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Revisiting the "Cotton Problem"—A Comparative Analysis of Cotton Reforms in Sub-Saharan Africa

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Summary. — The cotton sector has been among the most regulated in sub-Saharan Africa (SSA), and still largely is in West and Central Africa (WCA), despite repeated reform recommendations by international donors. On the other hand, orthodox reforms in East and Southern Africa (ESA) have not always yielded the expected results. This paper uses a stylized contracting model to investigate the link between market structure and equity and efficiency in SSA cotton sectors; explain the outcomes of reforms in ESA; and analyze the potential consequences of reforms in WCA. We illustrate our arguments with empirical observations on cotton sector performance.

Key words — sub-Saharan Africa, cotton reforms, self-enforcing contracts

1. INTRODUCTION

Cotton is sometimes referred to as African "white gold" (Moseley, 2008). It represents a crucial source of income in large parts of sub-Saharan Africa (SSA), both for rural populations and for national economies. [1] Due to widespread smallholder involvement, cotton is moreover often considered to play a key role in development and poverty reduction (e.g., Badiane, Ghura, Goreux, & Masson, 2002; Minot & Daniels, 2002; Pfeifer, 2005). [2]

In West and Central Africa (WCA), performance has been particularly impressive and described as a unique success-story in the literature (e.g., Bassett, 2001; Lele & Christiansen, 1989): in Benin, Burkina Faso, Chad, and Mali, yields increased more than threefold on average during 1960–85 (Table 1 and Figure 1).

Combined with considerable expansion of the area under cultivation, this resulted in dramatic production growth: cotton production increased more than twentyfold over the past 50 years (Table 2 and Figure 2). In East and Southern Africa (ESA), performance has been less impressive. In Tanzania, Uganda, Zambia, and Zimbabwe, yields declined in the 1970s and 1980s on average, and yield and output are now only at the level of the 1960s (Figures 1 and 2). However, some ESA countries have performed better. Notably in Zambia, production has increased considerably, at a pace comparable to those observed in WCA (Table 2). During 1980–2000, Africa's share of world cotton trade rose by 30%, while its average share of total world agricultural trade fell by 50% during the same period (Boughton, Tschirley, Zulu, Osorio Ofiço, & Marrule, 2003).

Two key characteristics are associated with historical cotton production systems in SSA. First, vertical coordination has been promoted in SSA cotton supply chains for decades. The production of cotton is relatively input-intensive. As small farmers often do not have access to credit or external inputs by themselves due to market imperfections, production has to a great extent occured through interlinked transactions, whereby cotton gins engage in input provision on credit in return for supplies of primary produce. Second, as cotton has been a major export cash crop for decades, it has been a source of government revenue. As argued by Bates (1981), at the time of independence, the common view of many African governments was that the fastest road to economic growth was using agricultural surplus to support industrial development. The agricultural sector is also known for having been widely used as a source of rent extraction by the ruling elite (van de Walle, 2001).

The combination of these characteristics has historically resulted in strong government intervention in SSA cotton supply chains, both at the level of output procurement and in terms of input provision, price setting, restriction of private competition, and investment in infrastructure and agricultural research. In WCA, parastatals have been in place since colonial times (in particular the 1950s). In ESA, state control of cotton supply chains rapidly intensified in the 1970s, after independence, through the nationalization of cotton gins and the creation of marketing boards (Delpeuch & Leblois, 2011).

Countries with state-controlled cotton markets have however been pressurized by international donors to reduce government intervention in cotton supply chains since the early 1980s (Berg, 1981). This pressure intensified after the cotton

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Table 1. *Growth of cotton productivity (yields) in ESA and WCA countries, 1961–2009 (1960s = 100)*

Country/region	1960s	1970s	1980s	1990s	2000s[a]
WCA					
Benin	100	240	317	356	337
Burkina Faso	100	235	408	423	462
Chad	100	130	208	197	187
Mali	100	240	301	276	238
Average	*100*	*211*	*301*	*303*	*291*
ESA					
Tanzania	100	108	83	109	138
Uganda	100	74	61	108	195
Zambia	100[b]	64	57	75	107
Zimbabwe	100	100	95	58	53
Average	*100*	*90*	*80*	*78*	*100*

Source: FAOStat (September 2, 2010).
[a] For the 2000s, data were available until 2009, unless specified otherwise.
[b] Countries with * have data for 1963–1969.

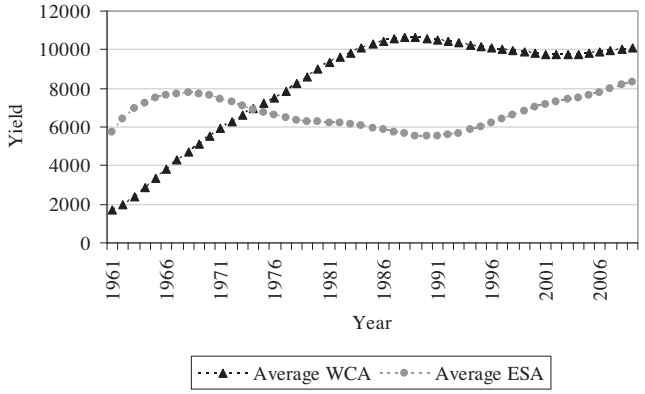

Figure 1. *Cotton productivity (yields) in ESA and WCA countries, 1961–2009 (Hg/Ha). Source: FAOStat (September 2, 2010). Note: WCA includes Benin, Burkina Faso, Chad, and Mali; and ESA Tanzania, Uganda, Zambia, and Zimbabwe. The data have been smoothed with a lowess factor of 0.4 in order to reduce random variation and increase readability.*

price collapse at the end of the 1980s. The main reason behind calls for reform was the fact that price setting mechanisms did not allow producer prices to reflect world prices and thus distorted production incentives. More specifically, state monopolies have traditionally been criticized for depressing farm gate prices. Conversely, in recent years, parastatals in WCA have subsidized producers to an extent that is generally agreed to be unsustainable from a budgetary point of view (Baffes, 2009a). In addition, inefficiencies in parastatal ginning have increasingly become a concern in ESA in the post-independence period and have also more recently become an issue in WCA (Baffes, 2011; Tschirley, Poulton, & Labaste, 2009). Finally, pan-territorial pricing schemes were considered to be ineffective in promoting rural development (Baghdadli, Chaikhrouhou & Raballand, 2007). These factors, in combination with the strong dependence of millions of poor rural households on cotton which complicates reform, have been referred to as "the Cotton Problem" (Baffes, 2005).

Responses to pressure from international donors and policy choices have differed strongly between regions in Africa. In ESA, cotton sectors were significantly reformed: Tanzania, Uganda, Zambia, and Zimbabwe all privatized ginneries, liberalized prices, and introduced competition in the mid-1990s. In WCA, resistance to reforms has been stronger.[3] Many stakeholders in this region believe that intensive cropping practices would not be feasible in the absence of state-sup-

Table 2. *Cotton production growth in ESA and WCA countries, 1961–2009 (1960s = 100)*

Country/region	1960s	1970s	1980s	1990s	2000s[a]
WCA					
Benin	100	301	671	2768	3259
Burkina Faso	100	282	728	1448	3380
Chad	100	121	109	166	162[c]
Mali	100	387	709	1595	1746
Average	*100*	*191*	*303*	*694*	*952*
ESA					
Tanzania	100	112	95	111	147[c]
Uganda	100	69	11	17	31
Zambia	100[b]	299	1222	2024	3454
Zimbabwe	100	419	624	564	728[c]
Average	*100*	*111*	*97*	*106*	*146*

Source: FAOStat (September 2, 2010).
[a] For the 2000s, data were available until 2009, unless specified otherwise.
[b] Countries with * have data for 1963–1969.
[c] Countries with ** have data for 2000–2008.

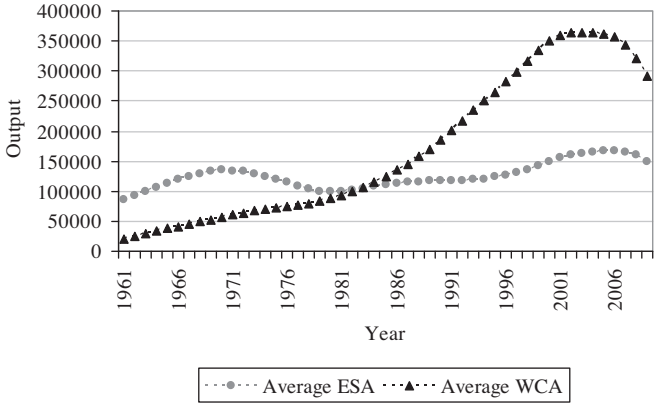

Figure 2. *Cotton production in ESA and WCA countries, 1961–2009 (MT). Source: FAOStat (September 2, 2010). Note: WCA includes Benin, Burkina Faso, Chad, and Mali; and ESA Tanzania, Uganda, Zambia, and Zimbabwe. The data have been smoothed with a lowess factor of 0.4 in order to reduce random variation and increase readability.*

ported integrated supply-chains with interlinked contracts. In addition, price stabilization and panterritorial pricing strategies are seen as necessary instruments for risk mitigation and spatial redistribution (Araujo Bonjean & Combes, 2001). While private entry has been allowed to some extent in Benin and Burkina Faso, in practice, markets remain strongly regulated. In Chad and Mali, markets remain both publicly-owned and monopolistic. In all four countries, the government still intervenes in price-setting.

These differences in resistance to reform may reflect differences in bargaining power of producer associations the processing sector or government stakeholders who are either unwilling to give up on rents, or believe that reforms would not be beneficial to farmers. This paper aims to contribute to the general understanding of the potential implications of liberalization of WCA cotton markets by analyzing the implications of reforms in ESA and identifying the differences in pre-liberalization conditions between these two regions.

Considerable empirical work has already been done in this field by, among others, Tschirley *et al.* (2009, 2010); however, our paper goes one step further by assessing the reform impacts in a formal theoretical framework adapted from Swinnen, Vandeplas, and Maertens (2010). This framework integrates key institutional characteristics of agricultural markets in developing countries such as factor market imperfections, the absence of effective contract enforcement institutions, and the prevalence of linkages between input and output markets.

The paper is organized as follows. First, we provide a brief account of cotton sectors in Sub Saharan Africa, with a focus on market organization, reforms, and performance in terms of yields and total output. Section 3 presents our conceptual framework, which is used to analyze the past cotton sector reforms in ESA in Section 4 and the potential implications of the envisaged cotton reforms in WCA in Section 5. Section 6 concludes.

2. REGIONAL TRENDS IN INSTITUTIONAL REFORMS AND COTTON PERFORMANCE

(a) *Cotton sector organization in SSA*

The cultivation of cotton requires the use of various external inputs that most smallholders cannot afford without resorting to credit. As credit access for smallholders is severely restricted in SSA, cotton production largely occurs through interlinked transactions, whereby external inputs are provided on credit by ginning companies.[4] Such transactions are also referred to as "contract farming" or "outgrower schemes".

This contracting has historically taken place in a regulated environment in most countries of SSA. While market organization varied considerably across SSA in the early decades of cotton commercial cultivation (1950s–1960s), it became "remarkably similar" (Baffes, 2005) in the post-independence period, when the degree of market concentration increased in the less regulated sectors. Competition between ginners was either ruled out by law, or very limited. Publicly owned companies or marketing agencies, which enjoyed both a monopoly and a monopsony position, were responsible for the purchase of raw cotton at regulated prices, its transformation into cotton lint and the trade of the latter on international markets. In all countries of WCA and some ESA countries (Zambia and Zimbabwe), single-channel supply chains were governed by parastatals, which also distributed inputs on credit and provided extension services.[5] In Tanzania and Uganda, cotton purchasing and ginning were organized through village level cooperative societies and a marketing board ensured marketing and enforced market regulation (Tschirley *et al.*, 2009). Regulation also included government intervention in price setting, and cotton prices were fixed pan-territorially and pan-seasonally (i.e., the producer price was fixed throughout the country and throughout the year).

The major advantage of such single-channel systems is the prevention of "side-selling", where farmers sell their cotton to other higher-bidding buyers at harvest, instead of to the company that has pre-financed their inputs. In WCA, where single-channel systems had been set up by the colonial rulers, successful input provision schemes for cotton production were maintained after independence, with possible positive spillovers for food crops through improved access to inputs as well as crop rotation (Foltz, Aldana, & Laris, 2011; IFPRI and LARES, 2001).[6] For several decades, cotton parastatals in WCA have been perceived as relatively efficient, even by proponents of orthodox market institutions.[7] However, the cotton price collapse at the end of the 1980s and early 1990s led the World Bank to advocate liberalization of WCA cotton markets more fiercely (Badiane *et al.* 2002). Apart from the reasons mentioned above, it was argued that strengthening the competitiveness of these sectors would be vital in ensuring their long-term financial sustainability and allowing a fair division of the profits between producers and ginners.

(b) *Reforms*

Market organization began to change in the late-1980s, with a drastic acceleration of reforms in the mid-1990s in ESA. Tanzania, Uganda, Zambia, and Zimbabwe all dissolved cotton boards and allowed private sector competition in the early to mid 1990s. In Tanzania the reform process started with the elimination of pan-territorial and pan-seasonal price-setting in 1992. In 1995, the sector was opened up, and the private sector entered progressively in cotton processing and distribution (Poulton, 2009). In Uganda, the cotton board was liquidated and the sector opened up to private entry in 1994 such that new buyers progressively competed with cooperative unions. In Zambia, the state cotton board was privatized in 1994. However, competition initially remained very limited. The state ginneries were sold to two companies, which benefited from *de facto* regional monopsony power until 1997. New small firms and independent traders then emerged and started

to compete for cotton supplies. In Zimbabwe, the cotton sector opened up to private entry in 1994, the year of liberalization, and the state board was privatized in 1997. Still, the level of competition has remained modest until the early 2000s. The degree of competition increased in 2001 when several smaller firms entered the ginning market (Poulton & Hanyani-Mlambo, 2009).

In WCA, reforms have been more recent and of a much more restricted scope. Prices have not been liberalized in any of the countries under consideration. Even though private entry has been allowed to some extent in Benin and Burkina Faso (respectively in 1995 and 2000), competition remains weak at best. In Burkina Faso, each of the three cotton companies has been allotted local monopsony rights for the purchase of cotton in a particular region (for details, see Kaminski, Headey, & Bernard, 2011) while, in Benin, seed cotton is allocated administratively to cotton ginners. In Chad and Mali, parastatal governance of cotton markets has not been touched upon as yet, even though reforms have been discussed for several years (Delpeuch & Leblois, 2011).

(c) *Performance*

Cotton sector performance has widely varied across regions and over time in sub-Saharan Africa. However, trends emerge at the regional level. First, in the post-independence era, in the 1970s and 1980s, WCA performed clearly better than ESA. Both productivity and output growth were strongly positive in all countries of WCA until the late 1980s with yields and production tripling, on average, compared to the 1960s (Tables 1 and 2). In ESA, on the other hand, average yields decreased in the 1970s and 1980s (Table 1) and a broadly stagnating average output growth hides strong differences between countries: while Zambia and Zimbabwe displayed high output growth, production almost collapsed in Uganda (Table 2). [8]

With regard to the last two decades, when reforms were implemented to a far greater extent in ESA, the picture is less clear. Productivity has broadly stagnated on average in WCA (Figure 1). Yields continued to grow, but at a lower pace, in Burkina Faso and in Benin. However, they decreased in Chad and in Mali (Table 1). Conversely, in ESA, productivity growth has slowly resumed in the two last decades, except in Zimbabwe where it has almost halved compared to the 1980s average (Table 1). Output growth, on the other hand, has remained much higher, on average, in WCA than in ESA (Figure 2), driven mainly by a strong increase in area under cultivation. [9] While Chad is the only exception to the cotton-boom in WCA, Zambia is an exception in ESA with output growth rates comparable to those witnessed in WCA (Table 2).

Tschirley *et al.* (2009, 2010) link cotton performance to organization. [10] They argue that competitive, market-based systems could enhance production by ensuring relatively high producer prices without any type of budgetary support but that they mostly fail in the provision of inputs and extension. Monopolistic and concentrated sectors, on the other hand, are better in providing inputs and services to farmers, although the latter tend to cover fewer farmers than the former. However, while prices can be high in monopolistic markets—even higher than in competitive markets—this may be at the cost of huge public transfers. As a result, Tschirley *et al.* (2009, 2010) maintain that no market sector type seems to have performed so well that it can be used as a reference for other countries.

To extend their analysis and to interpret the empirical observations into a more formal conceptual framework, we now turn to analyze the link between market structure and performance using a theoretical model adapted from Swinnen *et al.* (2010). After outlining the model predictions, we contrast these theoretical findings with a more detailed analysis of post-reform performance in ESA and a prospective analysis of possible reform implications in WCA.

3. CONCEPTUAL FRAMEWORK

(a) *A model of liberalization*

To produce cotton, farm resources (e.g., land and labor) need to be combined with external inputs (e.g., seeds, tools and fertilizers). To purchase external inputs, capital is required. We assume that in smallholder-based agricultural production systems, farms do not have direct access to the required capital and/or the required external inputs because of market imperfections. Conversely, processors do not have the skill or land to produce directly. However, processors have better access to credit and/or external inputs, such that they can provide external inputs on credit to farmers. A farmer and a processor can thus join forces to produce an amount q of cotton: the farmer will provide labor and land l, while the processor will provide external inputs of value k. [11] The farmer's opportunity cost of labor and land ($\bar{l}$) equals his disagreement payoff, i.e., his income when the contract does not materialize, and is an indicator of his alternative income opportunities. [12] The processor's opportunity cost of exporting cotton ($\bar{k}$) is the income forgone by not using capital k for any other investment. [13] His processing and marketing costs are assumed to be equal to the market valuation of processing and marketing.

To capture inefficiencies in processing and marketing (hereafter called "supply chain inefficiencies"), we define c as extra processing and marketing costs. These costs may encompass different inefficiencies such as excessive transport and storage costs (Kherallah *et al.*, 2000) or poor sales strategies, management tools, and technology (Baffes, 2007). They could also reflect, for example, the cost of pursuing multiple objectives, such as additional job creation to reward political support.

Finally, to account for government intervention in price setting, t represents a government tax ($t > 0$) or subsidy ($t < 0$). [14] This accounts for widespread government price setting, indirectly resulting in taxation or subsidization, depending on the level of the world price. The processor exports the cotton lint at price p, the exogenous world price for cotton. [15]

The net value or "surplus" that is created if a contract is agreed and enforced is denoted by θ, with

$$\theta = (p - c - t)q - \bar{k} - \bar{l} \tag{1}$$

Under perfect and costless enforcement conditions, if a surplus is realized (i.e., $\theta > 0$), it is shared according to a simple Nash bargaining process, in which total payoffs are obtained by adding each agent's outside option to his share of θ (Nash, 1953). The farmer will then receive share β, while the processor appropriates share $1 - \beta$. In this way, β can be considered as the farmer's bargaining power under perfect enforcement. [16]

In most of rural SSA, credible contract enforcement is however often unaffordable among other reasons because of the oral nature of many arrangements, the low volume of individual transactions, the geographical dispersion of agents and the weakness of judiciary systems. To account for this fact, we consider the extreme case that there is no external enforcement

mechanism and show how the respective pay-offs are affected. [17] This implies that after the farmer accepts a processor's offer for inputs, he can still decide ex-post (i) whether to use the inputs for cotton production or to divert them (by selling them or using them on other crops—in which case the farmer can earn $\bar{k}+\bar{l}$, that is, the extra income from selling the inputs, plus his opportunity cost of labor) and (ii), if inputs are used for cotton production, whether to supply it to the contracting party or side-sell, that is, sell the cotton to an alternative buyer at the spot market price ($p_s - t_s - c_s$), in which case we assume that spot market buyers may face supply chain inefficiencies and price distortions as well (with p_s, c_s, and t_s, respectively the world price, inefficiencies, and government taxation faced by the alternative, non-contracted buyers). An alternative processor may be able to offer a higher price than the contracting party, as he does not need to account for the cost of the provided inputs. On the other hand, if the contracted processor can access high-value cotton markets with specific quality standards by tailoring the production process to specific requirements and adequate monitoring, he may have a price advantage. By defaulting on his contract obligations, however, the farmer incurs a reputation cost φ. [18]

In the absence of a formal enforcement mechanism, contract compliance can be ensured only by making the contract self-enforcing. This implies that the processor might have to increase the price paid to his cotton supplier so as to incentivize the latter to comply with the contract. Indeed, while the farmer will participate in the contract if his expected return (Y) exceeds his disagreement payoff: $Y \geqslant \bar{l}$; he will comply with the contract only if his payoff from compliance is at least as high as his payoffs from input diversion ($\bar{k}+\bar{l}-\varphi$) and from side-selling ($(p_s - t_s - c_s)q - \varphi$). The respective payoffs of the contract (with Π the processor's return) are then given by:

$$Y = \max(\bar{l} + \beta\theta; \bar{k} + \bar{l} - \varphi; (p_s - c_s - t_s)q - \varphi) \tag{2}$$

$$\Pi = (p - c - t)q - Y \tag{3}$$

On the other hand, the processor will only join the contract if his expected return covers his opportunity cost of capital: $\Pi \geqslant \bar{k}$. As a result, a contract will be feasible only if the world price is sufficient to cover each of these constraints, that is, if it satisfies the following condition:

$$p \geqslant p_{\min} = \frac{1}{q}\max[\bar{k}+\bar{l}; 2\bar{k}+\bar{l}-\varphi; \bar{k}+(p_s - c_s - t_s)q - \varphi] + t + c \tag{4}$$

Condition (4) shows that the better the farmer's opportunity cost of labor (high $\bar{l}$), the higher the spot market price (p_s), and the lower the reputation cost (φ), the lower contract feasibility is. On the other hand, it can be seen from condition (2) that the same factors would cause producer prices to be higher. Furthermore, supply chain inefficiencies of the contracted buyer (c) are expected to reduce contract feasibility, as well as suppress producer and processor payoffs. Taxation by the government ($t > 0$) has a similar impact as processing inefficiencies, while subsidies by the government ($t < 0$) improve producer and processor payoffs as well as contract feasibility (as they reduce $p_{\min}$). Supply chain inefficiencies and taxes applying to spot market buyers (c_s and t_s) reduce producer payoffs, but improve contract feasibility. [19] In the case where the side-selling option is binding, and spot market buyers are subject to the same price distortions or face the same inefficiencies as contracted buyers, reduced taxes (t and t_s) or increased efficiency (c and c_s) will benefit producers but their respective effects on contract feasibility will net each other out.

Condition (4) also shows that the yield increase brought about by the use of external inputs has an important effect on contract feasibility. A higher q will facilitate contract formation—except when the side-selling constraint in Eqn. (2) is binding. In the latter case, a higher q will increase farm incomes but not improve contract feasibility. Swinnen *et al.* (2010) show how individual cotton production levels can be aggregated to assess total supply response. For the sake of brevity, we have not presented this aggregation here, as it does not affect our results.

(b) *The effects of liberalization: model predictions*

As in Swinnen *et al.* (2010), we focus on two crucial, and interrelated, aspects of the liberalization process: "price liberalization", i.e., the government no longer determines prices, and "market liberalization", i.e., the removal of state control over the structure of the cotton chain by allowing private trade and competition. Define T as the government's "price policy" and Z as the "market policy". Price liberalization is represented by $\Delta T > 0$ and market liberalization by $\Delta Z > 0$. [20]

First, we look at the impact of reforms on farm incomes (Y). Price liberalization removes government intervention in price-setting: $\partial Y/\partial T < 0$ for t or $t_s < 0$ (government subsidy) and $\partial Y/\partial T > 0$ for t or $t_s > 0$ (government tax).

Market liberalization is hypothesized to affect p_s, $\bar{l}$, φ, c and c_s, Competition indeed creates new options to side-sell: p_s is expected to increase, as we move from a monopsony (where p_s is virtually equal to zero) to a competitive environment (where it is high, as long as processors do not collude). Hence, $\partial p_s/\partial Z \geqslant 0$. As competition increases, it might also bring along improved contract options ex-ante: $\partial \bar{l}/\partial Z \geqslant 0$. [21] In addition, the farmer's reputation cost φ is likely to decrease: the more numerous processors are, the more expensive it gets for them to coordinate and share information (Zanardi, 2004) and the more alternative buyers remain after defaulting with one of them (Hoff and Stiglitz, 1998). Hence, $\partial\varphi/\partial Z \leqslant 0$.

Furthermore, because of the removal of soft budget constraints and the created competitive pressure, market liberalization might lead to increased processing efficiency ($\partial c/\partial Z \leqslant 0$ and possibly $\partial c_s/\partial Z \leqslant 0$), for example through the removal of excessive employment or the adaptation of better technologies and management strategies. This is in line with Hick's "quiet life" hypothesis (1935) which argues that competition brings incentives for cost minimization and the removal of processing inefficiencies, as was the case, for example, in Eastern Europe and China (Rozelle & Swinnen, 2004). On the other hand, some have suggested that competition might increase costs ($\partial c/\partial Z > 0$) by suppressing economies of scale (e.g., Demsetz, 1973; Guy, Bennison, & Clarke, 2004), increasing transaction costs (Shervani, Frazier, & Challagalla, 2007) or lowering incentives for investing in research (e.g., Pray, Oehmke, & Naseem, 2005). [22]

If we combine these effects with Eqn. (2), we can derive the impact of the orthodox reforms on the farmer's returns, at the condition that contracts can be sustained:

$$\frac{\partial Y}{\partial T}+\frac{\partial Y}{\partial Z} = \frac{\partial Y}{\partial t}\frac{\partial t}{\partial T}+\frac{\partial Y}{\partial t_s}\frac{\partial t_s}{\partial T}+\frac{\partial Y}{\partial \bar{l}}\frac{\partial \bar{l}}{\partial Z}+\frac{\partial Y}{\partial p_s}\frac{\partial p_s}{\partial Z}+\frac{\partial Y}{\partial \varphi}\frac{\partial \varphi}{\partial Z} + \frac{\partial Y}{\partial c}\frac{\partial c}{\partial Z}+\frac{\partial Y}{\partial c_s}\frac{\partial c_s}{\partial Z} \tag{5}$$

The first two terms in Eqn. (5) jointly capture the effect of price liberalization. Their aggregate effect will be positive

(or zero) if the government taxed farmers before the reform (implying that t and possibly $t_s > 0$), and negative (or zero) if farmers were subsidized (implying that t and possibly $t_s < 0$). The third, fourth, and fifth terms capture the effects of market liberalization on outside options before and after contracting, and are non-negative. Finally, the sixth and the seventh terms, which capture the effect of market liberalization on contracted and spot market buyers' efficiency, will be positive if the efficiency gains induced by liberalization outweigh the potential efficiency losses—which the literature points at as the most likely case (see e.g., Tschirley *et al.*, 2010).

Hence, if contracts remain sustainable after reform, and if farmers were taxed before reform and efficiency in the sector improves through reform, the right-hand side of Eqn. (5) will be strictly positive and reform is expected to benefit farmers. According to our model, reform may however hurt farmers if farmers were subsidized prior to reform and there are no strong improvements of their outside options and of buyer efficiency through reform.

In addition, if reform causes contract breakdown, farmers may be negatively affected as well—hence we need to consider the impact of liberalization on contract feasibility by performing comparative statics analysis on $p_{\min}$, the minimum level of the world price for cotton required to sustain contracts. Using Eqn. (4), the aggregate effect of liberalization on contract sustainability can be summed up as follows:

$$\frac{\partial p_{\min}}{\partial T}+\frac{\partial p_{\min}}{\partial Z}=\frac{\partial p_{\min}}{\partial t}\frac{\partial t}{\partial T}+\frac{\partial p_{\min}}{\partial t_s}\frac{\partial t_s}{\partial T}+\frac{\partial p_{\min}}{\partial \bar{l}}\frac{\partial \bar{l}}{\partial Z}+\frac{\partial p_{\min}}{\partial p_s}\frac{\partial p_s}{\partial Z}+\frac{\partial p_{\min}}{\partial \varphi}\frac{\partial \varphi}{\partial Z}+\frac{\partial p_{\min}}{\partial c}\frac{\partial c}{\partial Z}+\frac{\partial p_{\min}}{\partial c_s}\frac{\partial c_s}{\partial Z} \quad (6)$$

An increase of $p_{\min}$ reflects a deterioration of contract feasibility as it strengthens the condition on world market price p for contract feasibility. The net effect of the first two terms of Eqn. (6) will be positive if the sector was subsidized before liberalization and negative otherwise—unless the contracted and the spot market buyer are subject to the same price distortions ($t = t_s$) and the side-selling option is binding. The third, fourth, and fifth terms will be zero or positive; and the sign of the last two terms will depend on the efficiency effects of liberalization. The net effect will be negative, unless (i) efficiency losses due to losses of economies of scale outweigh efficiency gains; (ii) the side-selling option is binding and the contracted buyers and spot markets buyers experience identical efficiency gains (in which case the net effect is zero); or (iii) the spot market buyers experience more efficiency gains than the contracted buyers (in which case the net effect may be positive).

If production was subsidized before liberalization and processing efficiency is reduced, all partial effects in Eqn. (6) are zero or positive, implying that liberalization undermines contract feasibility (as $p_{\min}$ increases). If, on the other hand, production was taxed before liberalization and processing efficiency improves through liberalization—and more so for the contracted than for the spot market buyer in case of a binding side-selling option—the joint net effects of the first two and of the last two terms are negative and may counteract the detrimental impact of increased competition on contract feasibility.

In conclusion, while farm incomes are expected to improve with price and market liberalization as long as contracts do not collapse; contracts are more likely to collapse because of competition. This underscores the existence of a trade-off between competition and "coordination", as pointed out by Dorward, Poulton, Tschirley and their co-authors in various publications (e.g., Dorward, Kydd, & Poulton, 1998; Poulton *et al.*, 2004; Tschirley *et al.*, 2010). [23]

This trade-off is particularly relevant in cotton markets as cotton is a relatively homogenous product. Buyers seek broadly the same quality requirements that are imposed by the textile industry, which highly values homogeneity (Tschirley *et al.*, 2009). Moreover, contrary to other crops, the prices fetched by different firms on the world market depend largely on the national origin of cotton and on the quality reputation of that origin, rather than on the specific reputation of different firms (Larsen, 2003). If this means that non-contracted buyers willing to buy raw cotton are able to obtain prices in the international market similar to those fetched by the contracted buyers who pre-financed the inputs, and if spot market buyers face identical supply chain inefficiencies and price distortions as contracted buyers, prices offered by the spot market buyers may converge to $p - c - t$. In this case, Eqns. (2)–(4) reduce to:

$$Y = \max(\bar{l} + \beta\theta; (p - c - t)q - \varphi) \quad (7)$$

$$\Pi = pq - c - t - Y \quad (8)$$

$$p \geqslant p_{\min} = \frac{\bar{l} + \bar{k}}{q} + c + t \qquad s.t.\ \varphi \geqslant \bar{k} \quad (9)$$

The side-selling option then translates into a simple condition for contract sustainability which does not depend on p or on q: $\varphi \geqslant \bar{k}$. The condition on p implied by (9) is nothing more than the condition for socially efficient contracts, and will weaken (i.e., $p_{\min}$ will decrease) with an increasing q. Hence, while contracting can be sustained even with a nil reputation cost ($\varphi = 0$) in the case where the contracted buyer can fetch a higher price on the international market than its competitors, there is a lower bound to φ when such quality premiums do not exist. This implies that, whatever the efficiency gains of liberalization through the elimination of c and t, if the post-liberalization reputation cost is not sufficiently high (i.e., $\varphi < \bar{k}$), contracts will break down (irrespective of the level of p).

4. AN EXPLANATION OF REFORM EFFECTS IN ESA

We now combine insights from the theory model outlined in Section 3 with empirical insights from the literature, to develop a set of hypotheses to explain observed reform outcomes in ESA.

(a) *Price distortions (t)*

Our theory framework predicts that if farmers were taxed prior to reform, price liberalization will lead to a reduction in t and hence to positive effects on farm incomes as well as sector performance by reducing $p_{\min}$.

To investigate the extent of agricultural taxation, we look at the trends in nominal rate of assistance (NRA) to the cotton sectors in ESA during 1970–2005 (Figure 3). [24] It can easily be observed that NRAs have been significantly negative in ESA during the years of heavy government intervention, pointing at agricultural taxation.

This is in line with the political economy literature which shows that African governments (like governments in other developing countries) have largely taxed agriculture, especially exportable cash crops (e.g., Anderson & Masters, 2009; Bates & Block, 2009; Krueger, Schiff, & Valdés, 1988). [25]

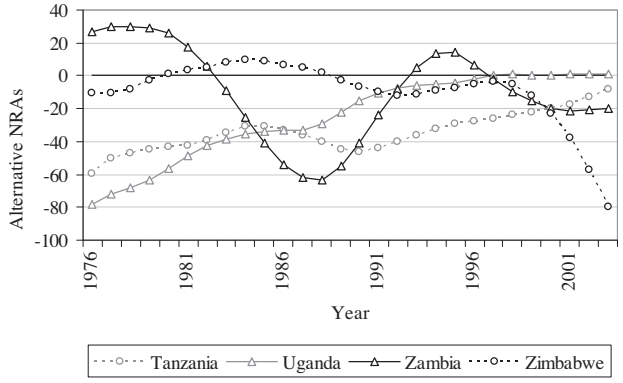

Figure 3. *NRAs to the cotton sector in ESA countries, 1970–2005. Source: Delpeuch & Poulton (2011). Note: ESA includes Tanzania, Uganda, Zambia, and Zimbabwe. The data have been smoothed with a lowess factor of 0.4 in order to reduce random variation and increase readability.*

It suggests that price liberalization in ESA also offered great potential in terms of eliminating taxation (reducing t), resulting in better producer prices as well as improving sector performance by reducing $p_{\min}$ if the distortions faced by spot market buyers did not decrease equally. Overall, NRAs indeed gradually converge to 0 in the post-reform period.

Zimbabwe is an exception over the whole period. First, taxation of cotton farms has never been very heavy there, and over the 1980s, NRAs were even positive, reflecting subsidization. A potential explanation is that production used to be dominated by commercial farmers, with higher political bargaining power, resulting in better producer prices (Figure 4). Second, over the 2000s, worsening exchange rates led to a new and significant drop in NRAs (Robinson, Govereh, & Ndlela, 2009).

(b) *Institutional organization and the degree of competition (ΔZ)*

While prior to reform, there was a common belief that opening up the sector would lead to considerable market entry by the private sector, and hence to a strong effect on Z and on producer prices (Y) and efficiency (c); private market entry turned out to be disappointing, only gradual at best, and in many cases it was reversed by government policies—motivated by imminent contract scheme failures.

Private market entry was observed after reform in Tanzania and Uganda, the two countries which already had a more decentralized market structure based on village level cooperatives prior to reform.

In Zambia and Zimbabwe, on the contrary, competition remained very weak in the years subsequent to reform as a remnant of the extremely concentrated pre-reform market structure (Brambilla & Porto, 2011). In Zimbabwe, a surge in competition was observed only several years after reform. The immediate cause was the onset of macroeconomic difficulties in 2001, when new companies entered into cotton trading to secure scarce foreign exchange for their other activities (Poulton & Hanyani-Mlambo, 2009).

The level of competition, however, was not sustained in a number of ESA countries. In Zambia, it is even said to have declined during the first half of the 2000s when the two biggest firms began to cooperate in an attempt to fight side-selling (Brambilla & Porto, 2011) and, simultaneously, "agents and independent buyers [...] largely disappeared" (Tschirley & Kabwe, 2010). Competition later resumed again with the market entry of new "larger and better-financed ginners" (Tschirley & Kabwe, 2010). In Zimbabwe and Uganda, competition was challenged by policy reversals. The Zimbabwean government started to restrict market entry to buyers who were willing to engage in input provision. Similarly, in Uganda, the detrimental effect of competition on contract schemes led the government to establish regional monopsony rights during 2003–2008 (Baffes, 2009b). A few ginners were allowed to operate in each zone under quota terms, which were proportional to companies' capacity for input provision. As a result, Tanzania is the only country where competition has been unrestrained since reform (Delpeuch & Leblois, 2011).

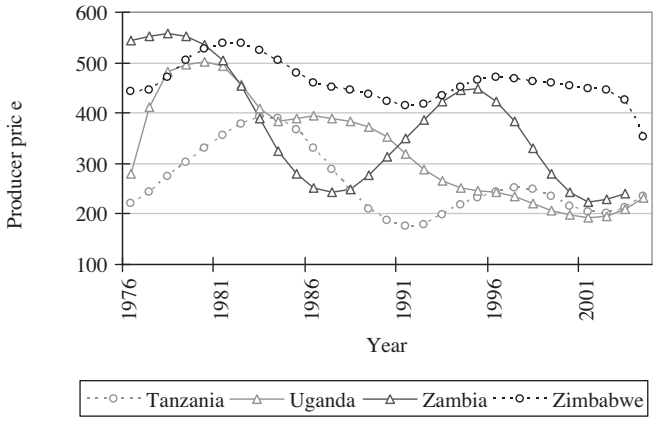

Figure 4. *Producer prices in ESA countries, 1976–2004 (US$/MT). Source: Anderson and Valenzuela (2007)—"national spreadsheets". Note: ESA includes Tanzania, Uganda, Zambia, and Zimbabwe. The data have been smoothed with a lowess factor of 0.4 in order to reduce random variation and increase readability.*

(c) *Supply chain inefficiencies (c)*

Prior to reform, cotton state boards in ESA suffered bad reputations with respect to supply chain efficiency, and liberalization was expected to bring substantial efficiency gains. According to our model, such reductions in c would improve farm incomes and contract feasibility, and thus sector performance if efficiency gains are higher for the contracting buyer. In retrospect, the available evidence suggests that the post-reform cotton sectors are indeed more cost-efficient than concentrated sectors, and both substantially outperform monopolistic sectors in terms of ginning efficiency (Tschirley *et al.*, 2010). In addition, the literature suggests that no negative impact of liberalization was found on research and development by foregoing economies of scale—in particular because, even after reform, most ESA cotton research programs remained in public hands (Tschirley *et al.*, 2009).

(d) *Overall impact on producer prices (Y)*

In summary, reforms were expected to improve producer prices by eliminating taxation, improving outside options for farmers, and raising efficiency in the sector, in line with the effect of an increase in Z predicted by our model. In hindsight, however, these expectations turned out to be overly optimistic. Competition did not increase as much as was expected. As a result, producer prices have increased post-reform only in Tanzania, and to a lesser extent in Zimbabwe, with significant variation over time (Figure 5).

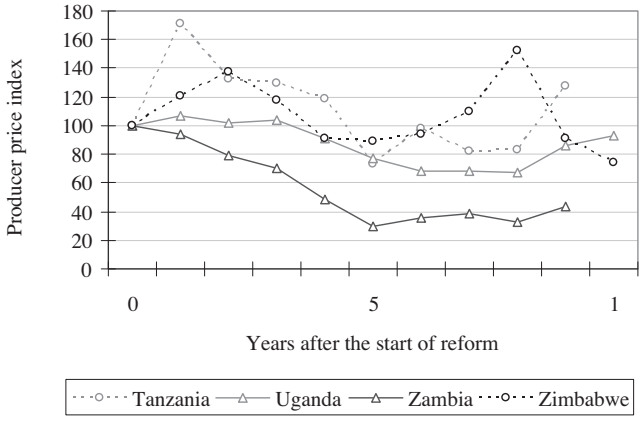

Figure 5. *Producer prices in ESA countries post-reform. Source: Anderson and Valenzuela (2007)*—"*national spreadsheets*". *Note: The price index is 100 in the year of reform. ESA includes Tanzania, Uganda, Zambia, and Zimbabwe. The year of reform taken is 1995 in Tanzania, and 1994 in Uganda, Zambia, and Zimbabwe. The data have been smoothed with a lowess factor of 0.4 in order to reduce random variation and increase readability.*

A general decline in world cotton market prices contributed to the stagnation or even decline of producer prices after liberalization.

(e) *Overall impact on contract sustainability (p_{min})*

Based on our model predictions, liberalization was expected to have mixed effects on contract sustainability. Positive effects would come from the removal of taxation (t), as well as of supply chain inefficiencies (c) faced by the contracting buyer. Conversely, potential negative impacts on contract sustainability could have resulted from higher outside options for farmers (higher $\bar{l}$ and p_s) and lower reputation costs (φ), with ultimately negative effects on input consumption and on yields and production.

Unfortunately, no data are available to directly observe the evolution of contract enforcement. If we focus on indirect indicators for post-reform performance instead, such as cotton yields (which are directly affected by contract sustainability through input use), the picture is indeed mixed—ranging from sustained yield increases in Zambia to long-term declines in Zimbabwe and variation over time in Uganda and Tanzania. The average effect is however positive (see Figure 6).

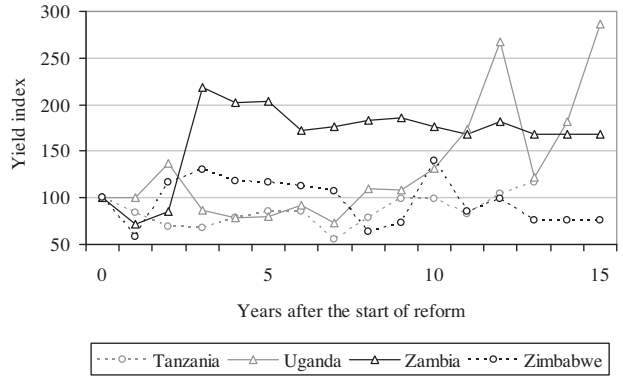

Figure 6. *Growth of cotton productivity (yields) in ESA countries post-reform. Source: FAOStat (September 2, 2010). Note: The yield index is 100 in the year of reform. ESA includes Tanzania, Uganda, Zambia, and Zimbabwe. The year of reform taken is 1995 in Tanzania, and 1994 in Uganda, Zambia, and Zimbabwe. The data have been smoothed with a lowess factor of 0.4 in order to reduce random variation and increase readability.*

Zambia performs best in terms of yields after reforms: yields have stabilized at a level of about 160% of their pre-reform level. This suggests that contracts have been sustained to a large extent after liberalization, as competition remained relatively restricted. Tschirley *et al.* (2009) even show that service provision has been used as a strategy for non-price competition in Zambia,[26] suggesting that, at low levels, competition stimulates rather than suppresses service provision and yield growth.

In principle, we would expect similar observations for Zimbabwe, where the cotton sector has remained relatively concentrated as well. However, in the 2000s, worsening macroeconomic conditions led to high inflation, fuel shortages, and great economic uncertainty in Zimbabwe, and have negatively impacted sectoral performance.

In Tanzania, the country where competition has increased most significantly, yields declined significantly in the immediate post-reform period and remained below the pre-reform level for most of the time until recently.

In Uganda, finally, a short-lived increase in yields gave rise to a significant decline, with yields remaining below pre-reform levels for five years. They subsequently recovered and peaked to over two times their pre-reform level, albeit with considerable year-to-year variation. This period of higher yields corresponds to the times when the government re-regulated the sector and restricted competition among buyers. This is in line with our model predictions.

Interestingly, as predicted by the model, liberalization seems to have impacted returns and contract sustainability in opposite directions: countries where the price response was the weakest (Zambia and Uganda) were also those where contracting and productivity increased most (Figures 5 and 6).

5. EXPECTED EFFECTS OF LIBERALIZATION IN WCA

Finally, we use the predictions of our theory model in combination with empirical observations and lessons learned from the ESA experience to set expectations on reform outcomes in WCA and feed the debate on cotton sector liberalization in the latter region.

(a) *Price distortions (t)*

First we look at the price distortions currently observed in WCA. As shown in Figure 7, while NRAs were more negative in WCA than in ESA (hence WCA farmers were taxed more) for most of the pre-2000 period, they have been strongly increasing since 2000, and nowadays WCA cotton farmers are subsidized (see Baffes (2007) for a discussion of the 1998–2007 period, and Kaminski *et al.* (2011) for a discussion of more recent years). Our model predicts that liberalization will lead to lower producer prices and reduced contracting if these subsidies are removed (subject to the caveat noted earlier with regard to t and t_s). This can be considered a major factor triggering resistance to reform in WCA. Less efficient and isolated farmers are likely to be affected most, as they are subsidized to a greater extent because of panterritorial pricing schemes.

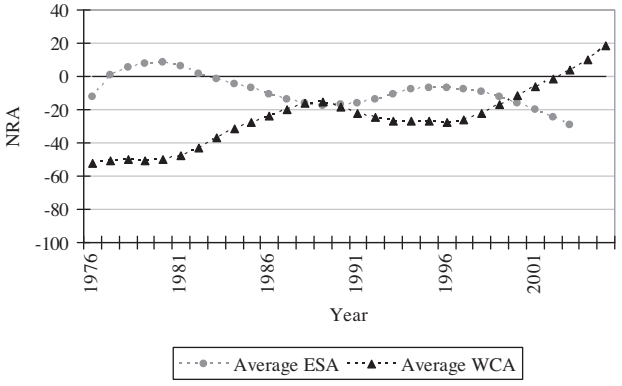

Figure 7. *NRAs to the cotton sector in ESA and WCA, 1970–2005. Source: Delpeuch & Poulton (2011). Note: WCA includes Benin, Burkina Faso, Chad, and Mali; and ESA Tanzania, Uganda, Zambia, and Zimbabwe. The data have been smoothed with a lowess factor of 0.4 in order to reduce random variation and increase readability.*

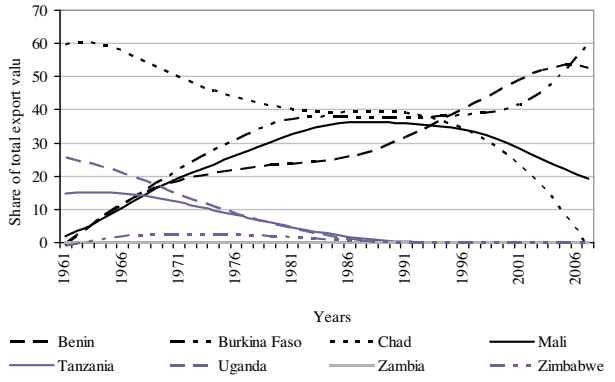

Figure 8. *Cotton export as a share of merchandize export value in ESA and WCA countries, 1961–2007. Source: FAOStat (September 2, 2010). Note: The data have been smoothed with a lowess factor of 0.4 in order to reduce random variation and increase readability.*

The reason for these subsidies may be rooted in the particular role of cotton in WCA. The governments in the region indeed have had few options other than to use the cotton sector as a resource to finance their public budgets. For example, in Benin and Burkina Faso, cotton accounted for more than 50% of the total merchandize export value in 2006 (Figure 8). [27] As a result, when world prices declined, governments have tried to sustain producer prices to avoid production disruptions (Figure 9; Bassett, 2008). [28]

(b) *Institutional organization and the degree of competition (ΔZ)*

As can be derived from our model, the expectations on reform effects depend to a large extent on the expected increase in competition through market liberalization. The ESA reforms experience has taught us that postreform market structure is to a large extent dependent on prereform market structure. In WCA, parastatals have been the sole operator of cotton purchasing, selling, and input provision for over half a century, and hence we should not expect massive private entry into the sector upon liberalization.

Preliminary evidence from the partial reforms introduced since the early 2000s also suggests that competition might be hard to achieve. In Benin, where the private sector has been allowed to enter ginning (but not to compete as cotton is publicly procured and administratively allocated to the different firms), strong consolidation trends have been observed after the initial entry of numerous private buyers on the market. At present, the sector is said to resemble a private monopsony (Gergely, 2009). As a result, the impact of liberalization on producer prices and sector performance is expected to be moderate at best.

(c) *Production inefficiencies (c)*

Our model predicts that liberalization may have an efficiency-enhancing effect. Expectations were high at this level for the reforms in ESA, where state-led cotton supply chains suffered a bad reputation for efficiency pre-reform. However, the comparative literature on cotton policies in SSA reveals that parastatals have historically been more efficient in WCA than boards in ESA, implying that there is less scope for efficiency gains in WCA than in ESA.

One indication of this is that, from the 1960s through the 1980s, as government-controlled organizations increased their involvement in the cotton sector, performance declined in most ESA countries, eventually resulting in debts and delayed payments to farmers as well as declining yields (Tschirley *et al.*, 2009). During the same period, in WCA, yields increased threefold (Table 1, Figure 1). As a result, in 1990, cotton yields in ESA were on average over 40% lower than in WCA while they were over twice as big during most of the 1960s (Figure 1).

There is some evidence that, in times of taxation, WCA governments used at least a part of the collected funds from the cotton sector for research and extension, as well as the development of infrastructure, with clear benefits to farmers (Townsend, 1999). Comparing the performance of cotton sectors in Tanzania and in Mali, Gillham *et al.* (1995) also found that while (i) "good leadership and management and integration of adaptive research, extension and production in Mali ensured that supplies of pure, quality seed were available to the farmers and that new developments in varieties and production technology reached them rapidly", (ii) "Tanzania is reflective of other East African countries where there was poor training of cotton professionals, inefficient administration and an absence of any integration of research, extension, production and marketing".

Recent evidence however points at deteriorating efficiency in WCA cotton sectors (e.g., Baffes, 2011).

(d) *Overall impact on producer prices (Y)*

The partial effects of liberalization discussed above suggests that, while reforms in ESA in the 1990s were expected to bring higher prices to farmers, expectations for price improvement after liberalization are significantly more modest in WCA today. First, price liberalization would likely eliminate subsidies, not taxes. Second, although some efficiency gains could be expected, it seems that in general, they will be more modest than in ESA. Third, the positive price effect resulting from increased competition is expected to be small since WCA markets are likely to achieve only limited competition.

(e) *Overall impact on contract sustainability (p_{min})*

Furthermore, the removal of subsidies and the more modest expectations on efficiency improvements are two reasons

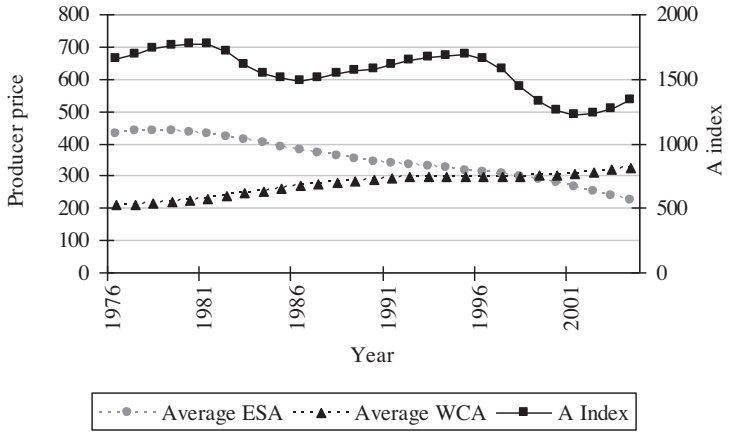

Figure 9. *Producer prices in ESA and WCA compared to the A index, 1976–2004 (US$/MT). Source: Anderson and Valenzuela (2007). Note: WCA includes Benin, Burkina Faso, Chad, and Mali; and ESA Tanzania, Uganda, Zambia, and Zimbabwe. The data have been smoothed with a lowess factor of 0.4 in order to reduce random variation and increase readability.*

why liberalization in WCA might be more detrimental for contract feasibility than in ESA. On the other hand, limited expectations with respect to the level of post-reform competition predict that contracting in WCA could remain sustainable even after reform, at least in the short run. This however holds only if the entry of a limited number of ginners does not lead to the extreme scenario where $p_s = p$ and high reputation costs cannot be maintained.

Due to environmental conditions, the yield improvement from using inputs in WCA is greater than in ESA where cotton can be produced relatively well without external inputs (i.e., q is larger in WCA). This implies that the supply response to contract breakdown would be more significant. WCA countries are also, on average, more dependent on cotton both at the household level and at the macro level (Figure 7). This, again, underscores the greater sensitivity of a liberalization of cotton markets in the latter region.

6. CONCLUSION AND POLICY IMPLICATIONS

This paper uses a stylized contracting model to investigate the link between market structure and equity and efficiency in SSA cotton sectors, explain the outcome of reforms in ESA and analyze their potential consequences in WCA. We argue that the level of price distortions, the nature of pre-reform market structure, as well as the degree of parastatal inefficiency, all contribute to making reforms less attractive to farmers and governments in WCA today, as compared to ESA in the mid 1990s. We illustrate our arguments with empirical observations on the performance of cotton sectors across SSA.

Obviously, in our attempt to draw general lessons from empirical observations, we have had to abstract from many specific factors affecting cotton sectors in each particular country. Further research is needed to further nuance the story and demonstrate causality between observed changes in market structure and performance. Two contributions have made progress in this respect: Delpeuch and Leblois (2011) in a macro comparative approach and Brambilla and Porto (2011), who use micro-econometric analysis to look at the link between market structure and cotton yields in Zambia.

Two further observations should be made. First, earlier reform experiences across the globe have taught us that macro-economic stability is of paramount importance to the performance of any sector. This is the case for the cotton sector as well. Hence, whatever sectoral reforms are implemented, their effects will always be dwarfed by the impact of potential macro-economic imbalances and hence sectoral market reforms should never be designed in isolation from broader economic reforms.

Second, by shifting the objective of the cotton sector policies from maximal production to efficient production, orthodox reforms are likely to have detrimental effects especially for farmers with high transaction costs of dealing with them, who often are also the poorest. In pointing at the limitations of orthodox market reforms in the WCA context, however, we do not intend to minimize the need for change: the present system is depleting public budgets, while failing to bring about yield increases in most countries of the region since the mid-1980s. The breakdown of inefficient contracts might thus ultimately be beneficial to the national economy if freed resources can be used to support poor farmers in finding alternative sources of income. Whereas governments in WCA have historically presented cotton production promotion as one of the most efficient ways of pulling rural populations out of poverty, they should now try to improve opportunities for diversification, or design more efficient social safety nets that target recipients based on needs rather than on cultivation choices. Moreover, from a macro-economic perspective, a movement out of cotton production of the less efficient farmers could help to reduce the strong dependency on a single commodity at the national level.

This is all easier said than done: market policies are more easily implemented than social policies in developing countries with limited budgets and administrative capacity (Brooks, 2011). Still, we believe that the strong focus on cotton reforms, both by donors and governments, should be put into perspective; and that more attention should be paid to designing global agricultural and rural policies that create opportunities for farmers to move out of cotton production.

NOTES

1. According to Tschirley, Poulton, and Labaste (2009), in SSA, cotton is the main source of cash revenue for more than two million poor rural household and a major source of foreign exchange for over fifteen countries. In West and Central Africa (WCA), the cotton sector in certain cases accounts for up to 10% of the gross domestic product, 10% of total merchandize exports, and over 60% of total agricultural exports. Moreover, it is the largest employer in countries such as Burkina Faso, Chad, or Mali (Townsend, 2006).

2. This view came under attack recently when national household survey data on Mali provided evidence of the fact that a very large share of cotton-producing households living in the fertile area of Sikasso (Mali), continued to live under the poverty line despite cultivating a cash crop and receiving public subsidies – making Sikasso the poorest rural region in Mali. However, these findings have been disputed by later research pointing at inadequacies in the data and methodology of the initial analysis (see Delarue, Mesple-Somps, Naudet, & Robilliard, 2009).

3. The geographical distinction between ESA and WCA in fact reflects more political/historical cleavages (Delpeuch & Leblois, 2011). For the purpose of this paper, however, we build on this useful distinction and restrict our country sample to a set of eight emblematic countries (Benin, Burkina Faso, Chad, and Mali in WCA Tanzania, Uganda, Zambia, and Zimbabwe in ESA).

4. Although input use is less intensive in ESA, transactions are interlinked in most countries, with the exception of Tanzania, where less than 10% of farmers used any fertilizers before liberalization (Larsen, 2003).

5. Especially in WCA, the parastatal would also be responsible for developing new seeds (to varying degrees, with public budget support), distributing inputs on credit, providing technical advice to farmers, taking care of relevant infrastructure, and sometimes, even building schools and dispensaries.

6. This issue remains debated. For example, based on a field survey in Mali, Moseley, Carney, and Becker (2010) find that over the 1990s, increased cotton production by poor households led to reduced food surpluses, as labor resources were shifted from food production to cotton production. Moseley *et al*. (2010) also show that, in more recent years, sorghum production has peaked while cotton production declined.

7. The Berg report, considered to be the reference paper for World Bank adjustment programs in developing countries' agricultural markets, notes: "some of the smallholder cotton growing schemes in francophone African countries are organized by agencies with mixed private-public ownership and are among the more successful ventures on the continent" (Berg, 1981).

8. The collapse of the cotton industry in Uganda was related to Idi Amin's expulsion of the Asian population in 1972 who owned and managed much of the industrial sector, including cotton gins. For a discussion of the importance of the Asians in the Ugandan cotton ginning industry, see Jamal (1976).

9. The expansion of area under cotton was to a large extent triggered by the devaluation of the CFA franc in 1994, which improved WCA competitiveness in cotton (Baffes & Estur, 2009). With this area expansion, less fertile land and lower performing farmers entered production, which might explain part of the WCA cotton yield stagnation or decline (Kaminski *et al*., 2011).

10. One of these elements, which we do not discuss in this paper, is cotton quality (Larsen, 2003; Gilbert and Tollens, 2003).

11. Note that we assume an indivisible production function and a fixed proportions production technology as well as perfect information (production, price, and market risks are thus not considered).

12. For example, if the farmer's only ex ante outside option is to produce food crops for the local market, then l equals the product of their quantity and their sales price.

13. K depends both on the capital intensity of cotton cultivation, and on the buyer's potential return to alternative investments.

14. Note that, as t only enters into the equations as a net tax contribution or a net subsidy received, we do not explicitly account for possible benefits that producers (or processors) could obtain from possibly beneficial effects of public expenditures on infrastructure, agricultural research and development, and research extension (or, conversely, for foregone benefits of public investment that has been crowded out by the subsidies to cotton farmers). This can however be considered to be implicitly comprised in the value of t.

15. African countries remain "small" exporters on the World market, unable to influence the world price. In 2007, the four WCA countries under consideration, which together are the first African exporter, accounted for just below 3% of world exports, while, for example, the US accounted for above 19% and Uzbekistan for above 5% (UN Comtrade, 2007).

16. In a principal-agent setting (as in Kranton & Swamy, 2008), β would equal zero. Here, we keep it as general as possible.

17. In this respect, this model can be viewed as a particular case of "bargaining with imperfect enforcement", as described in White and Williams (2009), which implies that the weakest party in the negotiation can actually gain a larger share of an agreement if it must be implemented non-cooperatively as "the lot of the weaker player must be improved in order that he finds continuing the agreement worthwhile."

18. The reputation cost is a short-hand way of introducing some dynamics in the model and keeping it simple (Kranton & Swamy, 2008). The source of this reputation cost can be very diverse: from the loss of future contracting opportunities and to access credit and input, over a fine which must be paid the contracted buyer, to a loss of face *vis-à-vis* other members of the local community.

19. One case in which t and t_s may differ is if spot market buyers participate in informal cross-border trade, and contract buyers do not (see e.g., Ackello-Ogutu & Echessah, 1997, on informal cotton trade between Uganda and Kenya).

20. T and Z are both continuous, with $T \in [0;1]$ and increasing with the size of taxation/subsidy and Z going from no competition ($Z = 0$) to perfect competition and no constraint on private ownership ($Z = 1$).

21. Note that ex-ante competition refers to competition between buyers at the time of negotiating the agreement, while ex-post competition relates to competition between buyers at the time of contract execution, i.e., trading. In the case of contract farming, ex-post competition is only possible in case of weak contract enforcement.

22. Also here, the caveat applies that if the side-selling option is binding and if spot market buyers experience the same efficiency gains as contracted buyers, the effects of increased competition on c and c_s will positively impact on producer prices, while leaving contract feasibility unaffected.

23. See also similar findings by Swinnen, Sadler, and Vandeplas (2007) in Central Asian cotton chains.

24. The NRA is defined as "the percentage by which government policies have raised gross returns to farmers above what they would have been without the government's intervention" (Anderson & Masters, 2009, p. 11) and is, to our knowledge, the best proxy for estimating the evolution of t over long time periods.

25. Various reasons have been put forward to explain this, among which, chiefly, the largely agricultural and rural nature of African economies. Taxation of agricultural products is indeed expected to be higher if agriculture occupies a larger share of the national GDP, and if the government has fewer alternative sources of income at its disposal. Besides, the more numerous farmers are, (i) the more costly it is to organize them (Olson, 1985) and (ii) the higher the costs on the rest of society are for supporting them (Swinnen, 1994, 2010). In addition, exported cash crops are considered to be a relatively easy target for taxation, because it is easier to control exports than domestic market products, and because there are no local consumers for whom prices should be kept low (Bates, 1981).

26. This is an issue that we have not accounted for in our model.

27. Also in Mali, cotton accounted for up to 40% of total merchandize export value. For a detailed discussion on the political economy of cotton in Mali, see e.g., Keeley and Scoones (2003).

28. The countercyclical nature of support to the agricultural sector is believed to be a common feature of agricultural policies (e.g. Gawande & Krishna, 2003; Swinnen, 2010). One possible explanation is that government preferences exhibit loss aversion (Tovar, 2009) and therefore tend to protect especially the sectors where profitability is on the decline. Another argument can be understood from a simple perspective of rent maximization: if cotton is governments' major source of income, it is rational for governments to subsidize their cotton sectors at times of low world prices.

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