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844

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Berlin, December 2008

IMPRESSUM

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Fax +49 (30) 897 89-200
http://www.diw.de

ISSN print edition 1433-0210
ISSN electronic edition 1619-4535

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Food price inflation and children's schooling

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November 27, 2008

Abstract

I analyze the impact of food price inflation on parental decisions to send their children to school. Moreover, I use the fact that food crop farmers and cotton farmers were exposed differently to that shock to estimate the income elasticity of school enrolment. The results suggest that the shock-induced loss in purchasing power had an immediate effect on enrolment rates. Instrumental variable estimates show that the effect of household income on children's school enrolment is much larger than a simple OLS regression would suggest. Hence, policies to expand education in Sub-Saharan Africa, should not neglect the demand side.

***JEL* Classification:** I21, O12, Q12.

Key words: Education, Household Income, Inflation, Aggregate Shocks, Africa.

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*I thank the Institut National de la Statistique et de la Démographie (INSD) in Burkina Faso for providing the household survey data. The paper benefited from comments by Francois Bourguignon, Denis Cogneau, Johannes Gräb, Rémi Jedwab, Bakary Kindé, Admasu Shiferaw, Robert Sparrow, and seminar and conference presentations in Ouagadougou (GTZ-MEF), Zürich (VfS), and Accra (PEGNet). This paper is part of a DFG (German Research Foundation) funded research program entitled 'Driving Forces of Rural Poverty and Distributional Change in Sub-Saharan Africa'. The financial support is greatly acknowledged.

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1 Introduction

These days many low income countries are confronted with rapidly rising food prices. This reduces in particular the purchasing power of the poor, given that they generally spend a large part of their income on food. Behind this background the United Nations' World Food Programme warns of the catastrophic effects of rising food prices on hunger and poverty.[1]

To assess the consequences of excessive food price inflation on household outcomes in poor countries it might be helpful to look at the past, given that most poor countries, in particular in Sub-Saharan Africa, are frequently confronted with periods of rising food prices as a result of variations in agricultural production due to climatic shocks.

In the second half of the nineties, Burkina Faso was confronted with such a substantial increase in food prices. This was caused by, among other things, a severe drought which hit the country in 1997/98. Following the drought and a resulting substantial decline in agricultural output, prices of the three main food crops, sorghum, millet and maize increased by more than 40 percent. These food crops account in normal times for about 30 percent of total expenditure (including imputed expenditures for own production) for rural households in the poorest quintile of the expenditure distribution.

In a context of incomplete financial markets, as in most parts of Sub-Saharan Africa, households confronted with such shocks have to rely on strategies such as the depletion of assets, increased labor supply and the withdrawal of children from school to meet their basic needs (see e.g., Jacoby and Skoufias, 1997). I analyze whether food price inflation, through its effect on real household income, led to reduced school enrolment in Burkina Faso.

To identify the *causal* impact of household income on investments in children's education, I use the fact that at the same time as food prices increased, cotton exports increased as well, driven by the devaluation of the CFA Franc in 1994, a favourable development of the world market price and a significant expansion of land used for cotton production. This boom prevented the real income of cotton farmers from declining as much as that of food crop farmers.

In other words I use the distinct development of real incomes between food crop farmers and cotton farmers between 1994 and 1998 to identify the income elasticity of children's school enrolment. Obviously, estimates of that elasticity based on a simple regression of schooling on income would probably be biased due to simultaneity, unobserved heterogeneity and possibly measurement error.

Identifying this effect is not only important in understanding the consequences of food-price-inflation-induced declines in real income on children's schooling, but also, more generally, to understand to what extent household income matters for children's education in poor rural settings. If income matters, policy makers may consider taking a more balanced view on the supply and demand side of education. Cash transfers to households or investments in infrastructure or agricultural productivity to increase the earning capacity of households may have to complement standard education policies such as the

[1] See http://www.wfp.org/.

construction of schools and the training of teachers in the African context.

In the literature there is an intense debate about the role of parental income on children's schooling. However, most of the evidence comes from developed countries or from the analysis of conditional cash transfer programs in Latin-America and some parts of South-Asia. Given the conditionality in these latter programs it is generally difficult to derive from them the direct effect of parental income. In addition, so far there there is only little evidence from Sub-Saharan Africa, although this region has the lowest education levels in the world.

In the coming years enormous financial resources will be allocated by governments and international donors to increase school enrolment in that region. Hence information of the type mentioned above is important in deciding how to spend these resources in the most effective way.

The remainder of the paper is organized as follows. Section 2 provides a short review of the relevant literature. Section 3 discusses the economic context in Burkina Faso and provides some information about the education system. Section 4 presents the data sources. Section 5 first analyzes descriptively the effect of food price inflation on children's schooling and then estimates the income elasticity of enrolment using the setting described above. Section 6 concludes.

2 A review of the literature

Various papers have analyzed the impact of transitory and unanticipated income shocks on indicators related to children's schooling in poor rural settings. The theoretical background of these papers is that under liquidity constraints, caused by the lack of insurance and limited possibilities to smooth consumption through credit and savings, the standard human capital investment model of child labor and schooling decisions introduced by Schultz (1960) and formalized by Ben-Porath (1967) does not apply. As pointed out by Baland and Robinson (2000), if parents face such constraints then, in the event of a negative shock, they have to trade off the future benefits of educating their children against their current consumption needs. Therefore children are not enrolled or drop out of school in order to contribute to household income and to help maintain current consumption, even if the return to child labor is below the return of education.

Using data for Peru, Jacoby (1994) was one of the first who empirically showed that income shocks can have a notable impact on school attendance in poor settings. He emphasized that this effect stemmed mainly from those households which were credit constrained, as measured by the predicted probability of having positive savings or outstanding non-business loans. In another paper, Jacoby and Skoufias (1997) focused in particular on the impact of seasonal fluctuations in the income of agrarian households, distinguishing aggregate from idiosyncratic and anticipated from unanticipated income shocks. Using panel data from India, the authors found that small farm households were inadequately insured ex ante, and, hence, unanticipated income shocks significantly affected children's school attendance. They also found that households, again in particular smaller farm households, faced serious credit market constraints, sometimes combined with limited storage opportunities, which again had adverse impacts on children's school attendance.

Kazianga (2005) used similar panel data for six villages in rural Burkina Faso, the country on which this paper also focuses. He also pointed to the potential benefit of informal insurance mechanisms. He showed that for households without any access to insurance the frequency of income shocks, as measured by the predicted income variance, reduced educational investments in boys and, in particular, in girls.

Beegle, Dehejia and Gatti (2006) used panel data for Tanzania to examine the extent to which transitory income shocks led to increases in child labor and whether household's asset holdings mitigated the effects of these shocks. For this purpose they regressed child labor hours on an interaction term of asset ownership and shocks controlling for household fixed effects and a number of time varying household characteristics. They found that crop shocks led to a significant increase in the level of child labor, but that households with assets were able to offset at least a large part of that shock. Richer households tended to prefer to use their assets as collateral against credit, whereas poorer households tended to prefer to use them as a buffer. However, school enrolment decreased less than expected because many children were able to combine school and work.

Other papers focused on child labor and children's school enrolment in the context of economic crisis. Thomas, Beegle, Frankenberg *et al.* (2004), for instance, analyzed the effects of the financial crisis in Indonesia on children's school enrolment, by relating income to school enrolment and education spending. They found a substantial effect on schooling in particular in poorer households. However, poorer households had a tendency to protect the education investments of older children at the expense of younger ones.

All these studies show convincingly that the level and variance of household income matter for children's schooling if households have only limited insurance and limited possibilities to smooth their consumption through credit and savings. However, these studies do not intend to provide an accurate estimate of the income elasticity of enrolment, which could be used to design safety nets, such as conditional or unconditional cash transfer programs, which would help households to overcome such shocks without withdrawing their children from school. To get an idea of how much income has to be transferred, one needs to know the income elasticity of enrolment, once the effects of reverse causality and omitted variables, in particular parents' unobserved preferences and abilities, have been controlled for.

For industrialized countries the causal impact of parental income on children's educational attainment is being intensively studied using either panel data (see e.g., Blau, 1999; Aughinbaugh and Gittleman, 2003) or instrumental variables (see e.g., Shea, 2000; Maurin, 2002; Chevalier, Harmon, O'Sullivan and Walker, 2005), the latter more and more often based on natural experiments (see e.g., Black, Devereux and Salvanes, 2005; Løken, 2007). The different identifying assumptions made in these studies can of course be subject to debate and it is difficult to draw a sharp conclusion. It is also plausible that the effect differs by country and time even within the group of industrialized countries. However, it seems that income effects in richer countries are relatively weak and that often the effect of omitted parental abilities dominates, i.e. the OLS estimate of the income effect is rather upward than downward biased, but there are exceptions (e.g. Maurin, 2002).

For developing countries this literature is relatively limited. Behrman and Wolfe (1987) used sibling data to analyze the respective roles of unobserved family backgrounds, parental education and income in Nicaragua. They showed that the impact of parental education is strongly reduced once family fixed effects are introduced. They did not find an effect of various measures of parental income on children's schooling. However, the use of family fixed effects in such a context is often criticized for inappropriately assuming that unobserved abilities are constant across siblings (see e.g., Ermisch and Francesconi, 2001).

Cogneau and Maurin (2003) offer one of the rare studies which investigated the issue for a Sub-Saharan African country, Madagascar. They instrumented parental income by the difference in parental and grand-parental education. Using past educational achievements ensures that the instrument is uncorrelated with the error term and transitory income. By taking the first difference, they eliminate the family fixed effect. In contrast to the results found Behrman and Wolfe (1987), their instrumented income effect is three to four times larger than the non-instrumented effect. Parental education becomes almost insignificant, suggesting that parental education is rather a proxy for permanent income.[2]

Other studies relied on natural experiments, as this study will do. Rucci (2004) looked at changes in enrolment rates during the Argentinean crisis and instruments household income by the lagged Brazilian Real-US Dollar exchange rate. She also found the IV estimate, depending on age and gender of the child, to be two to seven times larger than the OLS estimate. Cogneau and Jedwab (2008) took cocoa price shocks in Côte d'Ivoire as an instrument for income and explored the difference in investments in children's education and health in families of cocoa and food crop farmers. Regarding the effects on education, they find an income elasticity of primary school enrolment which is three to four times higher than an elasticity estimated by OLS. For instance, for the age group five to eleven years old, they found that an increase in income by ten percent increased enrolment by almost three percent.[3]

This paper contributes in two ways to the literature discussed above. First, it provides further evidence that an unanticipated transitory shock on (real) household income, such as a temporary hike in food prices, has an immediate effect on children's school enrolment, suggesting that other risk-coping instruments are insufficient. Second, it provides a relatively accurate estimate of the causal impact of household income on children's school enrolment in a very poor rural African setting.

[2] Behrman and Knowles (1999) survey a large number of other studies. However, most of them do not address the limitations regarding the use of current annual income or expenditures.

[3] Jensen (2000) and Kruger (2007) also rely on natural experiments to investigate the impact of income on education, however, they used reduced form estimators and thus did not provide an estimate of the income elasticity of enrolment.

3 Background

3.1 Agricultural production and prices

Burkina Faso is one of the poorest countries in the world. GDP per capita is estimated at only PPP US$ 1,213 and according to the Human Development Index (HDI), the country was ranked 176th out of 177 countries (UNDP, 2007). The bad performance in terms of the HDI is in particular caused by a very low education index. The country is landlocked in the middle of West-Africa and has a population of roughly 13.4 million. The country depends highly on cotton exports, which account for almost 60 percent of total export earnings, as well as on international aid. More than 80 percent of the Burkinabè population lives in rural areas working predominantly in the agricultural sector, which suffers from very limited rainfall and recurrent severe droughts.

Figure 1 shows that as a result of the severe drought in 1997/98 total production of the three main food crops decreased by almost 20 percent. Although the production of maize increased during that period, given its relative low weight in food consumption, maize production could not compensate for the decline in millet and sorghum production. At the same time cotton production increased by more than 70 percent.

[insert Figure 1]

Figure 2 shows that the prices of cereals rose tremendously between 1994 and 1998. This rise was caused first of all by the production shortage following the drought. But even before that drought prices tended to rise due to rising input prices after the devaluation of the CFA Franc in 1994 and a lack of productivity increases in cereal production, accompanied by continuous high population growth. In some years a high demand for cereals from neighboring countries also put pressure on prices in Burkina Faso.

[insert Figure 2]

Following the devaluation and the favorable development of the world market price of cotton, the Burkinabè cotton marketing board '*Société Burkinabè des fibres textiles*' (SOFITEX), which was in place at that time,[4] increased the producer price in several steps. Despite the fact that the costs of inputs also increased, as most of them have to be imported, the rise in producer prices still provided enough incentives to expand cotton production, mainly by the expansion of land allocated to cotton production (Grimm and Günther, 2007a).

After 1998 cereal prices fell back to lower levels, before rising again due to a second drought in 2000/01. The immediate consequences of the second drought are difficult to assess, since household survey data only exists for 1994, 1998 and 2003. As Figure 1 shows, in 2002 cereal production had already recovered

[4]At that time SOFITEX was the only importer of agricultural inputs such as fertilizer and pesticides and the only buyer of cotton. For a detailed description of the sector, see e.g. Kaminski (2007).

and prices for millet and sorghum in particular were significantly lower in 2002 than in 1998.

Obviously such price hikes in food staples can always have two types of consequences. Households who are net producers of these cereals will benefit, i.e. the income effect will more than outweigh the price effect. Households who are net consumers will, in turn, suffer real income losses. Household survey data for 1998 shows that in rural areas 94 percent of all households produced cereals, but only 15 percent sold any on the market. In contrast, the share of purchased cereals in total cereal consumption was on average 49 percent (Grimm and Günther, 2007a). Thus, in rural Burkina Faso most of the households should be losers of such price increases, in particular in periods of harvest failures since this obviously means also lower output.[5]

It is important to emphasize that the cereal prices shown in Figure 2 are consumer and not producer prices. The latter are often much lower given the negotiation power of traders and the information asymmetries prevailing between traders and farmers. Also, farmers do often not have appropriate storage facilities and thus are forced to sell their cereals directly after the harvest, resulting in a fall in prices. Traders on the other hand, are able to store cereals, to speculate in the market and to drive the price up by allocating their supply over the whole year.

To conclude, the hypothesis is that between 1994 and 1998 food crop farmers and cotton farmers experienced a substantially different development of (real) household income given that they were differently exposed to exogenous shocks. Because of the lack of formal insurance and credit and, as shown by Kazianga and Udry (2006), the only limited evidence of risk sharing and consumption smoothing available in Burkina Faso (see also Reardon, Matlon and Delgado (1996)), the tremendous loss in purchasing power for food crop farmers is likely to have led to a substantial decline of school enrolment of children living in these households. In contrast, school enrolment of children living in cotton households should have been affected less. The latter is of course only true as long as the income effect was higher than the substitution effect, i.e. children living in cotton households were not put to work more often given the increased opportunity cost of schooling. This latter issue will also be addressed below.

3.2 Schooling system

In Burkina Faso basic education includes pre-school classes for a maximum duration of three years; normally children from three to six years of age can attend. Primary school starts officially at the age of seven and lasts in total six years. Upon successful completion, children receive the *Certificat d'Etudes Primaires* (CEP) which qualifies for entry into secondary school.

Secondary school is comprised of two types of curricula: the general curriculum and a technical curriculum. Lower secondary education lasts four years and ends with the *Brevet d'Etudes du Premier Cycle* (BEPC) for the general curriculum and with the *Certificat d'Aptitude Professionnelle* (CAP) for the

[5]See Reardon, Matlon and Delgado (1988) for similar evidence on Burkina Faso

technical curriculum. General higher secondary education lasts three years. Technical higher secondary education can be three years (long) or two years (short). The respective diplomas are *Baccalauréat* (BAC), *Brevet de Technicien* (BT) and *Brevet d'Etudes Professionnelles* (BEP). The BAC enables entry into tertiary education.

In principle school is compulsory for the age group six to sixteen. But the law explicitly states that this is conditional on the availability of schools, teaching material and teachers (see e.g., Pilon, 2002). De facto, many children never go to school or if they do, only for a few years, particularly in rural areas. In addition, school entry is often delayed, repetition rates are high and there is still an important, although decreasing, gender gap in rural areas.

The schooling system is comprised of public and private schools. Private schools charge fees. Public schools are always free of charge and parents only have to buy pens, paper, books and a school uniform. Until 2007 it was also custom that parents paid 1,000 CFA F (about 10 PPP US$) each year into the parents' association. However, this was abolished in 2007. Today, public and private schools receive text books from the government.

4 Data

I use three nationwide representative household survey data sets, so-called *Enquête Prioritaires* (EP), undertaken in 1994 (EP I), 1998 (EP II) and 2003 (EP III) covering around 8,500 households in each year. These surveys were conducted by the *Institut National de la Statistique et de la Démographie* (INSD) with technical and financial support by the World Bank. These surveys contain relatively detailed information on households' socio-demographic characteristics, education, employment, agricultural and non-agricultural activities as well as consumption, income and some assets. A detailed description of these data sets can be found in Grimm and Günther (2007b).

Information on school enrolment is provided for all children older than five years. For all individuals who ever attended school, the surveys asked for the highest education level ever achieved. For children older than nine, the surveys also inform us whether a child worked, e.g. on the household's farm or non-farm business or outside the household.

Given the usual low quality of income data in poor rural settings, I use household expenditure per capita as a measure of households' income. The expenditure aggregate includes self-produced consumption and imputed rents. Expenditures were deflated over time and space using temporal and regional price deflators. Given the tremendous changes in relative prices in the second half of the nineties mentioned above, e.g. the substantial rise in cereal prices and the significant differences in consumption habits across the income distribution, I use decile-specific price indices to deflate expenditures over time. Using only the general consumer price index would over-estimate the living standard of the poor. This is shown in detail in Grimm and Günther (2007b, 2007c).

All those farmers who produced at least one kg of cotton in the survey year are coded as cotton farmers. Of course most of these farmers also produce some food crops. All other farmers are coded as food crop farmers. However, I will test the sensitivity of that definition to alternative assumptions. It should be noted that cotton farmers are, similarly to food crop farmers, usually small family farms with in most cases not more than a few hectares of land.

In what follows I restrict my sample to two relatively homogenous and well defined groups, namely food crop farmers and cotton farmers, and exclude pure livestock farmers and all other socio-economic groups. I only consider rural areas and limit the sample to households in the South and South-West of the country, excluding the relatively dry tropical savannah in the north.[6] Applying those criteria reduces the sample to in total 6,610 households for all three years together. The area is indicated on the map in Figure 3. Although one can find cotton cultivation almost everywhere in the country, in this area more than 80 percent of the total cotton exports are produced.

[insert Figure 3]

5 Empirical Evidence

5.1 Income

Table 1 shows the development of real household expenditure per capita. The shock on cereal output and the resulting food price inflation reducing the purchasing power of households are clearly visible. On average expenditures decreased by almost 24 percent in real terms. Afterwards households recovered and attained a living standard in 2003 which was slightly above that of 1994.

[insert Table 1]

Comparing cotton farmers with food crop farmers, one can state that both groups had a similar living standard in 1994. Then, between 1994 and 1998 real expenditures of food crop farmers decreased by almost 30 percent, whereas the real expenditure of cotton farmers decreased by 'only' 16 percent. Between 1998 and 2003, both groups again saw a very similar growth rate of about 37 percent over the whole period.

5.2 School enrolment

Column (1) in Table 2 shows the temporal pattern of enrolment rates for children six to thirteen years old living either in food crop or cotton farmer households. This pattern is obtained by regressing enrolment status on cotton and year dummies and cotton and year interaction terms. The regression also controls for age (coefficients not presented), relationship to the household head i.e.

[6] The narrow spatial and socio-economic definition of both groups to be compared ensures that this comparison is not affected by other shocks which might have occurred during that time. For instance, livestock farmers faced a different development in their production and in prices than pure food crop farmers. Urban households have suffered more under the price rise of imported food items than have rural households. Moreover, in the North there are only few cotton farmers, which would make a comparison with other farmers in this area somewhat fragile.

child of the head or not (coefficient not presented), gender and the interaction of gender, cotton and year effects. Note that on average only 22 percent of boys and 15 percent of girls within that age group are enrolled in school.

[insert Table 2]

The results suggest that children in cotton households have, on average, the same probability to be enrolled as children in food crop households. The cotton dummy is not statistically significant. In 1998 all children were significantly less likely to be enrolled than in 1994 and 2003. In that year the enrolment probability was on overage 8.7 percent lower than in the two other years. However, for children in cotton households this effect was on average much lower. The corresponding coefficient of the cotton-year interaction indicates that in 1998 these children had a probability to be enrolled which was higher by 6.4 percent. This interaction effect is insignificant in 2003.[7]

The other control variables indicate, as one can expect in the given context, that boys have, in general, a higher probability to be enrolled in school than girls. But it is interesting to see that in 1998 girls were less affected by delayed entry and school dropouts than boys. This could be explained by the higher opportunity costs for the schooling for boys. Below I will analyze this issue in more detail. However, it should already be noted that the interaction term of 'being a boy' and 'being a child of a cotton household' is insignificant. That suggests that in this age group boys in cotton households are on average not more likely to be enrolled or to be at work than boys in food crop households.

5.3 Education expenditures

Columns (2) and (3) in Table 2 show the development over time of schooling expenditures per household member and per child. The results are consistent with the impact observed for school enrolment: a general decline in schooling expenditures in 1998, but a positive and highly significant impact of the cotton-year interaction term in 1998. Thus in 1998 cotton households reduced their schooling expenditures significantly less than food crop farmers. The linear year effect in combination with the interaction effect even suggest that there was no reduction at all for children in cotton households. The cotton dummy is insignificant in column (2) and weakly significant in column (3), i.e. in normal times, there is hardly any difference in schooling expenditures between food crop and cotton farmers.

5.4 Child work

Table (3) shows the results of a multinomial logit regression. The dependent variable is a categorical variable taking the value 'one' if the child only attends school, 'two' if the child attends school and works, 'three' if the child only works and 'four' if the child neither attends school nor works. Information on activities other than schooling is available for children 10 years and older.

[7] The results are qualitatively the same, if a probit model is estimated.

Hence, I include the age group ten to thirteen in the regression. This is different to the age group considered in Table 2.

[insert Table 3]

Child work is relatively widespread among children ten to thirteen years old. In the study area between 60 and 70 percent of all children do some work without attending school and another five to ten percent combine school and work. Children who work help, in most cases, on the family farm (more than 90 percent of all cases). Work outside the household is rather an exception. The surveys do not contain any information on working hours. Children were only asked what the principal activity was; but for those working and attending school it was not asked whether one or the other activity was the main activity. I use the same control variables as in Table 2.

The multivariate analysis shows that in this age group children in cotton households worked slightly more often than that they attended school or were inactive than children in food crop households. Moreover, in 1998 all children were more likely to work than be at school. They were also less likely to combine work and school or to be inactive, implying that children either worked or attended school in that year. At the sample mean, the probability of working relative to attending school in 1998 is almost 19 percent higher than in 1994 and 2003.

The cotton-time interaction shows that in 1998 children in cotton households were much more likely than children in food crop households to attend school rather than to work. This effect is highly significant. In that year, children in cotton households were also more likely than children in food crop households to combine school and work rather than only attending school. However, this effect is only weakly significant. In 2003 these differential effects between children in cotton and food crop households disappeared again.

Regarding the gender differences, boys had a slightly higher probability than girls to combine school and work than to attend school only. Boys were less likely than girls to be inactive. There were no differences between boys and girls specific to the year 1998. However, in 2003 it seems that boys were less likely to work than attend school than girls were.

5.5 First conclusions

All results above suggest that food crop farmers were significantly hit by the drought and the rise in food prices and that they responded to the associated loss in purchasing power by reducing children's school enrolment and letting them work more often. This suggests, as some other studies have found before, that most rural households in Burkina Faso are unable to smooth consumption over time through credit and/or savings (Reardon, Matlon and Delgado, 1996; Kazianga and Udry, 2006). Moreover, the results imply that risk sharing, which would be possible with cotton farmers, does not happen or, again, happens only to a very limited extent. However, it is possible that food crop farmers benefitted to some extent from the cotton boom through a higher demand from cotton farmers for labor or goods produced by food crop farmers and that without these effects the impact of the price hike would have been even worse. It is also important to highlight that child work among cotton farmers did not increase relative to child work among food crop farmers despite the boom in the cotton sector.[8]

5.6 Income elasticity of school enrolment

5.6.1 Identification strategy

The simultaneous shocks induced by the cereal crises and the cotton boom caused a variation in income over time and household groups, which can help to identify the causal impact of household income on children's schooling. I rely on the period 1994 to 1998 for identification since this is the period in which both shocks occurred. Before and after that period, income and school enrolment in both groups of farmers followed a similar dynamic as documented in the previous sub-sections. I use expenditure as a proxy for income, thus ignoring the role of savings. This implies that, if consumption smoothing or insurance (or both) take place, for which again there is only weak evidence in Burkina Faso, the relationship which is analyzed is rather between permanent or average income and schooling than between current income and schooling.

A standard OLS model of the income effect can be written as follows:

$$S_{ijt} = \alpha + \beta Cotton_{ijt} + \gamma Year_t + \delta \ln Inc_{ijt} + \sum_{k=7}^{13} \zeta_k Age_{ijtk} + X'_{ijt}\eta + \theta_j + \varepsilon_{ijt}. \quad (1)$$

Enrolment, S_{ijt}, is a binary variable taking the value one, if the child i, living in province j is enrolled in school in year t. $Cotton_{ijt}$ takes the value one if the child lives in a cotton household. $Year_t$ takes the value one if the child is observed in 1998 (and zero if observed in 1994). The variable $\ln Inc_{ijt}$ stands for the logarithm of household expenditures. I do not express expenditures in per capita terms, because this could lead to identification problems in an enrolment equation, given that fertility and educational investments might be jointly determined and have the same unobservable determinants. However, if household composition responds to income shocks, income may have an omitted variable bias. Whether this is an issue will be examined below. The coefficient δ measures the income elasticity of school enrolment.

Age_{ijtk} are age-specific dummies for each age group between seven and thirteen years with the age of six being the reference group. X'_{ijt} is a vector of other household and individual control variables, including parental education, livestock and non-farm business ownership, wealth, access to credit, position of the child in the household, and variables reflecting the composition of the household. θ_j are province fixed effects which account for differences in education supply and other province-specific effects which otherwise might be picked up

[8] Ferreira and Schady (2008) discuss such income and substitution effects related to aggregate shocks.

by the remaining included variables if these are correlated.[9] Given that the unobservable characteristics of children living in the same household are likely to be correlated, I use robust standard errors for inference.

An OLS estimate of the income effect above is obviously subject to a number of biases. In principle, the most important ones are the simultaneity bias and the omitted variables bias. The simultaneity bias arises if enrolment is a substitute for child work and thus has a negative impact on household income. Simultaneity would bias δ downward. Given the extent of child work in Burkina Faso, it is likely that this bias arises. However, each of the activities—school and work on the family farm—need not necessarily occupy the whole day; both can be combined as seen above, probably reducing the downward bias.

Omitted variable bias can stem from a number of causes and can introduce a downward or upward bias. For instance, unobserved parental abilities may have a positive impact on income and make it more likely that parents send their children to school. This would upward bias the income effect. Household income could also be correlated with better opportunities for children to get a job which requires a certain level of education. This would increase the expected returns from education and thus again bias the income effect upward. The omission of parental education, household assets and location-specific characteristics could also lead to a biased estimate of δ, but these factors can, at least to some extent, be controlled.[10]

A further downward bias of the income effect may result from measurement error in the income variable. Although for most industrialized countries that bias should be relatively small, in the case of a poor agrarian country that bias can be very important and may even dominate the two other biases. Household surveys of the type undertaken in Burkina Faso ask households for pre-specified recall periods on how much they spent on a specific good or group of goods. The recall period for food expenditure is usually a week, for clothes, transport etc. a month and for durables, health and education expenditures a year. Obviously the potential error in these types of questions is large (see e.g., Deaton, 1997; and Deaton and Grosh, 2000).

It is not straightforward to get a rough estimate to what extent measurement error could bias the income effect. Validation surveys are frequently conducted in industrialized countries (see e.g., Bound, Brown and Mathiowetz, 2001), but do not exist for the Sub-Saharan African context. One possibility would be to rely on simulated errors and to make a sensitivity analysis under various assumptions about the variance of the error term and its correlation with income. This is however left for future work.

In order to obtain an unbiased estimate of the income effect on school en-

[9] One might prefer to include cluster-specific instead of province-specific fixed effects. However, those units are not constant over time and, hence, I would have to mix the time with the cluster-specific fixed effects. In addition, that would entail problems for my identification strategy, given that many of these clusters would not have enough farmers from either group.

[10] A detailed discussion why marginal private benefits of schooling are likely to be associated with household income in the context of a low income country and why a simple OLS estimate of the income elasticity of schooling might be biased is provided by Behrman and Knowles, 1999).

rolment, I rely on the distinct development of incomes of food crop and cotton farmers in the period 1994 to 1998. I use a 2SLS estimator and instrument income with the interaction effect 'being a child in a cotton household in 1998' conditional on 'being in a cotton household' and the time effect. Using this instrumentation strategy, Equation (1) can be rewritten as:

$$S_{ijt} = \alpha + \beta Cotton_{ijt} + \gamma Year_t + \delta \ln \hat{I}nc_{ijt} + \sum_{k=7}^{13} \zeta_k Age_{ijtk} + X'_{ijt}\eta + \theta_j + \varepsilon_{ijt}, \quad (2)$$

where the first stage equation is given by

$$\ln Inc_{ijt} = \vartheta + \iota Cotton_{ijt} + \kappa Year_t + \lambda(Year_t \times Cotton_{ijt}) + \sum_{k=7}^{13} \mu_k Age_{ijtk} + X'_{ijt}\nu + \xi_j + \omega_{ijt}.$$

This instrumentation yields a 'difference-in-difference' estimator, since it compares within provinces the difference between 1994 and 1998 in the difference in school enrolment between children of food crop farmers and cotton farmers. A similar instrumentation strategy is used by Cogneau and Jedwab (2008) to identify the income elasticity of schooling in Côte d'Ivoire.[11] Given the differences in enrolment patterns for boys and girls, I run the regression separately for boys and girls.[12]

Obviously a number of assumptions have to be verified to ensure that this instrumentation is valid and yields an unbiased income effect. First, the instrument needs to be relevant. That this is the case, was shown in Table 1. Whereas food crop farmers and cotton farmers had a similar living standard in 1994, cotton farmers were significantly richer than food crop farmers in 1998. After 1998, incomes of both groups followed again a similar dynamic. Second, I assume that being a child in a cotton household in that particular year 1998 is uncorrelated with the error term in the main equation of (2), i.e. the instrument does not have any direct impact on school enrolment other than its impact through income, once the linear effect of time and 'being a child in a cotton household' is controlled for. Note that there is no evidence that children in cotton households worked more often following the cotton boom (cf. Table 3). Third, I assume that children in cotton households and food crop households would have known the same change in school enrolment over time in the absence of the shocks on income. Table 2 suggests that this is indeed the case; the cotton dummy is insignificant and there is no difference in enrolment

[11] Rucci (2004) used both in her study, a simple difference estimator and a difference-in-difference estimator. To implement the latter she assumes that children of well educated parents have been differently affected by the Argentinean crisis than children of less educated parents. She argues that this difference arises because educated parents might be less credit constrained. However, if this was the case, the measured effect would no longer be a pure income effect, but an effect due to differences in access to credit.

[12] The model could also be estimated using a probit specification. However, for interpretational convenience and to avoid inconsistent estimates given that fixed effects are included, I use the linear specification.

rates between children in food crop households and cotton households in 2003 (insignificant interaction effect).

Table 4 shows the set of education related variables in the sample for all survey years and both types of children, those living in cotton households and those living in food crop households. There are no significant differences between both groups regarding the age of the children, gender of the children, the share of women in the household, age of the household head and the possession of a non-farm business. Although some of these variables vary over time, like for instance possession of a non-farm business, this seems to be due to the fact that the corresponding question was asked slightly differently in each survey. The difference in the mean age between 1994, 1998 and 2003 is consistent with the difference of the timing of the interviews in each survey year.

Household heads in cotton households are more often men than in food crop households, they and their spouses are also slightly better educated (however, this is partly due to the gender effect in household headship) and cotton households more often possess livestock and are a bit wealthier. However, they are credit constrained more often than food crop farmers, although being credit constrained is only measured rudimentarily. A household is considered to be credit constrained if it requested an agricultural credit but did not get one. It is of course possible that households who know that their request will be denied never ask for a credit.[13] The differences in all these variables are relatively constant over time. All these variables will be included as control variables in the regression.

The only issue which needs particular attention are the differences in the relationship of the children to the household head and household size between food crop and cotton farmers and the change in these differences over time. These structural changes could imply that some children living originally in food crop households were fostered by cotton households when incomes started to diverge between both groups. Akresh (2005) has provided evidence that, for instance, households in the Bazega province—which is outside the area which is covered by this study—rely on child fostering to mitigate shocks. It is difficult to say how that would bias the estimate of the instrumented income effect. In another paper, Akresh (2004) shows that the foster children are equally likely as their host siblings to be enrolled and they are slightly more likely to be enrolled than their biological siblings, but both the foster children and their biological siblings experience increased enrolment after the fostering exchange. If that would also be the case in the context analyzed here, it would mean that we underestimate the income elasticity of school enrolment. However, the bias should be moderate, since household size in cotton households increases by less than 0.3 persons per household. The share of children in the relevant age group (6-13) increases by only 1.2 percentage points in cotton households and does not decline (but rather increases) in food crop households.

[13] In 2005 in Burkina Faso only 22.5 percent of the households benefitted from credits from micro-lending institutions (African Development Fund, 2006). Cotton farmers have in addition access to credit to finance their inputs such as seeds and fertilizer, but these credits cannot be used to cover other expenditures.

[insert Table 4]

Finally the instrumentation would pose complications if the cotton boom provided an incentive to food crop farmers to switch to cotton production. If those switching households differed in unobservable characteristics correlated with their decisions regarding children's school enrolment, the estimated income effect could again be biased. Between 1994 and 1998 the share of cotton households, i.e. households which produced at least 1kg of cotton, increased by 13 percentage points from 21 percent to 34 percent. To account for the potential bias in the estimates due to switching households, I undertake below a number of robustness checks. For instance, I will introduce an interaction term for having been a cotton farmer in 1998, but not in 1997. I will also run the regression by excluding completely from the estimation those who joined after 1997. I will also change the definition of cotton farmers according to the amount of cotton produced or according to the share of cotton income in total agricultural income. Then, alternatively, I exclude from the sample the group of potential households which switched or attribute them to the group of food crop farmers and check whether this has any impact on the estimated income elasticity of schooling.

5.6.2 Results

Table 5 shows the estimation results. For boys the OLS estimate in column (1) suggests that a ten percent increase in household income leads to an increase in the probability of being enrolled of 0.64 percent, controlling for age, household composition, parental education, livestock ownership, non-farm business ownership and province fixed effects. For girls (column (7)) this elasticity is 0.49 percent. Both coefficients are highly significant. The cotton dummy is insignificant, supporting the identification strategy for the income effect below. The 1998 year dummy indicates that in 1998 enrolment rates were on average lower by seven percentage points for boys and 4.5 percentage points for girls. Parental education has (or more precisely education of the household head and his/her spouse) a significant positive impact on enrolment rates, in particular for girls. Ownership of a private non-farm business also has a positive impact, in particular for boys. This can be due either to a wealth effect or to a returns on education effect. If education is particularly valuable for the 'management' of a non-farm business, parents owning such a business may invest more in the education of their children. Livestock ownership has no significant impact.

[insert Table 5]

If income is instrumented (columns (2) and (8)) the income effect rises substantially. For boys the income effect increases to 0.268, suggesting that an increase of income by 10 percent increases the probability of enrolment, on average, by 2.7 percent: that is roughly four times the effect suggested by the OLS regression. The F-statistic in the corresponding first-stage regression is far above the critical value of ten, indicating again that the used instrument is relevant. For girls the instrumented income effect is even higher than for boys and again, the F-statistic indicates that the instrument is relevant. The cotton dummy is still insignificant. The effects of parental education decrease significantly, for both boys and girls, showing that a simple OLS estimation understates the income effect and overstates the parental education effect. Business ownership is no longer significant. The comparison of the OLS income effect with the instrumented income effect suggests that the simultaneity bias and the measurement error bias probably dominate, provided that the omitted variable bias would rather upward than downward bias the OLS effect.

In columns (3), (4), (9) and (10) I introduce as additional regressors a wealth index and the above-mentioned measure of access to credit. Introducing these controls can avoid a bias which could stem from the fact that cotton households have on average higher wealth holdings than food crop households. Both controls lower the OLS income effect, but do not alter the instrumented income effect. Finally, I add the square root of household size as a control variable (columns (5), (6), (7) and (8)) to account for the fact that households may respond to income shocks by adjusting their household size. Indeed, if household size is controlled, the instrumented income effect increases further, showing that income and household size are positively correlated. As I discussed above, it is possible that some cotton households fostered children from food crop households which then led to lower income growth in per capita terms than in absolute terms. This can also explain the lower F-statistic, though still above ten for boys and girls.

5.6.3 Robustness checks

If households who started to grow cotton after 1994 differed in their unobservable characteristics correlated with their decisions regarding children's school enrolment, the estimated income effect could be biased. In order to test the robustness of the estimates in Table 5, with respect to this issue, I re-estimate the model under various alternative assumptions. Table 6 shows the results.

First, I introduce in Equation (2) an interaction term between 'being a cotton farmer in 1998' and 'having not been a cotton farmer the season before' (i.e. in 1996/97).[14] For boys, the income effects for both estimations, OLS and IV, remain more or less unchanged. The F-statistic of the first-stage regression of the IV estimation goes even further up, showing that once controlled for the 'newcomer status', 'being a cotton farmer in 1998' is even more strongly correlated with income. For girls, the interaction term is significantly positive. The F-statistic goes down and the instrumented income effect becomes insignificant, although the size of the income effect is not much altered. In the next row, I exclude all households who joined the cotton sector after 1997 from the estimation. This removes about seven percent of all children in my sample. The F-statistics for boys and girls increase substantially. The instrumented income effect for boys is close to the estimate in Table 5 and for girls the effect decreases and is now similar to the effect for boys.

[insert Table 6]

[14] In absence of panel data, I cannot refer to the the season 1993/94.

Another way of dealing with the problem of households which switched to cotton production is to exclude those households which produced only relatively small quantities of cotton. The assumption is that new cotton farmers allocate on average less land to cotton than well-experienced cotton farmers.[15] Of course, the risk is that this systematically excludes cotton farmers who do not have much land and are thus relatively poor. I use two alternative cut-off points. The first eliminates all farmers who produced less than 50kg of cotton, which removes about five percent of the cotton farmers from the sample. The second cut-off point eliminates all farmers who produced less than 250kg of cotton, which removes about nine percent of the cotton farmers from the sample.[16] With the first cut-off point the results for boys lead to a lower IV estimate and a similar first-stage F-statistic. For girls the instrument becomes weak and the income effect turns out be insignificant. Using the second cut-off point, the instrumentation also looses its power for boys and the instrumented income effect goes substantially up. However, the second cut-off point is really far beyond the upper boundary and obviously removes not only many 'newcomers', but many poor cotton farmers as well.

Finally, I exclude those households from the cotton sample which draw only a relatively small share of their total agricultural income from cotton. Again I use two cut-off points, the first at ten percent (removing about four percent of all cotton households from the sample) and the second at 50 percent (removing about ten percent). In all cases, for boys and girls, the F-statistics go up, that is what one expects. Of course the higher the share of income a household draws from cotton, the more its income was (positively) affected in 1998. The IV estimates of the income effect go down for boys and girls, more so when the higher cut-off point is used. With the 50 percent cut-off point the income elasticity of enrolment is 0.223 for boys and 0.287 for girls. Both effects are significant.

I also tested whether all results hold if instead of removing those households which probably recently joined, I added them to the group of food crop farmers, i.e. if I left them in their initial group. The results were very similar. All effects hold, except for the variant where those households are defined as 'joiners', which earned less than 50% of their agricultural income from cotton production, which again is a very high threshold.

These robustness checks suggest that activity changes do not drive the results and do not lead to a substantial bias in my estimates. Thus, income matters. The true average income effect seems to be between 0.22 and 0.28, that is between three and four times the OLS effect. It is important to note that the OLS estimate might be strongly downward biased, not only because of a 'simultaneity bias' but also because of 'measurement error bias'.

[15] Note that the size of the plots allocated to cotton and cultivated land size in general is not available in the surveys.

[16] Note that quantities can only be computed approximately since respondents had the possibility to provide the quantities in terms of the number of baskets, sacks etc. This information was then converted into kg.

6 Conclusion

In this paper I analyzed the impact of a drought and resulting food price inflation on parental decisions to send their children to school. Moreover, I used the fact that in Burkina Faso food crop farmers and cotton farmers where exposed differently to that shock to estimate the income elasticity of school enrolment.

The results suggest that the loss of purchasing power, even if temporary, can have a severe impact on children's schooling. Between 1994 and 1998 Burkinabè food crop farmers experienced on average a decline of more than 30 percent in their income. This led to a substantial cut in their spending on education and a drop of more than ten percent in enrolment rates. This corresponds to more than 100,000 children which were not enrolled or were withdrawn from school during that period. In other words, instrumental variable estimates suggest that a decline in income by ten percent causes a decline in enrolment rates among children six to thirteen years old by about 2.2 to 2.8 percentage points, i.e. this impact is three to four times higher than what a simple OLS regression would suggest.

This is a further piece of evidence that income matters for children's school enrolment. However, so far existing evidence comes mostly from developed countries or from Latin-America and South-Asia, and is often based on an analysis of conditional cash transfer programs. Given the conditionality in these latter programs it is generally difficult to derive from them the direct effect of parental income. In addition, it is unlikely that these results can be generalized to the context of Sub-Saharan Africa. Given that this region has by far the lowest education levels in the world, the results from this paper might be particularly relevant.

In the coming years substantial resources will be spent on programs to increase school enrolment rates in Sub-Saharan Africa. The results of this study suggest that decision-makers should not only focus on the supply side of education, like school construction and the training of teachers, but should also implement measures to strengthen the demand side. That can be done directly by providing cash transfers to households[17] or indirectly by undertaking interventions which help increase the incomes of poor rural households. This can include investments in rural infrastructure, agricultural productivity and the provision of opportunities to diversify income sources. Of course the study also highlights that measures which help households to smooth income over time can prevent children from dropping out of school if households face negative income shocks. Time is pressing. In Burkina Faso for instance, between June 2007 and June 2008 cereal consumer prices rose again by 110.1%.[18]

[17] Such transfers could in principle be made conditional on enrolment. But it should be noted that monitoring can be very costly, in particular in a setting of weak institutions. Moreover, some studies suggest that the effects of conditionality are not always very large (see De Brauw and Hoddinott, 2008.

[18] Ministère de l'Economie et des Finances (2008).

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Tables and Figures

Table 1
Real yearly household expenditure per capita
(in 1000 CFA Francs, population weighted)

	1994	1998	2003
All Farm Househ.	61.7	47.0	64.3
		(-23.8)	(36.7)
Cotton Househ.	62.0	52.0	71.0
		(16.1)	(36.5)
Food Crop Househ.	61.5	43.4	59.4
		(29.4)	(36.9)

Notes: In parentheses total percentage increase relative to previous period.

Source: EP1, EP2, EP3; estimations by the author.

Table 2
Temporal pattern of differential enrolment rates and school expenditures
Cotton vs. Food Crop Households
Regression effects

	(1)			(2)			(3)		
	OLS			Tobit			Tobit		
	School enrollment 6-13 years old			Schooling expend. per househ. member			Schooling expend. per child 6-13 y. old		
	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.
Cotton Househ.	-0.001		0.029	0.795		0.511	0.989	*	0.566
Year 1998	-0.081	***	0.022	-1.398	***	0.327	-1.401	***	0.365
Year 2003	-0.005		0.024	-0.305		0.330	-0.166		0.367
Cotton × Year 1998	0.064	**	0.032	1.462	**	0.620	1.288	*	0.688
Cotton × Year 2003	-0.019		0.033	-0.372		0.617	-0.778		0.685
Boy	0.101	***	0.023						
Boy × Cotton	0.011		0.017						
Boy × Year 1998	-0.044	*	0.025						
Boy × Year 2003	-0.026		0.026						
Household Head Male				0.513		0.423	0.880	*	0.476
Observations	12273 (children)			6610 (households)			6610 (households)		

Notes: Standard errors are robust to arbitrary forms of heteroskedasticity and permit within-family correlations among unobservables. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level. Regression (1) also controls for age and relationship of child to household head. Intercept included but not reported here. Reference year is 1994.

Source: EP1, EP2, EP3; estimations by the author.

Table 3
Temporal pattern of school enrolment, child work and inactivity
Cotton vs. Food Crop Households, Children 10 to 13 years old
Marginal effects from a multinomial logit, enrolment is baseline outcome

	School and work			Work			Inactivity		
	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.
Cotton Househ.	0.012	*	0.012	0.093	*	0.045	-0.028		0.017
Year 1998	-0.030	*	0.011	0.143	*	0.039	-0.056	**	0.013
Year 2003	-0.053	***	0.011	0.038		0.040	-0.018	*	0.010
Cotton × Year 1998	0.027		0.021	-0.185	***	0.058	0.038		0.033
Cotton × Year 2003	-0.019		0.009	-0.055		0.057	0.006		0.023
Boy	0.014	*	0.008	0.013		0.038	-0.075	***	0.017
Boy × Cotton	-0.013	*	0.008	-0.012		0.030	0.016		0.017
Boy × Year 1998	0.004		0.010	-0.061		0.045	0.036		0.025
Boy × Year 2003	0.059		0.048	-0.122		0.054	0.056	*	0.029
Observations					5319				

Notes: Standard errors are robust to arbitrary forms of heteroskedasticity and permit within-family correlations among unobservables. Stars refer to standard errors of regression coefficients, not to those of marginal effects. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level. Regression also controls for age and relationship of child to household head. Intercept included but not reported here. Reference year is 1994.

Source: EP1, EP2, EP3; estimations by the author.

Table 4
Characteristics of children (6 to 13 years old) and the households they live in

	1994		1998		2003	
	Food crop	Cotton	Food crop	Cotton	Food crop	Cotton
Age	9.054	9.055	9.202	9.184	9.205	9.113
Boy	0.540	0.552	0.533	0.545	0.514	0.516
Child of househ. head	0.783	0.821	0.872	0.773	0.880	0.899
Household Size	9.101	10.959	8.795	11.213	8.051	9.067
Share women in househ.	0.496	0.477	0.509	0.492	0.522	0.505
Share children 6-13 in househ.	0.294	0.277	0.323	0.289	0.314	0.298
Household head male	0.914	0.967	0.919	0.974	0.896	0.978
Household head age	46.358	45.229	47.711	47.318	47.830	46.260
Househ. head migrated last 5 years	0.062	0.025	0.066	0.055	n.a.	n.a.
Househ. head some primary	0.061	0.089	0.060	0.090	0.066	0.097
Househ. head primary completed	0.028	0.056	0.029	0.055	0.030	0.057
Spouse of head some primary	0.045	0.054	0.047	0.051	0.047	0.059
Household owns livestock	0.669	0.776	0.798	0.920	0.796	0.933
Household owns non-farm business	0.516	0.596	0.266	0.276	0.391	0.358
Value of asset index	-0.757	-0.514	-0.836	-0.400	-0.785	-0.544
Household credit constrained	0.035	0.046	0.036	0.072	0.269	0.384

Notes: The means of 'Age', 'Boy' and 'Child of household head' are computed over all children. The remaining variables are means over all households to which the children belong. The questionnaire on 'Non farm business' varies slightly from year to year. The asset index includes ownership of the following assets: radio, TV, bike, motorbike, fridge, connection to electricity, connection to taped water, modern toilet, good floor and wall materials. The index is computed on the national level using principal component analysis. The national average is normalized to zero in each year. A household is defined as credit constrained if it asked for agricultural credit but did not get it.

Source: EP1, EP2, EP3; computations by the author.

Table 5
The income elasticity of school enrolment, 1994 – 1998
Children 6 to 13 years old

	(1) OLS			(2) 2SLS			(3) OLS			(4) 2SLS			(5) OLS			(6) 2SLS		
	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.
BOYS																		
Main equation																		
Cotton Househ.	-0.012		0.022	-0.040		0.028	-0.010		0.021	-0.040		0.027	-0.011		0.022	-0.019		0.021
Year 1998	-0.071	***	0.019	-0.092	***	0.021	-0.075	***	0.018	-0.094	***	0.020	-0.072	***	0.019	-0.114	***	0.031
Ln Expenditure (IV)	0.064	***	0.012	0.268	**	0.120	0.029	**	0.013	0.265	**	0.127	0.067	***	0.015	0.373	**	0.187
HH head some primary	0.101	***	0.034	0.088	**	0.035	0.079	**	0.034	0.081	**	0.034	0.100	***	0.034	0.065		0.041
Spouse some primary	0.190	***	0.053	0.151	***	0.051	0.154	***	0.059	0.140	***	0.047	0.189	***	0.053	0.137	***	0.053
HH owns livestock	-0.016		0.022	-0.099	*	0.053	-0.011		0.021	-0.100	*	0.052	-0.015		0.022	-0.074	*	0.042
HH owns non-agri. bus.	0.072	***	0.019	0.041		0.025	0.053	***	0.018	0.035	*	0.019	0.073	***	0.019	0.050	**	0.022
Wealth index							0.075	***	0.010	0.020		0.031						
Credit constrained							0.036		0.054	-0.014		0.057						
HH size (Square root)													-0.006		0.012	-0.136	*	0.081
Provincial fixed effects		yes			yes			yes			yes			yes			yes	
First stage																		
IV: Being a cotton farmer in 1998				0.291	***	0.050				0.274	***	0.048				0.196	***	0.044
F-Stat					33.5						32.9						19.7	
Observations		4359			4359			4359			4359			4359			4359	

Notes: See next page.

Table 5 (*... continued.*)

	(7) OLS			(8) 2SLS			(9) OLS			(10) 2SLS			(11) OLS			(12) 2SLS		
	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.
GIRLS																		
Main equation																		
Cotton Househ.	0.009		0.022	-0.042		0.043	0.007		0.022	-0.038		0.034	0.015		0.022	-0.005		0.026
Year 1998	-0.045	**	0.018	-0.077	***	0.027	-0.047	***	0.018	-0.074	***	0.022	-0.049	***	0.018	-0.094	***	0.036
Ln Expenditure (IV)	0.049	***	0.012	0.308	*	0.183	0.019		0.012	0.297	*	0.160	0.066	***	0.015	0.363	*	0.217
HH head some primary	0.161	***	0.040	0.140	***	0.038	0.147	***	0.039	0.147	***	0.035	0.155	***	0.039	0.108	**	0.048
Spouse some primary	0.158	***	0.048	0.123	**	0.054	0.128	***	0.047	0.134	***	0.048	0.161	***	0.047	0.142	***	0.047
HH owns livestock	0.037		0.023	-0.067		0.076	0.038	*	0.023	-0.059		0.059	0.040	*	0.023	-0.034		0.057
HH owns non-agri. bus.	0.030	*	0.017	-0.016		0.036	0.017		0.017	-0.009		0.021	0.033	*	0.017	0.009		0.023
Wealth index							0.058	***	0.012	-0.018		0.044						
Credit constrained							0.048		0.040	0.003		0.047						
HH size (Square root)													-0.028	**	0.012	-0.152	*	0.092
Provincial fixed effects		yes			yes			yes			yes			yes			yes	
First stage																		
IV: Being a cotton farmer in 1998				0.189	***	0.057				0.213	***	0.053				0.160	***	0.049
F-Stat					11.1						16.3						10.6	
Observations		3708			3708			3708			3708			3708			3708	

Notes: Standard errors are robust to arbitrary forms of heteroskedasticity and permit within-family correlations among unobservables. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level. Regressions control also for age, being the eldest child in the household, being a child of the household head, the share of female household members, the share of children 6-13 years old in the household and whether the household head is a male. Intercept included but not reported here. The first-stage regression includes also all other variables from the main equation as instruments. Base year for year effects is 1994.

Source: EP1, EP2, EP3; estimations by the author.

Table 6
The income elasticity of school enrolment, 1994 – 1998 — Robustness checks
Children 6 to 13 years old

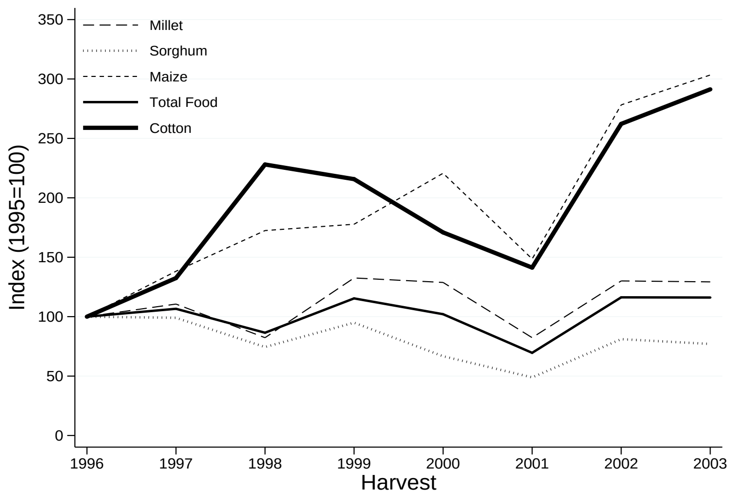
	Boys						Girls					
	(1) OLS			(2) 2SLS			(3) OLS			(4) 2SLS		
	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.
Interaction term: Household was not a cotton household in previous year												
Cotton Househ.	-0.015		0.023	-0.047		0.030	-0.010		0.024	-0.054		0.044
Cotton × No Cott. in $t-1$	0.013		0.033	0.041		0.033	0.081	**	0.037	0.097	***	0.034
Ln Expenditure (IV)	0.064	***	0.012	0.249	**	0.111	0.050	***	0.012	0.253		0.171
First stage F-Stat					37.9						11.8	
Without those households having not been a cotton hh in previous year (removes 6.5% of all boys (7.0% of all girls))												
Ln Expenditure (IV)	0.060	***	0.013	0.269	***	0.103	0.050	***	0.012	0.239	*	0.144
First stage F-Stat					44.6						16.3	
Without those households having produced less than 50kg cotton (removes 4.5% (4.0%) from sample)												
Ln Expenditure (IV)	0.066	***	0.013	0.226	*	0.119	0.053	***	0.012	0.271		0.231
First stage F-Stat					30.4						5.9	
Without those households having produced less than 250kg cotton (removes 8.6% (9.2%) from sample)												
Ln Expenditure (IV)	0.062	***	0.013	0.410	*	0.224	0.051	***	0.012	0.600		0.394
First stage F-Stat					10.3						3.1	
Without those households where cotton income share less than 10% (removes 3.9% (4.0%) from sample)												
Ln Expenditure (IV)	0.061	***	0.013	0.229	**	0.109	0.048	***	0.012	0.347	**	0.149
First stage F-Stat					39.9						17.9	
Without those households where cotton income share less than 50% (removes 10.0% (10.8%) from sample)												
Ln Expenditure (IV)	0.065	***	0.012	0.223	**	0.106	0.053	***	0.012	0.287	*	0.151
First stage F-Stat					41.9						15.6	

Table 6 (… *continued.*)

Notes: Standard errors are robust to arbitrary forms of heteroskedasticity and permit within-family correlations among unobservables. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level. Regressions correspond to those presented in Table 5 (columns (1), (2), (7) and (8)).

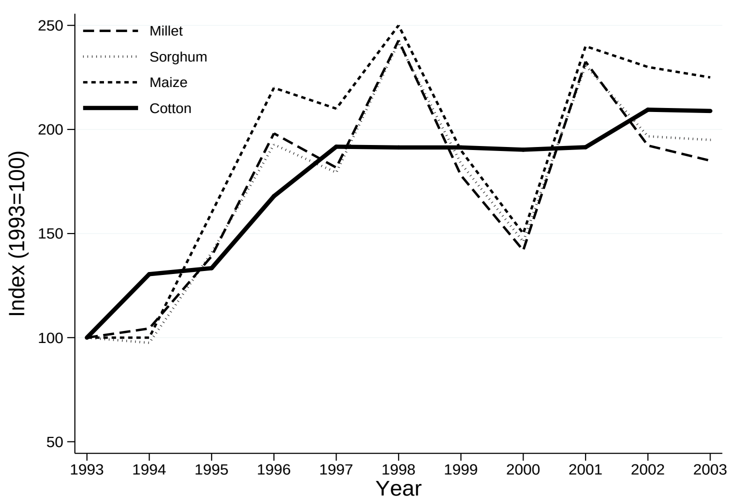
Source: EP1, EP2, EP3; estimations by the author.

Figure 1
Production of main cereals and cotton (in tons)



Notes: Total food means tons of millet, sorghum and maize.
Source: Economic Accounts for the Agricultural Sector, based on Enquête Agricole (data not available for harvests before 1996).

Figure 2
Consumer prices of main cereals and cotton producer price



Notes: Annual average prices (collected on 37 different regional markets).
Source: Cereal prices: Grain Market Price Surveillance System, Ministry of Trade. Cotton price: Ouedraogo, Sanou and Sissao (2003).

Figure 3
Provinces included in empirical analysis

Source: United Nations.