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Price Liberalization and Farmer Welfare Under Risk Aversion: Cotton in Benin and Ivory Coast*

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Abstract

Commodity producers in Africa often benefit from guaranteed and relatively stable prices for their crops. This paper shows how to estimate the required increase in crop price necessary to offset the higher risk for farmers that price liberalization would entail due to large variations over time in world commodity prices.

Keywords: Cotton, Price liberalization, Risk Aversion, Poverty, Benin, Ivory Coast.

JEL Codes: D81, D63, I30, O13.

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1 Introduction

Small-scale export-oriented agriculture is critical for poverty reduction in Sub-Saharan Africa (Belshaw, 2002). Yet as former integrated monopolies for the production and exportation of commodities such as cotton, cocoa, and coffee are being privatized in many Sub-Saharan African countries, the question of the mechanism used to set producer prices is on the agenda (Goreux, 2003). Currently, farmers are typically guaranteed a price for their crop that is fixed annually by Governments and is much more stable over time than the world price for the commodity. This is for example the case for cotton producers in West Africa, where most governments use some form of stabilization fund in order to smooth producer prices over time (and provide bonuses the next year if especially good results have been obtained during the previous year).

Given that world cotton prices have been falling in recent years (Minot and Daniels, 2002), and that governments have been reluctant to adjust prices downward, farmers have been protected to a large extent from the impact of the drop in the world price of cotton. Obviously, if world prices were to remain low for many years, the protection granted by governments to farmers could not be maintained without substantial budgetary costs. At some point, the guaranteed producer prices would probably have to be reduced. But to the extent that world price movements are only temporary, the guarantee provided by governments (or more precisely by parastatals under the control of governments) is essentially an insurance mechanism which may well be necessary given that rural credit and insurance markets are underdeveloped in Africa.

On the other hand, the systems put in place to organize the production of commodities and to pay farmers for their crops have long been judged inefficient and costly, leading to relatively low payments to farmers in comparison to the world price of commodities. Indeed, increasing the share of the world price accruing to farmers has been one of the considerations taken into account by International Financial Institutions such as the World Bank and the International Monetary Fund when promoting privatizations (Coulter and McKenzie, 2003)¹.

¹On the impact of these reforms, see also Akiyama et al. (2003), Badiane et al. (2002), Gibbon

If the privatization logic were implemented fully, the cotton sector could work through a system of contract farming, whereby farmers would make individual or group yearly contracts with competing ginneries (the factories buying raw cotton to produce cotton fiber), without any interference or support from the Government. Under contract farming, farmers would promise to deliver their cotton production at a given price to a given ginnery, and the ginnery would commit to purchase the cotton at the agreed price, while also providing a range of services to the farmers to facilitate the production process (for a review of contract farming in Africa, see Porter and Phillips-Howard, 1997). This system could generate advantages for farmers, but without good insurance mechanisms it could also imply that farmers would be fully exposed to world price shocks if these were transferred by ginneries to them.

Under the assumption of risk aversion among farmers, and in the absence of adequate private insurance mechanisms against swings in world cotton prices, what would be the increase in the producer price paid to farmers necessary to compensate them for the higher volatility in prices brought about by contract farming? Building on a simple framework for welfare measurement under risk aversion (Makdissi and Wodon, 2003; see also Cruces, Makdissi, and Wodon, 2004), this paper provides a simple methodology to answer this question.

We find that if we assume high levels of risk aversion among cotton producers, and if we also require that only a minority (say, one fourth) of poor producers be hit by price liberalization, as could be argued in a Poverty and Social Impact Analysis of reforms placing a high weight on poverty reduction within the context of each country's Poverty Reduction Strategy, relatively large increases in domestic cotton prices might be required in order to justify price liberalization. Such increases in prices may be fairly difficult to achieve under present circumstances in the two countries under consideration. This suggests that some form of insurance mechanisms is needed to protect poor farmers from swings in world cotton prices, especially in Benin where cotton revenues represent a larger share of household income and consumption than in Ivory Coast.

Section 2 describes the methodology used for assessing the impact of price liberalization. (1999), Goreux (2003), Larsen (2002, 2003), Poulton et al. (2003), and Raikes et al. (2000).

alization on farmer welfare under risk aversion. Section 3 provides empirical results on the increase in price necessary to offset higher risk under price volatility. The empirical results are obtained using recent household survey data for both Benin and Ivory Coast. A brief conclusion follows.

2 Theoretical Framework

Suppose that there are S possible states of nature. Consider a household i with per capita income (or consumption) x_{is} in state s . The household is exposed to variability in income over the states of nature. As defined in the risk theory literature, the certainty equivalent of the household's income, y_i , is

$$u(y_i) = \frac{1}{S} \sum_{s=1}^S u(x_{is}). \quad (1)$$

This certainty equivalent is the amount that, if received for sure in each state of the world, would generate the same utility as the state-contingent x_{is} . It is common in the literature to use a Taylor approximation of y_i

$$y_i(\rho) = \mu_i - \frac{1}{2} \frac{\rho}{\mu_i} \sigma_i^2, \quad (2)$$

where μ_i is household expected income, σ_i^2 is the variance of the household's stream of incomes and ρ is the Arrow-Pratt measure of relative risk aversion.

Household per capita income is the sum of K income sources, one of them being income from cotton production or any other similar commodity. In this context, expected total income is $\mu_i = \mu_{ic} + \mu_{io}$, where μ_{ic} and μ_{io} are respectively the expected income from cotton production and from all other sources of income. Using the definition of the variance of income and assuming for simplicity no covariance between income from cotton production and income from other sources, we can write $\sigma_i^2 = \sigma_{ic}^2 + \sigma_{io}^2$, where σ_{ic}^2 and σ_{io}^2 are respectively the variance of income from cotton production and the variance of income from all other income sources. We can rewrite (2) as

$$y_i(\rho) = \mu_{ic} + \mu_{io} - \frac{1}{2} \frac{\rho}{\mu_i} (\sigma_{ic}^2 + \sigma_{io}^2). \quad (3)$$

If we denote the size of household i by h_i , the price of cotton by p_c , and the quantity of cotton produced by the household by q_{ic} , we have $\mu_{ic} = (q_{ic}p_c)/h_i$. Assume now that price liberalization increases both the expected income from cotton (for example because it is assumed that under contract farming, producers will command a higher share of the world price) and the variance of income (because households are now subject to a higher degree of variability in prices). The question we ask is whether or not household i will gain from price liberalization. Assuming for simplicity that producers cannot change the quantity produced when prices change, from (3) we find that

$$\Delta y_i(\rho) = \frac{q_{ic}}{h_i} \Delta p_c - \frac{1}{2} \frac{\rho}{\mu_i} \frac{q_{ic}^2}{h_i^2} \Delta \sigma^2(p_c). \quad (4)$$

The minimum increase in the average price $\Delta_{p_c}^{\min}(i | \rho)$ that will induce a welfare gain for household i at a given level of risk aversion ρ is

$$\Delta_{p_c}^{\min}(i | \rho) = \frac{1}{2} \frac{\rho q_{ic}}{\mu_i h_i} \Delta \sigma^2(p_c). \quad (5)$$

Households who derive a large share of their income through cotton (i.e., households for whom the value of $q_{ic}/\mu_i h_i$ is high) will require a larger increase in price to offset the higher price variability brought about by the price liberalization. In many African cotton producing countries, these households are likely to be poorer, with fewer alternative ways of making a living.

Note that while we will focus here on estimating the average minimum required price increase to offset the risk effect of price liberalization (as well as the required price increase to ensure that respectively 50 percent, 75 percent, or 90 percent of farmers benefit from the reform), another approach would consist in directly assessing the impact of the reform on poverty measures. For any level of risk aversion, we could use (3) to estimate the impact on poverty of any potential combination of increases in prices Δp_c and in the variance of prices $\Delta \sigma^2(p_c)$.

3 Empirical Results

To estimate the price increase necessary to offset the negative impact of the increase in risk for farmers under price liberalization, we use household survey data for Benin

and Ivory Coast. For Benin, we use the QUIBB 2003 survey, a nationally representative household survey with a cotton module in the questionnaire (QUIBB stands for Questionnaire des Indicateurs de Base du Bien-Être). In Ivory Coast, we rely on the 2002 survey on the living conditions of households (Enquête sur le niveau de vie des ménages), which has information on the production of cotton, among other crops. Our indicator of well-being is per capita consumption, which is better measured in these surveys than total per capita income. For each household, we know whether the household is producing cotton, as well as the quantity produced. The prices currently received by households are the same for all households since they are guaranteed.

Table 1 provides data from Goreux (2003) on the world prices for cotton, and the guaranteed prices paid to farmers in both Benin and Ivory Coast. We consider prices paid over a six year period, from 1996 to 2002². In order to obtain an estimate of the change in the variance of domestic prices using a “one-to-one” transmission from changes in world price to changes in domestic prices under price liberalization, we rescale the world prices in table 1 so that the mean world price is equal to the mean domestic price (this means that our adjusted mean world prices in Benin and Ivory Coast are slightly different since the prices paid to producers are slightly different as well). The key result in table 1 is that the variance in the domestic price guaranteed to farmers by their respective governments is much lower (132 in Benin and 129 in Ivory Coast) than the variance in adjusted world prices (1769 in Benin and 1594 in Ivory Coast), as expected.

Table 2 provides estimates of the average price increase that would be necessary to compensate farmers from the increase in the variance of producer price assumed under

²Goreux provides two additional years of data, for 1994 and 1995, but the domestic prices paid to producers paid in these two years increased substantially following the devaluation of the Franc CFA, which leads to a higher degree of variance in domestic prices which may not represent the actual impact of exchange rate risks on domestic prices in a more normal environment. That is, the 100 percent devaluation of the Franc CFA in 1994 was a rather exceptional event, and the increase in domestic prices in the following two years was therefore exceptional as well. Since 2000, despite fairly large variations of the Euro – to which the Franc CFA is tied – against the US dollar, Governments in West Africa have kept producer prices relatively constant, and thus have absorbed exchange rate variations. Here, in order to focus on world price variability, we consider only the period 1996 to 2002 to estimate the variance in domestic and world prices, without considering exchange rates.

price liberalization and estimated using the six years of data on prices. The table also gives the required price increases necessary for respectively 50 percent, 75 percent, and 90 percent of farmers to benefit from price liberalization. We compute these statistics both for the sample of all cotton producers in both surveys (689 household in Benin and 414 households in Ivory Coast), and a sub-sample of households considered to be in poverty. For simplicity, and somewhat arbitrarily, we used a relative poverty line equal to half the mean per capita consumption in each of the two surveys to identify the poor. The resulting poverty lines are Franc CFA 96,499 per person per year in Benin, and Franc CFA 179,920 per person per year in Ivory Coast (Ivory Coast's per capita private consumption in the National Accounts per capita is 50 percent higher than Benin's). This leads to relatively low poverty rates of 21.4 percent in Benin (22.7 percent among cotton producers) and 37.4 percent in Ivory Coast (44.6 percent among cotton producers).

Under very low levels of risk aversion (say, $\rho < 2$), the average increase in producer price that is necessary to offset the impact of higher risk is fairly low, at less than five Franc CFA per kilo (the baseline price being close to Franc CFA 200 per kilo). However, under higher levels of risk aversion, with for example $\rho = 12$, the required average price increase is much higher, at between 13 and 27 Franc CFA.

Figures 1 and 2 show that even if these average price increases are achieved, many farmers would still stand to loose. Especially in the case of Benin, with $\rho = 12$, quite a few farmers require an increase of more than Franc CFA 50 in order to be as well off under price liberalization as under the current system of guaranteed prices. The farmers who need a higher price increase to offset the increase in risk are those for whom the value of $q_{ic}/\mu_i h_i$ is higher, i.e. those farmers for whom per capita revenues from cotton production represent a larger share of their per capita consumption. Clearly, from Figures 1 and 2, it can be seen that in both countries, those farmers tend to be poorer than the average cotton producer. This is also shown in table 3. With $\rho = 12$, a price increase of Franc CFA 48.41 is needed to enable 75 percent of poor cotton producers to gain from price liberalization in Benin.

What are the actual levels of risk aversion of cotton farmers in Benin and Ivory Coast? Unfortunately, we do not have adequate data in the surveys to estimate these

levels, and we did not find estimates elsewhere. There are estimates of risk aversion in the literature, especially in developing countries, but they differ substantially between studies. One recent study for Italy by Eisenhauer and Ventura (2003) suggests levels of relative risk aversion between 7 and 9 on average. It would however be reasonable to assume that risk aversion among cotton producers in Benin and Ivory Coast is higher than for a typical Italian household, given the dire consequences of income losses for poor households in developing countries without safety nets, and the fact that the “lottery” to which households would be exposed under price liberalization would affect a very large share of their income (in table 2, among the poor, the average value of per capita cotton revenues is more than half the per capita consumption, and in Ivory Coast, cotton revenues account for one third of the poor’s per capita consumption).

Thus, it seems appropriate to argue that a move towards terminating Government price guarantees for cotton producers would need to be combined with the implementation of some alternative form of insurance mechanism, explicit or implicit, in order to reduce the risk of serious negative impacts on farmers.

Note that other arguments could be invoked in favor of such alternative insurance mechanisms. For example, in a country like Benin where cotton represents three fourths of national exports, if a significant number of farmers were to be hit by short term price drops and would abandon cotton production as a result of price liberalization without the financial means to start again production at a later stage, this could have a large negative effect on the economy as a whole. Such an argument for cotton would be weaker in Ivory Coast, where the main export is cocoa, but of course a similar argument against price liberalization without insurance mechanisms could be made for cocoa in that country.

4 Conclusion

Producers of commodities such as cotton, cocoa, and coffee in Africa typically benefit from guaranteed Government prices for their crops. The fact that there is often less volatility in Government prices than in world market prices essentially represents an

insurance mechanism, which may be especially valuable in rural areas where poor households may not have access to alternative insurance mechanisms. At the same time, it has been argued that under more flexible pricing systems such as those associated with contract farming, farmers might be able to obtain a higher share of the world market price for their crops. Some observers have been sceptical about such claims, as cotton ginneries might try to minimize the price paid to farmers for their cotton production rather than enter in “bidding wars” with competitors for their purchases. Such bidding wars might be observed in practice only under circumstances of occasional shortages³.

But even if we assume for the sake of the argument that indeed, under a privatized system, producers may obtain a higher share of the world price, this does not necessarily mean that they will be better off. This paper has provided a simple framework for analyzing the increase in producer price required to compensate farmers from the higher risk resulting from price liberalization. If risk aversion among farmers is high (which is likely to be the case given the fact that many farmers are poor and that safety nets are lacking in Sub-Saharan African countries), and if reforms are judged in part on the fact that they are not likely to affect negatively a large portion of poor farmers, the increase in producer prices necessary to make farmers better off may be large. This means that unless alternative insurance mechanisms are implemented, fully liberalizing crop price may well lead to negative consequences.

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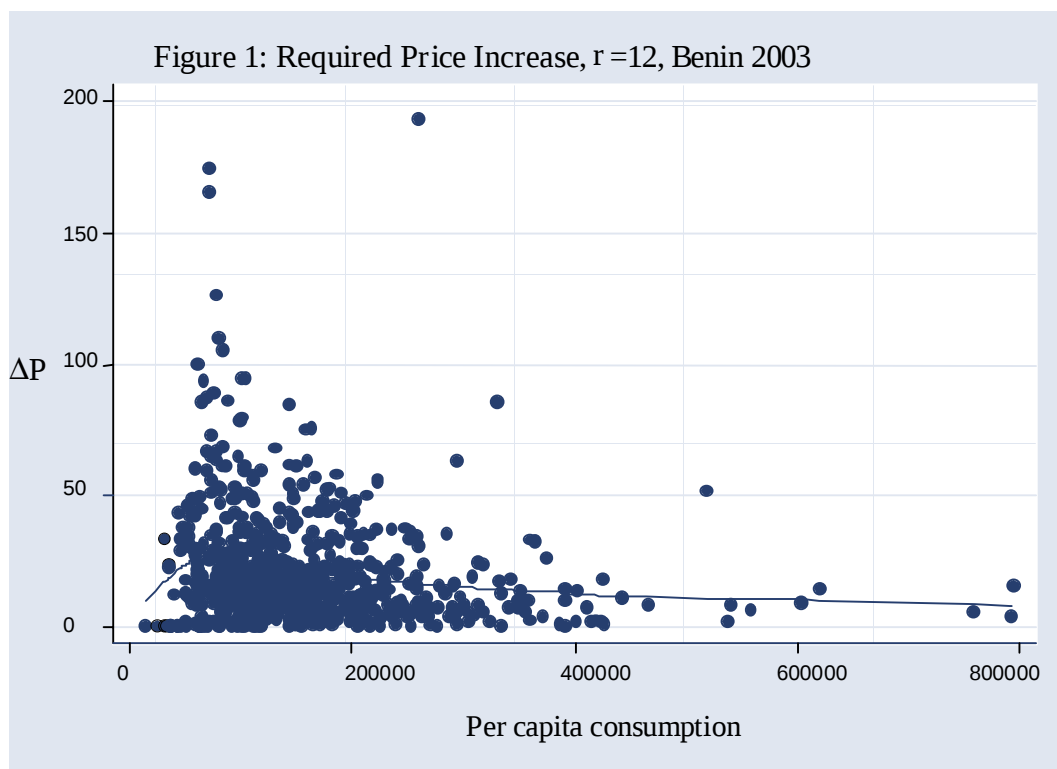
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³Isolated farmers or their cooperatives may very well obtain a higher share of the world price under systems through which producer prices are obtained as the residual value of world price less ginning, transportation and other intermediary costs.

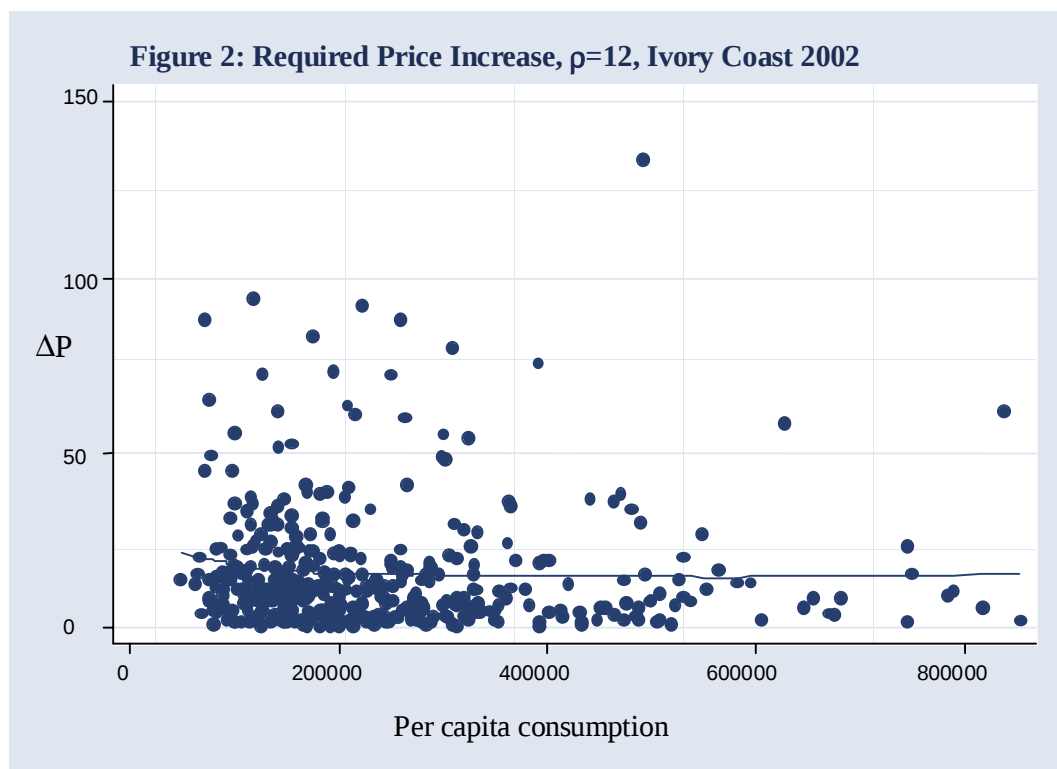
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Source: Authors' estimation using Benin's QUIBB 2003 survey.



Source: Authors' estimation using Ivory Coast's 2003 Enquête sur les conditions de vie des ménages.

Table 1: World Cotton Prices and Producer Prices, Benin and Ivory Coast 1996-2002

	World Price (Cents per pound)	World Price Adjusted for Benin	Benin Producer Price (FCFA/kg)	World Price Adjusted for Ivory Coast	Ivory Coast Producer Price (FCFA/kg)
1996/1997	79	248	200	236	182
1997/1998	72	228	200	217	199
1998/1999	59	186	221	177	195
1999/2000	53	167	185	159	174
2000/2001	57	180	200	171	205
2001/2002	42	132	200	126	190
Mean	64	201	201	191	191
Variance	167	1769	132	1594	129

Source: Goreux (2003). The world prices adjusted for Benin and Ivory Coast are simply rescaled so that the mean world price is equal to the mean domestic prices, in order to be able to compare variances. One dollar is worth approximately Franc CFA600 (Benin and Ivory Coast are both part of the West Africa Economic and Monetary Union, and thereby share the same currency.)

Table 2: Basic household survey statistics, Benin 2003 and Ivory Coast 2002

	Benin: All Producers	Benin: Relative Poor	Ivory Coast: All Producers	Ivory Coast: Relative Poor
Number of cotton producers in survey	689	180	414	170
Mean p.c. consumption (FCFA/year)	154981.3	72181.43	359839.7	120303.5
Mean p.c. cotton revenue (FCFA/year)	52461.31	40662.06	76195.47	40134.35
Headcount index (relative poverty)	21.4%	29.9%	37.4%	44.6%

Source: Authors' estimation using Benin's QUIBB 2003 survey and Ivory Coast's 2002 Enquête sur les conditions de vie des ménages.

Table 3: Required price increase to keep risk-adjusted income constant

	Benin: All Producers	Benin: Relative Poor	Ivory Coast: All Producers	Ivory Coast: Relative Poor
Average required price increase				
$\rho=1$	1.72	2.27	1.12	1.29
$\rho=2$	3.43	4.54	2.23	2.58
$\rho=4$	6.87	9.08	4.46	5.15
$\rho=8$	13.74	18.16	8.92	10.30
$\rho=12$	20.60	27.24	13.38	15.46
$\rho=16$	27.47	36.32	17.85	20.61
$\rho=20$	34.34	45.40	22.31	25.76
Median required price increase				
$\rho=1$	1.27	1.60	0.69	0.91
$\rho=2$	2.54	3.19	1.38	1.83
$\rho=4$	5.08	6.39	2.76	3.65
$\rho=8$	10.15	12.78	5.52	7.31
$\rho=12$	15.23	19.17	8.28	10.96
$\rho=16$	20.30	25.56	11.03	14.61
$\rho=20$	25.38	31.95	13.79	18.26
75 th percentile required price increase				
$\rho=1$	2.15	3.03	1.28	1.46
$\rho=2$	4.31	6.05	2.56	2.92
$\rho=4$	8.62	12.10	5.11	5.83
$\rho=8$	17.23	24.21	10.22	11.67
$\rho=12$	25.85	36.31	15.34	17.50
$\rho=16$	34.47	48.41	20.45	23.33
$\rho=20$	43.09	60.52	25.56	29.17
90 th percentile required price increase				
$\rho=1$	3.76	5.07	2.43	2.61
$\rho=2$	7.53	10.15	4.86	5.23
$\rho=4$	15.05	20.30	9.72	10.46
$\rho=8$	30.10	40.60	19.43	20.92
$\rho=12$	45.16	60.89	29.15	31.38
$\rho=16$	60.21	81.19	38.86	41.84
$\rho=20$	75.26	101.49	48.58	52.30

Source: Authors' estimation using Benin's QUIBB 2003 survey and Ivory Coast's 2002 Enquête sur les conditions de vie des ménages.