotton. At baseline, about 21.8 percent of households reported farming cotton in the old cotton region and 2.4 percent of households reported farming cotton in the new cotton region. In the non-cotton region, about 3.1 percent households farmed cotton. After the policy reform (1998-2003), the percentage of households farming cotton increased to 40.3 percent in the old cotton region and to 11.3 percent in the new cotton region. The percentage of households who reported farming cotton decreased slightly in the non-cotton region. Stated differently, between 1994 and 1998/2003, the share of households who reported farming cotton increased by 84 percent in the old cotton region and by 385 percent in the new cotton region, while it remained constant in the non-cotton region. Hence, even if in absolute terms there were more cotton farmers in the old cotton region, it is unambiguous that cotton adoption was increasing at a faster rate in the new cotton region. We seek to assess the effect of this rapid change in the adoption of cotton on education and child labor.

Turning to the other crops, the statistics indicate that fewer households were growing millet in the old cotton region (67.3 percent) compared to the new cotton (86.6 percent) and non-cotton region (87.2 percent). In the subsequent period, the number of household farming millet increased in the old cotton while it remained virtually the same in the new cotton region. The number of household farming sorghum remained almost the same over time across the three regions, without any notable difference between the pre-reform and the post reform surveys. Overall, there was more adjustment in crop choice in the old cotton region than in the new cotton region, and this makes it relatively easier to ascertain the effect of the policy reform in the new cotton region than in the old cotton region.

Identification Strategy

We use the cotton expansion to identify the effects of cotton farming on school participation and child labor in the new cotton region. The cotton expansion to the new region was decided at the central government level, and therefore, was essentially given to local households. In particular, there is no evidence that local households and decision makers initiated the policies that induced the central government to expand cotton production in their areas. The available evidence points to the National Cotton Board having determined whether investing in the necessary physical and administrative infrastructure to start growing cotton in a region was a viable option, given the local agronomic and long-run rainfall conditions (Ministère de l'Agriculture et des Ressources Animales, 1996).

The cotton companies provided credit for fertilizers and other inputs as well as extension services to farmers who chose to grow cotton. Conditional on living in a cotton growing region, farmers chose whether or not grow cotton, given the local rainfall and geology conditions, their price expectations and presumably the labor and land constraints they faced. Our empirical strategy (in the new cotton region) identifies the average effect of making the option to farm cotton available on education and child labor, regardless of the number of households who actually adopt cotton.

We consider three regions: the southern and southwestern provinces that have always farmed cotton, the new cotton provinces that started growing cotton after 1995, and the rest of the country that did not grow cotton before or after 1995. Figure 2 uses administrative data to illustrate the evolution of cotton production in a new cotton region and non-cotton region. It is apparent that cotton production surged in the new region after 1995, both in terms of quantity and acreage. By contrast, in the non-cotton region, cotton production remained unchanged. Figure 3 repeats the exercise for the old cotton region. Area allocated to cotton and cotton harvest have fluctuated between 1985 and 1994 but after 1994, we observe a steady upward trend. In the new cotton region, the policy reform presumably induced some households, which would have not otherwise, to take up cotton farming. The identification strategy exploits these variations across time and space.

The crucial assumption is that the local population had no input in the decision to expand cotton, which was entirely up to the central government. While we cannot investigate this assumption formally, the available information suggests that the decisions were made at the central government level and were essentially based on rainfall and geological conditions combined with changes in the macroeconomic environment – the devaluation of the local currency (e.g. Government of Burkina Faso, 2007; Ministère de l'Agriculture et des Ressources Animales, 1996).

In the old cotton region, however, there are three potential explanations for the post-1994 growth in acreage and harvest. First, it is possible that farmers who did not cultivate cotton before started cultivating cotton after the reform. Second, it is possible that farmers who were already cultivating cotton increased their cotton acreage after the reform. Third, one cannot rule out that the post-1994 growth is in part due to the cumulative effects of all reforms in the sector undertaken before 1994. For these reasons, our identification strategy is more credible for the new cotton region than for the old cotton region.

In table 2, we use household-level data collected in 1994, 1998, and 2003 to confirm the trend observed in the aggregate data. Given concerns regarding serial correlation when difference-in-difference (DID) models extend over several years (Bertrand et al., 2004), we divide the sample into pre- and post-reform periods (1994 versus 1998 and 2003). We estimate the following regression, first for the new cotton region relative to non-cotton region and then for the old region relative to the non-cotton:

$$c_{ijk} = \alpha_1 + \alpha_2 Newcott_i + \alpha_3 \text{postreform} + \beta_1 \left(\text{postreform} \times Newcott_i\right) + \varepsilon_{ijk} \qquad (1)$$

where c_{ijk} is a binary variable indicating whether household i in region j in year k (i.e., pre-reform versus post-reform) cultivates a given crop, namely cotton, millet, sorghum, or maize, which together represent more than 70 percent of crop area in Burkina Faso in any given year. The variable $Newcott_i$ takes the value one if a household i lives in a new cotton region and zero if a household lives in a non-cotton region. We use a dummy variable, *postreform*, to indicate the period after the policy reform, that is, the 1998 and 2003 rounds of the survey. All regressions also control for child and household characteristics and survey months. The DID estimate of the policy reform for crop choice is denoted by β_1. For the old cotton region, we re-estimate the same regression but replace the variable '$Newcott_i$' by '$Oldcott_i$', i.e. a dummy variable which is one if a household lives in the old cotton region and zero if a household lives in the non-cotton region.

The regression results are shown in table 2. All regression results in this table and in subsequent tables report robust standard errors clustered at the province level. In these regressions and in subsequent ones, we use a linear probability model (LPM) for the binary dependent variables. Since our main purpose is to approximate the partial effects, the LPM is an acceptable specification, and it is also amenable to controlling for fixed effects (Wooldridge, 2010).

Panel A shows the effect of the policy reform on cotton farming in the new cotton region. The estimate in column 1 indicates that, relative to the non-cotton region, the likelihood of cotton farming increased by 9.3 percentage points in the new cotton region after the policy reform. The policy reform did not, however, have any statistically significant effect on other crops (columns 2–4). In columns 5–8, we report estimation results that control for province fixed effects. The effect on cotton is slightly larger (10.2 percentage points), and none of the point estimates in columns 5–8 are significant. In 1994, only 2.4 percent of households were farming cotton in the new cotton region. Thus, the 10.2 percentage points correspond to a change of 425 percent in the proportion of households who farmed cotton. Overall, the results in Panel A demonstrate that, relative to the non-cotton region, more households began farming cotton in the new cotton region after the policy reform, a result which is consistent with the patterns observed in Figure 2.

In Panel B, we investigate the effect of the policy reform on cotton adoption in the old cotton region relative to the non-cotton region. In column 1, the DID point estimate is -0.098 and significant at the five percent level, and the overall effect that combines both the DID estimate and the region dummy is positive. However, the positive effect disappears after we control for province fixed effects in column 5. Thus, it appears that the results in column 1 were mostly driven by the fact that most households were already growing cotton in the old cotton region, even before the policy reform. Taken together, these estimates suggest that the patterns in Figure 3 are likely driven by households increasing their cotton acreage in response to the post-1994 reforms[6], and not by households started to cultivate cotton after the reform.

Overall, both the aggregate data described in Figure 2 and the household data indicate that more households began growing cotton in the new cotton region after the policy reform. Since the household survey did not record farm area, we cannot investigate land allocation between cotton and the other crops. It is plausible that, at the intensive margin, land allocated to the other crops may have decreased, unless cotton expansion was initiated on previously uncultivated land. Nevertheless, the overall patterns provide strong suggestive evidence that in the new cotton region, the policy reform induced more households to begin growing cotton, but did not have any detectable effect on household decisions to grow other crops, namely millet, sorghum and maize.

Effects of Cotton Expansion on Education Outcomes

We now estimate the effect of cotton expansion on enrollment and on number of years of education completed. We use specifications similar to regression 1, where the dependent variable is either a dummy variable indicating whether a child was enrolled in a school at the time of the survey or the number of years of education completed. The survey asked about the highest grade completed, and we converted this in years of education using the number of years required to complete the grade. Because grade repetition is not uncommon, years of education (as we define it) likely underestimates the actual number of years a child spends in school. The market, however, rewards the highest grade completed that can be perceived as the "effective" years of education completed that we refer to as "years of education completed" for short.

We estimate the following regression for the new cotton region and the old region:

$$y_{ijk} = \alpha_1 + \alpha_2 Newcott_i + \alpha_3 \text{postreform} + \beta_1 \left(\text{postreform} \times Newcott_i\right) + \varepsilon_{ijk}, \qquad (2)$$

where y_{ijk} is either the enrollment status or years of education completed for child i in region j in period k (i.e., pre-reform versus post-reform); all other variables are as previously defined. We show estimates for the pooled sample and also disaggregate the results by gender. Again, we re-estimate the same regression for the old cotton region where we replace the variable '$Newcott_i$' by '$Oldcott_i$', i.e. a dummy variable which is one if a household lives in the old cotton region and zero if a household lives in the non-cotton region.

Table 3 reports the first set of results. The enrollment status is in the first three columns and years of education completed in the last three. The estimates in columns 1 and 2 indicate that cotton expansion did not have a significant effect on enrollment for the pooled sample (boys and girls) or for boys. In contrast, relative to the non-cotton region, girls' enrollment increased 3.7 percentage points in the new cotton region relative to the non-cotton region and the point estimate is significant at the five percent level. Columns 4–6 show the estimated effects of cotton expansion on years of education completed. The results corroborate those shown in columns 1–3. There is no significant effect on years of education completed for the pooled sample or the boys' sub-sample. For girls, however, relative to the non-cotton region, years of education completed increased by about 0.13 years in the new cotton region and the point estimate is significant at the five percent level. The estimation results are robust to controlling for child age, household head's age and education, and survey month dummies[7]. In the pooled sample of boys and girls, the 'Girl' dummy is consistently negative and statistically significant for all education outcomes. Hence, relative to boys, girls are less likely to be enrolled in school, and they have also completed fewer years of education. Such a large gender gap in education in Burkina Faso has been previously documented (e.g Kazianga et al., 2013; Kazianga, 2012; Kazianga et al., 2012; UNESCO Institute for Statistics, 2014)

These estimates are small in terms of percentages points but represent significant changes considering that enrollment rates and number of years of education completed are low to start with. The estimated effect on enrollment corresponds to 28.5 percent increase starting from 13 percent enrollment rate in 1994 in the combined sample of the new cotton and the non-cotton regions. The estimated effect on years of education corresponds to 30 percent increase starting from an average years of education completed of 0.45 years in 1994 in the new cotton and the non-cotton regions combined.

Panel B of table 3 reports the results for the old cotton areas and shows that the estimates for the policy impact are negative for school enrollment and years of education completed. For the first outcome, the point estimate is significant at the ten percent level for the pooled sample (column 1) and boys' enrollment (column 2), but not for girls' enrollment (column 3). The coefficient for years of education completed is significant at the ten percent level only for boys (column 5). The estimates of the interaction terms are negative, but the overall effect, that is, the sum of the interaction term and treatment dummy, is small in magnitude and not statistically significant. Hence, education outcomes are improving at a slower pace in the old cotton region relative to the non-cotton region, but education outcomes in levels remain higher in the old cotton region.

It is possible that geographic unobserved factors that affect enrollment are also correlated with the policy reform. This would be the case if, for example, the government tends to systematically invest more (or less) in public infrastructures (including schools) in the drier regions that never farmed cotton. We include province fixed effects in an attempt to control for such unobserved factors. The results from these estimations are shown in table 4. The point estimates in Panel A are consistent with the results in table 3. In column 3, relative to non-cotton regions, girls' school enrollment increased by 3.9 percentage points in cotton expansion areas and the coefficient is significant at the five percent level. In columns 1 and 2, the estimates of the enrollment status for the pooled sample and boys' sub-sample are of a smaller magnitude and not significant. There is evidence of increased enrollment only for girls. The results in columns 4–6 confirm those in columns 1–3. Girls gained about 0.15 additional years of education (column 6), and the point estimate is significant at the five percent level. The policy change did not have a statistically significant effect on the pooled sample (column 4) or the boys' sub-sample (column 5). These point estimates imply an increase of 30.1 percent in enrollment and 32.4 percent in number of years of education completed for girls in the new cotton region relative to the non-cotton region.

We investigate the effect of the policy reform in the old cotton regions in Panel B using the specifications that control for province fixed effects. None of the point difference-in-difference estimates is statistically significant. In particular, the estimates for girls in column 3 and 6 are not statistically significant, a contrast to the results shown in table 3. Overall, there is no evidence of change in school enrollment and years of schooling in areas that began cotton farming after the policy reform. All remaining estimations include province fixed effects to control for time invariant systematic differences across provinces.

Cohort Analysis of the Effects of Cotton Expansion on Education Outcomes

We construct a counterfactual based on age and the timing of the policy reform (e.g., Duflo, 2001). We exploit the observation that older cohorts (i.e., children who were too old to enroll in primary school at the time of the policy reform) would not have been affected by the policy reform, regardless of the region of residence[8]. On the other hand, children who were at the right age would be directly affected by the policy reform only if they resided in the cotton expansion area. A DID can then be used to identify the impact of the policy reform on the outcomes of interest.

Officially, children in Burkina Faso attend primary school when they are 6–12 years old.

In practice, because of delayed admissions and grade repetitions, children older than 12 years can also enroll in elementary school. We pool the 1998 and 2003 rounds of the survey and construct two cohorts. The young cohort comprises children who were observed in 1998 or 2003 and born between 1987 and 1996 (*young*). Children from this cohort who resided in cotton expansion areas would have been affected by the policy reform. The old cohort comprises individuals born between 1972 and 1981 and who were observed either in 1998 or 2003 (*old*). Formally, we estimate the following regression first for the new cotton region relative to non-cotton region and then for the old region relative to the non-cotton:

$$y_{ijk} = \beta_0 + \beta_1 \left(\text{young} \times Newcott_i\right) + \beta_3 \text{young} + \delta_p + \varepsilon_{ijk} \tag{3}$$

where the variable *young* designates a child belonging to the young cohorts, δ_p is province fixed effects, and all other variables are as defined before. The old cohort is the excluded category. We re-estimate a similar regressing for the old cotton region, with $Newcott$ replaced by *Oldcott*. The cotton region dummy variable $Newcott$ (or *Oldcott*) is absorbed by the province fixed effects. In this regression, β_1 identifies the effect of the policy reform under the assumption that changes in education outcomes across cohorts and regions are constant in the absence of external shocks.

We show the estimates of regression 3 in table 5. The layout is the same as that of the previous tables. Because older individuals have already left school, we define a variable 'ever been enrolled' that takes the value one for a person reporting a positive number of years of education completed, and zero otherwise[9]. The estimates in columns 1–3 indicate that for younger girls living in regions affected by the policy reform, enrollment increased by 4.6 percentage points as compared to girls of the same cohort who lived in the control areas; the point estimate is significant at the ten percent level. There is no detectable effect when boys and girls are pooled together or when boys are treated as a separate sample. Columns 4–6 display the results for years of schooling. Girls gained about 0.19 years of education, which is significant at the ten percent level while there is no significant effect on the pooled sample (column 4) or for the boys' sub-sample (column 5). While the point estimates are marginally higher than those reported in the fixed-effects specification (table 4), it is comforting to find that the two different specifications led to the same qualitative conclusion, that is, the policy reform had a positive impact on girls' education but did not affect boys' education.

In Panel B, the same exercise is repeated for old cotton areas, and we find that none of the point estimates are statistically significant. Thus, the interaction of the policy reform with time does not significantly change the education outcomes in the old cotton region. Overall, the results of the cohort analysis are consistent with previous findings: relative to the non-cotton region, girls in the new cotton region were enrolled at higher rates and also had a higher number of years of education completed.

Effects of Cotton Expansion on Child Labor

One of our main arguments is that cotton adoption alters the opportunity cost of child time, which in turn affects school participation. To assess this argument, we test whether the policy reform affected child labor. The three survey rounds include questions on labor participation of all individuals who were at least 10 years old at the time of the survey. The survey asked whether an individual worked in the week before the survey and if they worked on the farm. We extract the sub-sample of individuals aged 10–15 years to assess the effects of the cotton policy reform on child labor.

The estimates are shown in table 6. In Panel A, for the new cotton regions, the point estimates for girls in column 3 is -0.235 and is significant at the one percent level, that is, girls in these regions are 23.5 percentage points less likely to participate in any type of work than girls of comparable age in the non-cotton regions. The point estimate in column 6, that is, girls' participation in farm labor is -0.223 and is significant at the five percent level. Taken together, the point estimates in columns 3 and 6 suggest that the reduction in child labor for girls comes almost exclusively from the reduced participation in farm labor. The estimates in columns 1, 2, 4, and 5 are not statistically significant, indicating that the policy reform did not have a significant effect on labor participation for boys.

The estimates for the old cotton region are shown in Panel B. The estimates in columns 1–3 indicate that the participation of child labor decreased in these regions as well. Boys are about 7.3 percentage points (column 2) and girls about 8.5 percentage points (column 3) less likely to report child labor participation. The point estimates are significant at the five and ten percent levels. None of the estimates for farm labor (columns 4–6) are significant, suggesting that the effects on child labor detected in columns 1–3 are not driven by changes in child participation in farm labor.

Overall, the results in table 6 demonstrate that cotton expansion decreased the participation of girls on farms in new cotton regions. The policy change, however, did not have a statistically significant effect on boys' participation on farms. These results are consistent with the findings for school participation[10].

Discussions

In societies that favor males, policy reforms that benefit girls more than boys are rare. Conditional on our identification strategy, one could argue that the cotton expansion in rural Burkina has provided certain unusual outcomes. We propose three possible explanations for these puzzling results. First, these results may reflect the argument that in low-income settings, girls' human capital is a luxury and thus, is more income elastic than boys' human capital (e.g., Alderman and Gertler, 1997; Rosenzweig and Schultz, 1982). In this case, the increase in income that results from cotton adoption would be more beneficial for girls' human capital than boys' human capital.

To investigate the income effect, we test whether the policy reform affected household income, which we proxy by household expenditures per capita. The results are summarized in table 7. Columns 1 and 2 report the estimates for the new and old cotton areas, without controlling for province fixed effects. The point estimates indicate that households who were exposed to the policy reform have higher consumption expenditures while those in the old cotton area did not experience any significant change. In columns 3 and 4, we demonstrate that the estimates are robust to controlling for province fixed effects. In total, the policy reform unambiguously raised household expenditures (income) in new cotton regions. This can potentially explain the effects on the policy reform for girls' education if indeed investment in girls' human capital is more income elastic than investment in boys' human capital, as argued by Alderman and Gertler (1997), and Rosenzweig and Schultz (1982).

Second, in patrilinear societies, where boys inherit land, the introduction of cotton (the most valuable cash crop in the area) increases the value of bequest for boys (e.g., Quisumbing et al., 2001). Parents may increase investment in girls' education if they are concerned about equality among their offspring (e.g., Fafchamps and Quisumbing, 2005). This also would lead to more investment in girls' education if parents believe that education could compensate girls for the increased value of land that the boys would eventually inherit.

Third, the gender difference in the amount of schooling received can be explained by the fact that the prominent economic activity, cotton farming, rewarded physical strength (e.g., Pitt et al., 2012). Thus, boys would have a comparative advantage in growing cotton if they are physically stronger than girls. As a result, cotton adoption would increase the opportunity cost of boys' schooling relative to that of girls. It is also plausible that farm work is divided along gender lines, such that boys work more than girls in cotton fields. This would be the case, for example, if cotton is perceived primarily as 'male-crop' (e.g., Duflo and Udry, 2004). We provide some indirect evidence for this explanation using data from a national agricultural survey, which collected information on labor at the plot level. The data allow for testing whether the number of boys and girls in a household affects how intensively cotton plots are cultivated relative to other crops[11].

The estimation results are shown in table 8. In all three columns, the dependent variable is the natural logarithm of labor (measured in man-days) per hectare applied to each plot[12]. Across all three columns, the number of boys and girls consistently increases household labor supply at the plot level. In column 2, the main crop grown on the plot is interacted with the number of boys (row 5) and girls (row 6). First, it is apparent from column 2 (row 4) that cotton plots are farmed more intensively than other crops. The coefficient of the interaction term between cotton plot and the number of boys is 0.069 and significant at the one percent level. The coefficient of the interaction term between cotton plot and the number of girls is relatively smaller in magnitude 0.013, and statistically indistinguishable from zero. These estimates suggest that households with more boys tend to farm their cotton plots more intensively. The results in column 3 show that there is no gender difference in how intensively plots planted with cereals are cultivated[13].

Conclusion

This study used variations in cotton expansion across time and space in Burkina Faso to estimate the effects of cotton adoption on education in rural Burkina Faso. The evidence suggests substantial gains for girls in the new cotton region relative to girls in the non-cotton region. Based on our preferred specification, enrollment rates for girls increased by 28.5 percent and years of education completed increased by 30 percent. Consistent with the gains in education, girls'participation in farm labor decreased by 56.3 percent. In contrast, the cotton policy reform did not have any significant effect on boys' education.

This is a relatively large effect, especially when contrasted with interventions that were specifically designed to increase girls' enrollment. For instance, Kazianga et al. (2013) estimated that a large girl-friendly school construction program in Burkina Faso led to a gain of about 24 percentage points in girls' enrollment. Kazianga et al. (2012) estimated that a school feeding intervention (in the form of dried food and take-home rations) that targeted girls increased enrollment by about 6 percent in northern Burkina Faso. It is worth highlighting the time horizon and the associated costs when comparing the effects of the cotton policy to more specific interventions. Nevertheless, the evidence strongly suggests that cotton expansion had some positive spillover effects on girls' human capital.

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Notes

[1]Note that there are numerous varieties of cotton grains in Africa, some of which are indigenous and have been traced back to the tenth and thirteenth centuries (Gardi, 2003).

[2]In particular, see pages 16-17 of Government of Burkina Faso (2007) and pages 7-8 of Ministère de l'Agriculture et des Ressources Animales (1996).

[3]If the three regions are pooled together, enrollment rate is about 22.23 percent in 1994, and 22.20 percent in the 1998 and 2003-- combined. The unconditional average years of education is 0.82 years in 1994 0.88 years in 1998 and 2003 combined. Conditional on ever being enrolled, the average years of education completed is 3.67 years in 1994 and 3.99 years in 1998 and 2003 combined. These large differences between the conditional and the unconditional average years of education completed, combined with overall low enrollment rates indicate that relatively fewer children are enrolled but those enrolled stay in school long enough. The pattern is consistent with the findings by Akresh et al. (2012) who show that, in rural Burkina Faso, parents strategically select only few of their children to enroll and then make sure that those enrolled attend school regularly. For the rest of the analysis we follow the common practice in the literature and focus on the unconditional years of education (e.g. Psacharopoulos, 1997).

[4]The 1993/1994 round of the survey was fielded in October, November, December and January. The 1998 round was fielded in May, June, July and August. The 2003 round was fielded in April, May, June and July. The summer school break runs from mid or late June to late September.

[5]These conditional differences estimated by the parameter β_1 of regressions in the form of $y_i = \beta_0 + \beta_1 oldcott + \sum \delta_k Month_k + \varepsilon_i$, (column 6) and by the parameter α_1 from the regressions $y_i = \alpha_0 + \alpha_1 newcott + \sum \delta_k Month_k + \varepsilon_i$ (column 7). In each set of regressions, the omitted category is the non-cotton region.

[6]Unfortunately, the survey recorded whether or not a household farms cotton and did not collect data on farm acreage. Thus, we can only speculate on these patterns.

[7]In results not shown, we restrict the sample to the month during which school is in session and find similar effects.

[8]Notice that it is plausible that the policy reform induced older children in the new cotton region to stay relatively longer in school, resulting in more years of education completed. If this happened, it would lead to a downward bias. Moreover, this would not be a concern for the dummy variable 'ever enrolled'. The two sets of results (ever enrolled and years of education completed) shown below are broadly consistent, suggesting that older children in the new cotton region were not affected by the policy reform.

[9]In results not shown, we find that our estimates remain qualitatively the same if we use years of education, conditional on ever having enrolled.

[10]We also conduct several robustness checks to examine the sensitivity of our results to alternative outcomes and samples. First, we pool the 1998 and 2003 rounds survey to run a DID similar to regression 3, where the sample is restricted to cohorts who were too old to begin schooling in 1995 when the cotton policy reform was implemented. The cotton policy change should not have an effect on the education of these individuals. The cohorts include individuals who were born between 1972 and 1979 (*young1*) and those born between 1959 and 1966 (*old1*) observed in 1998 and 2003. Second, we re-estimate the effect of the policy reform (equation 2) using the urban households sub-sample. Arguably, most urban households are non-agricultural households and should not have been affected by the policy change. Third, we examine the effect of the policy reform on child labor in urban areas. As we argued above for education outcomes, there is no reason *a priori* for child labor in urban areas to respond to the policy reform. Fourth, we combine data from the 1985 census from Burkina Faso and the 1994 survey to run a difference-in-difference similar to regression 2 where the baseline is 1985, and the follow up is 1994. If the changes we observed above are attributable to the cotton expansion in the new region, then we should not detect any significant effect when the sample is restricted to the period between 1985 and 1994. Overall, the results of these robustness checks support the argument that we are indeed estimating the effect of the cotton expansion in new regions on education and child labor. All these results shown in the online appendix.

[11]Hired labor is negligible such that the household composition essentially determines labor supply.

[12]The regressions also control for plot characteristics, plot owner characteristics, and the number of male and female adults.

[13]Note that crop choice is endogenous. For example, a household with a large number of boys could choose to farm cotton. This would be, however, consistent with the idea that boys contribute more than girls on cotton plots.

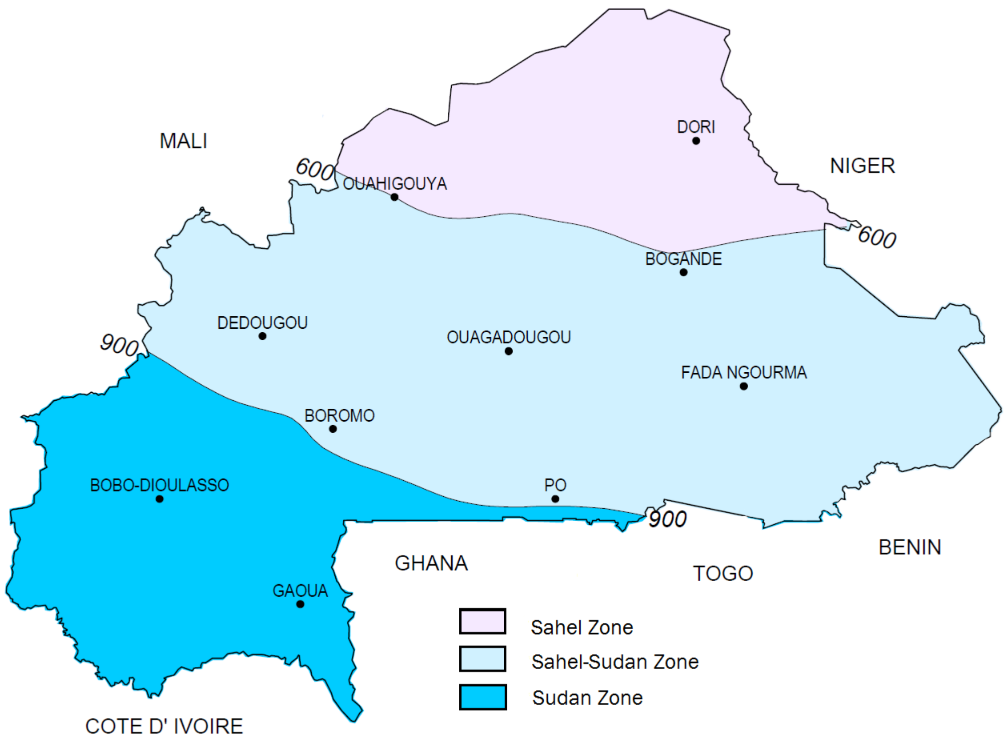

Figure 1. Mean annual rainfall of Burkina Faso over 1961-1990

Note: Ministère de l'Environnement et du Cadre de Vie (2007). The Sahel zone corresponds to annual rainfall amount below 600 mm. The Sudan zone in the center indicates annual rainfall amount between 600 mm and 900 mm. The Sudan zone in the south represents annual rainfall above 900 mm, with average rainfall season lasting around 180 to 200 days.

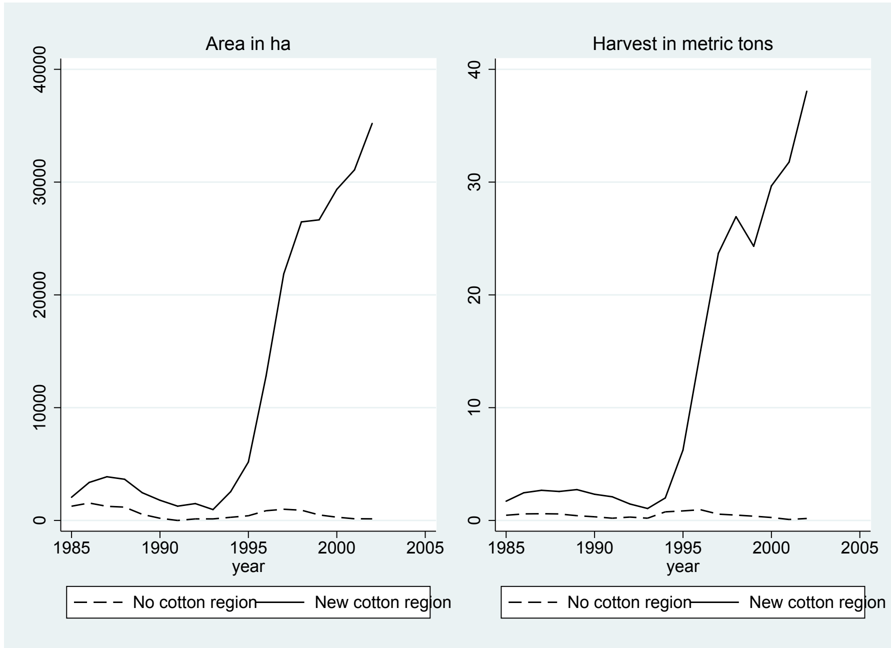

Figure 2. Evolution of cotton production in new cotton and non-cotton regions

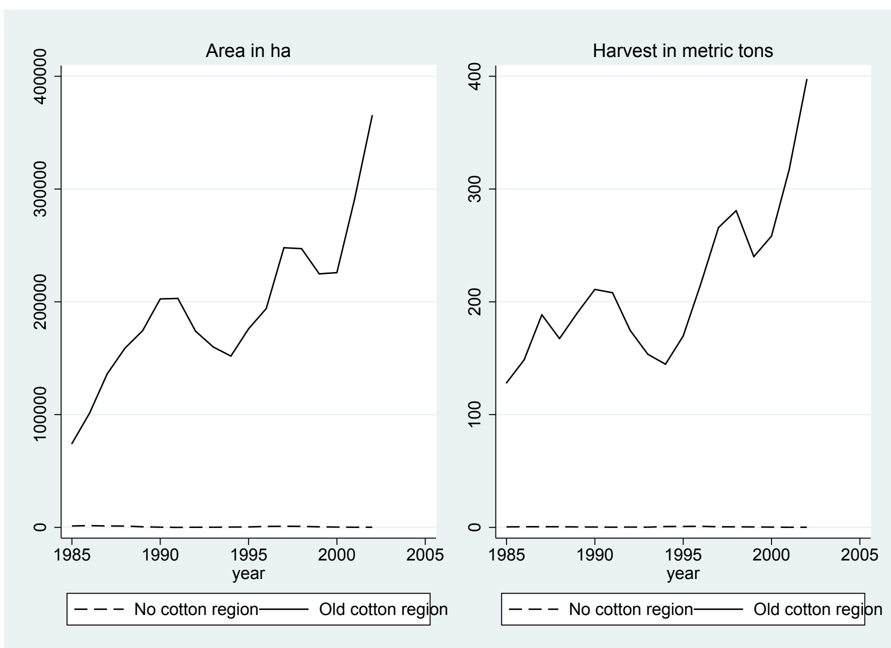

Figure 3. Evolution of cotton production in old cotton and non-cotton regions

Table 1A. Descriptive Statistics (1994)

	Old cotton region	New cotton region	Non cotton region	Difference with non cotton region		Conditional diff with non cotton region	
				Old cotton	New cotton	Old cotton	New cotton
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Education and Child labor							
Enrolled	0.263	0.203	0.176	0.087**	0.027	0.084***	0.020
Enrolled, boys	0.309	0.240	0.224	0.085	0.016	0.077***	0.011
Enrolled, girls	0.211	0.156	0.119	0.092***	0.036	0.094***	0.030
Years of educ.	0.946	0.718	0.630	0.316**	0.088	0.269***	0.069
Years of educ., boys	1.094	0.863	0.815	0.279	0.048	0.229**	0.039
Years of educ., girls	0.779	0.533	0.413	0.366***	0.120	0.323***	0.101
Child labor	0.413	0.424	0.416	-0.002	0.009	-0.018	0.008
Child labor, boys	0.404	0.417	0.427	-0.024	-0.010	-0.024	-0.014
Child labor, girls	0.424	0.434	0.402	0.022	0.032	-0.009	0.035
Farm labor	0.405	0.416	0.407	-0.002	0.009	-0.013	0.013
Farm labor, boys	0.397	0.415	0.424	-0.027	-0.010	-0.022	-0.010
Farm labor, girls	0.414	0.418	0.387	0.027	0.031	-0.002	0.041
Child characteristics							
Age	10.496	10.331	10.605	-0.109	-0.274***	-0.195***	-0.320***
Girl	0.468	0.439	0.460	0.009	-0.021	0.014	-0.007
Household characteristics							
Head education	0.110	0.070	0.051	0.059**	0.019	0.066***	0.027
Head age	50.338	50.671	51.088	-0.750	-0.417	-1.232*	-0.391
Head male	0.964	0.973	0.979	-0.015	-0.005	-0.016**	-0.005
Household size	12.005	10.902	12.112	-0.107	-1.210	-0.387	-0.844*
Crop Choice							
Cotton	0.218	0.024	0.031	0.187***	-0.007	0.194***	-0.006
Sorghum	0.813	0.850	0.787	0.025	0.062	0.018	0.075**
Millet	0.673	0.866	0.872	-0.200***	-0.006	-0.221***	-0.020

Note: Asterisk (*) indicates significance at 10%; Asterisk (**) indicates significance at 5%; Asterisk (***) indicates significance at 1%. Authors' calculations using the rural sub-samples of Burkina Faso's 1994 priority survey. Columns 1-3 report the unconditional sample means for the old cotton region, the new cotton region and for the non-cotton region. Columns 4-5 report the differences in the sample means between the old cotton region and the non-cotton region (column 4), and between the new cotton region and the non-cotton region (column 5). Columns 6-7 report the differences in means, conditional on the month in which the survey was fielded. In column 6, those are the coefficients β_1 of regressions in the form of $y_i = \beta_0 + \beta_1 oldcott + \sum \delta_k Month_k + \varepsilon_i$, and in column 7, we report α_1 from the regressions $y_i = \alpha_0 + \alpha_1 newcott + \sum \delta_k Month_k + \varepsilon_i$. In each set of regressions, the omitted category is the non-cotton region.

Table 1B. Descriptive Statistics (1998-2003 combined)

	Old cotton region	New cotton region	Non cotton region	Difference with non cotton region		Conditional diff with non cotton region	
				Old cotton	New cotton	Old cotton	New cotton
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Education and Child labor							
Enrolled	0.232	0.213	0.206	0.026	0.007	0.011	0.007
Enrolled, boys	0.268	0.235	0.253	0.016	-0.017	-0.002	-0.014
Enrolled, girls	0.190	0.188	0.154	0.037	0.035	0.025	0.032*
Years of educ.	0.934	0.836	0.794	0.140	0.043	0.083	0.041
Years of educ., boys	1.099	0.914	0.966	0.133	-0.051	0.065	-0.041
Years of educ., girls	0.743	0.751	0.603	0.140	0.148	0.101	0.136*
Child labor	0.555	0.528	0.521	0.035	0.008	0.058***	-0.007
Child labor, boys	0.545	0.536	0.533	0.012	0.003	0.045**	-0.010
Child labor, girls	0.568	0.520	0.507	0.061	0.013	0.073***	-0.004
Farm labor	0.548	0.540	0.506	0.042	0.034	0.064***	0.018
Farm labor, boys	0.540	0.546	0.518	0.023	0.029	0.054**	0.015
Farm labor, girls	0.558	0.533	0.493	0.065	0.040	0.076***	0.022
Child characteristics							
Age	10.614	10.559	10.466	0.147***	0.093	0.167***	0.086
Girl	0.464	0.478	0.474	-0.010	0.004	-0.006	0.009
Household characteristics							
Head education	0.081	0.052	0.043	0.037***	0.009	0.037***	0.008
Head age	50.310	50.134	50.510	-0.200	-0.376	-0.274	-0.295
Head male	0.969	0.961	0.973	-0.004	-0.012	-0.005	-0.011*
Household size	11.424	10.098	10.539	0.885	-0.441	0.948***	-0.293
Crop Choice							
Cotton	0.403	0.113	0.028	0.374***	0.085*	0.389***	0.082***
Sorghum	0.788	0.884	0.863	-0.075	0.021	-0.076***	0.020
Millet	0.745	0.851	0.877	-0.132***	-0.026	-0.130***	-0.030

Note: Asterisk (*) indicates significance at 10%; Asterisk (**) indicates significance at 5%; Asterisk (***) indicates significance at 1%. Authors' calculations using the rural sub-samples of Burkina Faso's 1998 and 2003 priority surveys.Columns 1-3 report the unconditional sample means for the old cotton region, the new cotton region and for the non-cotton region. Columns 4-5 report the differences in the sample means between the old cotton region and the non-cotton region (column 4), and between the new cotton region and the non-cotton region (column 5). Columns 6-7 report the differences in means, conditional on the month in which the survey was fielded. In column 6, those are the coefficients β_1 of regressions in the form of $y_i = \beta_0 + \beta_1 oldcott + \sum \delta_k Month_k + \varepsilon_i$, and in column 7, we report α_1 from the regressions $y_i = \alpha_0 + \alpha_1 newcott + \sum \delta_k Month_k + \varepsilon_i$. In each set of regressions, the omitted category is the non-cotton region.

Table 2. Impact of Cotton Expansion on Crop Choice

	(1) Cotton	(2) Millet	(3) Sorghum	(4) Maize	(5) Cotton	(6) Millet	(7) Sorghum	(8) Maize
Panel A: New cotton region								
Newcott×Postreform	0.093**	-0.030	-0.152	-0.157	0.102**	-0.036	-0.061	0.114
	[0.042]	[0.062]	[0.088]	[0.118]	[0.036]	[0.032]	[0.035]	[0.101]
Postreform	0.071	-0.127**	-0.081**	0.658***	0.024	-0.175***	-0.270***	0.266**
	[0.044]	[0.057]	[0.035]	[0.051]	[0.025]	[0.054]	[0.058]	[0.118]
Newcott	-0.006	-0.035	0.107	0.108				
	[0.008]	[0.027]	[0.082]	[0.118]				
F-test Newcott×Postreform	4.85	0.23	2.97	1.76	8.01	1.26	3.02	1.28
Observations	10,109	10,109	10,109	10,109	10,109	10,109	10,109	10,109
R-squared	0.012	0.003	0.006	0.005	0.004	0.000	0.000	0.001
Panel B: Old cotton region								
Oldcott×postreform	-0.098**	0.121*	-0.003	-0.129	0.002	-0.064	0.076*	0.037
	[0.045]	[0.070]	[0.100]	[0.143]	[0.036]	[0.049]	[0.040]	[0.126]
Postreform	0.717***	-0.009	-0.472***	0.588	0.362***	0.567	-0.300**	0.172
	[0.074]	[0.297]	[0.097]	[0.370]	[0.090]	[0.366]	[0.144]	[0.279]
Oldcott	0.165***	-0.228***	0.085	0.095				
	[0.040]	[0.059]	[0.099]	[0.128]				
F-test Oldcott×Postreform	4.786	3.011	0.001	0.813	0.005	1.710	3.725	0.085
Observations	13,361	13,361	13,361	13,361	13,361	13,361	13,361	13,361
R-squared	0.023	0.028	0.005	0.004	0.000	0.000	0.000	0.000
Child age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Head age and education	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	No	No	No	No	Yes	Yes	Yes	Yes

Note: Asterisk (*) indicates significance at 10%; Asterisk (**) indicates significance at 5%; Asterisk (***) indicates significance at 1%. Standard errors in brackets are clustered at the province level. The dependent is a binary variable indicating whether a household is observed growing a given crop in the survey year. All regressions control household head's age, education and gender, the month in which the survey was fielded, year of the survey and province fixed effects. In addition, columns 5-8 also control for province fixed effects. The sample consists of all rural households with at least a school age child.

Table 3. Impact of Cotton Adoption on School Enrollment and Years of Education completed

	Enrolled			Years of education		
	Boys and girls	Boys	Girls	Boys and girls	Boys	Girls
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: New cotton region						
Newcott×Postreform	0.011	-0.010	0.037**	0.019	-0.075	0.134**
	[0.018]	[0.025]	[0.014]	[0.075]	[0.106]	[0.060]
Postreform	0.029	0.069	0.005	0.123	0.261	0.010
	[0.031]	[0.061]	[0.031]	[0.136]	[0.185]	[0.134]
Newcott	-0.003	-0.022	0.012	-0.013	-0.077	0.036
	[0.023]	[0.032]	[0.017]	[0.082]	[0.120]	[0.053]
Girl	-0.103***			-0.375***		
	[0.020]			[0.070]		
Observations	19,540	10,238	9,302	19,540	10,238	9,302
R-squared	0.018	0.001	0.001	0.013	0.001	0.001
Panel B: Old cotton region						
Oldcott×Postreform	-0.044*	-0.061*	-0.025	-0.151	-0.206*	-0.092
	[0.024]	[0.030]	[0.021]	[0.095]	[0.119]	[0.083]
Postreform	0.219***	0.361***	0.076***	0.845***	1.239***	0.404**
	[0.050]	[0.060]	[0.025]	[0.197]	[0.251]	[0.143]
Oldcott	0.056	0.061	0.044	0.265*	0.329*	0.179
	[0.033]	[0.041]	[0.026]	[0.138]	[0.168]	[0.107]
Girl	-0.116***			-0.452***		
	[0.013]			[0.045]		
Observations	26,983	14,146	12,837	26,983	14,146	12,837
R-squared	0.022	0.002	0.001	0.018	0.002	0.001
Child age dummies	Yes	Yes	Yes	Yes	Yes	Yes
Head age and education	Yes	Yes	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	No	No	No	No	No	No

Note: Asterisk (*) indicates significance at 10%; Asterisk (**) indicates significance at 5%; Asterisk (***) indicates significance at 1%. Standard errors in brackets are clustered at the province level. The dependent variable in columns 1-3 is a binary variable indicating whether a child is enrolled in school at the time of the survey. In columns 4-6, the dependent variable is the number of years of education completed. The regressions also control for child age, household head's age, education and gender, the month in which the survey was fielded and year of the survey.

Table 4. Impact of Cotton Adoption on School Enrollment and Years of Education Completed, Controlling for Province Fixed Effects

	Enrolled			Years of education		
	Boys and girls	Boys	Girls	Boys and girls	Boys	Girls
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: New cotton region						
Newcott×Postreform	0.019	0.004	0.039**	0.062	-0.007	0.145**
	[0.019]	[0.029]	[0.014]	[0.084]	[0.124]	[0.061]
Postreform	-0.017	0.043	0.028	-0.081	0.099	0.061
	[0.027]	[0.053]	[0.021]	[0.111]	[0.163]	[0.085]
Girl	-0.102***			-0.368***		
	[0.020]			[0.070]		
Observations	19,540	10,238	9,302	19,540	10,238	9,302
R-squared	0.017	0.000	0.000	0.012	0.000	0.000
Panel B: Old cotton region						
Oldcott×Postreform	-0.030	-0.038	-0.018	-0.079	-0.107	-0.042
	[0.025]	[0.032]	[0.020]	[0.104]	[0.128]	[0.091]
Postreform	0.185***	0.321***	0.071***	0.704***	1.055***	0.369**
	[0.044]	[0.047]	[0.021]	[0.184]	[0.215]	[0.135]
Girl	-0.115***			-0.445***		
	[0.013]			[0.045]		
Observations	26,983	14,146	12,837	26,983	14,146	12,837
R-squared	0.021	0.001	0.000	0.016	0.000	0.000
Child age dummies	Yes	Yes	Yes	Yes	Yes	Yes
Head age and education	Yes	Yes	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Asterisk (*) indicates significance at 10%; Asterisk (**) indicates significance at 5%; Asterisk (***) indicates significance at 1%. Standard errors in brackets are clustered at the province level. The dependent variable in columns 1-3 is a binary variable indicating whether a child is enrolled in school at the time of the survey. In columns 4-6, the dependent variable is the number of years of education completed. All regressions control for child age, household head's age, education and gender, the month in which the survey was fielded, year of the survey and province fixed effects.

Table 5. Impact of Cotton Adoption on School Enrollment and Years of Education Completed of Younger Cohorts

	Ever enrolled			Years of education		
	Boys and girls	Boys	Girls	Boys and girls	Boys	Girls
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: New cotton region						
Newcott×Young	0.013	-0.013	0.046*	0.092	0.025	0.190*
	[0.028]	[0.036]	[0.025]	[0.102]	[0.126]	[0.090]
Young	0.186***	0.229***	0.121***	0.384***	0.487***	0.217***
	[0.027]	[0.038]	[0.020]	[0.089]	[0.131]	[0.073]
Girl	-0.068***			-0.234***		
	[0.012]			[0.038]		
Observations	13,864	7,407	6,457	13,864	7,407	6,457
R-squared	0.023	0.021	0.009	0.009	0.005	0.003
Panel B: Old cotton region						
Oldcott×Young	0.018	0.011	0.031	0.107	0.109	0.123
	[0.026]	[0.033]	[0.024]	[0.102]	[0.129]	[0.097]
Young	0.185***	0.231***	0.115***	0.370***	0.473***	0.186**
	[0.027]	[0.036]	[0.021]	[0.095]	[0.131]	[0.075]
Girl	-0.076***			-0.287***		
	[0.008]			[0.030]		
Observations	20,200	10,970	9,230	20,200	10,970	9,230
R-squared	0.028	0.025	0.010	0.012	0.007	0.002
Cohort dummies	Yes	Yes	Yes	Yes	Yes	Yes
Head age and education	Yes	Yes	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Asterisk (*) indicates significance at 10%; Asterisk (**) indicates significance at 5%; Asterisk (***) indicates significance at 1%. Standard errors in brackets are clustered at the province level. The dependent variable in columns 1-3 is a binary variable indicating whether a child has ever been enrolled in school at the time of the survey. In columns 4-6, the dependent variable is the number of years of education completed. "Young" includes children born between 1987-1996 and observed in the 1998 or 2003 survey rounds. The excluded group regroups children born between 1972-1981 and observed in the 1998 and 2003 survey rounds. Children from the younger cohort would have been affected by the policy reform if they resided in the new cotton region. All specifications control for child age, household head's age, education and gender, the month in which the survey was fielded, year of the survey and province fixed effects.

Table 6. Impact of Cotton Adoption on Child Work and Farm Labor

	Child Work			Farm Labor		
	Boys and girls	Boys	Girls	Boys and girls	Boys	Girls
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: New cotton region						
Newcott×Postreform	-0.127	-0.051	-0.235***	-0.092	0.001	-0.223**
	[0.079]	[0.080]	[0.078]	[0.082]	[0.078]	[0.090]
Postreform	0.206	-0.203	-0.005	0.248	-0.133	0.070
	[0.147]	[0.123]	[0.150]	[0.152]	[0.117]	[0.170]
Girl	0.012			0.006		
	[0.048]			[0.049]		
Observations	10,656	5,695	4,961	10,656	5,695	4,961
R-squared	0.002	0.001	0.005	0.001	0.000	0.005
Panel B: Old cotton region						
Oldcott×Postreform	-0.087**	-0.073**	-0.085*	-0.069	-0.056	-0.066
	[0.034]	[0.033]	[0.046]	[0.045]	[0.034]	[0.076]
Postreform	0.555***	0.707***	0.308***	0.542***	0.728***	0.252**
	[0.054]	[0.064]	[0.082]	[0.071]	[0.054]	[0.120]
Girl	0.025			0.018		
	[0.030]			[0.031]		
Observations	17,461	9,337	8,124	17,461	9,337	8,124
R-squared	0.002	0.001	0.000	0.001	0.001	0.000
Child age dummies	Yes	Yes	Yes	Yes	Yes	Yes
Household head age and education	Yes	Yes	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Asterisk (*) indicates significance at 10%; Asterisk (**) indicates significance at 5%; Asterisk (***) indicates significance at 1%. Standard errors in brackets are clustered at the province level. The dependent variable in columns 1-3 is a binary variable indicating whether a child worked in the week before the survey. In column 4-6, the dependent variable is a binary variable that indicates whether a child worked on the farm. All regressions control for child age, household head's age, education and gender, the month in which the survey was fielded, year of the survey and province fixed effects.

Table 7. Impact of Cotton Adoption on Rural Household Expenditures

	Total Expenditure			
	(1)	(2)	(3)	(4)
Newcott×Postreform	1,281.150**		1,844.869***	
	[543.499]		[407.764]	
Oldcott×Postreform		563.737		-10.647
		[529.820]		[628.436]
Postreform	5,023.598***	8,487.975***	2,337.428***	8,657.582***
	[1,574.270]	[1,885.088]	[761.113]	[1,481.396]
Newcott	-508.786			
	[294.867]			
Oldcott		-209.103		
		[359.062]		
Observations	7,321	9,721	7,321	9,721
R-squared	0.001	0.000	0.002	0.000
Household head age and education	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes
Province fixed effects	No	No	Yes	Yes

Note: Asterisk (*) indicates significance at 10%; Asterisk (**) indicates significance at 5%, Asterisk (***) indicates significance at 1%. Standard errors in brackets are clustered at the province level. The dependent variable represents household expenditures per capita. The control variables are household head's age and education, and survey month dummies. In columns 3 and 4, regressions include province fixed effects.

Table 8. Cotton Adoption and Child Labor

	Ln(Labor)		
	(1)	(2)	(3)
Plot size in ha	-0.540***	-0.555***	-0.526***
	[0.028]	[0.027]	[0.027]
Number of boys	0.020***	0.017**	0.015**
	[0.007]	[0.007]	[0.006]
Number of girls	0.026***	0.025***	0.027***
	[0.008]	[0.008]	[0.010]
Cotton plot		0.215***	
		[0.050]	
Cotton plot × Number of boys		0.069***	
		[0.022]	
Cotton plot × Number of girls		0.013	
		[0.030]	
Cereals plot			-0.266***
			[0.025]
Cereals plot × Number of boys			0.006
			[0.010]
Cereals plot × Number of girls			-0.003
			[0.012]
Constant	4.935***	4.932***	5.079***
	[0.051]	[0.051]	[0.052]
Observations	34,866	34,866	34,899
R-squared	0.41	0.42	0.42

Note: Asterisk (*) indicates significance at 10%; Asterisk (**) indicates significance at 5%; Asterisk (***) indicates significance at 1%. Standard errors in brackets are clustered at the province level. The dependent variable is the natural log of labor in man-days per hectare applied to each plot. All regressions include number of men and women, plot characteristics, plot owner's age and gender, and village fixed effects. The data are taken from the 2008 round of a household survey conducted by the Ministry of Agriculture of Burkina Faso.