Market Competition in Export Cash Crops and Farm Income

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Abstract: This paper studies how the internal structure of agriculture export markets and the level of competition affect poverty and welfare in rural areas in Africa. We develop a game-theory model of supply chains in cash crop agriculture between many atomistic smallholders and a few exporters. The model provides the tools needed to simulate the changes in farm-gate prices of export crops given hypothetical changes in the structure of the supply chain. Using household surveys, we assess the poverty impacts of those changes in the value chains for twelve case studies. We investigate the average impact for all rural households, the distribution of these impacts for poor vis-à-vis non-poor households, and the differences in impacts between male- and female-headed households. Overall we find that an increase in competition among processors is good for the farmers. However, small changes to the level of competition are unlikely to have significant effects on farmers' livelihood. We also find that, on average, non-poor, male headed household are the ones that benefit the most from an increase in competition. The introduction of outgrower contracts in our model only produces significant changes in the simulations of one of our case studies.

JEL codes: O13, L11, Q12.

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1. Introduction

In this paper, we study how the internal structure of export markets and the level of competition affect poverty and welfare in remote rural areas in Africa. The commercialization of export agriculture is produced along a supply chain where intermediaries, exporters, and downstream producers interact with farmers. Often, the sector is concentrated, with a few firms competing for the commodities produced by atomistic smallholders. This structure of the market conduces to oligopsony power: firms have market power over farmers and are able to extract some of the surplus that the export market generates. The extent of oligopsony power depends on the number of competitors and on the relative size of each competitor. Changes in the configuration of the market will thus affect the way the firms interact with the farmers. In principle, tighter competition induced by entry or by policies that foster competition can affect farm-gate prices and therefore household welfare and poverty. This is the topic of our investigation.

The relationship between firms and farmers in export markets in Africa is complex. On top of the standard game theoretic interrelationship, where firms interact with each other and take into account the response of farmers when setting prices, many markets are characterized by the presence of outgrower contracts. When there are distortions in the economy, or missing markets (especially for credit and capital), it may be impossible for farmers to cover any start-up investments related to the production of the export crop. In those scenarios, farmers would not be able to purchase seeds, or the pesticides needed for cash crop production and the market for these crops can disappear. In Africa, one way to solve this issue is with outgrower contracts, whereby firms provide inputs on loan at the beginning of the season. These loans, and any interest bore, are then recovered at harvest time. While outgrower contracts can be a very useful instrument to make these markets work, they may fail, sometime catastrophically, when there are enforceability problems. Clearly, an inadequate legal system may prevent enforceability. Equally important, the presence of too many players/firms interacting simultaneously can facilitate side-selling, a situation in which a farmer takes up a loan with one firm, sells to a different one at harvest, and thus default on the original loan. In these cases, it is possible for increased competition to make contract monitoring very costly. Interest payments may become too burdensome for the farmers. In extreme cases, this may lead to a vicious cycle where the system fully collapses. Our analysis covers these scenarios.

Our analytical methodology has two main parts. The first is a game-theory model of supply chains in cash crop agriculture between many atomistic smallholders and a few exporters. The model provides the tools needed to simulate the changes in farm-gate prices of export crops given hypothetical changes in the structure of the supply chain. Farm-gate prices are set by firms. The firms buy raw inputs from the farmers (coffee beans, cotton seeds, etc.) and sell them in international markets at given prices. In contrast, the firms enjoy oligopsony power internally. The oligopsony game delivers the equilibrium farm-gate prices that the firms offer to the farmers. Given these prices, farmers allocate resources optimally and supply raw inputs to the firms and this supply affects the quantity that firms can supply in the export market. In equilibrium, firms take into account the supply response of the farmer when choosing optimal farm-gate prices. Once the equilibrium of the model is found, and the solution is calibrated to match key features of the economy, we simulate various changes in competition. Our simulations cover a large number of general settings, from entry to exit.

The second component utilizes household surveys to assess the poverty impacts of those changes in the value chains. We follow a standard first order effects approach, as in Deaton (1989, 1997). Using the microdata from the household surveys, we use income shares derived from the production of different crops to evaluate the income impacts of a given farm-gate price change. We investigate the average impact for all rural households, the distribution of these impacts across levels of living and the differences in impacts between male- and female-headed households.

We explore 12 case studies: the cotton sector in Zambia, Malawi, Burkina Faso, Cote d'Ivoire, and Benin; the coffee sector in Uganda, Rwanda and Cote d'Ivoire, the tobacco sector in Malawi and Zambia, and the cocoa sector in Cote d'Ivoire and Ghana. We focus on those crops that are plausible vehicles for poverty eradication and on those countries where the household survey data needed for the poverty analysis is available.

In the next section we develop the theoretical model of supply chains in export agriculture. The purpose of the model is to provide an analytical framework to study how changes in the structure of the supply chain affect farm-gate prices. In section 3, we combine the household survey with the farm-gate price changes to carry out the poverty analysis. We estimate the impact, at the farm level, of changes in the supply chain on household income. Section 4 concludes.

2. A Model of Supply Chains in Agriculture

We present a game-theory model of supply chains in export agriculture.[1] There are two main actors in the model: firms and farmers. There are a large number of farmers who must choose to produce home-consumption goods or exportable goods. They are atomistic and face exogenous farm-gate prices offered by the firms. These prices and the characteristics of the farmer (land endowment, productivity) determine the allocation of resources of each farmer to the "export market" or to home-production activities.

The firms buy raw inputs from the farmers and sell them in international markets. We assume that these firms are small in international markets and thus take international commodity prices as given. In contrast, the firms enjoy monopsony power internally. There are only a few firms in each market, and they compete in an oligopsony to secure the raw input provided by the farmers. The oligopsony game delivers the equilibrium farm-gate prices that the firms offer to the farmers. Given these prices, farmers allocate resources optimally and supply raw inputs to the firms and this supply affects the quantity that firms can supply in the export market. In equilibrium, firms take into account the supply response of the farmer when choosing optimal farm-gate prices.

The solution to the game depends on various parameters. On the firm side, the equilibrium depends on both the number of firms and on their share of the market. In other words, it matters if the market is characterized by symmetrical firms or, instead, by a large dominant firm and many small competitors. Firm characteristics, such as production costs, also matter. On the farmer side, the equilibrium depends on factor endowments, preferences, and farm productivity (costs) in export agriculture. These factors determine the export supply response of the farmers and how this is affected by the structure of the market. Our model incorporates all these features.

Once the equilibrium of the model is found, and the solution is calibrated to match key features of the economy, we study comparative static results. We do this to compute the changes in farm-gate prices that we need for the poverty analysis. We explore a variety of comparative static results. Given the initial structure of the market (that is, the number of firms and their market shares), we simulate various changes in competition. Our simulations cover a large number of general settings, from entry to exit. We

[1] Our model builds on the ideas and the analytical framework developed by, among many others, Salop (1979), Barnum and Squire (1979), Singh, Squire and Strauss (1986), De Janvry, Fafchamps, and Sadoulet (1991), Benjamin (2001), McMillan, Rodrik, and Welsh (2003), Taylor and Adelman (2003), Syverson (2004), Sheldon (2006), Sexton, Sheldon, McCorriston, and Wang (2007), and Kranton and Swamy (2008).

study the impacts of the entrance of a small competitor, of a hypothetical merge of the two leading firms, and of the split of the leader into smaller competitors. Given the initial equilibrium, we find the new equilibrium of the model and study the changes in farm-gate prices, profits, and farmer utility. In the simulations, we take into account both firm and farm responses. This means that our comparative static results allow firms to adjust prices and quantities separately (implying that market shares may change in equilibrium). Farmers also adjust crop supply, and this is, in turn, taken into account by the firms when choosing the new equilibrium prices.

We also study outgrower contracts. Many markets in Africa are characterized by distortions and missing markets and this impedes the optimal allocation of resources. This is critical in export agriculture. If credit is needed up-front to undertake the necessary investments in export cropping then a malfunctioning credit market may push farmers out of the export market, even in the case of relatively high farm-gate prices. To study these issues, we extend our model by including outgrower arrangements. In these arrangements, firms cover up-front a fraction of the farmer's crop production costs. Farmers repay these costs at the harvest time after paying an interest rate on the loan. The key feature of the extended model is that the interest rate charged by the firms may depend on the structure of the market. Increases in competition thus have two opposing effects, one effect via higher farm-gate prices, which encourages export participation and reduces poverty, and another via a potentially higher interest-rate, which hinders export participation and increases poverty.

2.1. The Economy

We study an economy where individuals are endowed with (small) pieces of productive land. These agents must choose between being "peasants," who live in autarky and consume all their home-production, or "farmers" who grow and sell exportable goods and buy consumption goods from the market. The main assumption driving our results is simply that market-acquired consumption goods are a superior good. In other words, a diversified consumption portfolio becomes desirable as the person's wealth increases. In terms of behavior, this means that poorer individuals will home-consume 100 percent of their endowment, while richer families (in terms of initial endowment) will trade a fraction of their endowment in the market, in exchange for other goods. That is to say, the superior-goods assumption generates a wealth effect driving the peasant/farmer occupation decision in this economy.

The structure of the market for the tradable good will naturally have a strong impact on the equilibrium prices of the endowments. The more competitive the market structure is, the more individuals will leave autarky and become farmers. In consequence, as competition increases, the richest peasants will become farmers. Autarky behavior will move down along the distribution of income.

The model

This is a one-period endowment economy populated by a measure *I* of farmers and a finite number *n* of exporters. Farmers are identical in preferences but are heterogeneous in the size/productivity of their farms. Specifically, each farmer i is endowed with a farm that can produce e_i units of crop. e_i takes values on an interval $[\underline{e}, \overline{e}]$ and its distribution over values is represented by the continuously differentiable probability function $F(e)$, density $f(e)$.

Farmers

Individual farmers are identical in their preferences, but are heterogeneous in the size/productivity of their farms. Their Cobb-Douglas utility function defined on home consumption *h* and market goods *m* is given by

$$u(\boldsymbol{h}, m) = \boldsymbol{h}^{\alpha} (m + c)^{\mathbf{1}-\alpha}$$

The constant c is a preference parameter and implies that $m = \mathbf{0}$ can be a rational choice. The level c will effectively play the role of imposing a "subsistence" level $\hat{e}$ of the endowment that must be consumed by farmers. Poor farmers whose initial endowment is lower than the subsistence level will live in autarky. Rich farmers, instead, whose endowment e_i is larger than the "subsistence" level $\hat{e}$ will sell part of the "surplus" $e_i - \hat{e}$ to the market. The cutoff "subsistence" level is decreasing in p. The intuition is a wealth effect. When p is higher, farmers are richer, and therefore can afford to diversify their consumption goods.

Each farmer $i \in I$ is endowed with a farm with productivity e_i. The farmer operates the farm and its output can be either consumed by the farmer or sold to exporters in the market. The optimization problem is

$$V(e_i; p, R) = \max_{h,m} h^{\alpha} (m + c)^{1-\alpha}$$

$$s.t. \quad m + ph \leq (p - \lambda r) e_i$$

$$h \geq 0$$

$$m \geq 0$$

where e_i is individual i's initial endowment, p is the price for farmers of the crop, $r > 0$ is the interest rate. Preferences are parameterized by $0 < \alpha < 1$. We now discuss the different pieces of the optimization problem.

The farmer produces e_i units of crop, of which he will apply h units to own consumption. The remaining units will be sold to the exporters at a market price of p. In addition, we allow for the possibility of a liquidity constraint affecting the home-market decision. The liquidity constraint is parameterized by λ. When $\lambda = 0$, there is no liquidity constraint. When $\lambda > 0$, the interpretation is that a farmer planning to produce output of $(e_i - h)$ for the market will need to borrow an amount $\lambda . (e_i - h)$ beforehand. The farmer will then need to pay an interest rate r on the borrowed amount. This possibility of liquidity constraints is introduced to study outgrower contracts later on. For the remainder of the section we will assume $\lambda = 0$.

Exporters

There are n exporters who sell the crop at an international price of P. They buy from farmers at the internal market price of p. These are Cournot oligopsonists. They choose how much quantity to demand from the market at the prevailing price p, and they understand and correctly anticipate that their own demand behavior affects p.

The problem faced by an exporter is then to maximize revenues:

$$\Pi\left(P, p, c_j^p\right) = \max_{q_j} \left(P - p - c_j^p\right). q_j$$

where q_j and c_j^p are, respectively, the demanded quantity and the unit cost of production of exporter j. In principle, exporters may face different marginal costs and this determines the equilibrium market shares.

Farmer Solution

We begin with the solution to the problem of the farmers. With $\lambda = 0$, the Lagrangian and first order conditions are

$$\mathcal{L} = \boldsymbol{h}^{\alpha}\,(m+c)^{1-\alpha} + u_1(pe_i - p\boldsymbol{h} - m) + u_2\boldsymbol{h} + u_3 m$$
$$\frac{\partial \mathcal{L}}{\partial \boldsymbol{h}}:\ \alpha\frac{\boldsymbol{h}^{\alpha}\,(m+c)^{1-\alpha}}{\boldsymbol{h}} - u_1 p + u_2 = 0$$
$$\frac{\partial \mathcal{L}}{\partial m}:\ \frac{(1-\alpha)\left(h^{\alpha}\,(m+c)^{1-\alpha}\right)}{m+c} - u_1 + u_3 = 0$$

From this we can solve

$$\alpha\frac{\boldsymbol{h}^{\alpha}\,(m+c)^{1-\alpha}}{\boldsymbol{h}} = p(1-\alpha)\frac{\boldsymbol{h}^{\alpha}\,(m+c)^{1-\alpha}}{m+c}$$
$$\Rightarrow\ m = \frac{1-\alpha}{\alpha}p\boldsymbol{h} - c$$

Using the budget constraint, we get

$$pe_i = p\boldsymbol{h} + m \ \Rightarrow\ pe_i = p\boldsymbol{h} + \frac{1-\alpha}{\alpha}p\boldsymbol{h} - c$$
$$\Rightarrow\ \boldsymbol{h} = \frac{\alpha}{p}(pe + c)$$
$$\Rightarrow\ m = (1-\alpha)\,pe_i - c\alpha$$

Note that this can only be a solution provided $m \geq 0$. Therefore, we can solve for the cutoff level of parameters:

$$m = (1-\alpha)pe_i - c\alpha \geq 0 \Leftrightarrow e_i \geq \frac{\alpha}{1-\alpha}\frac{c}{p}$$

Define the cutoff level

$$\hat{e}(p) \equiv \frac{\alpha}{1-\alpha}\frac{c}{p}$$

For any $e_i \leq \hat{e}(p)$, the optimal responses are

$$m = 0, \boldsymbol{h} = e_i$$

For any $e_i \geq \hat{e}(p)$, the optimal responses are the usual Cobb-Douglas budget allocation rules:

$$p\boldsymbol{h} = \alpha(pe_i + c); \qquad m + c = (1-\alpha)(pe_i + c)$$

In this sense, we interpret $\hat{e}(p)$ as a "subsistence" endowment level. Poor farmers whose e_i is lower than this "subsistence" level live in autarky and self-consume 100% of their endowment. Notice that the cutoff "subsistence" level is decreasing in p. The intuition is an income effect. At higher p, farmers are richer, and therefore can afford to diversify their consumption goods.

The individual farmer's market supply function is

$$s\ (p;e) = \max\ \{e - \boldsymbol{h}, \boldsymbol{0}\} = \max\ \left\{e - \alpha\left(e + \frac{c}{p}\right), \boldsymbol{0}\right\}$$

With some algebra, this can be rewritten as

$$s\ (p;e) = (1-\alpha)\max\ \{e - \hat{e}(p), 0\}$$

The interpretation of this equation is that each farmer supplies a percentage $1 - \alpha$ of the "subsistence surplus" $e - \hat{e}(p)$.

We can now easily derive the aggregate supply of export crops that firms will face. Integrating across individuals, we get the aggregate supply function

$$\frac{S(p)}{1-\alpha} = \int_{\hat{e}}^{\bar{e}} e_i f(e)de - \hat{e}(1 - F(\hat{e}(p)))$$

Exporter Solution

We look for a equilibrium for the exporters' oligopsony game. Exporters correctly understand and anticipate that the market price p depends on their own actions, other exporters' actions, and aggregate supply behavior from farmers. Let $Q \equiv \sum_{j=1}^{n} q_j$ denote aggregate demand from exporters, then a given exporter perceives the following problem:

$$\Pi\left(q_{k\neq j}, P, c_j^p\right) = \max_{q_j} \left(P - p - c_j^p\right). q_j$$

$$s.t.\ Q \equiv q_j + \sum_{k\neq j} q_k$$

We now turn to the first order conditions. With n exporters, we have

$$q_j = (1-\alpha)\left(P - p^s(Q) - c_j^p\right)\frac{\left(1 - F\left(\hat{e}(p^s(Q))\right)\right)\hat{e}(p^s(Q))}{p^s(Q)}$$

$$\Rightarrow Q = (1-\alpha)\left(nP - np^s(Q) - \sum_{j=1}^{n} c_j^p\right)\frac{\left(1 - F\left(\hat{e}(p^s(Q))\right)\right)\hat{e}(p^s(Q))}{p^s(Q)}$$

2.2. The Simulations

The first step in the analysis is the calibration of the parameters of the farmer model. Note that we need to perform a different calibration for each of the country-crop case studies. We calibrate α, the parameter of the utility function, the farm supply parameters and the subsistence cutoff. To do this, we assume that the distribution of endowments follows a log normal distribution with mean μ and standard deviation σ. Then, we use the household survey data and choose the parameters so as to match (as closely as possible) the observed aggregate shares of income derived from the production of the export crop. The calibrated parameters are in Table 2.1.[2]

[2] Note that we calibrate a different set of parameters for each case study. This means that we use different parameters for different crops, even in a given country (such as cotton and tobacco in Zambia, for instance). We do this for consistency with the fact that our model is designed to describe one market in isolation. This assumption makes sense if, for instance, different crops are produced by different farmers (because of geography). A model with multiple choices of export crops could be an interesting extension of our work.

Table 2.1: Model Calibration

Case	Income Share	Producer`s Utility /Total Utility	μ	σ	pf	c	α
Burkina Faso Cotton	1.31	1.31	6.020	2	31.8	10000000	0.43
Zambia Tobacco	0.73	0.73	4.633	2.1	47.4	10000000	0.16
Uganda Coffee	2.40	2.40	5.216	2	41.6	3600000	0.36
Cote d'Ivoire Cotton	4.24	4.24	4.623	2	32.2	1000000	0.30
Zambia Cotton	2.97	2.98	4.236	2	33.7	1200000	0.16
Malawi Tobacco	3.82	3.82	4.985	2	38.2	1800000	0.37
Benin Cotton	6.59	6.59	4.188	2	41.9	600000	0.25
Rwanda Coffee	0.88	0.88	6.071	2.1	37.7	25000000	0.45
Malawi Cotton	0.47	0.47	6.015	2.1	31.4	30000000	0.37
Cote d'Ivoire Cocoa	17.12	17.12	3.867	2	40.7	150000	0.30
Ghana Cocoa	4.15	4.14	4.740	2	37.2	1300000	0.32
Cote d'Ivoire Coffee	6.81	6.81	4.355	2	38.8	600000	0.30

Note: The income share comes from the household surveys.
μ: mean endowment (lognormal distribution)
σ: standard deviation (lognormal distribution)
pf: farm-gate price
c: utility function parameter (see text)
α: utility function parameter (see text)

As for the solution of the model, we work with the aggregate farm supply:

$$S(p) = (1-\alpha)\int_{\hat{e}}^{\bar{e}} e_i f(e)de - \hat{e}(p)(1-F(\hat{e}(p)))$$

and the first order conditions of the oligopsony game. Firms incur different costs of manufacturing, c_j^p . In equilibrium, given *P*, market shares differ across firms. In consequence, we search for farm-gate prices and a structure of firms' costs so as to match the number of firms and the distribution of market shares observed in the data. To summarize, the search procedure comprises the following steps:

1. Given Q, we find an equilibrium price $p^s(Q)$ from the aggregate supply equation.
2. We know the market shares for each firm, sh_j, so $q_j = sh_j \cdot Q$ is identified.
3. Finally, we solve for c_j^p using the best response function of each firm.

This algorithm delivers the solution to the model, given the calibrated parameters. The solution comprises exogenous parameters, the firm costs, and an endogenous quantity, farm-gate prices. Now, given the calibrated parameters *and* the structure of costs associated with the solution, we can simulate comparative static results numerically.

We carry out seven simulations for each case study. The main component of our simulation is a hypothetical change in the structure of the supply chain. To cover different types of changes in market structure, we explore the following seven cases:

1. Leader Split (with equal marginal costs)
2. Small Entrant (with marginal costs equal to smaller firm)
3. Leader's merge and small entrant (with costs equal to that of the most efficient merger and that of the smaller incumbent, respectively)
4. Leaders merge (with cost of the most efficient merger)
5. Exit of largest firm
6. Equal Market Shares (all firms have the cost of the leader)
7. Perfect Competition ($p^s(Q)$ equal to *P* less marginal cost of the most efficient firm)

These simulations are performed with the following algorithm. In each of the simulations, there is a change in the number of firms, n , and/or a change in the baseline structure of costs, c_j^p . To find the solution, we need to find Q and $p^s(Q)$ that solve the first-order condition for each firm subject to aggregate farm supply. That is, we solve

$$q_j = (1-\alpha)\left(P - p^s(Q) - c_j^p\right)\frac{\left(1 - F\left(\hat{e}(p^s(Q))\right)\right)\hat{e}(p^s(Q))}{p^s(Q)} \ \forall j \in n$$

subject to

$$Q = S(p)$$

$$\sum_{j=1}^{n} q_j = (1-\alpha)\int_{\hat{e}}^{\bar{e}} e_i f(e)de - \hat{e}(p)(1 - F(\hat{e}(p)))$$

As a result, we calculate a new q_j for firm $j \in n$.

2.3. Simulation Results

We investigate 12 case studies and we run a total of 7 simulations for each case study. The results farm gate prices, quantities, utility, and total and average industry profits are reported in Tables 4.2a and 4.2b.

Table 4.2a
SIMULATIONS - BASIC MODEL
(% changes)

	Leader Split	Small entrant	Leader`s merge + small entrant	Leaders merge	Exit of largest	Equal market shares	Perfect Competition
ZAMBIA - COTTON							
Farm- gate price	8,92	1,01	-6,22	-8,59	-11,84	27,21	71,64
Quantities	5,32	0,62	-3,90	-5,44	-7,58	15,35	35,91
Utility	0,11	0,01	-0,08	-0,11	-0,15	0,35	0,93
Total Industry Profits	10,29	-3,86	-7,71	-0,36	-22,37	-1,33	-100,00
Average Industry Profits	10,29	-19,88	-7,71	24,55	-2,96	-1,33	-100,00
BENIN - COTTON							
Farm- gate price	9,15	0,25	-1,44	-1,90	-10,52	57,34	97,39
Quantities	5,01	0,14	-0,82	-1,08	-6,20	27,04	41,43
Utility	0,26	0,01	-0,04	-0,05	-0,29	1,63	2,79
Total Industry Profits	39,70	-0,95	2,79	4,47	-63,93	-14,77	-100,00
Average Industry Profits	39,70	-11,96	2,79	19,40	-58,78	-14,77	-100,00
BURKINA FASO - COTTON							
Farm- gate price	19,55	1,00	-1,23	-3,22	-27,68	37,66	89,38
Quantities	18,13	0,95	-1,17	-3,07	-27,30	34,15	76,26
Utility	0,15	0,01	-0,01	-0,03	-0,25	0,28	0,65
Total Industry Profits	15,07	-2,57	2,39	7,28	-66,36	-10,24	-100,00
Average Industry Profits	15,07	-26,93	2,39	60,92	-49,54	-10,24	-100,00
COTE D`IVORE - COTTON							
Farm- gate price	8,85	0,76	-5,43	-7,37	-11,46	26,78	67,20
Quantities	5,77	0,51	-3,69	-5,05	-7,95	16,63	37,82
Utility	0,16	0,01	-0,10	-0,14	-0,21	0,50	1,28
Total Industry Profits	10,34	-3,21	-3,60	3,23	-24,57	-0,54	-100,00
Average Industry Profits	10,34	-19,34	-3,60	29,04	-5,72	-0,54	-100,00

	Three firms	Four firms	Small entrant with half of
MALAWI - COTTON			
Farm- gate price	12,15	19,64	6,09
Quantities	11,62	18,62	5,86
Utility	0,16	0,24	0,08
Total Industry Profits	-14,67	-26,52	-16,05
Average Industry Profits	-43,11	-63,26	-44,03

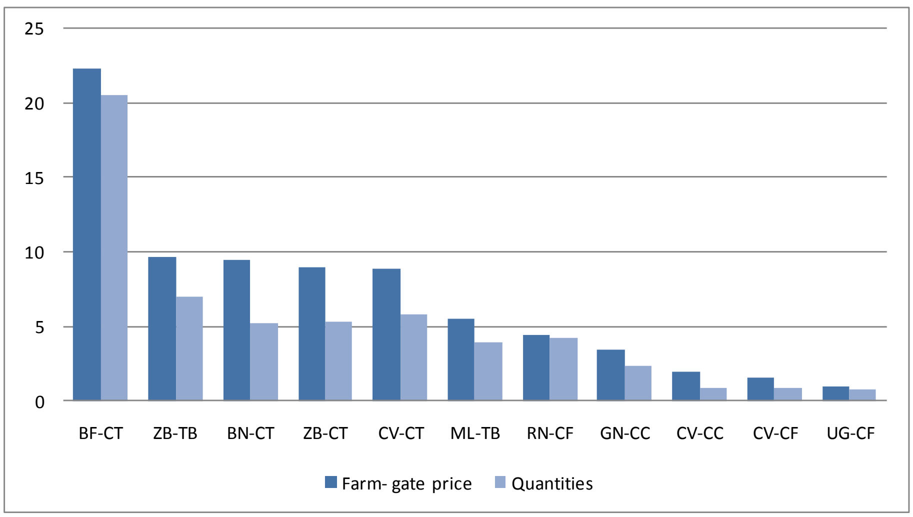
Table 4.2b
SIMULATIONS - BASIC MODEL
(% changes)

	Leader Split	Small entrant	Leader`s merge + small entrant	Leaders merge	Exit of largest	Equal market shares	Perfect Competition
COTE D`IVORE - COCOA							
Farm- gate price	1,95	0,37	-1,11	-1,58	-2,18	18,24	37,21
Quantities	0,85	0,16	-0,49	-0,70	-0,97	7,44	14,10
Utility	0,14	0,03	-0,08	-0,12	-0,16	1,33	2,70
Total Industry Profits	6,96	-2,91	-3,38	0,14	-8,65	-1,24	-100,00
Average Industry Profits	0,28	-8,98	-3,38	7,29	-2,13	-1,24	-100,00
GHANA - COCOA							
Farm- gate price	3,43	0,28	-1,05	-1,46	-4,02	29,27	47,48
Quantities	2,35	0,20	-0,72	-1,02	-2,81	18,71	29,05
Utility	0,06	0,01	-0,02	-0,03	-0,07	0,54	0,88
Total Industry Profits	29,47	-2,17	0,66	3,68	-37,56	-7,07	-100,00
Average Industry Profits	18,68	-10,32	0,66	14,05	-31,32	-7,07	-100,00
COTE D`IVORE - COFFEE							
Farm- gate price	1,52	0,29	-1,47	-1,08	-1,71	14,25	27,57
Quantities	0,90	0,17	-0,88	-0,64	-1,02	8,08	15,00
Utility	0,04	0,01	-0,04	-0,03	-0,05	0,41	0,81
Total Industry Profits	6,78	-2,95	-3,22	-6,89	-8,25	-5,87	-100,00
Average Industry Profits	0,11	-9,02	3,69	-6,89	-1,69	-5,87	-100,00
RWANDA - COFFEE							
Farm- gate price	4,44	0,56	-4,25	-5,84	-6,08	8,71	31,91
Quantities	4,21	0,54	-4,07	-5,61	-5,84	8,21	29,28
Utility	0,05	0,01	-0,05	-0,07	-0,07	0,09	0,29
Total Industry Profits	-3,93	-3,92	-5,05	3,84	2,17	-4,32	-100,00
Average Industry Profits	-3,93	-19,94	-5,05	29,80	27,72	-4,32	-100,00
UGANDA - COFFEE							
Farm- gate price	0,96	0,13	-0,66	-0,85	-1,08	9,16	17,89
Quantities	0,77	0,11	-0,53	-0,68	-0,87	7,18	13,76
Utility	0,01	0,00	-0,01	-0,01	-0,01	0,10	0,20
Total Industry Profits	3,94	-2,10	-2,36	0,43	-4,71	-14,38	-100,00
Average Industry Profits	-2,17	-7,86	-2,36	7,12	1,65	-14,38	-100,00
MALAWI - TOBACCO							
Farm- gate price	5,14	0,14	-4,37	-5,12	-6,00	21,39	46,12
Quantities	3,74	0,10	-3,26	-3,82	-4,49	14,96	30,52
Utility	0,09	0,00	-0,07	-0,09	-0,10	0,36	0,78
Total Industry Profits	7,27	-0,88	-10,34	-6,50	-15,93	-14,54	-100,00
Average Industry Profits	7,27	-13,27	-10,34	9,09	-1,92	-14,54	-100,00
ZAMBIA - TOBACCO							
Farm- gate price	9,63	2,20	-3,44	-7,33	-13,90	21,42	64,45
Quantities	6,95	1,62	-2,56	-5,52	-10,64	15,05	41,40
Utility	0,08	0,02	-0,03	-0,07	-0,13	0,16	0,42
Total Industry Profits	7,64	-7,98	-0,05	12,08	-21,17	11,26	-100,00
Average Industry Profits	-13,89	-26,38	-0,05	49,44	5,10	11,26	-100,00

Rather than discussing all the possible simulations, we focus on the case of cotton in Zambia and provide detailed explanations of the results for all the endogenous variables of the model. Then, we summarize the key findings from the remaining case studies, emphasizing both differences and similarities. We chose cotton in Zambia as our leading case because the cotton sector has undergone several of the transformations that our simulations aim to capture. Until 1994, the sector was controlled by a state monopoly. Immediately after the privatization, the sector was dominated by a duopoly, but over the years competition ensued. The Zambian cotton sector has also seen several outgrower schemes with variable degrees of success.

We begin with the baseline model and we discuss results from the seven market structure simulations. The *Leader Split* simulation reveals an increase of both farm-gate prices and quantities because it raises competition among exporters. In the case of Zambian Cotton, the increases in farm-gate prices and quantities are 8.92 and 5.32 percent, respectively. Figure 2.1 shows that prices and quantities increase in all 12 case studies. The largest price increase is observed in the case of cotton in Burkina Faso and this is because the leader absorbs around 85 percent of the market in the initial situation. In other cases, such as coffee in Uganda, the split of the leader does not boost competition by much and thus the changes in prices are small.

Figure 2.1. Changes in Farm-gate Prices and Quantities: Leader Splits Simulations

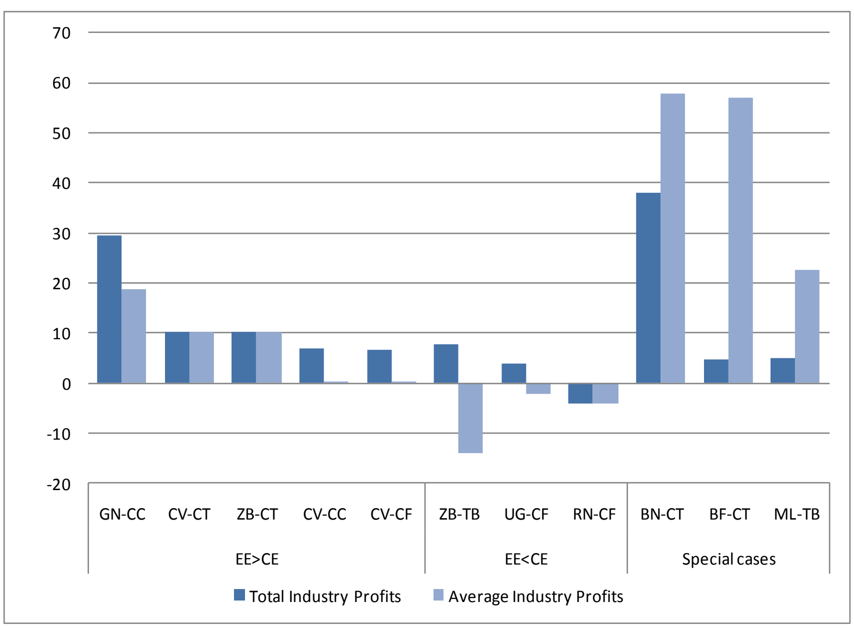


The impact of higher prices on welfare is positive, both for producers and for non-producers (some of whom become producers). At the same time, the increase in prices makes cotton production more profitable for the marginal farmer and this triggers a supply response. This supply response is, however, small. Those farmers that do switch enjoy very large gains, however. In the Zambian cotton case, the average gain of the switchers is 26.64 percent. The switchers, nevertheless, are a small group, and consequently the average impact on non-producers is negligible.

In principle, the change in profits in the Leader Split simulation is ambiguous. There are three different discernable patterns (Figure 2.2). In the first case, total and average industry profits increase in the same proportion. This occurs when the leader is very efficient compared with its competitors, and the split into two efficient firms significantly increases total profits and average profits. In the case of Zambian cotton, for instance, average and total profits increase by 10.29 percent. In the second case, total industry profits increase but average industry profits decrease. This occurs when the leader is efficient enough to increase total profits as it splits, but not sufficiently efficient to maintain average profits unaffected. For instance, in the case of coffee in Uganda, total profits rise by 3.94 percent but average profits decline by 2.17 percent. Finally, there are cases where both total an average profits decline. This happens when the marginal cost of the leader is similar to the marginal costs of the competitors. In consequence, while the split of the leader does not enhance efficiency, the increase in competition brings average and total profits down. For instance, in the Rwandan coffee case, average and total profits declined by 3.94 percent.

The cases of Burkina-Cotton, Malawi-Tobacco, and Benin-Cotton are intriguing. In these cases, there are large differences between the market shares of the largest firm and the smaller competitors and this implies big differences in marginal costs. As a result, when the largest firm splits, some of the smaller and less efficient firms cannot compete and they must exit the market. This reduces the number of firms and, in the end, average profits can show a large increase.

Figure 2.2. Changes in Total and Average Profits: Leader Splits Simulation



Another market simulation that enhances competition, although at a very different scale, is the *Small Entrant* scenario. This means that the impacts on farm-gate prices, quantities, and average utility are qualitatively similar as in the *Leader Splits* simulations, but much smaller in magnitude. In the case of Zambian cotton, for instance, prices and quantities increase by 1.01 and 0.62 percent, respectively.

A Small Entrant causes profits to decline in all simulations (unlike in the *Leader splits* simulation). Recall that changes in market structure bring about a competition effect and an efficiency effect. A small entrant increases competition and this reduces total and average profits. But, since the small entrant is assumed to have the cost structure of the least efficient firm, the efficiency effect disappears. As a result, in all the case studies, average and total profits are lower when a small firm enters. For example, in the Zambian cotton case study, total industry profits fall by 3.86 percent, and average industry profits, by 19.88 percent.

We now discuss the results of the *Leaders Merge* simulation, which is the anti-competitive counterpart of the *Leaders Split* model. Since competition among firms is now lower, farm-gate prices decline and, therefore, the producers average utility declines, too. The switchers are, in this scenario, farmers that were producing the export crop and retrench into subsistence agriculture as prices decline. The utility of the switchers decline significantly. Note, however, that non-producers' utility remains unchanged because these farmers did not participate in the supply chain at the original prices and thus their decisions are unchanged by the lower price of the export crop.

Due to the co-existence of the competition and efficiency effects, profits can either increase or decrease. Since competition is actually less intense when the leaders merge, the competition effect tends to increase profits. However, the "elimination" of the second largest producer can entail relative efficiency gains or losses. If, for instance, the second firm is relatively efficient, then its elimination by the merger can decrease aggregate efficiency (when a lot of its output is diverted to smaller firms). This pushes industry profits down. In contrast, if the second largest producer is relatively inefficient, then the resulting output reallocation may entail efficiency gains and higher industry profits. It is thus not surprising to observe that profits increase in case such as Burkina Faso-Cotton or Benin-Cotton, where the leader is significantly more efficient than its merged partner. In contrast, in cases such as Malawi-Tobacco, Rwanda-Coffee, or Cote d'Ivoire-Coffee, both mergers are relatively similar in efficiency and thus profits tend to decline.

We now turn to the *Leaders Merge and Small Entrant* simulation, which is in fact a combination of the two previous cases. There are, nevertheless, some interesting results to highlight. As we explained before, the leaders merge simulation eliminates the second largest firm from the market, and the small entrant simulation just duplicates the smaller and less efficient firm. Therefore, there are no efficiency gains because, in practice, in this exercise we are replacing the second-most efficient firm with a least efficient one. This means that the efficiency effect is negative. Additionally, the extent of competition is necessary lower because the anti-competitive effect of the merger more than compensates for the pro-competitive effect of a small entrant. It follows that the impact on prices, quantities and profits are negative. For instance, in the Zambian cotton case, prices fall by 6.22 percent and total average utility decline by 0.07 percent.

This simulation delivers interesting results when we look at profits. In three cases, average and total profits increase. This is because the incumbent firm that merges with the leader is actually similar (in terms of costs and market shares) as the third largest firm (which now becomes the second firm in terms of market shares). This implies a relatively small efficiency effect so that the impact of the decline in competition prevails. In the other eight cases, average and total profits decline. In these cases, the competition effect (which increases profits) is not large enough to compensate for the efficiency losses caused by the merge. In Zambian cotton case, both total and average profits fall by 7.71 percent. Instead, in Benin-Cotton, both increase by 2.79 percent.

In the next simulation, the *Exit of Largest* firm, we study the effects that would take place if the leader leaves the market. Thus, the most efficient firm, with the smallest marginal cost, disappears and the market is covered by the remaining (more inefficient) firms. Farm-gate prices and quantities fall because the total demand of farm output shrinks—in the Zambian cotton case, they fall by 11.84 and 7.58 percent, respectively.

Surprisingly, there is heterogeneity in the response of profits. In principle, profits should decline because the most efficient firm leaves de market. In fact, this is the case in five case studies. For example, in Zambia-cotton, total profits decline by 22.37 percent and average profits, by 2.96 percent. However, in two cases total profits fall but average profits increase, probably because the effect of lower competition is enough to compensate for the efficiency losses caused by the exit of the largest company, though not large enough to cause average profits to fall. For example, in Zambia- Tobacco, total profits fall by 21.7 percent but average profits increase by 5.10 percent. Finally, in the case of Rwanda-Coffee for instance, we find increases in average and total profits (by 2.17 and 27.72 percent, respectively). In this particular case, the anti-competitive effect is very strong and thus it compensates for the efficiency losses.

We now turn to study more extreme pro-competitive simulations. The first scenario that we consider is one where the existing firms are all equally efficient (and as efficient as the leader). This is the *Equal Market Shares* simulation. In this model, competition is enhanced and efficiency improves, and both channels cause large increases in price and quantities. In turn, this has a positive effect in the average utility of all farmers, both producers and non-producers. For example, in the Zambia cotton case, prices increase by 27.21 percent. In the majority of the case studies, profits fall because the competition effect is stronger than the efficiency effect. In our leading-case, Zambia-Cotton, profits decline by 1.33 percent.

We end with a discussion of the *Perfect Competition* simulation, where we impose the marginal cost of the larger firms on all incumbents, as in *Equal Market Shares*, and we set farm-gate prices at the difference between the international prices and the marginal cost. Clearly, profits drop to zero, while prices and quantities significantly increase. As a result, utility increases significantly as well. While this scenario can only be hypothetically realized, it nevertheless provides an interesting baseline for comparison purposes.

2.4. Outgrower Contracts: Theory

In this section, we extend our standard model to include outgrower contracts. To allow for the possibility of a liquidity constraint affecting the home-market decision, we re-write the farmer's problem as follows

$$V(e_i;p,R) = \max_{\mathbf{h,m}} h^{\alpha}\ (m+c)^{1-\alpha}$$

$$s.t. \quad m + ph \le (p - \lambda r)e_i$$

$$h \ge \mathbf{0}$$

$$m \ge \mathbf{0}$$

As we explained above, the liquidity constraint is parameterized by λ. For our purposes, the distinctive feature of the model is that the farmer pays an interest rate r on any loan taken from the firms. This interest rate r depends on the structure of the market.

The model behaves as before, except that we now add a function that determines the interest rate

$r = r(r^*, sh_1, \ldots, sh_n, J)$

The interest rate depends on the exogenous cost of funds for the firms r^*, the number of firms n, the share of each firm sh_j and a parameter J (the "legal" system) that captures how good "institutions" are. For instance, a country with a given market structure (say, three firms) may have a well-functioning outgrower scheme because of good rules of law, while another country with the same market structure may suffer from a collapse of outgrower schemes because of bad institutions. Given these assumptions, we can write

$$r = r^* + \varphi(sh_1, \ldots, sh_n, J)$$

Ideally, the form of the function $\varphi(.)$ should be determined as part of the equilibrium game. However, this entails a much more complicated dynamic game-theoretic oligopsonistic game. Since developing such a model is outside the scope of our analysis, we will work with functional form assumptions. While this is a shortcoming, we believe we can still illustrate the main economic phenomena that we want to explore.

To operationalize the model, we proceed as follows. First, to capture the notion that the equilibrium interest rate depends on both the number of firms and the structure of competition, we assume that $\varphi(sh_1, \ldots, sh_n, J)$ is a function of the Herfindahl Index $H = \sum_{j=1}^{n} (sh_j)^2$. H ranges from $\frac{1}{n}$ to 1, where n is the number of firms---if there are n firms and they are symmetric, then each has a share equal to $\frac{1}{n}$ and thus $H = \frac{1}{n}$.

Also, we want $\varphi(.)$ to depend on the institutional framework. If the market does not have good "institutions", it could be hard for firms to collect loans. This will be more difficult as *n* increases. So, we need φ to be close to zero when there is, say, a monopolist and/or when J is low. On the other extreme, φ can be very high when the market tends to perfect competition (if J is not good enough). Note that φ should also depend on N; in other words, even in the case of symmetry, it matters if there are two firms, three firms, and so on.

In the end, we assume that

$$r = r^{*} + (1 - H)\,\frac{2\,r^{*}}{\max(1 - H_0)}$$

where $\max(1 - H_0)$ is the higher value that $(1 - H)$ could have before the simulations are performed. That is,

$$r = r^{*} + (1 - H)\,\frac{2\,r^{*}}{\left(1 - \frac{1}{n_0}\right)}$$

Note that the role of the second parenthesis is a sort of normalization for the value that *r* can get. In our normalization, the maximum spread over r^{*} is just $2r^{*}$ (so that, in the worst scenario, the interest rate charged to the farmers will be thrice as high as the cost of capital to the firms).

A key issue to note is that, in the model with outgrower contract, the supply of the farmer depends on r . This makes sense: if the interest rate that the farmer pays while producing for the market goes up, then the choice of market production may be affected. This fact requires that we modify the model.

Given $r = r^{*} + \varphi$ and given λ , the fraction of the investment that is financed with a loan, the modified cut-off is

$$\hat{e}(p) \equiv \frac{\alpha\,(1 + \lambda r)}{1 - \alpha}\frac{c}{p}$$

and this gives a "new" supply function

$$S(p) = (1 - \alpha)\int_{\hat{e}}^{\bar{e}} e_i\, f(e)de - \hat{e}(p)(1 - F(\hat{e}(p)))$$

Note that, in the end, the formula is the same as before. The difference is that now $\hat{e}(p)$ depends on r and λ and, importantly, r depends among other things on the number of firms and on the market shares. In consequence, when we do the simulations and the number of firms *n* and the shares sh respond endogenously, this affects farm-gate prices and the interest rate and, in turn, both affect the supply of the farmers. This means that the model with outgrower contract cannot be solved in the same way as the standard model. Instead, we need solve simultaneously

$$H = \sum_{j=1}^{n} \left(\frac{q_j}{\sum_{j=1}^{n} q_j}\right)^2 \quad (1)$$

$$r = r^* + (1-H)\,\frac{2\,r^*}{\left(1-\frac{1}{n_0}\right)} \quad (2)$$

$$\hat{e}(p) = \frac{\alpha\,(1+\lambda r)}{1-\alpha}\frac{c}{p} \quad (3)$$

$$\sum_{j=1}^{n} q_j = (1-\alpha)\int_{\hat{e}}^{\bar{e}} e_i\, f(e)\,de - \hat{e}(p)(1-F(\hat{e}(p))) \quad (4)$$

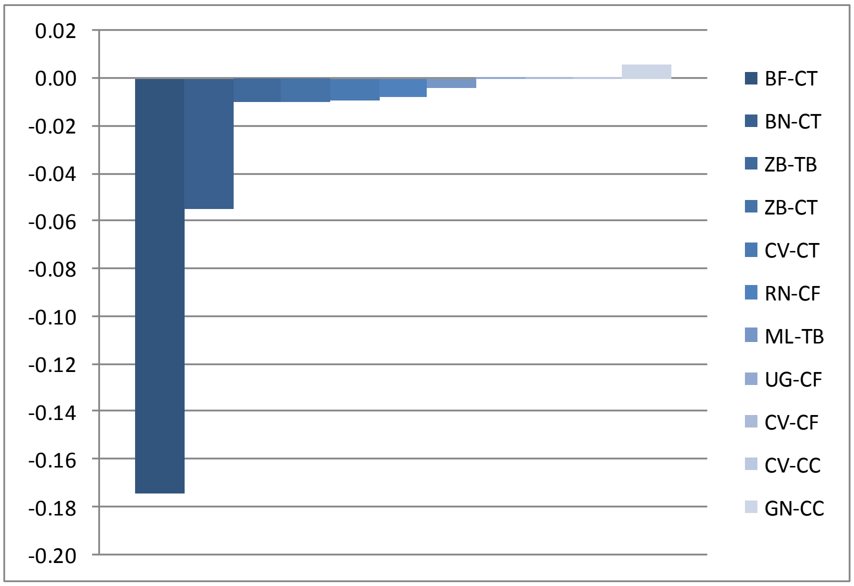
$$q_j = (1-\alpha)\left(P - p^s(Q) - c_j^p\right)\frac{\left(1-F\left(\hat{e}(p^s(Q))\right)\right)\hat{e}(p^s(Q))}{p^s(Q)}\ \forall j \in n \quad (5)$$

2.5. Simulation Results with Outgrower Contracts

The main purpose of the model with outgrower contracts is to assess the poverty impacts of the inter-relationship between the provision of services to the farmers (access to credit, seeds, and so on) and the level of competition. We are particularly interested in identifying situations where increases in competition can jeopardize the market by hindering the success of the outgrower contracts

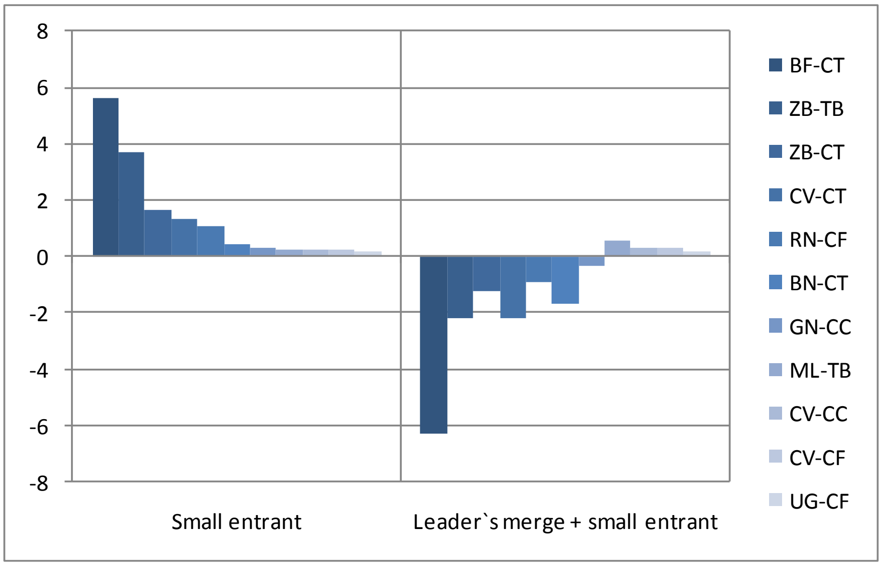
In Figure 2.3, we plot the differences in the proportional change in farm-gate prices between the standard model and the model with outgrower contracts for the *Leader Splits* simulation. Interestingly, we find that the differences in the price effects are tiny. Specifically, they are never larger than 0.2 percentage points. In most cases, the differences are negative, thus suggesting that the increase in farm-gate prices is slightly larger in the model with outgrower contracts. The reason is that when the leader splits, competition increases. While this pushes prices up, the interest rate increases too, and this reduces farm supply. In the end, the increase in prices is slightly higher than in the standard model. Note that there are cases were the *Leader Splits* simulation produces a more fragmented market and the interest rate falls, so the opposite result holds. For example, in the Burkina Faso-Cotton case, farm-gate prices increase by 0.17 percent more in the otugrower contract model. As it can be seen in Table 4.3, the changes in farm-gate prices are very similar in all the market structure simulations.

Figure 2.3. Changes in Farm-gate Prices: Standard Model and Outgrower Contract Model



In the outgrower contract model, the change in the interest rate is one of the main channels through which farmers are affected. To see the kind of impacts delivered by our model, we plot in Figure 2.4 the percentage change in the interest rate for the *Small Entrant* and *Leaders Merge and Small Entrant* simulations. Here, whereas the standard and the ourgrower contract models generate quite similar changes in farm-gate prices, there are sizeable changes in the interest rate. In the Zambian cotton case, the interest rate would increase by slightly less than 2 percent in the *Small Entrant* simulation and would decrease by over 1 percent in the *Leaders Merge and Small Entrant* case. For our purposes, an increase in the interest rate is akin to a decline in farm-gate prices (or, in other words, to a lower increase in prices). The poverty implications of these mechanisms are explored in the next section.

Figure 2.4. Changes in the Interest Rate



3. Supply Chain Simulations and Farm Income in Sub-Saharan Africa

In this section, we estimate the impact on household income, at the farm level, of changes in the supply chain. In the previous section, using our theoretical model, we identified the farm-gate price changes generated by shocks to the level of competition in the value chain for our 12 case studies. We simulated seven alternative market configurations for the baseline model. We also run the same set of simulations under the extended model with outgrower contracts.

We now want to use these prices changes to carry out a comprehensive analysis of the impacts of changes in value chains on poverty and welfare. Using standard methods to approximate welfare changes with first-order effects, we estimate the impact on average household income for both the total population as well as for the subset of export crop producers. Furthermore, the household data also allow us to differentiate the effect among poor and non-poor households. We also explore gender issues by looking at results for male- and female-headed households.

We focus, as in section 2, on the case of cotton in Zambia. We then summarize the main findings and discrepancies for the other eleven cases grouped by crop to facilitate the comparison.

3.1. Welfare simulations

As in the previous section, we explore the Zambian cotton case in detail and then we summarize the major findings from the remaining 11 case studies.

Table 5.1a
WELFARE SIMULATIONS - BASIC MODEL
Changes in Household income (in percentage). Only Producers.

		Leader Split	Small entrant	Leader`s merge + small entrant	Leaders merge	Exit of largest	Equal market shares	Perfect Competition
ZAMBIA - COTTON	*Total*	2,40	0,27	-1,68	-2,32	-3,19	7,33	19,30
	Poor	2,60	0,29	-1,82	-2,51	-3,46	7,95	20,92
	Non- Poor	2,29	0,26	-1,60	-2,21	-3,04	6,99	18,40
	Male- Headed	2,41	0,27	-1,68	-2,32	-3,20	7,36	19,37
	Female- Headed	2,35	0,26	-1,64	-2,26	-3,12	7,17	18,87
BENIN - COTTON	*Total*	3,33	0,09	-0,51	-0,67	-3,69	20,11	34,16
	Poor	3,25	0,09	-0,49	-0,65	-3,60	19,64	33,36
	Non- Poor	3,47	0,09	-0,53	-0,70	-3,85	20,99	35,66
	Male- Headed	2,15	0,06	-0,33	-0,43	-2,38	12,97	22,02
	Female- Headed	3,38	0,09	-0,51	-0,68	-3,75	20,42	34,68
BURKINA FASO - COTTON	*Total*	12,36	0,55	-0,68	-1,79	-15,36	20,91	49,61
	Poor	11,85	0,53	-0,66	-1,71	-14,74	20,05	47,59
	Non- Poor	12,67	0,57	-0,70	-1,83	-15,75	21,44	50,87
	Male- Headed	12,55	0,56	-0,69	-1,81	-15,60	21,23	50,39
	Female- Headed	3,95	0,18	-0,22	-0,57	-4,91	6,68	15,86
COTE D`IVORE - COTTON	*Total*	4,62	0,40	-2,84	-3,85	-5,99	13,99	35,11
	Poor	4,45	0,38	-2,73	-3,71	-5,76	13,47	33,79
	Non- Poor	4,69	0,40	-2,88	-3,91	-6,08	14,21	35,66
	Male- Headed	4,58	0,39	-2,81	-3,82	-5,94	13,87	34,80
	Female- Headed	6,04	0,52	-3,70	-5,03	-7,83	18,28	45,88

		Three firms	Four firms	Small entrant with half of the benefits
MALAWI - COTTON	*Total*	1,87	3,02	0,94
	Poor	1,49	2,40	0,75
	Non- Poor	2,12	3,43	1,06
	Male- Headed	1,89	3,05	0,95
	Female- Headed	1,68	2,72	0,84

Table 5.1b
WELFARE SIMULATIONS - BASIC MODEL
Changes in Household income (in percentage). Only Producers.

		Leader Split	Small entrant	Leader`s merge + small entrant	Leaders merge	Exit of largest	Equal market shares	Perfect Competition
COTE D`IVORE - COCOA	*Total*	1,13	0,21	-0,64	-0,91	-1,26	10,53	21,49
	Poor	1,13	0,21	-0,64	-0,92	-1,27	10,60	21,62
	Non- Poor	1,12	0,21	-0,63	-0,91	-1,25	10,46	21,33
	Male- Headed	1,14	0,22	-0,65	-0,92	-1,27	10,64	21,70
	Female- Headed	0,92	0,17	-0,52	-0,75	-1,03	8,60	17,55
GHANA - COCOA	*Total*	0,86	0,07	-0,26	-0,37	-1,01	7,33	11,90
	Poor	0,82	0,07	-0,25	-0,35	-0,96	7,01	11,37
	Non- Poor	0,91	0,07	-0,28	-0,39	-1,06	7,75	12,57
	Male- Headed	0,89	0,07	-0,27	-0,38	-1,04	7,56	12,26
	Female- Headed	0,77	0,06	-0,23	-0,33	-0,90	6,57	10,67
COTE D`IVORE - COFFEE	*Total*	0,58	0,11	-0,33	-0,47	-0,65	5,42	11,06
	Poor	0,67	0,13	-0,38	-0,54	-0,75	6,26	12,77
	Non- Poor	0,42	0,08	-0,24	-0,34	-0,48	3,97	8,10
	Male- Headed	0,59	0,11	-0,34	-0,48	-0,66	5,53	11,27
	Female- Headed	0,35	0,07	-0,20	-0,29	-0,40	3,31	6,75
RWANDA - COFFEE	*Total*	0,39	0,05	-0,38	-0,52	-0,54	0,77	2,82
	Poor	0,49	0,06	-0,47	-0,64	-0,67	0,96	3,51
	Non- Poor	0,34	0,04	-0,33	-0,45	-0,47	0,67	2,47
	Male- Headed	0,37	0,05	-0,35	-0,48	-0,50	0,72	2,64
	Female- Headed	0,47	0,06	-0,45	-0,61	-0,64	0,91	3,35
UGANDA - COFFEE	*Total*	0,09	0,01	-0,06	-0,08	-0,10	0,81	1,59
	Poor	0,09	0,01	-0,06	-0,08	-0,10	0,81	1,59
	Non- Poor	0,09	0,01	-0,06	-0,08	-0,10	0,81	1,59
	Male- Headed	0,09	0,01	-0,06	-0,08	-0,10	0,87	1,70
	Female- Headed	0,07	0,01	-0,05	-0,06	-0,08	0,64	1,25
MALAWI - TOBACCO	*Total*	1,45	0,04	-1,16	-1,36	-1,59	5,68	12,24
	Poor	1,13	0,03	-0,91	-1,06	-1,25	4,44	9,57
	Non- Poor	1,60	0,04	-1,28	-1,50	-1,76	6,26	13,50
	Male- Headed	1,47	0,04	-1,18	-1,38	-1,61	5,75	12,40
	Female- Headed	1,27	0,03	-1,02	-1,20	-1,40	5,00	10,78
ZAMBIA - TOBACCO	*Total*	3,25	0,74	-1,16	-2,48	-4,69	7,23	21,75
	Poor	2,52	0,58	-0,90	-1,92	-3,64	5,61	16,86
	Non- Poor	3,71	0,85	-1,32	-2,83	-5,36	8,26	24,84
	Male- Headed	3,37	0,77	-1,20	-2,56	-4,86	7,49	22,53
	Female- Headed	2,51	0,57	-0,90	-1,91	-3,63	5,59	16,82

Table 5.2a
WELFARE SIMULATIONS - OUTGROWER MODEL
Changes in Household income (in percentage). Only Producers.

		Leader Split	Small entrant	Leader`s merge + small entrant	Leaders merge	Exit of largest	Equal market shares	Perfect Competition
ZAMBIA - COTTON	*Total*	2,26	0,14	-1,57	-1,89	-3,22	6,46	18,41
	Poor	2,45	0,15	-1,71	-2,05	-3,49	7,01	19,96
	Non- Poor	2,15	0,13	-1,50	-1,80	-3,07	6,16	17,55
	Male- Headed	2,27	0,14	-1,58	-1,90	-3,23	6,49	18,48
	Female- Headed	2,21	0,14	-1,54	-1,85	-3,15	6,32	18,00
BENIN - COTTON	*Total*	3,80	0,04	-0,33	-0,41	-5,53	18,12	32,13
	Poor	3,71	0,04	-0,32	-0,40	-5,40	17,70	31,37
	Non- Poor	3,97	0,04	-0,34	-0,43	-5,77	18,92	33,53
	Male- Headed	2,45	0,03	-0,21	-0,26	-3,56	11,68	20,71
	Female- Headed	3,86	0,04	-0,33	-0,42	-5,61	18,40	32,61
BURKINA FASO - COTTON	*Total*	6,51	-0,38	0,35	1,26	-21,78	9,87	38,43
	Poor	6,25	-0,36	0,34	1,20	-20,89	9,47	36,86
	Non- Poor	6,68	-0,39	0,36	1,29	-22,33	10,12	39,41
	Male- Headed	6,61	-0,38	0,36	1,28	-22,12	10,03	39,03
	Female- Headed	2,08	-0,12	0,11	0,40	-6,96	3,16	12,29
COTE D`IVORE - COTTON	*Total*	4,34	0,19	-2,50	-2,96	-6,19	12,33	33,41
	Poor	4,17	0,18	-2,41	-2,85	-5,96	11,86	32,15
	Non- Poor	4,40	0,19	-2,54	-3,00	-6,28	12,52	33,93
	Male- Headed	4,30	0,19	-2,48	-2,93	-6,13	12,22	33,11
	Female- Headed	5,67	0,24	-3,27	-3,87	-8,09	16,11	43,66

		Three firms	Four firms	Small entrant with half of the benefits
MALAWI - COTTON	*Total*	0,86	1,50	0,15
	Poor	0,68	1,20	0,12
	Non- Poor	0,98	1,71	0,17
	Male- Headed	0,87	1,52	0,15
	Female- Headed	0,77	1,35	0,13

Table 5.2b
WELFARE SIMULATIONS - OUTGROWER MODEL
Changes in Household income (in percentage). Only Producers.

		Leader Split	Small entrant	Leader`s merge + small entrant	Leaders merge	Exit of largest	Equal market shares	Perfect Competition
COTE D`IVORE - COCOA	*Total*	1,16	0,17	-0,66	-0,88	-1,32	10,23	21,18
	Poor	1,17	0,17	-0,66	-0,89	-1,33	10,30	21,31
	Non- Poor	1,16	0,17	-0,65	-0,87	-1,31	10,16	21,03
	Male- Headed	1,18	0,17	-0,66	-0,89	-1,33	10,33	21,39
	Female- Headed	0,95	0,14	-0,54	-0,72	-1,08	8,36	17,30
GHANA - COCOA	*Total*	1,06	0,05	-0,24	-0,30	-1,31	6,93	11,49
	Poor	1,01	0,04	-0,23	-0,29	-1,25	6,62	10,98
	Non- Poor	1,12	0,05	-0,25	-0,32	-1,38	7,32	12,14
	Male- Headed	1,09	0,05	-0,24	-0,31	-1,35	7,14	11,84
	Female- Headed	0,95	0,04	-0,21	-0,27	-1,17	6,21	10,30
COTE D`IVORE - COFFEE	*Total*	0,60	0,09	-0,34	-0,45	-0,68	5,27	10,90
	Poor	0,69	0,10	-0,39	-0,52	-0,78	6,08	12,59
	Non- Poor	0,44	0,07	-0,25	-0,33	-0,50	3,86	7,98
	Male- Headed	0,61	0,09	-0,34	-0,46	-0,69	5,37	11,11
	Female- Headed	0,37	0,05	-0,21	-0,28	-0,41	3,21	6,65
RWANDA - COFFEE	*Total*	0,32	0,02	-0,35	-0,41	-0,44	0,66	2,70
	Poor	0,40	0,03	-0,44	-0,51	-0,55	0,82	3,37
	Non- Poor	0,28	0,02	-0,31	-0,36	-0,39	0,57	2,37
	Male- Headed	0,30	0,02	-0,33	-0,39	-0,41	0,61	2,53
	Female- Headed	0,38	0,02	-0,42	-0,49	-0,52	0,78	3,21
UGANDA - COFFEE	*Total*	0,09	0,01	-0,06	-0,07	-0,10	0,77	1,54
	Poor	0,09	0,01	-0,06	-0,07	-0,10	0,77	1,54
	Non- Poor	0,09	0,01	-0,06	-0,07	-0,10	0,77	1,54
	Male- Headed	0,09	0,01	-0,06	-0,08	-0,11	0,82	1,65
	Female- Headed	0,07	0,01	-0,05	-0,06	-0,08	0,60	1,21
MALAWI - TOBACCO	*Total*	0,80	0,02	-1,20	-1,30	-1,67	4,87	11,56
	Poor	0,63	0,01	-0,94	-1,01	-1,31	3,81	9,04
	Non- Poor	0,88	0,02	-1,33	-1,43	-1,84	5,37	12,74
	Male- Headed	0,81	0,02	-1,22	-1,31	-1,69	4,94	11,71
	Female- Headed	0,70	0,02	-1,06	-1,14	-1,47	4,29	10,18
ZAMBIA - TOBACCO	*Total*	2,93	0,37	-0,94	-1,53	-4,50	6,48	20,99
	Poor	2,27	0,29	-0,73	-1,19	-3,49	5,03	16,27
	Non- Poor	3,35	0,42	-1,07	-1,75	-5,14	7,40	23,97
	Male- Headed	3,04	0,38	-0,97	-1,58	-4,66	6,72	21,74
	Female- Headed	2,27	0,29	-0,73	-1,18	-3,48	5,01	16,23

3.1.1 Cotton in Zambia

Most of the cotton seeds in Zambia are devoted to the exports of cotton lint. Atomistic farmers produce cotton, which is purchased by the ginneries to produce cotton lint to be exported to world markets. While two ginneries control 72 percent of the market and therefore can exercise monopsonistic power over farmers, their share in the world market is insignificant and consequently take the international price as given.

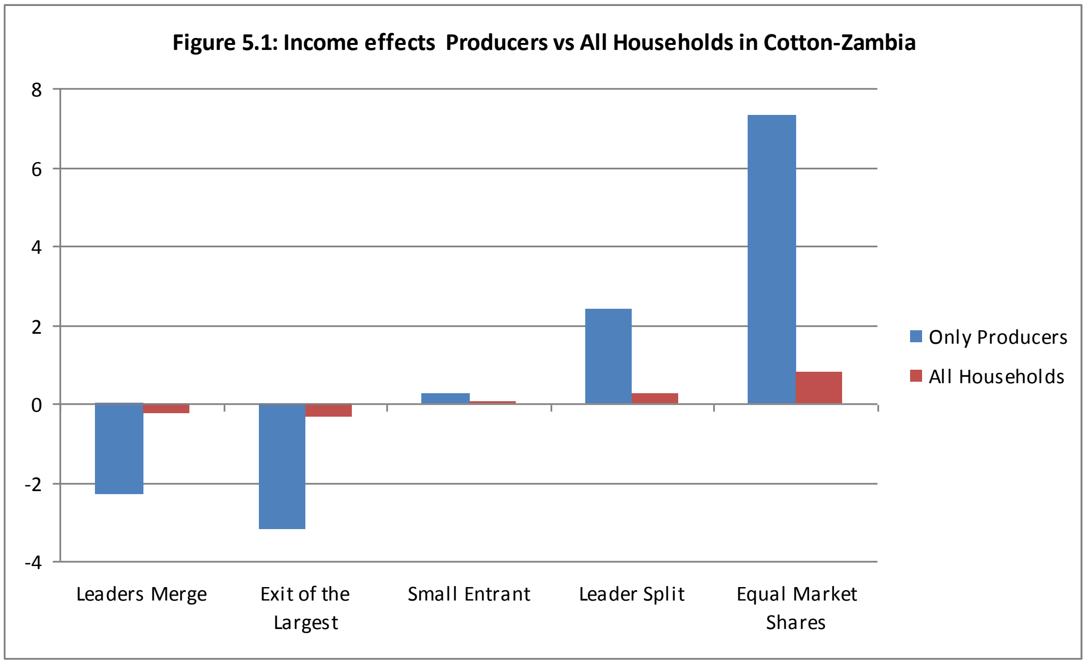
3.1.1.1 Baseline Model

The simulation exercise in the previous section showed that the change in farm-gate cotton prices ranged from -11.84 percent (in the case of exit of the largest firm) to 71.64 percent (in the case of perfect competition). The overall impact of these prices changes on average household income depends on the share of cotton on total household income. In section 2 we showed that most households in the survey do not produce cotton or when they do, in general they do not specialize in its production. For the average rural household in Zambia, cotton generates less than 3 percent of its total income. Among producers, the cotton share in income increases to 23 percent.

The main conclusion from the simulations is that in our baseline model competition among ginneries is good for the cotton farmers because they fetch a higher farm-gate price and therefore enjoy a higher level of income. For example, if Dunavant splits, the increase in income for the average producer would be equivalent to 2.4 percent of its initial income. On the other hand, if the two largest firms Dunavant and Cargill were to merge, the income of the average producer would decline by 2.3 percent. The largest possible gain for the farmers comes under perfect competition where farmers would enjoy an income gain of 19.3 percent. The upper bound increase in income under imperfect competition is 7.3 percent, and this takes place in the Equal Market Share simulation. Another evident conclusion from our basic model is that small changes in the level of competition among ginneries are not likely to generate important impacts on farmers' income. For instance a small firm entering the market would generate only an increase of one quarter of a percentage point in producers' income.

One concern often encountered in practice is to understand the implications of exit, in particular of the largest firm. The exit of Dunavant would imply a reduction in competition among the remaining firms what would impact negatively in the farm-gate price for cotton in Zambia. In addition, in our model, the largest firm is also the most efficient one (smallest marginal cost) so the exit would imply a reduction in the total demand for cotton further depressing the farm-gate price. In our basic simulation, this is the worst scenario for producers with an average income loss of 3.2 percent.

It should be noted that we are estimating only the first order effects of the price changes and, in consequence, only farmers that were initially producers are affected. The non-producers are in fact isolated from the changes in the supply chain, meaning both that they do not enjoy the benefits of increased competition, if any, or the losses from higher oligopsony power. In Table 5.1a, we only reported the income changes for households that produce some cotton but we did not include the changes for the whole population of rural households to save space. Figure 5.1 illustrates the difference in income impacts for the two groups for different shocks to the level of competition for our basic model. For instance in the case of equal market shares, producers would enjoy a gain of 7.3 percent while the gain for the whole rural population is only 0.8 percent.



Non-producers are not affected because we are not incorporating estimates of second order effects. The main reason to do this is that we do not have a model to estimate those effects that can be convincingly utilized with Sub-Saharan data. Estimates of second order effects require estimates of supply responses, which in turn require some evidence on farm supply elasticities. Even if these elasticities were available, the estimated second-order welfare impacts would nevertheless be small because, in the margin, the returns to different economic activities are equalized. This may not necessarily be the case in the presence of distortions or market imperfection that generate a wedge between the marginal return to factors allocated to export crops and to subsistence crops. The analysis in section 4 identified some of these effects by uncovering a discrete increase in utility for those farmers that switch activities and adopt export crops when prices increase. But, as we also showed in section 4, these welfare effects are very small, on average. This is mostly because initial farmer participation in the export supply chain is very limited and thus the majority of households are non-producers. In consequence, even if the switchers enjoy sizeable gains, there are only a few of them in any given simulation. In the end, these gains are averaged out across many non-participants, thus creating negligible welfare effects. In short, the addition of those supply responses is unlikely to affect our welfare and poverty analysis. This feature of the analysis is a general result, not a property of our data.

With the survey data, we can also distinguish differential effects for poor and non-poor rural households. Given a farm-gate price change, the results among the two groups will depend entirely on the initial income incidence of cotton across groups of households. Our micro-data show that, among Zambian cotton producers, cotton is relatively more important for poor than for non-poor households. For instance, an increase in competition represented by the split of the leader increases the income of poor producers by 2.6 percent, and of non-poor producers by 2.3 percent. Once again, we do not discuss the differential impact for the poor and the non-poor across different market and policy configurations because the result is proportional to the change in price and this change is the same for all households. This is a limitation of the model that is partially driven by the restriction imposed by the available data.

An important result to discuss is the presence of gender-specific impacts, that is differential impacts for male- and female-headed households. As before, since our theoretical model delivers a common price change that applies to all producers, the differences in the poverty impacts will be driven by the share of cotton in total income across households. For producers, the share of income among male- and female-headed households is similar and therefore the results of the simulations do not differ significantly across genders. In the case of equal market shares, the average income of a male-headed producer household increases by 7.36 percent while it increases by 7.17 percent in the case of the average female-headed producer household.

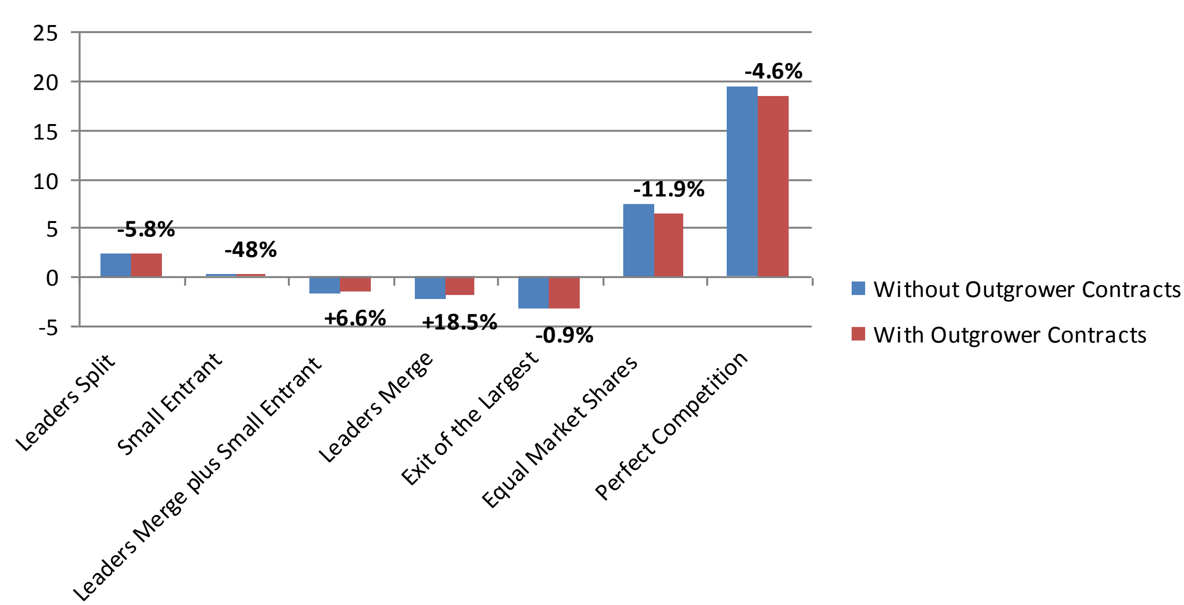
3.1.1.2 Outgrower Contracts

In the previous analysis we assumed that farmers have access to working capital and that the structure of the market does not affect the cost of those inputs. However, in the absence of enforcement mechanisms, processors may be reticent to advance the inputs needed for production, or, if they do, charge a premium to compensate for the possibility that the contracts are not honored. In our analysis, we have assumed that the borrowing cost for the farmers increases with the level of competition. This modification to the basic model does not introduce sizeable changes on equilibrium farm-gate prices but it does affect the production costs of the farmers and thus affects their net income.

Figure 5.2 illustrates the effects on producers' income of the introduction of outgrower contracts and liquidity constraints. We plot the change in average income for cotton producers due to changes in market configuration in the models with and without outgrower contracts. Despite the fact that the differences in levels seem to be minor, the percentage changes among the two models are economically important. All the simulations where market competition increases show lower gains for farmers in the model with outgrower contracts. These gains are reduced to 5.8 percent in the case of leader splits, 11.9 percent in the equal market shares, and almost to half in the small entrant simulation. On the other hand, in the simulations generating market concentration, the losses under outgrower contracts are smaller due to a reduction in the borrowing costs (for instance, 18.5 percent lower in the leaders merge simulation). The exit of the largest firm is an interesting case as it reduces market competition but increases nevertheless the borrowing costs for the farmers and their income falls further.

The presence of outgrower contracts affects the magnitude of the impacts, but it does not affect the sign. In principle, however, it could happen that an increase in competition breaks down the whole contractual agreement thus leading to a collapse of the market. The case of the cotton sector in Zambia in the early 2000s is an example of this type of effects and these implications should thus be taken into account when designing competition policies in the Sub-Saharan cash-crop sector.

Figure 5.2: Income Effect with and without Outgrower Contracts in Cotton-Zambia



3.1.2 Other case studies

3.1.2.1 Cotton

Besides our leading case of Zambia, we study the effects of competition among cotton processors on farm-gate prices and household income for other four Sub Saharan African countries. For Benin, Burkina Faso, and Cote d'Ivoire we run the same set of simulation we did for Zambia. In the case of Malawi, since there are only two ginneries controlling each 50 percent of the market, we decided to study the effects of splitting the market among three and later four firms, and we also allow for the entrance of a small firm. We apply both a model with and without outgrower contracts.

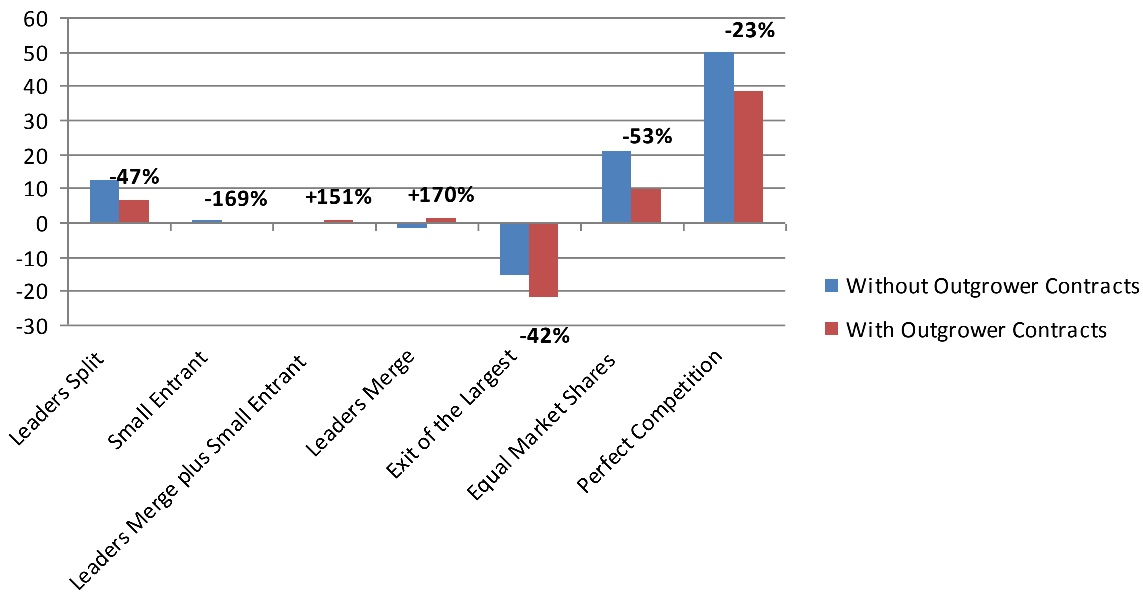
Qualitatively, we found the same result that we found in the Zambian case: competition is good for the farmers. The income effects, as expected, are much larger for those households producing the crop than for the typical rural household that may or may not produce cotton (five times larger in Benin and more than forty times in the case of Burkina Faso). For that reason, we discuss mainly the result of the income simulation for cotton producers. The income effect depends both on the magnitude of the price change and on the importance of cotton in the total income of the average producer-household. Take the case of an increase competition due to the split of leading firm. The income effects are, on average, 3.3 percent in Benin, 4.6 percent in Cote d'Ivoire, and 12.4 percent in Burkina Faso (all these impacts are larger than in the case of Zambia, which was slightly over 2 percent). In the Burkina Faso case, part of the result is due to the fact that the leader SOFITEX controls 85 percent of the market. In the other countries, the differences in the impacts on income are mainly driven by income shares as the farm-gate prices changes when the leader splits are of the same magnitude (around 9%) for the three countries. In the case of Malawi, moving from two to three firms in the market causes income gains of only 1.9 percent, while moving to four firms causes income gains of 3 percent.

The analysis of the impact on poor versus non-poor households shows a different pattern than in the case of Zambia. Non-poor households benefit more than poor households from an increase in competition in Benin, Burkina Faso, Cote d'Ivoire, and Malawi. The differences however are very small. For instance, in our baseline model under the equal market shares simulation, non-poor households in Burkina Faso will earn 21.4 percent more than under the actual market configuration, while poor households would see their income rise by 20.1 percent.

Turning now to gender issues, we find that male-headed households benefit relative more than female-headed households in Burkina Faso and Malawi, while the opposite happens in Benin and Cote d'Ivoire. The gender differences are not trivial. For example, in the case of perfect competition in Burkina Faso, male-headed households would enjoy income gains of 50.4 percent while female-headed households would enjoy gains of 15.9 percent. On the contrary, female-headed households in Benin would benefit from a 34.7 percent increase in income and male-headed households, from a 22 percent increase.

The last issue we want to discuss for the cotton sector is the analysis of the plausible negative effects of competition when we introduce the need of outgrower contracts that may not be perfectly enforceable. The cases of Benin, Cote d'Ivoire, and Malawi are similar to the Zambia case. In general, competition is still good in our calibrations but the benefits for farmers are slightly offset by increasing borrowing cost. On the other hand, the case of Burkina Faso merits a thorough discussion. Figure 5.3 displays the seven shocks to the level of competition in cotton processors in Burkina Faso for the basic model. Contrary to what we found in the other cotton case studies, the benefits of tighter competition are greatly offset by the increasing costs of funds in the model with outgrower contracts. While farm-gate prices and quantities changes are about the same in the model with and without outgrower contracts, the interest rate greatly increases in the model with outgrower contracts. For example, a leader splits situation would generate an increase in the interest rate of 39.3 percent in Burkina Faso but only 1.8 percent in the case of Zambia. That would reduce gains for producing households in Burkina Faso from 12.4 percent to 6.5 percent in the baseline case with outgrower contracts.

Figure 5.3: Income Effect in Basic Model with and without Outgrower Contracts in Cotton-Burkina Faso



3.1.2.2 Cocoa

We now study the effects of competition in farm gate prices and rural household income in the two largest cocoa producers, Cote d'Ivoire and Ghana. The general results is that, as before, an increase in competition among exporting companies raises prices and benefits producers and a decrease in competition reduces farm-gate prices and hurts farmers. The effects are however small in comparison with other case studies. For example, in the case of the exit of the largest firm, the average Ivorian cocoa producer loses 1.3 percent of its income and the Ghanaian counterpart loses around 1 percent. This result is both a combination of small induced changes in prices due to a relatively low market power concentration and a moderate share of cocoa in income due to producers' diversification.

A scenario of increasing competition due to all firms having the same market shares would lead to an increase in farm gate prices of 18.2 in Cote d'Ivoire and 29.3 percent in Ghana (see section 4). Despite the significant price differential in favor of Ghanaian producers, the overall impact on income is larger in Cote d'Ivoire because the average cocoa income share is around twice as large as in Ghana.

The income impact of more or less competition among exporters on poor and non-poor cocoa producing households is about the same in both countries. In the simulation of perfect competition in our baseline model, poor Ivorian households earn 21.6 percent while non-poor households earn 21.3 percent more. On the other hand, in Ghana, non-poor households benefit more than the poor, although the income gain is only marginally higher. In both countries, male-headed households benefit on average more than female-headed households from increases in competition. The gender difference is slightly bigger in Cote d'Ivoire.

The introduction of outgrower contracts does not generate sizeable income effects in cocoa. In both countries, the effects are modest, even in the extreme cases of equal market shares and perfect competition.

3.1.2.3 Coffee

Increasing competition benefits coffee smallholder producers in Cote d'Ivoire, Rwanda, and Uganda. However, the effects are modest for the three countries, with a larger effect in Cote d'Ivoire and Rwanda than in Uganda. The farmers' income effects are also modest in the case of a reduction in competition, with the most negative effect taking place in Rwanda where the average producing household loses slightly more than half of a percentage point of their income when the two leading firms merge.

In Cote d'Ivoire and Rwanda, poor households benefit on average more than non-poor households. These differences are sizeable. In contrast, the effects for poor and non-poor households are similar in Uganda. Male-headed households benefit on average more in Cote d'Ivoire and Uganda, while female-headed household do so in Rwanda. Once again, the differences are sizeable.

The effects of outgrower contracts are similar to what was discussed above for the cotton and cocoa cases.

3.1.2.4 Tobacco

The tobacco sectors in Malawi and Zambia are our last two case studies. As before, we find positive effects of competition among exporters. We illustrate this with two of our several simulations. In the case of the "exit of the largest" the negative impact of lower competition is worst felt by farmers in Zambia where the average tobacco producer loses 4.7 percent of its income. This is almost three times as high as the effect in Malawi and it is mostly due to the price effect. The largest firm in tobacco in Zambia controls almost half of the market while in Malawi the leading firm controls one third of it. On the other hand, the increase in competition generates sizeable increases in income in both countries. Under the "equal market shares" scenario, producing households in Malawi earn on average 5.7 percent more income while in Zambia the increase is of 7.2 percent.

Non-poor households benefit more than poor households from increases in competition among domestic tobacco buyers. In the scenario of perfect competition, for example, non-poor farmers would gain 41 and 47 percent more than poor producers, in Malawi and Zambia respectively. The income effect is larger in both countries for male-headed household. The gender difference is larger in Zambia where the income gain of male-headed households is 34 percent higher than the income gain of female-headed households.

In both tobacco case studies, the introduction of outgrower contracts reduces the farmers' income gains from further competition among exporters. For instance in the "leader split" simulation in Malawi, the improvement in tobacco households' income is 44.8 percent lower in the model with outgrower contracts.

4. Conclusions

The main conclusion of the analysis is that competition among processors is good for farmers as it increases the farm gate price of the crop. Scenarios were the leading firm in the market splits or all the firms have equal market shares often generate sizeable income gains for producing household. On the other hand, small changes to the level of competition are unlikely to have significant effects on farmers' livelihood. We were also interested in assessing the effects on farmers' income of a reduction in competition among upstream firms. This was done by studying the effects of the merging of the largest two firms in the market and through the case of the exit of the largest (and most efficient) firm. The effect is the opposite than under more competition, with small holders receiving a lower income due to the increase in market power of processing firms. The survey data allowed us to distinguish the effect of the different simulations on poor versus non poor households and across genders groups. Here the results depend on the income share of the crop in each country for each group as the price simulations are unique. In nine out of the twelve simulations, the benefits of more competition have a larger income effect in male-headed households than in the female counterpart. The three exceptions were the cases of cotton in Benin and Cote d'Ivoire and coffee in Rwanda. Only in four out of the twelve case studies, the increase in competition has been pro poor. The income gains on average benefited more poor households in the case of coffee and cocoa in Cote d'Ivoire, coffee in Rwanda, and cotton in Zambia. We present also the results for a model that incorporates outgrower contracts. Small farmers can receive financing from processors in exchange of future output sales through outgrower schemes. We assume that the cost of enforcing these contracts increases with market competition and that those costs are transferred to producers through increasing borrowing costs. We therefore, run the same set of simulations taking this feature into consideration and compare it with our original set of simulations. What we find is that with outgrower contracts, the benefits of increasing competition and the negative effects of a more concentrated market are both reduced. The effect is, however, rather small except for the case of cotton in Burkina Faso.

The model we developed is rich enough to incorporate other market features easily. We can study the effects of complementary policies affecting farmers, firms, or both. It is also possible to simulate the effects of exogenous changes in the international price of the crop on farm income. We have done these simulations and the results are presented in our forthcoming book (Depetris-Chauvin and Porto, 2011).

Nevertheless, we recognize that our model so far has several limitations. The first one is that we have a stylized version of a value chain with two main actors in the model: firms and farmers, where the farmers act as price takers. While this is a good enough simplification as most of the crops are exported with little processing and there is not often collusion between smallholders, in some cases other intermediaries, farmers cooperatives, and specially the government play an important role in determining the farm gate price. A second limitation in our analysis is that we are not incorporating estimates of second order effects. As we already mentioned in section 5, the main reason for this is that we do not have a model to estimate those effects that can be convincingly utilized with Sub-Saharan data. Estimates of second order effects require estimates of supply responses, which in turn require some evidence on farm supply elasticities that are not always available or they are unreliable. A third limitation of the analysis is that the price simulations in section 4 are used across all type of households. A richer model could incorporate policies or market changes that affect poor or female-headed households in a different way than non poor and male-headed households but it is not the case in our simulations.

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