Market Competition in Export Cash Crops and Farm Income in Africa

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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. In Sub-Saharan Africa, rural poverty is a widespread phenomenon. While most farmers produce for home consumption, some are engaged in high-value export agriculture. Here, we focus on export crops such as coffee, cotton, cocoa, and tobacco. For many African countries, these crops, which are typically produced by smallholders, are a major source of export revenue. In consequence, changes in export prices and in the conditions faced in export markets (both internally and externally) can play a big role in shaping poverty in the region. Traditionally, the literature has focused on how external conditions affect poverty, for example by addressing whether agricultural subsidies in the developed world affect world prices and how this in turn affects farm-gate prices. Our objective in this paper is to explore domestic factors. In particular, we investigate the role played by the structure of competition in export agriculture supply chains.

In Africa, 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 (the distribution of market shares). 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 (e.g., merger or antitrust policies) 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. We study the impacts of the entrance of a small competitor, of a hypothetical merger between the two leading firms, and of the split of the leader into smaller competitors (the "small entrant," "leaders merge," and "leader split" simulations). We also explore scenarios with tightest, albeit still imperfect, competition (the "equal market shares" simulations) as well as a hypothetical "perfect competition" scenario. In all these cases, given the initial equilibrium, we find the new equilibrium of the model and study the changes in farm-gate prices.

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 (e.g., for poor vis-à-vis non-poor households) 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 discussing the results from the simulations and the poverty impacts, we study the case of Zambian cotton in detail. We then briefly explore differences and similarities with the remaining eleven case studies. The Zambian cotton sector is our leading case because it has undergone several of the transformations our simulations aim to capture (i.e., privatization, entry, and exit) and because several outgrowers schemes have been implemented. The main conclusion of our analysis for the case of cotton in Zambia is that competition among processors is good for farmers as it increases the farm gate price of the crop and therefore it improves their livelihood. This general conclusion also applies to the other case studies. However, the general finding that increases in competition among processors benefit farmers needs to be put into perspective. One import result from our simulations is that small changes in the level of competition are unlikely to have significant effects on farmers' livelihood.

The survey data allows us to distinguish the effect of the different simulations on poor versus non poor households and across genders groups. 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 are the case of cotton in Benin and Cote d'Ivoire and coffee in Rwanda. It is noteworthy that in only four out of the twelve case studies, the increase in competition is pro poor. This is because of the relatively lower participation of poor households in the production of the export crop. The income gains are larger for the poor, on average, in the cases of coffee and cocoa in Cote d'Ivoire, coffee in Rwanda, and cotton in Zambia.

When considering the model with outgrowers contracts, farms need to borrow to finance the production of export crops. In consequence, we find that, in all simulations, the gains from more competition and the losses from higher market concentration tend to be lower. We find that, in all case studies except for cotton in Burkina Faso, an increase in competition is beneficial and, in turn, a higher market concentration is prejudicial, for farmers. In general, the discrepancies with the results from models without outgrower contracts are rather small. Interestingly, the cotton sector in Burkina Faso is the only case where less competition is better for smallholders.

The rest of the paper is organized as follows. In the next section we introduce the twelve case studies and we document how and why we chose them. We describe the availability of household surveys across countries and we explore crops that provide an important source of cash income for the economy. In section 3, we briefly describe the main institutional arrangements that characterize the supply chains in the each of the twelve case studies. In section 4, 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 5, 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 6 concludes.

2. The Case Studies

In this section, we describe the twelve case studies that comprise our investigation on supply chains, agricultural exports, and poverty in Sub-Saharan Africa. The case studies were selected following two criteria. First, the export crop has the potential to eradicate poverty, and, second, the micro-data needed for the poverty analysis has to be available in the target country. In the end, we investigate 12 case studies covering four crops, namely cocoa, coffee, cotton, and tobacco, in 8 countries, namely Benin, Burkina Faso, Cote d'Ivoire, Ghana, Malawi, Rwanda, Uganda, and Zambia.

The objective of this section is to document our selection of the case studies. To this end, we begin by looking at export data to assess how important different export crops are for different countries. Given the nature of our analysis, we only focus on crops that are a major source of cash income for the economy (thus leaving aside food crops). We later explore the availability of household surveys in Sub-Saharan countries and, for those countries where these data is available, we check whether the selected export crops are grown by a significantly large number of households and whether those crops generate a significant share of total household income. Finally, we use the micro-data from these surveys to characterize those farmers that produce the export crops.

2.1. Exports

To get a sense of the overall importance of the export crops for the local economy, we begin with a description of the export structure of each target country. Table 2.1 provides the summary statistics. In general, all the selected crops are very important for the economy of at least one of the countries. Cocoa is a crucial foreign exchange generator both in Cote d'Ivoire and Ghana, where it raises between twenty and twenty-five percent of all export revenue. Coffee exports account for more than ten percent of the total exports in both Rwanda and Uganda. Cotton accounts for more than one third of total exports in Benin and Burkina Faso. Finally, Tobacco accounts for more than seventy percent of export earnings in Malawi. Despite the strategic importance of these crops for the economies under study, most of these agricultural exports involve little local processing.

Table 2.1. Agricultural Exports in Sub-Saharan Africa

Country-Crop	2004	2005	2006
1) Benin - Cotton			
Cotton Exports (1000 $)	208128	181448	113306
% of Agricultural Exports	0.75	0.69	0.33
% of Total Exports	0.39	0.31	N/A
Exports of goods and services as % GDP	0.13	0.13	N/A
2) Burkina Faso - Cotton			
Cotton Exports (1000 $)	270329	213614	235290
% of Agricultural Exports	0.81	0.78	0.81
% of Total Exports	0.49	0.39	0.35
Exports of goods and services as % GDP	0.11	0.10	0.12
3) Cote d'Ivoire - Cocoa, Coffee and Cotton			
Cocoa Exports (1000 $)	2124649	1988939	1946273
% of Agricultural Exports	0.68	0.66	0.62
% of Total Exports	0.28	0.24	0.21
Coffee Exports (1000 $)	130255	113436	166007
% of Agricultural Exports	0.04	0.04	0.05
% of Total Exports	0.02	0.01	0.02
Cotton Exports (1000 $)	163256	148336	121026
% of Agricultural Exports	0.05	0.05	0.04
% of Total Exports	0.02	0.02	0.01
Exports of goods and services as % GDP	0.49	0.51	0.53
4) Ghana - Cocoa			
Cocoa Exports (1000 $)	984034	914605	1224309
% of Agricultural Exports	0.77	0.79	0.79
% of Total Exports	0.28	0.26	0.27
Exports of goods and services as % GDP	0.39	0.32	0.36
5) Malawi - Tobacco and Cotton			
Cotton Exports (1000 $)	16443	12302	32648
% of Agricultural Exports	0.04	0.03	0.06
% of Total Exports	0.03	0.02	0.05
Tobacco Exports (1000 $)	257974	320715	431787
% of Agricultural Exports	0.64	0.71	0.73
% of Total Exports	0.39	0.57	0.73
Exports of goods and services as % GDP	0.25	0.20	0.19
6) Rwanda - Coffee			
Coffee Exports (1000 $)	28458	36966	48008
% of Agricultural Exports	0.88	0.57	0.60
% of Total Exports	0.14	0.15	0.17
Exports of goods and services as % GDP	0.10	0.10	0.10
7) Uganda - Coffee			
Coffee Exports (1000 $)	124236	172942	189841
% of Agricultural Exports	0.35	0.42	0.42
% of Total Exports	0.12	0.13	0.12
Exports of goods and services as % GDP	0.14	0.14	0.15
8) Zambia - Cotton and Tobacco			
Cotton Exports (1000 $)	126075	62542	66992
% of Agricultural Exports	0.35	0.19	0.21
% of Total Exports	0.06	0.03	0.02
Tobacco Exports (1000 $)	60383	63473	75205
% of Agricultural Exports	0.17	0.20	0.23
% of Total Exports	0.03	0.03	0.02
Exports of goods and services as % GDP	0.38	0.34	0.38

Source: FAO and WDI

2.2. The Household Surveys

In order to perform the poverty analysis, we need household survey data with detailed information on crop production and income. The available household surveys for the eight target countries in Sub-Saharan Africa are listed in Table 2.2. In the case of Benin, we use the “Questionnaires des indicateurs de base du bien-être” conducted in 2003. The survey covered 5,350 households out of a population of 1.4 million households. Rural households accounted for 61.5% of total respondents. In Burkina Faso, we use the “Enquête Burkinabe sur les conditions de vie des ménages”, also from 2003, which surveyed 8,500 household (0.48% of the total population) of which 69.4% were located in rural areas. In Cote d’Ivoire, we utilize the “Enquête niveau de vie ménages” studying 10,801 of the existing 3.2 million households in the country. Household classified as rural were 47.9% of the total. In Ghana, we use the “Ghana living standards survey” of 1998. This survey reviewed the standard of living of 5,998 Ghanaian households, 63.3% of them residing in rural areas. Information about Malawian households is taken from the “Integrated household survey” of 2004. This survey covers 11,280 household (coverage rate of 0.42%), 87.2% in rural areas. In Rwanda, the most recent available survey is the “Enquête intégrale sur les conditions de vie des ménages” from 1998. This survey covers 6,420 households amounting to 0.4% of the household population. Households in rural areas are 82.1% of the total households interviewed. The “Uganda national household survey” of 2005 interviewed 7,425 households from a population of 5.2 million households. The share of rural households is 77.12%. Finally, in the case of Zambia, we use the “Living conditions monitoring survey III” from 2003. This survey covers 4,837 households (a coverage rate of 0.23%) of which 47.9% were located in rural areas.

Table 2.2: List of Sub Saharan Africa household surveys

Country	Year	Survey	Households	Rural share	Sample share	HHs (Mill)
Benin	2003	QUESTIONNAIRE DES INDICATEURS DE BASE DU BIEN-ÊTRE	5.350	61.5%	0.39%	1.4
Burkina Faso	2003	ENQUÊTE BURKINABE SUR LES CONDITIONS DE VIE DES MÉNAGES	8.500	69.4%	0.48%	1.8
Cote d'Ivoire	2002	ENQUÊTE NIVEAU DE VIE MÉNAGES	10.801	47.9%	0.34%	3.2
Ghana	1998	GHANA LIVING STANDARDS SURVEY	5.998	63.3%	0.14%	4.4
Malawi	2004	INTEGRATED HOUSEHOLD SURVEY	11.280	87.2%	0.42%	2.7
Rwanda	1998	ENQUÊTE INTÉGRALE SUR LES CONDITIONS DE VIE DES MÉNAGES	6.420	82.1%	0.40%	1.6
Uganda	2005	UGANDA NATIONAL HOUSEHOLD SURVEY	7.425	77.1%	0.14%	5.2
Zambia	2003	LIVING CONDITIONS MONITORING SURVEY III	4.837	47.9%	0.23%	2.1

Source: Own Elaboration

2.3. The Distribution of Income and Export Crop Income

We use the household survey data to perform the analysis of households' income shares. Results are reported in Tables 2.3 to 2.10. We present the descriptive statistics for the total population of households (panel A) and separately for male-headed (panel B) and female-headed households (panel C). The bottom panels present the summary statistics for the subsample that includes only those households that produce at least one of the crops under study. The first column in each table reports statistics from the national sample, the second column, from the urban sample, and the third, from the rural sample. Since our focus is mainly on rural households, we also report statistics across quintiles of per capita expenditure for rural households. In each Table, the first row reports the average per capita expenditures and the following rows the average income shares (in percentage). We identify the share of income derived from agriculture and within this category we also report the share derived from the export crop under study. For completeness, we report the share of income derived from home-production activities as well as from other sources (wages, nonfarm businesses, and transfers).

Data for Benin is in Table 2.3. The share of agricultural income in total income for rural households is 34% for the whole sample and 56.3% for those households that produce cotton, the main export crop of the country. Cotton generates 6.6% of total income for the average rural household, and 33.8% for the average rural cotton producer. This crop is particularly important for the poorest farmers since it generates 10.4% and 7.1% of total income for households in the first and second quintiles of the income distribution, respectively. Among producers, cotton generates about one third of the total income in each of the quintiles. Panels B and C highlight some of the differences in income shares between male- and female-headed households. Cotton is mostly an important source of income for female-headed households, accounting for 7.6% of their total income---in contrast to 1.1% in male-headed households---for the total rural population. Conditional of being a cotton producer, cotton income accounts for 33.3% and 21.8% of total income in female- and male-headed households, respectively.

Table 2.4 presents income shares for the case of Burkina Faso. In our data, agricultural sales play a minor role, relative, for example, to income from home production. However, if we consider only the sub-sample of producers, agricultural income amounts to 70.5% of the total rural household income. The most important crop is cotton, which generates 1.31% of the income of the average rural household and 56.4% of the income of the average cotton producer. Among producers, cotton is a more important source of income for male-headed household (56.4%) than for female-headed households (17.7%). For male-headed households, cotton generates a similar share of income across quintiles. Instead, female-headed households in the second quintile earn a significantly higher share of income from cotton than the rest of the quintiles (31% of their total income).

The case of Cote d'Ivoire is presented in Table 2.5. Around 52% of the total income of rural households comes from agriculture; for export crop producers (any of the three major crops in Cote d'Ivoire), agriculture accounts for 77% of total income. The relevant export crops are cocoa (with an income share of 17.1%), coffee (6.8%), and cotton (4.2%). Conditional on being an export crop producer, the income shares are 38.5%, 15.3%, 9.5%, for cocoa, coffee, and cotton, respectively. The share of cocoa is similar across the first four quintiles, but declines for the richest rural households. Coffee is particularly important for households in the first and second quintiles. In contrast, the importance of cotton as an income generator increases with household income: while the first quintile only derives 0.8% of their income from cotton, households in the last quintile earn 8.6% of their income from cotton. On average, rural male-headed households depend more heavily on agricultural income (64.6%). Rural female-headed households only get 36.8% of their income from agricultural, cocoa being the only significant contributor (with 4.1% of the household income). Conditional on being a producer, agricultural income is important for both genders (78.1% for male- and 63.2% for female-headed households).

Rural households in Ghana (Table 2.6) receive 29% of their income from agricultural activities (45.9% if they are cocoa producer). Agricultural income is particularly important for the first two quintiles, where households get one third of their income from agriculture; these shares decline sharply for households in the last quintile, who get only 23% of their income from this activity. Conditional on being a cocoa producer, the average rural household gets a similar share of income from agriculture regardless of the quintile. For the average rural household, cocoa contributes with 4.8% of the total income in male-headed households and with 2.8% of the income in female-headed households (24.1% and 22.2% respectively for the sub-sample of producers). For both genders, households in the third quintile are the ones that more heavily depend on cocoa with 6.3% (male-headed) and 4.2% (female-headed).

Malawi (Table 2.7) is one of the countries in our study with the lowest income share coming from agricultural sales, at only 11.6% for the average rural household (34.3% for producers). This share is even smaller for female-headed households at 7% (29.4% for producers). Most of the income of rural households comes from home production activities. This source of income declines with the level of consumption of the household and the share of agricultural income increases up to 15.4% for the average rural household in the last quintile (42.3% for producers). Tobacco (with a share of 3.8%), and cotton (with a share of 0.5%), (21.8% and 2.7% respectively for producers), are the most important crops.

Rwandese rural households get on average 18.8% of their income from the commercialization of agriculture products (Table 2.8). This share increases to 28.3 for the households producing the export crops in our study. The share of male-headed households is slightly higher, at 20.1%. As in the case of Malawi, the share of agriculture income increases with the level of household consumption. Those in the last quintile get 25.8% of their income from agriculture. Among producers, the agriculture share does not drastically change across quintiles. Coffee is the main cash crop, contributing slightly less than one percent to total household income. Among producers, instead, coffee---with an average share of 8%---is an important source of household income, in particular for the household of the first quintile (with a share of 11.57%).

The case of Uganda (Table 2.9) is very similar to the Rwandese case. On average, a rural household generates 15.1% of its income from agricultural products but this average is very different across quintiles. The share of agricultural income for rural households in the first quintile is only 5%, while for those in the fifth quintile is 25.7%. Among producers, we observe a similar pattern but the shares are higher. Male-headed households rely more on agricultural income than female-headed households. Coffee is also here the main cash crop, contributing with 2.4% of the rural household income (8.2% if they are producers).

The last country in our analysis is Zambia (Table 2.10). Around one fifth of the rural household income comes from the commercialization of agricultural products (36.4% among producers). This percentage is similar across quintiles with slightly higher shares for the poorest households in the total sample, but slightly higher shares for the richest households among producers. Cotton and tobacco are the main sources of agricultural income. Cotton contributes, on average, with 3.2% (23.3% among producers) of the total income in male-headed rural households and with 2.1% (23% for producers) in the case of female-headed households. The contribution of tobacco is 0.8% and 0.4% for male- and female-headed rural households (5.9% and 4.6% respectively for the sub sample of producers).

Table 2.3: Per Capita Expenditure and Income Sources in Benin

Sample	National Total	Urban Total	Rural Total	q1	q2	q3	q4	q5
A) National								
p/c expenditure	14557	21080	10193	2054	4719	7325	11117	26082
Share Agriculture	25.84	13.32	34.04	38.92	37.70	35.53	32.91	24.78
Cotton	5.35	3.47	6.59	10.39	7.05	6.71	4.58	3.98
Share Home-prod.	26.79	22.64	29.50	44.32	31.60	27.08	22.58	21.13
Share Other	47.37	64.04	36.46	16.76	30.7	37.39	44.51	54.09
B) Male headed								
p/c expenditure	16850	21837	12664	2278	4746	7322	11161	26217
Share Agriculture	11.50	4.42	17.36	27.18	21.87	18.46	18.34	9.21
Cotton	0.90	0.61	1.14	4.07	1.27	0.38	1.32	0.26
Share Home-prod.	18.99	14.37	22.81	37.81	28.39	26.14	15.45	16.73
Share Other	69.51	81.21	59.83	35.01	49.74	55.4	66.21	74.06
C) Female headed								
p/c expenditure	14099	20903	9753	2033	4715	7325	11108	26043
Share Agriculture	28.71	15.41	37.01	40.00	40.24	38.40	35.85	29.32
Cotton	6.24	4.14	7.56	10.97	7.97	7.77	5.24	5.06
Share Home-prod.	28.35	24.59	30.70	44.92	32.11	27.24	24.02	22.41
Share Other	42.94	60	32.29	15.08	27.65	34.36	40.13	48.27
D) Producers								
p/c expenditure	8139	10251	7325	1890	4699	7298	11106	23407
Share Agriculture	56.3	55.55	56.53	51.79	54.74	57.4	64.28	64.85
Cotton	33.76	36.56	32.89	30.86	32.16	33.94	34.63	36.99
E) Producers (males)								
p/c expenditure	7925	11048	6138	1913	4887	7294	10330	20960
Share Agriculture	54.17	44.12	57.24	58.42	58.73	60.51	55.36	34.47
Cotton	24.08	31.63	21.77	20.82	17.18	11.54	37.2	33.61
F) Producers (females)								
p/c expenditure	8150	10198	7377	1889	4690	7298	11151	23473
Share Agriculture	56.39	56.02	56.5	51.44	54.55	57.32	64.71	65.36
Cotton	34.15	36.76	33.35	31.38	32.89	34.49	34.51	37.04

Source: Own elaboration based on household surveys. See Table 2.2.

Table 2.4: Per Capita Expenditure and Income Sources in Burkina Faso

Sample	National Total	Urban Total	Rural Total	q1	q2	q3	q4	q5
A) National								
p/c expenditure	12163	26187	8480	1243	2641	4399	7429	25756
Share Agriculture	4.15	1.48	4.73	2.85	2.98	3.86	5.88	7.91
Cotton	1.10	0.13	1.31	1.08	0.93	1.04	1.29	2.21
Share Home-prod.	48.59	16.21	55.60	66.67	59.57	55.97	50.36	46.08
Share Other	47.26	82.31	39.67	30.48	37.45	40.17	43.76	46.01
B) Male headed								
p/c expenditure	11769	25593	8470	1250	2647	4394	7441	25359
Share Agriculture	4.40	1.63	4.93	3.00	3.11	4.00	6.13	8.17
Cotton	1.19	0.15	1.39	1.17	0.97	1.1	1.37	2.32
Share Home-prod.	50.17	17.78	56.42	67.54	60.46	57.04	51.00	47.06
Share Other	45.43	80.59	38.65	29.46	36.43	38.96	42.87	44.77
C) Female headed								
p/c expenditure	16612	29579	8629	1157	2557	4468	7223	33017
Share Agriculture	1.34	0.72	1.69	0.95	1.19	1.90	1.83	2.95
Cotton	0.1	0	0.15	0	0.41	0.13	0	0.22
Share Home-prod.	30.68	8.21	43.31	55.79	47.38	40.85	39.88	27.64
Share Other	67.98	91.07	55.00	43.26	51.43	57.25	58.29	69.41
D) Producers								
p/c expenditure	26034	31136	18245	1451	2693	4511	7624	38753
Share Agriculture	70.79	91.09	70.52	71.52	64.24	68.86	71.64	73.11
Cotton	55.92	87.41	55.51	58.79	52.68	49.77	56.2	57.93
E) Producers (males)								
p/c expenditure	25608	30860	17840	1460	2655	4532	7611	37698
Share Agriculture	71.72	91.09	71.46	71.52	65.26	70.65	71.64	74.46
Cotton	56.78	87.41	56.37	58.79	53.84	51.61	56.2	58.96
F) Producers (females)								
p/c expenditure	31483	34140	25245	1307	2987	3885	8098	56690
Share Agriculture	29.75	-	29.75	-	45.17	29.46	-	14.26
Cotton	17.74	-	17.74	-	31.03	9.15	-	13.07

Source: Own elaboration based on household surveys. See Table 2.2.

Table 2.5: Per Capita Expenditure and Income Sources in Cote d'Ivoire

Sample	National Total	Urban Total	Rural Total	q1	q2	q3	q4	q5
A) National								
p/c expenditure	29931	35756	23386	3625	8109	13583	23098	70970
Share Agriculture	41.36	29.47	51.99	59.53	57.59	50.11	48.70	41.50
Cotton	2.89	1.36	4.24	0.81	2.36	4.91	5.58	8.61
Coffee	5.39	3.75	6.81	11.91	9.00	4.95	4.16	2.81
Cocoa	14.60	11.69	17.12	17.53	17.67	18.87	18.41	12.48
Share Home-prod.	4.64	2.75	6.34	8.74	8.38	5.87	3.92	4.00
Share Other	54	67.78	41.67	31.73	34.03	44.02	47.38	54.5
B) Male headed								
p/c expenditure	30381	35967	24112	3641	8151	13536	23131	71727
Share Agriculture	45.30	33.13	56.11	64.63	61.35	55.29	52.74	44.29
Cotton	3.38	1.64	4.93	0.93	2.33	6.04	6.59	9.76
Coffee	6.33	4.40	7.98	14.41	10.55	5.94	4.79	2.89
Cocoa	17.02	13.79	19.82	20.38	20.41	22.54	21.74	13.54
Share Home-prod.	4.90	2.93	6.66	9.10	8.83	6.23	4.20	4.21
Share Other	49.8	63.94	37.23	26.27	29.82	38.48	43.06	51.5
C) Female headed								
p/c expenditure	27606	34611	19798	3551	7895	13788	22955	65675
Share Agriculture	22.43	11.74	32.11	36.75	38.61	28.08	31.04	22.45
Cotton	0.50	0.03	0.92	0.25	2.51	0.09	1.17	0.71
Coffee	0.87	0.59	1.14	0.72	1.16	0.73	1.39	2.23
Cocoa	2.95	1.56	4.12	4.81	3.82	3.28	3.85	5.27
Share Home-prod.	3.40	1.88	4.79	7.16	6.10	4.36	2.68	2.53
Share Other	74.17	86.38	63.1	56.09	55.29	67.56	66.28	75.02
D) Producers								
p/c expenditure	29892	35354	24330	3561	8154	13546	23001	73379
Share Agriculture	77.97	79.37	77.36	75.47	78.65	79.55	76.67	76.31
Cotton	8.23	5.61	9.54	1.74	5.16	11.25	12.27	21.24
Coffee	15.37	15.43	15.3	25.65	19.66	11.34	9.13	6.93
Cocoa	41.63	48.14	38.48	37.78	38.59	43.26	40.46	30.8
E) Producers (males)								
p/c expenditure	29215	34254	24154	3544	8164	13518	22947	73323
Share Agriculture	78.57	79.74	78.07	76.04	79.36	80.52	77.08	77.24
Cotton	8.33	5.74	9.65	1.72	4.48	11.73	12.4	22.27
Coffee	15.59	15.45	15.6	26.49	20.25	11.53	9	6.61
Cocoa	41.93	48.4	38.74	37.47	39.16	43.75	40.87	30.89
F) Producers (females)								
p/c expenditure	37138	45930	26468	3821	8023	13920	23522	74011
Share Agriculture	64.21	66.79	63.17	62.46	65.05	58.4	68.58	60.92
Cotton	5.95	0.86	7.42	2.37	18.17	0.88	9.84	3.97
Coffee	10.29	14.66	9.22	6.66	8.39	7.26	11.71	12.38
Cocoa	34.92	39.11	33.28	44.73	27.65	32.61	32.5	29.25

Source: Own elaboration based on household surveys. See Table 2.2.

Table 2.6: Per Capita Expenditure and Income Sources in Ghana

Sample	National Total	Urban Total	Rural Total	q1	q2	q3	q4	q5
A) National								
p/c expenditure	93515	136077	66940	14753	27426	41344	63763	170249
Share Agriculture	22.47	11.63	28.96	33.47	32.49	30.21	26.21	23.18
Cocoa	2.91	0.84	4.15	2.39	4.42	5.69	4.26	3.82
Share Home-prod.	24.62	8.73	34.15	47.10	40.13	35.21	29.31	21.03
Share Other	52.91	79.64	36.89	19.43	27.38	34.58	44.48	55.79
B) Male headed								
p/c expenditure	93405	141895	65394	14487	27220	41161	63436	170681
Share Agriculture	24.11	10.66	31.53	36.00	36.24	32.92	27.74	24.92
Cocoa	3.44	1.04	4.76	2.39	5.24	6.30	4.98	4.76
Share Home-prod.	25.36	8.48	34.67	47.94	38.03	36.05	29.05	22.85
Share Other	50.53	80.86	33.8	16.06	25.73	31.03	43.21	52.23
C) Female headed								
p/c expenditure	93740	125774	70396	15480	27895	41798	64376	169375
Share Agriculture	19.09	13.35	23.14	26.59	23.94	23.53	23.28	19.57
Cocoa	1.82	0.49	2.76	2.40	2.56	4.18	2.89	1.88
Share Home-prod.	23.12	9.18	32.96	44.82	44.89	33.11	29.82	17.26
Share Other	57.79	77.47	43.9	28.59	31.17	43.36	46.9	63.17
D) Producers								
p/c expenditure	83122	124121	71297	15829	27437	40859	63374	192875
Share Agriculture	46.22	49.34	45.89	42.55	48.14	44.81	44.21	49.27
Cocoa	23.99	27.13	23.65	18.62	22.03	25.49	22.89	27.98
E) Producers (males)								
p/c expenditure	83538	125681	72380	15730	27122	40769	62985	211379
Share Agriculture	47.51	48.4	47.42	42.25	50.46	45.94	46.25	50.94
Cocoa	24.38	27.31	24.07	17.04	21.95	25.05	25.27	29.96
F) Producers (females)								
p/c expenditure	81897	120512	67855	16212	28880	41222	64160	143971
Share Agriculture	41.56	52.78	40.39	43.74	37.05	40.22	39.54	43.24
Cocoa	22.56	26.45	22.15	24.82	22.44	27.3	17.45	20.78

Source: Own elaboration based on household surveys. See Table 2.2.

Table 2.7: Per Capita Expenditure and Income Sources in Malawi

Sample	National Total	Urban Total	Rural Total	q1	q2	q3	q4	q5
A) National								
p/c expenditure	1385	3643	1078	274	498	742	1129	2709
Share Agriculture	10.52	2.88	11.55	6.82	9.63	11.89	13.90	15.40
Tobacco	3.47	0.86	3.82	1.41	2.68	4.06	4.80	6.10
Cotton	0.41	0.00	0.47	0.33	0.37	0.49	0.72	0.44
Share Home-prod.	40.82	10.04	44.97	56.76	49.76	47.08	41.56	30.01
Share Other	48.66	87.08	43.48	36.42	40.61	41.03	44.54	54.59
B) Male headed								
p/c expenditure	1488	3768	1142	279	499	742	1128	2742
Share Agriculture	11.64	2.86	12.97	8.11	10.99	13.22	14.98	16.39
Tobacco	4.09	0.81	4.59	1.92	3.30	4.81	5.38	6.86
Cotton	0.48	0.00	0.56	0.44	0.45	0.57	0.80	0.50
Share Home-prod.	39.25	9.08	43.79	57.09	49.29	46.25	40.86	29.10
Share Other	49.11	88.06	43.24	34.8	39.72	40.53	44.16	54.51
C) Female headed								
p/c expenditure	1037	2935	875	265	498	744	1131	2539
Share Agriculture	6.72	2.99	7.04	4.22	5.76	7.51	9.92	10.32
Tobacco	1.37	1.14	1.39	0.38	0.93	1.59	2.67	2.18
Cotton	0.18	0.00	0.20	0.11	0.14	0.21	0.44	0.13
Share Home-prod.	46.11	15.39	48.71	56.08	51.09	49.80	44.12	34.65
Share Other	47.17	81.62	44.25	39.7	43.15	42.69	45.96	55.03
D) Producers								
p/c expenditure	1255	2866	1205	292	496	755	1132	2598
Share Agriculture	34.39	36.42	34.34	23.47	28.35	33.8	36.2	42.35
Tobacco	21.97	27.97	21.82	13.64	17.29	21.63	22.36	28.52
Cotton	2.63	0	2.69	3.2	2.39	2.59	3.37	2.06
E) Producers (males)								
p/c expenditure	1294	3207	1238	294	498	756	1135	2610
Share Agriculture	34.91	34.79	34.91	24.97	29.01	34.66	36.11	42.07
Tobacco	22.3	26.32	22.21	14.68	17.92	22.13	22	28.47
Cotton	2.64	0	2.7	3.37	2.47	2.63	3.27	2.08
F) Producers (females)								
p/c expenditure	920	845	923	277	481	745	1107	2398
Share Agriculture	29.96	45.64	29.41	15.21	23.64	26.96	36.96	46.98
Tobacco	19.12	37.28	18.49	7.92	12.79	17.7	25.44	29.48
Cotton	2.52	0	2.61	2.29	1.86	2.31	4.22	1.73

Source: Own elaboration based on household surveys. See Table 2.2.

Table 2.8: Per Capita Expenditure and Income Sources in Rwanda

Sample	National Total	Urban Total	Rural Total	q1	q2	q3	q4	q5
A) National								
p/c expenditure	6487	18074	5215	602	1451	2599	5100	16228
Share Agriculture	17.25	2.26	18.84	11.15	14.91	19.24	23.61	25.41
Coffee	0.80	0.02	0.88	0.87	0.79	0.96	0.70	1.09
Share Home-prod.	42.89	6.35	46.76	56.50	50.30	47.10	41.66	38.04
Share Other	39.86	91.39	34.4	32.35	34.79	33.66	34.73	36.55
B) Male headed								
p/c expenditure	7060	19660	5585	635	1463	2606	5105	15555
Share Agriculture	18.18	1.91	20.06	11.14	16.16	20.44	23.72	25.77
Coffee	0.82	0.02	0.91	1.03	0.78	0.97	0.75	1.06
Share Home-prod.	39.60	4.28	43.69	53.08	46.61	45.27	41.00	35.75
Share Other	42.22	93.81	36.25	35.78	37.23	34.29	35.28	38.48
C) Female headed								
p/c expenditure	5271	13993	4447	562	1428	2584	5085	18419
Share Agriculture	15.28	3.25	16.30	11.16	12.63	16.67	23.29	24.23
Coffee	0.75	0.02	0.81	0.68	0.81	0.96	0.56	1.16
Share Home-prod.	49.93	12.21	53.16	60.51	57.01	51.00	43.62	45.52
Share Other	34.79	84.54	30.54	28.33	30.36	32.33	33.09	30.25
D) Producers								
p/c expenditure	6159	9020	6030	623	1438	2628	5115	15225
Share Agriculture	28.28	26.15	28.3	29.79	28.22	30.01	24.67	29.04
Coffee	7.96	2.17	8.02	11.52	8.76	8.06	5.99	7.34
E) Producers (males)								
p/c expenditure	6210	13034	6074	642	1489	2657	5168	13799
Share Agriculture	28.44	27.98	28.44	28.26	29.8	30.8	21.79	30.93
Coffee	7.43	2.41	7.48	10.34	8	7.68	6.28	6.67
F) Producers (females)								
p/c expenditure	6026	7042	5909	582	1339	2555	4947	21798
Share Agriculture	27.8	21.8	27.87	33.62	24.57	28.03	33.92	20.09
Coffee	9.57	1.62	9.67	14.5	10.51	8.99	5.04	10.56

Source: Own elaboration based on household surveys. See Table 2.2.

Table 2.9: Per Capita Expenditure and Income Sources in Uganda

Sample	National Total	Urban Total	Rural Total	q1	q2	q3	q4	q5
A) National								
p/c expenditure	26514	53670	20780	3675	9085	13964	21219	54102
Share Agriculture	13.19	3.88	15.14	5.00	10.44	14.16	20.09	25.69
Coffee	2.05	0.40	2.40	1.22	2.30	2.57	3.19	2.67
Share Home-prod.	49.08	47.35	49.45	41.49	54.19	54.74	51.83	45.16
Share Other	37.73	48.77	35.41	53.51	35.37	31.1	28.08	29.15
B) Male headed								
p/c expenditure	26795	55137	21042	3850	9112	13970	21264	51916
Share Agriculture	14.91	4.59	16.99	5.75	11.27	15.31	21.46	28.41
Coffee	2.29	0.49	2.65	1.20	2.40	2.83	3.44	3.11
Share Home-prod.	49.23	46.76	49.73	41.96	55.35	55.30	51.49	44.13
Share Other	35.86	48.65	33.28	52.29	33.38	29.39	27.05	27.46
C) Female headed								
p/c expenditure	25749	50118	20049	3344	9008	13943	21071	61558
Share Agriculture	8.53	2.20	10.01	3.57	8.33	10.79	15.23	15.99
Coffee	1.41	0.19	1.69	1.28	2.05	1.82	2.33	1.14
Share Home-prod.	48.67	48.74	48.66	40.59	51.28	53.13	53.05	48.80
Share Other	42.8	49.06	41.33	55.84	40.39	36.08	31.72	35.21
D) Producers								
p/c expenditure	24012	47873	22882	4260	9402	14066	21367	46836
Share Agriculture	24.69	24.88	24.68	17.35	19	23.33	26.18	30.44
Coffee	8.18	6.91	8.23	8.63	7.59	7.96	8.33	8.66
E) Producers (males)								
p/c expenditure	25293	55403	23888	4113	9454	14074	21469	48177
Share Agriculture	26.94	30.06	26.81	18.49	20.35	25.38	29.1	32.02
Coffee	8.64	8.11	8.66	8.7	7.54	8.43	9.09	9.07
F) Producers (females)								
p/c expenditure	19657	23807	19450	4721	9278	14036	21042	40593
Share Agriculture	17.09	10.59	17.4	13.79	15.77	15.85	16.92	23.08
Coffee	6.64	3.61	6.78	8.44	7.7	6.25	5.94	6.77

Source: Own elaboration based on household surveys. See Table 2.2.

Table 2.10: Per Capita Expenditure and Income Sources in Zambia

Sample	National Total	Urban Total	Rural Total	q1	q2	q3	q4	q5
A) National								
p/c expenditure	80764	107191	66597	25641	43127	60424	86042	169201
Share Agriculture	13.54	2.54	19.61	20.34	21.38	19.45	17.27	18.41
Tobacco	0.47	0	0.73	0.43	0.7	0.72	0.7	1.35
Cotton	1.92	0.02	2.97	1.97	3.25	3.99	2.55	3.27
Share Home-prod.	25.86	2.18	38.91	42.17	39.83	39.24	37.62	32.71
Share Other	60.6	95.28	41.48	37.49	38.79	41.31	45.11	48.88
B) Male headed								
p/c expenditure	81515	108948	66475	25714	43122	60430	85817	166574
Share Agriculture	13.94	2.69	20.23	21.47	21.59	20.09	17.43	19.47
Tobacco	0.52	0	0.81	0.54	0.59	0.8	0.86	1.61
Cotton	2.05	0.01	3.18	2.13	3.54	4.26	2.61	3.42
Share Home-prod.	25.08	1.74	38.12	42.07	39.46	38.22	36.29	31.23
Share Other	60.98	95.57	41.65	36.46	38.95	41.69	46.28	49.3
C) Female headed								
p/c expenditure	77739	99565	67066	25389	43146	60400	86863	179898
Share Agriculture	11.86	1.88	17.06	16.34	20.46	16.42	16.62	13.77
Tobacco	0.26	0.02	0.39	0	1.18	0.36	0.07	0.22
Cotton	1.4	0.03	2.11	1.41	2.01	2.71	2.31	2.62
Share Home-prod.	29.12	4.13	42.15	42.53	41.4	44.07	42.8	39.14
Share Other	59.02	93.99	40.79	41.13	38.14	39.51	40.58	47.09
D) Producers								
p/c expenditure	68064	81291	65810	24695	43305	60417	87480	153442
Share Agriculture	36.29	20.79	36.38	34.98	37.35	36.19	33.26	39.75
Tobacco	5.68	3.71	5.69	5.06	5.4	4.61	5.5	8.48
Cotton	23.17	11.64	23.23	23.49	24.87	25.47	20.13	20.48
E) Producers (males)								
p/c expenditure	68131	87224	64885	24654	43421	60769	87568	150609
Share Agriculture	36.57	12.63	36.71	35.43	35.96	36.41	34.55	41.51
Tobacco	5.89	0.6	5.92	5.81	4.06	4.78	7.09	9.62
Cotton	23.19	9.62	23.26	22.75	24.25	25.5	21.56	20.38
F) Producers (females)								
p/c expenditure	67807	58848	69346	24847	42683	58987	87257	164377
Share Agriculture	34.6	64.84	34.4	31.93	50.33	34.57	29.15	29.43
Tobacco	4.36	20.54	4.26	0	17.89	3.4	0.45	1.79
Cotton	23.05	22.53	23.05	28.47	30.59	25.33	15.58	21.11

Source: Own elaboration based on household surveys. See Table 2.2.

3. Institutional Arrangements and Market Structure

In this section we briefly describe the main institutional arrangements in each of the value chains to be considered in the analysis. More importantly for our simulations, for each case study we present a list of the main processing/exporting firms and their respective market share. This information is summarized at the end of this section in Table 3.1.

3.1. Cotton

Benin

Until 1999, producers' prices were fixed by the government. From that year on the responsibility was supposedly transferred to the Cotton Inter-professional Association (AIC). The new price mechanism established that seed cotton price was to be determined through negotiations between cotton producers and ginners with AIC acting as a facilitator. A base price is set in March-May for the upcoming marketing year. The final producer price is then fixed in October when the harvest is about to begin using the cotton world market price as a reference and deducting the processing and marketing cost. Despite the liberalization process, in practice, the government remained a key player in determining the price and local prices has remained sticky despite of considerable world price fluctuations.

The seeds are ground locally and exported as cotton lint or oil. Each cotton company is allocated a quota proportional to its installed capacity, which contributes to segment the market and restrict entry and competition. The country has an installed ginning capacity of 20 units. Ten plants belong to SONAPRA, while private actors, either foreign companies (LBC/Aiglon, Louis Dreyfus, Kamsal, IBECO, MCI, and Sodicot) or the local private sector (Talon and cooperatives) have invested in the private plants. The effective allocation of grains often differs from the quota based on the installed capacity. We will use in our simulations the allocation of the 2007/8 campaign.

Burkina Faso

Cotton production in Burkina Faso is semi-privatized, and is often cited as a model of reform away from the old vertically integrated state-owned cotton companies (Hanson, 2008). The process of privatization of the sector began in 1998 when the Government sold some of its shares to the producers' organization (UNPCB). The subsequent partial privatization of the cotton sector in Burkina Faso created three regional cotton companies. SOFITEX, the core of the former parastatal operates in the Western part of the country, owns 13 gins making up approximately 85 percent of the ginning capacity. Faso Coton was formed in 2004 and operates in the central region with its single gin located in Ouagadougou and controlling 5% of the market. SOCOMA, which operates 3 gins in the eastern region, is the second private company created in 2004 and has a market share of 10%.

Until recently, there was a guaranteed producers` base price that was set before the crop year. The system included the possibility of bonus payments (in case of profit, the producers received a higher price the following season[1]) similar to the system applied in Côte d'Ivoire and Benin. From the 2007-8 campaign the system has been changed in favor of a market-based producer price-setting mechanism. The new mechanism aligns domestic producer prices with world market prices and thus makes producers share part of the risk. However, to limit excessive price fluctuations for producers, who have little access to credit, the producer floor price is smoothed by basing it on a 5-year centered average of world market prices.

Côte d'Ivoire

Until the late 1990s, a single vertically integrated state enterprise ("*Compagnie ivoirienne de développement des textiles*" - CIDT) was responsible for organising virtually all services needed for cotton production and marketing, utilizing the institutional frameworks derived from French colonial heritage (UNCTAD). The privatization of CIDT began in 1998, when it was broken into regional companies, but each of those held a monopoly over their region, and the state did not divest a majority interest in those companies until 2002. This did not lead to competition as the price of seed cotton remained the same for the three zones; in addition, each company retained exclusive purchasing rights within its zone. Recently two new companies, DOPA and SICOSA, have entered the market somehow breaking up the geographically designated monopolies.

Malawi

Until recently, virtually all the cotton was sold within Malawi to the two ginning companies, Great Lakes Cotton Company and Clark Cotton Malawi (both subsidiaries of international companies) that have half of the market each. The market structure is currently changing as a new company has been established. The Malawian government in association with China has created the Malawi Cotton Company. Historically a high proportion of cotton lint was sold to the local textile company (David Whitehead and

[1] The return premium was divided in 50% to growers, 25% to the state, and 25% to the ginning companies.

Sons) but its financial problems led to a drop in its output and local ginneries started to export most of the cotton lint to South Africa and South Asian countries.

Every year, the Government of Malawi sets a minimum seed cotton price with 2-3% deduction from gross sales for out grower costs. This price is probably higher than the one that would exist under collusion of the two ginning companies. This higher price is compensated for by reducing the ginner's investment in out-grower extension and other services, thereby threatening the sustainability of high quality and productivity in the cotton sub-sector. Seed cotton is sold to the ginneries in three different ways: through traders, by producer organizations, and directly to ginners. Traders operate in remote areas, providing transportation to central markets. The sales through farmers association has been increasing over time. The purchase done by these associations are often limited by the amount of available cash. In general, they offer better prices and deliver other services such as training, organizing inputs, and transportation. Farmers located close to the four ginneries and to the Ginners' own buying points can sell directly to the ginning companies, receiving a better price but having to organize and afford the cost of transportation.

Zambia

Until 1994, the sector was dominated by a state monopoly (LINTCO) that was responsible for every activity in the industry. The reform period began in 1994 when LINTCO was breakup and its ginneries sold to Lonrho (later succeeded by Dunavant) and Clark Cotton (Koyi, 2005). In the first eight years following the privatization of LINTCO Zambia's cotton sector operated as a concentrated, market-based system with almost no government involvement, even on a regulatory basis. Since year 2002 the Zambian government has developed a more noticeable presence in the sector, and efforts at sector-wide coordination have increased markedly (Tschirley and Kabwe 2007).

There has been no government mandated price since liberalization in 1994. Dunavant has typically acted as a price leader, announcing a minimum pre-planting price to farmers, which may be adjusted upwards at the start of the buying season. Cargill typically follows Dunavant's pricing, while smaller ginners frequently pay higher prices than Dunavant. New entrants in the market led to more competition among private firms and price became a key tool in attracting buyer.

3.2. Cocoa

Côte d'Ivoire

Following the independence of the country, the *Caisse de stabilisation des prix des produits agricoles* (Caistab) was established to regulate farm gate and export prices (both for cocoa and coffee), provide extension service and inputs, as well as collecting substantial taxes. The reform process started in 1987 but it was in the middle of the 1990s, the state's control was diminished, in order to reduce marketing costs, raise producer prices and encourage the creation of producers' organisations. In 1999 the Caistab was disbanded and the producer price fully liberalized. The Caistab was replaced by four agencies to manage and monitor the sector. The *Autorite de Regulation du Café/Cacao* (ARCC) is the regulatory authority in charge of defining and enforcing a regulatory framework ensuring competition at all levels of value chain. The *Fonds de Regulation et de Controle* (FRC) is a financial regulation fund managing the price stabilization system through taxes of cocoa exports and forward selling. The *Bourse du Café/Cacao* (BCC) is a marketing bourse managed by farmers and exporters, responsible for managing export operations. The *Fonds de Developpement et de Promotion des Producteurs de café et cacao* (FDPCC) is a development fund established by producers, funded by voluntary levy, to finance demand-driven development programs. These four structures have been in charge of the regulation of the cacao (and coffee) sector since 2001. However, the system has suffered a number of drawbacks due to external (decline in world market prices) and internal factors (civil conflict, an excessive tax burden on cocoa farmers, and apparent corruption cases leading to the arrest of some of the officials in charge of these agencies). Currently, the system configuration is in the process of been revised.

Ghana

The Cocoa Marketing Board (CMB) was established in 1947 (called The Ghana Cocoa Board or COCOBOD after 1979). Its presence in the cocoa industry was omnipresent and covered extension services, input marketing, and the maintenance and rehabilitation of roads in cocoa-producing villages (Brooks et al 2007). The CMB was the only authorized buyer and exporter of cocoa. The CMB carried out its activities through its subsidiaries the Produce Buying Company (PBC) and the Cocoa Marketing Company (CMC). The internal marketing system was liberalized in 1993 allowing Licensed Buying Companies (LBCs) to compete with the PBC. In addition, the PBC was partly privatized in year 2000. Despite the reforms, the Ghanaian government still plays an important role in the sector. Through COCOBOD, the government controls cocoa quality, hands out licenses, finances and controls activities of private companies.

Farm gate price for cocoa in Ghana is determined in a very unique way. The ceiling price is determined by the international price of cocoa to which the government then nets out a variety of margins to pay for the many layers of its intervention in the sector. The Producer Price Review Committee (PPRC) is very much in charge of how the floor price paid to the farmer is ultimately determined, and this committee is made up of a variety of stockholders ranging from the Ministry of Finance, industry representatives, the Cocobod, LBCs, farmers representatives, and the University of Ghana. The producer price is a price floor but in practice the price paid to the farmers is not raised above this minimum level. This producer price is set at the beginning of each crop year and is constant throughout the seasons. In addition to setting the producer price, the PPRC sets a yearly fixed purchase price, i.e. the price that the LBCs receive from selling the cocoa to COCOBOD. This price corresponds to the buyer's margin and is set taking into account average transport costs, commissions paid to purchasing clerks and other costs faced by the LBC. Each LBC receives the same buyer's margin. The system contemplates the existence of a price stabilization mechanism. Despite the fact that the number of registered LBCs has increased gradually since the liberalisation reform, the number of companies that are active players in the local market remains much smaller as fewer than ten of them purchase up to 90 percent of the total harvest. The liberalization of the internal market has not implied the liberalization in the external front. The PBC is the only company that is allowed to export.

3.3. Coffee

Côte d'Ivoire

The evolution of the institutional setting for the coffee sector has been similar to that of cocoa. In 1964 the Caisse de Stabilisation des Prix des Produits Agricoles (CAISTAB) was created as a price stabilization and support fund for the cocoa and coffee sector. The CAISTAB was in charge of the primary collecting, of the transportation and export of the crops. It also provided extension and inputs but the state intervened little in the production process itself. It paid the farmers, through private agents, a preannounced price for their crops and sold the output on international markets. The difference between these two prices, net of marketing cost, was a surplus that constituted an important part of the government's revenue. However, from the late 1980s on, the international prices dropped below the producer prices and the surpluses became deficits (Benjamin and Deaton, 1993). This marked the beginning of a gradual liberalization process. The CAISTAB and the cocoa and coffee sectors were privatized in 2000. The BCC (Coffee and Cocoa Marketing Exchange) and ARCC (Coffee and Cocoa Regulatory Authority) took over CAISTAB functions. The reform process continued through the 2000s aiming at improving producer prices and productivity, marketing arrangements and the monitoring of the sector by government and public and private agencies. However, the results of these reforms have been disappointing as the producers' price and the competitiveness of the sector as a whole has not improved. As it was mentioned in the section regarding cocoa in Cote d'Ivoire, the sector is undergoing a new set of reforms since late 2008. Because of this flowing state of the system and also because of the civil conflict, it was not possible to find reliable information on coffee exporters market shares. For that reason, we decided to use in our simulations the same market shares that we have for the case of cocoa in Cote d`Ivoire.

Rwanda

The Rwanda Coffee Authority -OCIR-Café- was created after the independence of the country with the mission of supervising coffee related activities in the country, from production to commercialization (OCIR). The coffee industry was liberalized in the mid-1990s and since then the Coffee Board is no longer engaged in coffee processing, marketing or exports. However, OCIR-Café still distributes seedlings and insecticides and provides certification on quality standards. The organization also issues licenses to private coffee traders. The fix price policy for producers was abandoned in 1997 and replaced by an indicative weekly price. This "floating" price is announced before each week end as a baseline for negotiations between coffee producers and buyers. The calculation of this price is based on a "moving scale" which takes into account the various elements related to coffee picking, processing, transportation, and export (WTO 2004).

In the marketing link of the value chain, middlemen collect coffee beans from door to door, bulk them, and deliver them to large buyers, who transport them to Kigali for hulling and export. Large buyers are generally located in Kigali (Habyalimana 2007). At present, secondary processing of coffee is handled mainly by five factories exporters.[2]

Uganda

Until 1991, the roles of stakeholders in the coffee supply chain were clearly segregated. The smallholders produced, harvested, and dried their coffee. The dried cherry was then sold to either primary cooperative societies or private stores. Primary societies sold their coffee to cooperative unions, while the private stores sold the beans either to huller operators who, after hulling, sold the coffee to the Coffee Marketing Board (CMB). The CMB in turn reprocessed the crop and exported it as green

[2] Primary processing is done by the producers themselves using traditional or semi-modern methods. Only a small quantity is processed at modern washing stations.

coffee. The prices paid at each level were pre-determined by the authorities and did not change with movements in the international coffee market (Masiga et al, 2007). The Coffee Marketing Board monopoly was abolished in 1991. This opened the possibility for cooperatives and private operators to export coffee directly and nearly all exporters became vertically integrated. The supply chain for exported coffee was dominated by coffee processing and trading companies. Private traders and the old cooperative trading system gradually lost ground to private exporters. In recent years, multinational coffee companies have became also important in Uganda, generating an alternative channel for exporting coffee (Cheyns et al, 2006). For the majority of farmers the price is negotiated at the time of sale and payment is not made until then. Most coffee sales are made at the farm-gate to small traders. These small-scale traders act as aggregators either for bigger independent traders who often own a store or mill or for exporters and their agents (Vargas Hill, 2010). After the coffee has been milled, it is transported to Kampala and sold to exporters. Coffee exporters in Uganda have to be registered with the Ugandan Coffee Development Authority (UCDA). The number of registered coffee subsector players at post harvest levels was 324 in 2007/08 comprising: 30 exporters, 19 export graders, 271 primary processors, and 4 roasters. At the export level, over 90% of the volume was handled by 10 companies.

3.4. Tobacco

Malawi

Before 1989, the Tobacco Control Commission closely controlled the production activity. All tobacco producers had to obtain a license from the government regulatory body. The system was biased against smallholders as only estates and landowners were eligible to apply for production license. Moreover, to be allowed to sell tobacco directly on the auction floor, a grower had to reach a certain production scale. This was the case until early 1995 when Malawi embarked on a structural adjustment program that, among other things, allowed smallholder farmers to produce cash crops.

The value chain of tobacco in Malawi is relatively simple as most of the exported tobacco is unmanufactured. The intermediate buyers functioned as the middlemen between small-scale tobacco growers and the auction market, buying tobacco leaf from many small-scale growers at a negotiated price and them selling them on the auction floor at the market price (FAO 2003). Tobacco leaf is generally sold in auction markets owned by Auction Holding Limited. The tobacco buyers in Malawi have been described as an ‘oligopsony’ where each of the few buyers exerts a disproportionate influence on the market.

Zambia

There is not an auction system like in Malawi. Tobacco is bought at buying stations established by merchants at strategic points in the growing districts. Most of this tobacco is then exported to Malawi, where it is processed and sold to cigarette manufactures that sell in world markets (Balat and Porto, 2008). A few companies dominate the market.

Table 3.1: Market Shares in Export Supply Chains

Ranking	Benin Cotton		Burkina Faso Cotton		Cote d'Ivoire Cotton		Malawi Cotton		Zambia Cotton		Cote d'Ivoire Cocoa	
	firm	share	firm	share	firm	share	firm	share	firm	share	firm	share
1	SONAPRA	55.1	SOFITEX	85.0	Ivoire Coton	45.0	Great Lakes	50.0	Dunavant	44.0	ADM Cocoa Sifca	11.9
2	SOCOBE	6.8	SOCOMA	10.0	CIDT	29.0	Clark Cotton	50.0	Cargill	32.0	Armajaro	3.3
3	Ibeco	6.2	Faso Coton	5.0	LCCI	16.0			Amaka	13.0	Barry Callebaut	3.1
4	LCB	10.0			DOPA	6.0			Mulungushi	6.0	Cargill West Africa	16.4
5	MCI	3.4			SICOSA	4.0			Continental	5.0	Cemoi	3.8
6	ICB	8.4							Mukuba	1.0	Cipexi	6.0
7	CCB	8.5									Cocaf	4.4
8	SODICOT	1.6									Dafci and IFCO	4.5
9											Delbau	4.7
10											Outspan Ivoire	5.2
11											Proci	6.0
12											Sifca-Coop	4.9
13											Tropival	8.3
14											Zamacom	3.4
15											Others	14.1

Ranking	Ghana Cocoa		Rwanda Coffee		Uganda Coffee		Malawi Tobacco		Zambia Tobacco	
	firm	share	firm	share	firm	share	firm	share	firm	share
1	PBC	32.83	Rwacof	30.4	Ugacof Ltd.	16.2	AOI	34.0	Zambia Tobacco Leaf	47.61
2	Akuapo	11.97	Rwandex	29.2	Kyagalanyi Coffee Ltd.	14.0	Universal (LIMBE)	29.0	Alliance One Tobacco	16.34
3	OLAM	10.71	CBC	22.8	Kawacom (U) Ltd.	13.3	Africa Leaf	16.0	Tombwe Tobacco	25.21
4	Adwumapa	8.62	Agrocoffee	13.7	Ibero (U) Ltd.	9.3	Premium	13.0	Associated Tobacco	10.84
5	Fed	7.04	SICAF	3.9	Job Coffee	8.3	Malawi Leaf	5.0		
6	Kuapa	5.91			Great Lakes	7.2	ATC	2.0		
7	Transroyal	5.72			Lakeland Holdings Ltd.	7.2	Wallace	1.0		
8	Armajaro	5.7			Kampala Domestic Store	5.6				
9	Cocoa Gh	3.17			Savannah Commodities	4.9				
10	Diaby	2.7			Pan African Impex	4.7				
11	Others	5.63			Others	9.4				
12										
13										
14										
15										

4. Exporters and Farmers: A Model of Supply Chains in Agriculture

In this section, we develop a 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. These farm-gate price changes will feed into the poverty analysis in Section 5.

We present a game-theory model of supply chains in export agriculture.[3] 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.

Farm-gate prices are set by firms. The firms buy raw inputs from the farmers (coffee beans, cotton seeds) and sell them in international markets. We assume that these firms are small in international markets and thus take international commodity prices (for coffee or cotton), 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.

[3] 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), Horn and Levinsohn (2001), McMillan, Rodrik, and Welsh (2003), Taylor and Adelman (2003), Syverson (2004), Sheldon (2006), Sexton, Sheldon, McCorriston, and Wang (2007), Kranton and Swamy (2008), Ennis (2009), Cadot, Dutoit, and de Melo (2010), and Ludmer (2010).

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 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. In all these cases, given the initial equilibrium, we find the new equilibrium of the model and study the changes in farm-gate prices, profits, and farmer utility (for different farmers). 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. In this sense, while the model is a partial equilibrium model of the agricultural export markets, it incorporates responses from all agents and their feedback in determining the equilibrium.

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 (purchase of seeds, fertilizers, pesticides), 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, that is on the number of firms and also on their market shares. This is because the legal system is imperfect and thus we assume firms cannot perfectly monitor farmers. In consequence, farmers may default on the loan, and even side-sell to other exporters.

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. This analysis introduces new interesting dimensions to the discussion of competition policies and poverty in Sub-Saharan Africa.

This section is organized as follows. In Section 4.1, we introduce the basic structure of the standard model without outgrower contracts. In Section 4.2, we explain how we set up the simulations and in Section 4.3, we discuss the main results. In Section 4.4 and 4.5, we extend the standard model to include outgrower contracts and we present the simulation results.

4.1. 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. In particular, perfect competition among buyers of the farmers' produce will deliver higher equilibrium prices than monopsony or oligopsony situations. In turn, higher prices for the farmers' produce means higher wealth for individuals. And through the wealth effect, this means that 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

More formally, 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— marginal utility of m will be finite even for $m = \mathbf{0}$. 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 (and self-consume the rest). We will also show that the cutoff "subsistence" level is decreasing in p. The intuition is a wealth effect (or equivalently, in this simple one-period endowment economy, income 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

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

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

$$\boldsymbol{h} \geq \mathbf{0}$$

$$m \geq \mathbf{0}$$

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 $0 < \alpha < \mathbf{1}$. We now discuss the different pieces of the optimization problem.

We begin with the budget constraint. 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 $(e_i - \boldsymbol{h})$ for the market will need to borrow an amount $\lambda \,.\, (e_i - \boldsymbol{h})$ 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 (sections 4.4. and 4.5). For the remainder of the section, however, we will leave outgrower contracts aside, thus assuming that $\lambda = 0$.

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.

Markets and Equilibrium

Individuals sell their output to exporters. Each exporter chooses its individual demand from the farmers. The price P at which exporters sell their output in the international markets is exogenously given in this model. The domestic price p earned by farmers is determined in equilibrium, given farmers' aggregate supply and exporters' aggregate demand. We next define an equilibrium for this economy.

Definition 1 *An equilibrium in this economy is a collection of individual decisions and prices* $\{(h_i)_{i\varepsilon I}, (m_i)_{i\varepsilon I}, (q_j)_{j=1}^{n}, p, r\}$ *such that:*

1. For each farmer i *, (*$\boldsymbol{h}_i$*,* m_i *) maximizes utility given price* p *and interest rate* r *.*

2. For each firm j *, (*q_j *) is a best-response to the other firms' decisions* $(q_k)_{k \neq j}$ *,to farmers' aggregate behavior.*

3. The goods market clears: $\int_{i\varepsilon I} (e_i - h_i) di = \sum_{j=1}^{n} q_j$

Condition (1) is the standard requirement that farmer's behavior be utility-maximizing given the structure of the problem. Farmers take prices as given and act accordingly.

The optimality condition for exporters introduces oligopolistic competition. Firms chose demanded quantities in anticipation of their own effect on farmers' aggregate behavior, in a context of strategic interaction with other firms. Equilibrium in the economy requires that firms' decisions be a Cournot-Nash Equilibrium of the game between firms, given the farmers' aggregate supply function.

Condition (3) is a standard market clearing condition requiring that output sold by farmers to the market coincides with the aggregate demand from exporters.

Farmer Solution

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

$$\mathcal{L} = \boldsymbol{h}^{\alpha} (m + c)^{1-\alpha} + u_1(pe_i - p\boldsymbol{h} - m) + u_2 \boldsymbol{h} + u_3 m$$

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

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

The complementary slackness conditions are

$$u_1(pe_i - p\boldsymbol{h} - m) = 0, u_2 \boldsymbol{h} = 0, u_3 m = \mathbf{0}$$

$$u_1 \geq 0, u_2 \geq 0, u_3 \geq \mathbf{0}$$

It is simple to show that any solution must have $h > 0$, since marginal utility of h converges to ∞ when $h \to 0$. Therefore, $u_2 = 0$ will always hold. Moreover, we look for a solution with $m > 0$. This implies $\mu_3 = 0$, and the first-order condition becomes:

$$\frac{\partial \mathcal{L}}{\partial h}: \ \alpha \frac{h^{\alpha}(m+c)^{1-\alpha}}{h} - u_1 p = 0$$

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

From this we can solve

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

$$\Rightarrow \ m = \frac{1-\alpha}{\alpha} p h - c$$

Using the budget constraint, we get

$$pe_i = \ ph + m \ \Rightarrow \ pe_i = ph + \frac{1-\alpha}{\alpha} ph - c$$

$$\Rightarrow \ h = \frac{\alpha}{p}(pe + c)$$

$$\Rightarrow \ m = (1-\alpha)\, pe_i - c\alpha$$

We get the standard response functions with Cobb-Douglas utility, for which it is optimal to assign constant shares of the budget to each consumption good.

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

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

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" $e - \hat{e}(p)$.

The indirect utility function is

$$e \leq \hat{e}(p) \Rightarrow V(e;p) = e^{\alpha}c^{1-\alpha}$$

$$e \geq \hat{e}(p) \Rightarrow V(e;p) = \frac{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}{p^{\alpha}(pe + c)}$$

This function is strictly increasing. To the left of $\hat{e}(p)$, it is strictly concave. It has a convex kink at $e = \hat{e}(p)$, and is linear to the right of $\hat{e}(p)$. To see this, consider the derivative:

$$e < \hat{e}(p) \Rightarrow \frac{\partial V(e;p)}{\partial e} = \alpha \frac{c^{1-\alpha}}{e^{1-\alpha}} > 0 \quad and \quad \frac{\partial^2 V(e;p)}{\partial e^2} = -\alpha(1-\alpha)\frac{c^{1-\alpha}}{e^{2-\alpha}} < \mathbf{0}$$

$$e > \hat{e}(p) \Rightarrow \frac{\partial V(e;p)}{\partial e} = \alpha^{\alpha}(1-\alpha)^{1-\alpha}p^{1-\alpha} > 0 \quad and \quad \frac{\partial^2 V(e;p)}{\partial e^2} = \mathbf{0}$$

It takes simple algebra to see that the kink at $\hat{e}(p)$ is convex. The left-hand first derivative for $\hat{e}(p)$ is smaller than the right-hand first derivative:

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

$$\Rightarrow \alpha^{\alpha}(1-\alpha)^{1-\alpha}p^{1-\alpha} > \alpha^{\alpha}\alpha^{1-\alpha}\frac{c^{1-\alpha}}{e^{1-\alpha}} = \alpha\frac{c^{1-\alpha}}{e^{1-\alpha}}$$

The shape of the supply function will be relevant for the exporters' decision. Note that, over the range where $s\ (p;\ e) > \mathbf{0}$, the individual supply function is strictly increasing and strictly concave:

$$\frac{\partial s(p;e)}{\partial p} = \frac{c}{p^2}\alpha > 0,$$

$$\frac{\partial^2 s(p;e)}{\partial p^2} = -2\frac{c}{p^3}\alpha < 0.$$

However, the function has a kink at the level which implies $e = \hat{e}(p)$. It is globally weakly increasing but not concave.

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

$$S(p) = \int_{\hat{e}}^{\bar{e}} s(p;e) f(e)de = (1-\alpha)\int_{\hat{e}}^{\bar{e}} \max\left\{e - \hat{e}(p), 0\right\} f(e)de = (1-\alpha)\int_{\hat{e}}^{\bar{e}} (e_i - \hat{e}(p)) f(e)de$$

Thus, the aggregate supply function is

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

What is the shape of the aggregate supply function? To avoid carrying around the term $(1-\alpha)$, which is strictly positive, we look at the shape of $\tilde{S}(p) \equiv \frac{S(p)}{1-\alpha}$. First, to see that the aggregate supply function is non-decreasing in p note that:

$$\frac{d\tilde{S}(p)}{dp} = \frac{\partial \tilde{S}(p)}{\partial \hat{e}(p)} \frac{\partial \hat{e}(p)}{\partial p}$$

The second term is decreasing in p as mentioned before:

$$\frac{\partial \hat{e}(p)}{\partial p} = -\frac{\alpha}{1-\alpha}\frac{c}{p^2} = -\frac{\hat{e}(p)}{p} < 0$$

The first term is

$$(\partial(\tilde{S})(p))/(\partial \hat{e}(p)) = -\hat{e}(p)f(\hat{e}(p)) - (1 - F(\hat{e}(p))) + \hat{e}(p)f(\hat{e}(p)) = -(1 - F(\hat{e}(p))) \leq 0$$

This establishes that the aggregate supply function is non-decreasing:

$$\frac{S'(p)}{1-\alpha} = \tilde{S}'(p) = \frac{\partial \tilde{S}(p)}{\partial \hat{e}(p)} \frac{\partial \hat{e}(p)}{\partial p} = -\left(1 - F(\hat{e}(p))\right)\left(-\frac{\hat{e}(p)}{p}\right) = \left(1 - F(\hat{e}(p))\right)\left(\frac{\hat{e}(p)}{p}\right) \geq 0$$

What about the second derivative?

$$\frac{d\tilde{S}'(p)}{dp} = \frac{c}{p^2}\frac{\alpha}{1-\alpha}\partial \frac{\partial\left(1 - F(\hat{e}(p))\right)}{\partial \hat{e}(p)} \frac{\partial \hat{e}(p)}{\partial p} + \left(1 - F(\hat{e}(p))\right) \frac{\partial\left(\frac{\hat{e}(p)}{p}\right)}{\partial p}$$

$$= f(\hat{e}(p))\left(\frac{c}{p^2}\frac{\alpha}{1-\alpha}\right)^2 - \left(1 - F(\hat{e}(p))\right)2\frac{c}{p^3}\frac{\alpha}{1-\alpha}$$

This reduces to

$$\frac{d\tilde{S}'(p)}{dp} = f(\hat{e}(p))\left(\frac{\hat{e}(p)}{p}\right)^2 - \left(1 - F(\hat{e}(p))\right)2\frac{\hat{e}(p)}{p^2}$$

The sign of this derivative is not unambiguous. We can look for conditions under which it will be negative:

$$\tilde{S}''(p) < 0$$
$$\Leftrightarrow f(\hat{e}(p))\left(\frac{\hat{e}(p)}{p}\right)^2 - \left(1 - F(\hat{e}(p))\right)2\frac{\hat{e}(p)}{p^2} < 0$$
$$\Leftrightarrow \frac{f(\hat{e}(p))\hat{e}(p)}{1 - F(\hat{e}(p))} < 2$$

Note that there is not a straightforward intuition for this term. This condition reads as follows: Take any p . Then the aggregate supply function will be locally concave at p if, evaluated at the "subsistence level" $\hat{e}(p)$ corresponding to such p , the distribution function $F(\cdot)$ satisfies

$$\frac{f(\hat{e}(p))}{1 - F(\hat{e}(p))} < \frac{2}{\hat{e}(p)}$$

This condition basically puts a bound on "mass points." In other words, for $S(p)$ to be locally concave at a given p , the distribution function must satisfy the condition that probability doesn't "grow too fast" (i.e. too high an $f(\hat{e}(p))$ relative to the "remaining" probability $1 - F(\hat{e}(p))$.

While this condition will hold in the simulations that we run below, it is useful to discuss the shape of the supply function. This is because this discussion illustrates some of the major issues that drive the economic decision of the farmers and their participation in export markets. To this end, let's do a thought experiment in which we start off with a very low price (say, $p = 0$) for the traded good, and we increase it gradually to see how the economy responds.

When the market price for the exportable good is very low, all farmers are poor and they all self-consume their endowment. As the price of the tradeable good increases, all farmers experience a positive wealth effect. This effect entices them to diversify their consumption portfolio by selling part of their endowment to the market to buy other goods. Mathematically, as the price increases, the "subsistence level" of endowment starts decreasing. However, for price low enough this "subsistence level" is still higher than each and every farmer’s endowment (including the rich).

The wealth effect is larger for "richer" farmers, which means that as the endowment value increases, these people are the first to experience the cutoff moment in which the market value of their endowment surpasses their "subsistence level". Therefore, there is a first, low price p that triggers that rich farmers start selling part of their endowment to the market in exchange for market consumption goods. After rich farmers have entered the market, there is a region of prices where rich farmers are selling their goods, but poor farmers are still below their "subsistence levels", and therefore are operating in autarky and self-consumption. In such region where only the rich are trading, the slope of the aggregate supply curve is just the slope of the rich farmers’ individual supply curves — the individual supply curves of poor farmers still has zero slope. Hence, in this region the aggregate supply curve will be locally concave. Eventually the price raises enough to bring poor farmers to the market as well. This happens when the value of their endowments grows enough to cross the "subsistence level". At the precise point where the poor farmers enter the market, there will be a convex kink in the aggregate supply curve. The reason is that, at that point, the slope of the poor farmers’ supply curve switches from zero to strictly positive.

Economically, there is a form of "increasing return" to price increases at the point where poor farmers, who were previously operating in autonomy, enter the market and start providing a positive supply of tradeable goods. In consequence, one intuition for the shape of the aggregate supply curve (and of the drivers of this shape) is that in societies with very high inequality of income, this type of price regions with "increasing returns" will be present. Tipping points will exist which, when surpassed, suddenly large numbers of previously-autarkic farmers enter the market with supply.

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:

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

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

The state variables are the international price P , and other exporters' actions $q_{k\neq j}$. It can be shown that a sufficient condition for the problem to be concave is that the aggregate supply function $S(p)$ be concave as well, so that $S''(p) < \mathbf{0}$. As discussed before, this is not guaranteed by concavity of the individual supply functions $s(e;\ p)$. In other words, when the aggregate supply function is concave, the exporters' profit maximization problem will be concave in their choice variable. If the aggregate supply function is not concave, then the problem may not be concave as well.

Of course, if the problem is concave then the first order condition $\frac{\partial \pi}{\partial q_j} = \mathbf{0}$ will be necessary and sufficient. Moreover, by the Maximum Theorem under convexity (Stokey and Lucas, 1989; Sundaram, 1996), the function $q_j(Q)$ is well defined and continuous.

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

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

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

4.2. The Simulations

The equations that characterize the equilibrium are a set of the best responses of the firms and, given the aggregate supply of the farmers, market clearance (total farm supply of raw inputs equal to total firm demand of raw inputs). The solution to this problem has to be found numerically and we used Matlab routines to do this.

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 (see section 2) 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 4.1.[4]

Table 4.1: 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:

[4] 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.

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

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. These market shares were described in detail in section 3. 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, $\boldsymbol{sh}_j$, so $q_j = \boldsymbol{sh}_j \cdot Q$ 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 (country-crop pair, as in section 2). 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 $j \in n$ (now the number of firms can be different from that in the baseline case, depending on the simulation performed).

The simulations are designed to compute different changes in farm-gate prices in different scenarios. These price changes feed into the poverty analysis of section 5. However, the theoretical model can be used to preliminary assess changes in farmer's utility and in industry profits. To explore changes in utility, note that the individual indirect utility function is

$$\begin{aligned} e \leq \hat{e}(p) &\Rightarrow V_{NP}(e;p) = e^{\alpha}c^{1-\alpha} \\ e \geq \hat{e}(p) &\Rightarrow V_P(e;p) = \frac{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}{p^{\alpha}(pe+c)} \end{aligned}$$

So, average utility is

$$\begin{aligned} \overline{V} &= \int_{\underline{e}}^{\bar{e}} V(e,p)f(e)de \\ &= \int_{\underline{e}}^{\hat{e}} V_{NP}(e;p)f(e)de + \int_{\hat{e}}^{\bar{e}} V_P(e;p)f(e)de \\ &= \int_{\underline{e}}^{\hat{e}} e^{\alpha}c^{1-\alpha}f(e)de + \int_{\hat{e}}^{\bar{e}} \frac{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}{p^{\alpha}(pe+c)f(e)de} \end{aligned}$$

Individual profits are

$$\pi_j = \left(P - p^s(Q) - c_j^p\right) q_j$$

Total profits are $\sum_{j=1}^{n} \pi_j$, thus average profits are equal to $\sum_{j=1}^{n} \frac{\pi_j}{n}$.

4.3. Simulation Results

We investigate 12 case studies in the book and, as we just explained, we run a total of 7 simulations for each case study.[5] The results farm gate prices, quantities, utility, and total and average industry profits are reported in Tables 4.2a and 4.2b.

[5] We have 7 additional simulations in the model with outgrower contracts. See sections 4.4 and 4.5 below.

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

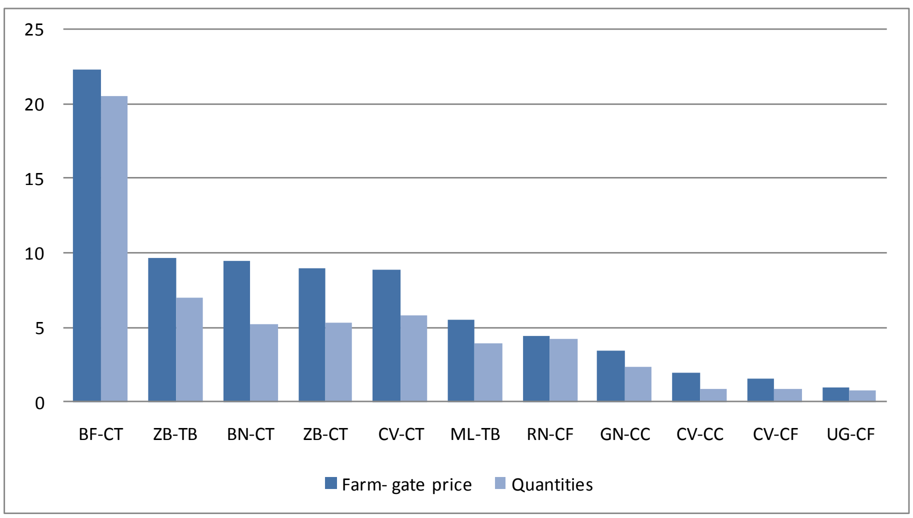
Table 4.2b
SIMULATIONS - BASIC MODEL
(% changes)

	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 (see Sections 4.4 and 4.5).

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 4.1 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 4.1. Changes in Farm-gate Prices and Quantities: Leader Splits Simulations

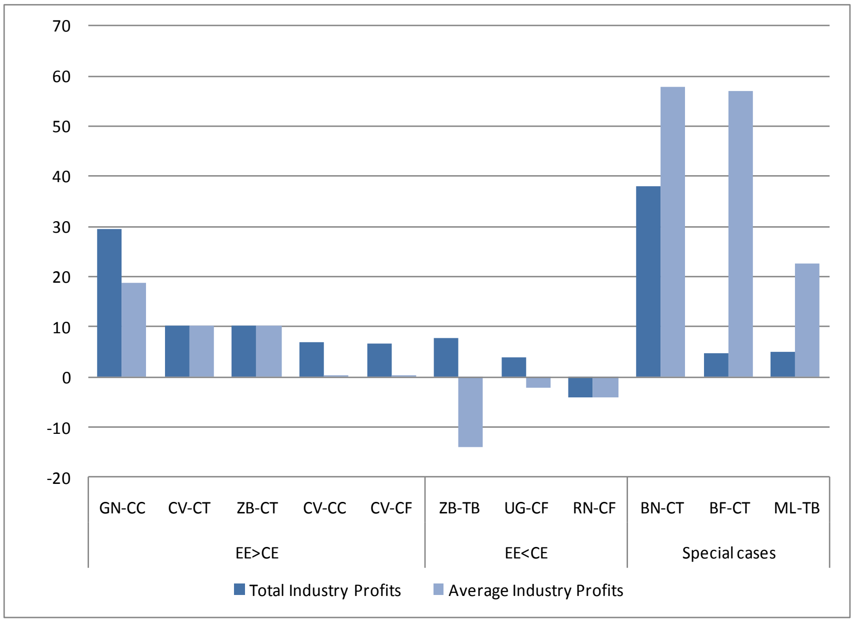


The impact of higher prices on welfare is positive, both for producers and for non-producers (some of whom become producers). In Zambia, the average utility gain of cotton producers is equal to 1.56 percent. At the same time, the increase in prices makes cotton production more profitable for the marginal farmer and this triggers a supply response. This supply response is, however, small. In the end, the increase in utility for the average non-producer is only 0.06 percent. 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. The unconditional change in total utility is a weighted average of changes in utility for producers and non-producers. Given the low participation rate in cotton, this increase is equivalent to only 0.11 percent of pre-shock average utility.

In principle, the change in profits in the Leader Split simulation is ambiguous. There are three different discernable patterns (Figure 4.2). 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. Note that this is a compositional effect.

Figure 4.2. 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 (of producers, non-producers and switchers) 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; total average utility, by only 0.1 percent, and the average utility of the producers by a meager 0.17 percent. These are, by and large, negligible impacts. Note, however, that while the utility of the switchers increases significantly, by over 26 percent, there are only very few switchers.

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. Note that, in practical terms, this simulation is equivalent to the elimination of the second largest producer. 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. Total average utility is just a weighted average of these changes in utility. In the Zambia-cotton example, farm gate prices fall by 8.59 percent, the average utility of cotton producers, by 3.28 percent, the average utility of the switchers, by 20.24 percent, and total average utility is reduced by only 0.10 percent.

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 (with marginal costs that are close to those of the leader), 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 (compared to the leader), 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 tends 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 (in practice, the elimination of the second largest firm) more than compensates for the pro-competitive effect of a small entrant. It follows that the impact on prices, quantities and profits are negative.[6] For instance, in the Zambian cotton case,

[6] Note that the effect of this simulation is not the sum of "leader splits" and "small entrant."

prices fall by 6.22 percent and total average utility decline by 0.07 percent. However, the utility of cotton producers drops by 2.38 percent and the utility of the switchers drops by 20.24 percent. Since prices are going down, the utility of non-producers is not affected.

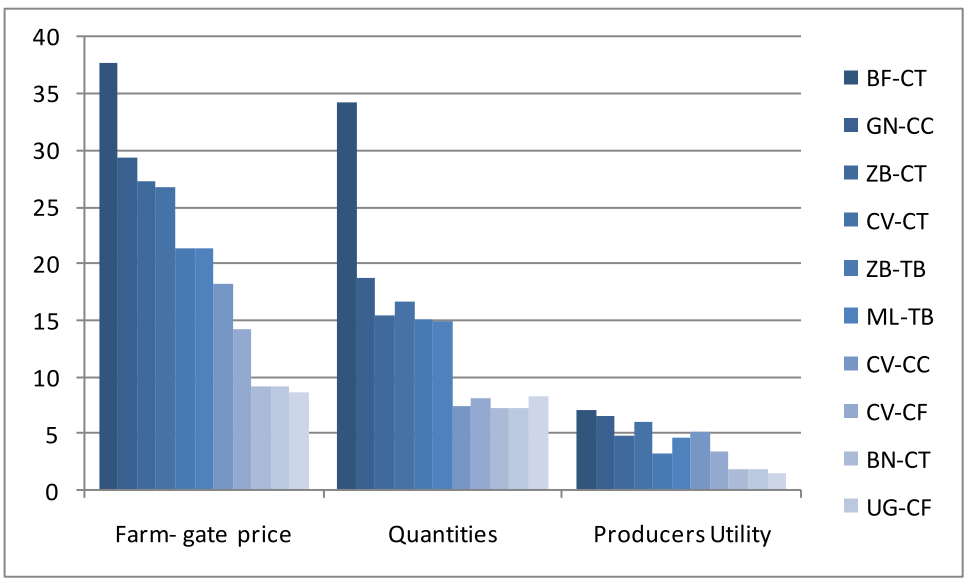
This simulation delivers interesting results when we look at profits. In three cases, average and total profits increase. This is because the incumbent firm that merges with the leader is actually similar (in terms of costs and market shares) as the third largest firm (which now becomes the second firm 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. Total average utility, the average utility of the producers, and the average utility of the switcher decline (by 0.14, 4.51, and 20.25 percent, respectively, in the Zambian cotton case). The utility of the non-producers remains unchanged.

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 (because only four firms remain and two of them have similar marginal costs as the one that left the market) 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. A summary of results is reported in Figure 4.3. For example, in the Zambia cotton case, prices increase by 27.21 percent, total average utility, by 0.34 percent, the average utility of the producers, by 4.89 percent, and the average utility of the switchers, by 26.78 percent. In the majority of the case studies, profits fall because the competition effect is stronger than the efficiency effect (as the number of firms remains unchanged, average and total profits show the same proportional change). In our leading-case, Zambia-Cotton, profits decline by 1.33 percent.[7]

Figure 4.3. Farm-gate Prices, Quantities, and Utility: Equal Market Shares



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

[7] There is only one case, Zambia-Tabacco, where the efficiency effect is stronger and total and average profits increase by 11.26 percent.

scenario can only be hypothetically realized, it nevertheless provides an interesting baseline for comparison purposes.

4.4. Outgrower Contracts: Theory

In this section, we extend our standard model to include outgrower contracts. We first solve the model with this addition and we later explain how to adapt the simulations to deal with these issues. To allow for the possibility of a liquidity constraint affecting the home-market decision, we re-write the farmer's problem as follows

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

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

$$h \geq \mathbf{0}$$

$$m \geq \mathbf{0}$$

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

$$r = r(r^*, s\boldsymbol{h}_1, \dots, s\boldsymbol{h}_n, J)$$

The interest rate depends on the exogenous cost of funds for the firms r^*, the number of firms n, the share of each firm $s\boldsymbol{h}_j$ 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

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

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. Yet in other words, let us say we have symmetry and two firms and symmetry and five firms. Clearly, the interest rate should be different in these two scenarios.

In the end, we assume that

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

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

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

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 $\boldsymbol{sh}$ 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

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

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

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

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

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

By using this system of non linear equations all variables are identified at the same time. With this model in mind, we run again the simulations to see how the results are affected by the existence of outgrower contracts. We discuss these results next.

4.5. 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. For this reason, in this section we briefly focus on how different market structures affect farm-gate prices and interest rates. Results are reported in Tables 4.3a and 4.3b for all the endogenous variables of the model. As before, here we use summary graphs to illustrate the results.

Table 4.3a
SIMULATIONS - OUTGROWER 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	8,93	1,01	-6,22	-8,62	-11,84	27,28	71,64
Quantities	5,24	0,54	-3,85	-5,21	-7,59	14,85	35,32
Utility	0,09	0,01	-0,06	-0,08	-0,13	0,26	0,75
Total Industry Profits	10,19	-3,93	-7,65	-0,10	-22,38	-1,93	-100,00
Average Industry Profits	10,19	-19,94	-7,65	24,87	-2,98	-1,93	-100,00
Interest rate	1,82	1,67	-1,26	-5,37	0,38	11,01	11,01
BENIN - COTTON							
Farm- gate price	9,13	0,25	-1,45	-1,91	-10,46	57,47	97,39
Quantities	5,23	0,13	-0,76	-0,99	-6,83	26,25	40,56
Utility	0,26	0,00	-0,03	-0,04	-0,33	1,38	2,42
Total Industry Profits	39,94	-0,97	2,85	4,56	-64,27	-15,58	-100,00
Average Industry Profits	39,94	-11,97	2,85	19,50	-59,16	-15,58	-100,00
Interest rate	-5,69	0,43	-1,71	-2,49	17,67	19,35	19,35
BURKINA FASO - COTTON							
Farm- gate price	19,64	1,01	-1,25	-3,28	-27,80	37,93	89,38
Quantities	16,77	0,68	-0,88	-2,25	-25,46	30,40	71,41
Utility	0,12	0,00	-0,01	-0,01	-0,21	0,21	0,54
Total Industry Profits	13,71	-2,81	2,68	8,22	-65,40	-13,19	-100,00
Average Industry Profits	13,71	-27,11	2,68	62,33	-48,10	-13,19	-100,00
Interest rate	26,35	5,63	-6,28	-18,47	-50,26	67,13	67,13
COTE D`IVORE - COTTON							
Farm- gate price	8,86	0,76	-5,44	-7,40	-11,46	26,85	67,20
Quantities	5,68	0,44	-3,59	-4,79	-8,01	16,08	37,17
Utility	0,14	0,01	-0,09	-0,11	-0,19	0,42	1,11
Total Industry Profits	10,24	-3,27	-3,49	3,54	-24,63	-1,17	-100,00
Average Industry Profits	10,24	-19,39	-3,49	29,43	-5,79	-1,17	-100,00
Interest rate	1,85	1,35	-2,17	-5,79	1,29	10,84	10,84

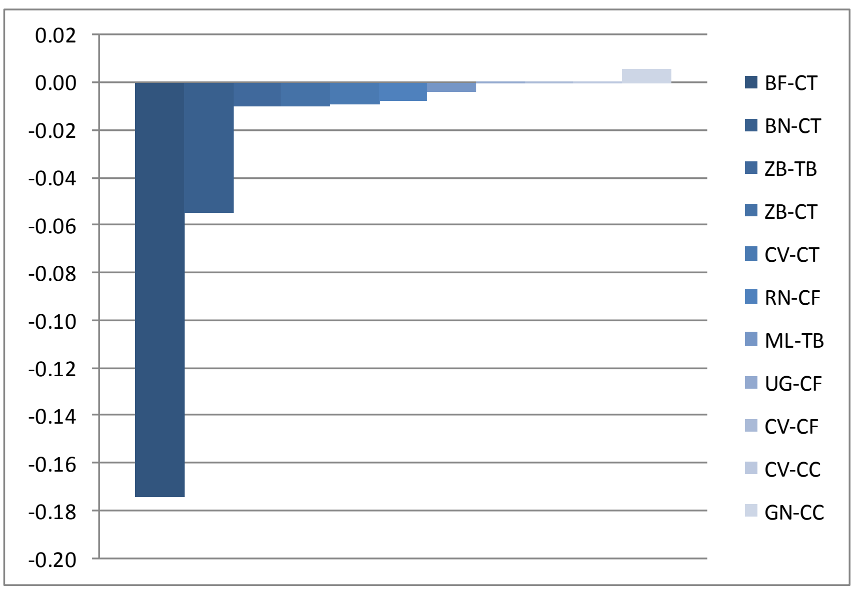
	Three firms	Four firms	Small entrant with half of the benefits
MALAWI - COTTON			
Farm- gate price	12,25	19,77	6,16
Quantities	9,80	15,75	4,49
Utility	-1,01	0,20	0,06
Total Industry Profits	-16,27	-28,59	-17,27
Average Industry Profits	-44,18	-64,29	-44,84
Interest rate	22,22	33,33	17,38

Table 4.3b
SIMULATIONS - OUTGROWER 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	18,25	37,21
Quantities	0,86	0,15	-0,49	-0,70	-0,98	7,37	14,04
Utility	0,14	0,02	-0,08	-0,11	-0,15	1,23	2,53
Total Industry Profits	6,97	-2,92	-3,38	0,15	-8,67	-1,34	-100,00
Average Industry Profits	0,29	-8,99	-3,38	7,30	-2,14	-1,34	-100,00
Interest rate	-0,22	0,23	0,09	-0,20	0,33	1,77	1,77
GHANA - COCOA							
Farm- gate price	3,43	0,28	-1,05	-1,47	-4,01	29,28	47,48
Quantities	2,49	0,18	-0,71	-0,97	-3,02	18,40	28,71
Utility	0,06	0,00	-0,02	-0,02	-0,08	0,47	0,78
Total Industry Profits	29,64	-2,19	0,68	3,73	-37,73	-7,41	-100,00
Average Industry Profits	18,84	-10,34	0,68	14,10	-31,50	-7,41	-100,00
Interest rate	-2,63	0,34	-0,34	-0,83	4,02	5,41	5,41
COTE D`IVORE - COFFEE							
Farm- gate price	1,52	0,29	-1,47	-1,08	-1,70	14,26	27,57
Quantities	0,91	0,16	-0,88	-0,66	-1,04	8,00	14,91
Utility	0,04	0,01	-0,04	-0,03	-0,05	0,37	0,73
Total Industry Profits	6,80	-2,97	-3,23	-6,90	-8,26	-5,98	-100,00
Average Industry Profits	0,12	-9,03	3,69	-6,90	-1,71	-5,98	-100,00
Interest rate	-0,25	0,23	0,03	0,33	0,34	1,77	1,77
RWANDA - COFFEE							
Farm- gate price	4,48	0,57	-4,25	-5,85	-6,11	8,72	31,91
Quantities	3,17	0,46	-4,00	-5,33	-5,15	7,88	28,87
Utility	0,03	0,00	-0,05	-0,06	-0,06	0,08	0,28
Total Industry Profits	-5,03	-4,01	-4,98	4,18	3,00	-4,67	-100,00
Average Industry Profits	-5,03	-20,00	-4,98	30,22	28,75	-4,67	-100,00
Interest rate	13,89	1,10	-0,92	-3,95	-9,80	4,34	4,34
UGANDA - COFFEE							
Farm- gate price	0,96	0,14	-0,66	-0,85	-1,08	9,17	17,89
Quantities	0,78	0,10	-0,53	-0,68	-0,88	7,06	13,63
Utility	0,01	0,00	-0,01	-0,01	-0,01	0,09	0,18
Total Industry Profits	3,95	-2,11	-2,36	0,44	-4,72	-14,50	-100,00
Average Industry Profits	-2,16	-7,87	-2,36	7,13	1,64	-14,50	-100,00
Interest rate	-0,12	0,15	0,06	-0,14	0,16	1,79	1,79
MALAWI - TOBACCO							
Farm- gate price	5,16	0,14	-4,37	-5,12	-6,00	21,43	46,12
Quantities	3,34	0,09	-3,29	-3,78	-4,55	14,36	29,94
Utility	0,06	0,00	-0,07	-0,08	-0,09	0,30	0,69
Total Industry Profits	6,84	-0,89	-10,37	-6,45	-15,98	-15,12	-100,00
Average Industry Profits	6,84	-13,28	-10,37	9,14	-1,98	-15,12	-100,00
Interest rate	7,16	0,24	0,54	-0,79	1,01	10,27	8,65
ZAMBIA - TOBACCO							
Farm- gate price	9,65	2,21	-3,44	-7,38	-13,90	21,46	64,45
Quantities	6,77	1,41	-2,44	-5,03	-10,54	14,60	40,86
Utility	0,07	0,01	-0,03	-0,05	-0,13	0,14	0,37
Total Industry Profits	7,44	-8,18	0,08	12,73	-21,07	10,72	-100,00
Average Industry Profits	-14,05	-26,54	0,08	50,30	5,23	10,72	-100,00
Interest rate	3,18	3,71	-2,22	-9,50	-1,90	7,52	7,52

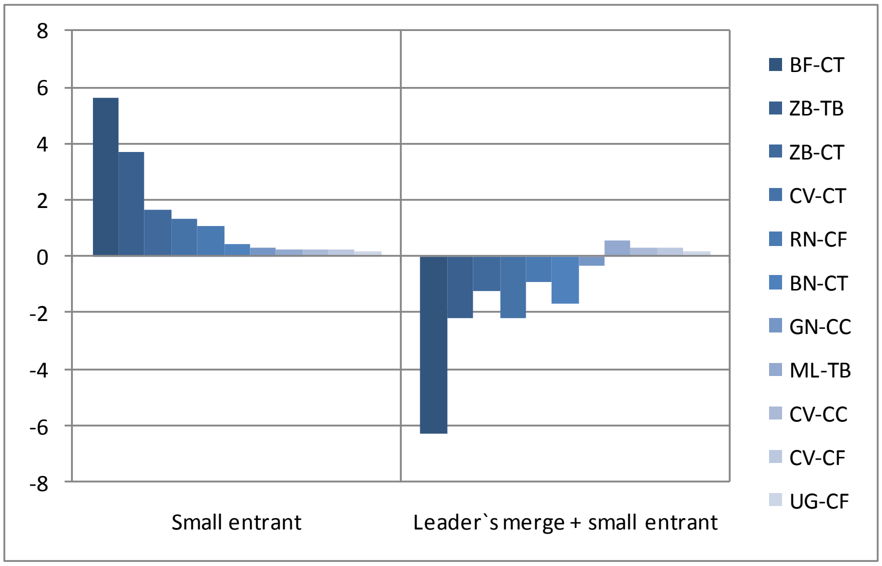
In Figure 4.6, we plot the differences in the proportional change in farm-gate prices between the standard model and the model with outgrower contracts for the *Leader Splits* simulation. Interestingly, we find that the differences in the price effects are tiny. Specifically, they are never larger than 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 4.6. 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 4.7 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 4.7. Changes in the Interest Rate



5. 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. In the end, we have 14 simulations with 14 corresponding changes in farm gate prices, the main variable of interest for our analysis.

We now want to use these prices changes, and the household survey data described in section 2, 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 (see section 5.1), 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, a distinction that will help us understand under which circumstances commercial agriculture can work as an effective vehicle for poverty alleviation. We also explore gender issues by looking at results for male- and female-headed households and advance some explanations for any potential differential impacts.

In section 5.2, we present the welfare implications of our simulations for each of the twelve country-crop case studies. Rather than providing a detailed discussion of the 14 simulations per case study, we focus, as in section 4, 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. We present all the tables with the simulation results for the interested reader.

5.1. The Methodology

Our task is to estimate the welfare effects of the changes in farm-gate prices and in input costs due to changes in the conditions under which outgrower contracts are implemented. We adopt the standard first order approach advanced by Deaton (1989a).[8]

5.1.1. Calculation of Income Changes *without* Outgrower Contracts

To derive the formulas that we need for the poverty analysis, we start from the income-expenditure equality. This equation just indicates that, in equilibrium, expenditures need to be covered with income (we can allow for transfers, savings, and so on). Suppose for simplicity that the farmer produces only two crops, the exportable crop q_1 and the subsistence crop q_2. Then we can write:

(1) $$p \cdot c + r_1 v_1 = p_1 q_1 + p_2 q_2 + x_0 .$$

In (1), $r_1 v_1$ is the "expenditure" in investment in sector 1 (we could also include a similar term for the second crop, but we do not need it for the analysis). The term $r_1 v_1$ includes expenditures in seeds, fertilizer, pesticides, and so on. The term $\boldsymbol{p \cdot c}$ is total expenditure in goods and services. Finally, $p_1 q_1$ and $p_2 q_2$ are gross income from sales of product 1 and 2, respectively and x_0 is an exogenous source of income.

[8] This approach has been extensively utilized in the literature. Early examples include Deaton (1989b), Budd (1993), Benjamin and Deaton (1993), Barret and Dorosh (1996), and Sahn and Sarris (1991). More recent examples include Ivanic and Martin (2008) and Wodon et al. (2008). Deaton (1997) provides an account of the early use of these techniques in distributional analysis of pricing policies.

We are first interested in studying the first order effect assuming no changes in production costs. The welfare effect of a price change is defined as $-dx_o/y$, where $y=p_1q_1+ p_2q_2$. Assume there is an increase in p_1, keeping v_1 and p_2 constant for the moment. We then have:

$$-\frac{dx_0}{y} = s_1\, d\ln p_1$$

This means that the proportional change in income dy/y is the product of the income share s_1 and the proportional change in prices (these are the price changes from the different simulations in the previous chapter). For example, if a household earns 50 percent of its income from cotton and the price of cotton increases by 10 percent, then the impact effect for the household would be equivalent to 5 percent of its initial income.

5.1.2. Calculation of Income Changes *with* Outgrower Contracts

The model is the same as above:

$$p \cdot c + r_1 v_1 = p_1 q_1 + p_2 q_2 + x_0$$

The difference is that now when there is a change in the supply chains, there are effects on output prices p_1 and also on the interest rate charged on inputs. Input expenditures are r_1v_1, which in turn we assume equals a fraction δ of sales p_1q_1

$$r_1 v_1 = \delta p_1 q_1$$

As in the theoretical model, we will now assume that farmers finance a fraction λ of their expenditures in inputs with outgrower contracts. This means that the amount being financed is

$$\lambda r_1 v_1 = \lambda \delta p_1 q_1$$

The farmer needs to pay interest on this equal to $r\lambda\delta p_1 q_1$. Hence,

$$p \cdot c + r_1 v_1 + r\lambda r_1 v_1 = p_1 q_1 + p_2 q_2 + x_0$$

To calculate the welfare effects, allow changes in p_1 and in r

$$-\frac{dx_0}{y} = s_1\, d\ln p_1 - \delta\lambda s_1\, d\ln r$$

5.2. Welfare simulations

In this section, we study the poverty impacts of changes in the supply chain in the 12 case studies. To do this, we plug the farm-gate price changes generated by each of the 14 simulations of Section 4 in the formulas derived above. Tables 5.1a and 5.1b present household income changes for those households that produce at least one of the crops in the analysis[9]. We present the income effect on all producers and in poor vis a vis non poor households and on male- versus female-headed households. Tables 5.2a and 5.2b present the same results but for the model with outgrower contracts. 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.

[9] The results for the whole population (producers and non producers) were not included to save space but are available upon request.

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

5.2.1 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.

5.2.1.1 Baseline Model

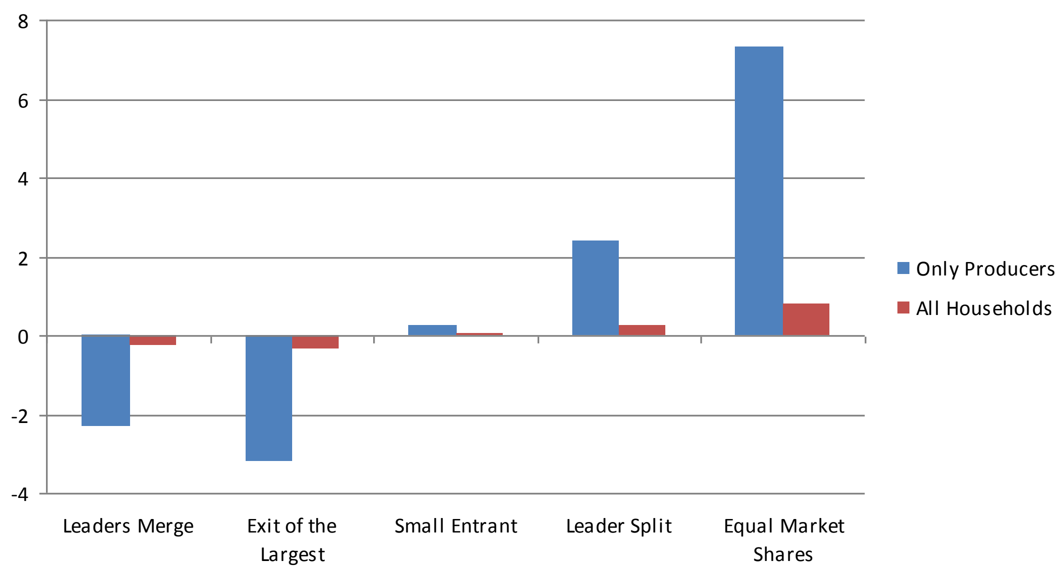
The simulation exercise in the previous section showed that the change in farm-gate cotton prices ranged from -11.84 percent (in the case of exit of the largest firm) to 71.64 percent (in the case of perfect competition). The overall impact of these prices changes on average household income depends 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 (the leader firm) 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.

Figure 5.1: Income effects Producers vs All Households in Cotton-Zambia



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 (see for example Cadot et al (2009), McMillan et al (2003), Heltberg and Tarp (2002), Key et al (2000), and Lopez et al (1995)).

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. It should be mentioned that we are not considering second order effects to have a different impact based on gender considerations.[10]

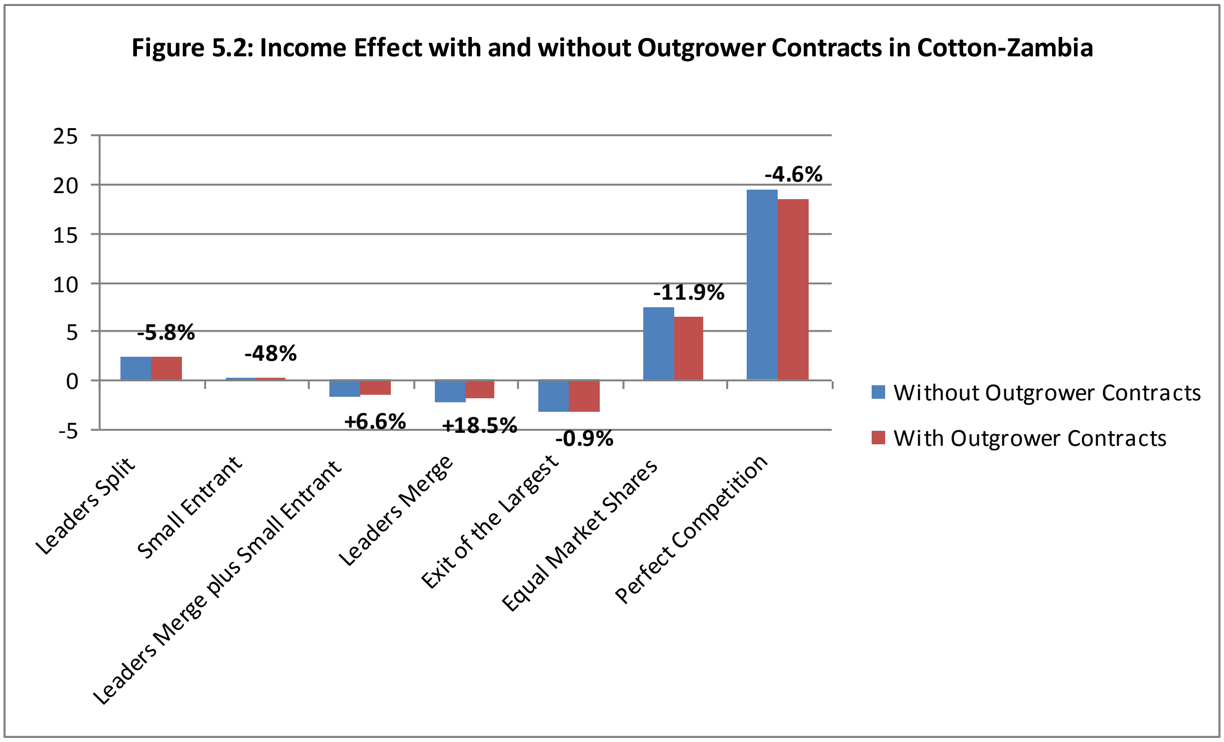
5.2.1.2 Outgrower Contracts

[10] This is a simplification of the model, which, once again, it is driven by data constraints. Note that the literature points out several constraints that affect particularly female farmers and their ability to improve yield, profit, and efficiency in agriculture production. Some of these constraints are women's legal and cultural status, which affects the degree of control women have over productive resources, inputs, and the benefits which flow from them (Olawoye, 1989); property rights and inheritance laws, which govern access to and use of land and other natural resources (Jiggins, 1989a); the relationship among ecological factors such as the seasonality of rainfall and availability of fuelwood, economic factors such as product market failures, and gender-determined responsibilities such as feeding the family, which trade off basic household self-provisioning goals and care of the family against production for the market (Jiggins, 1989b; Horenstein, 1989); and the way that agricultural services are staffed, managed, and designed (FAO, 1993; Saito and Weidemann, 1990; Gittinger et al, 1990). Given these constraints changes in the level of competition and complementary policies may have different effects among female farmers.

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.

In the simulations that we implemented above, 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 (Brambilla and Porto, 2010; Tschirley and Kabwe, 2007; Tschirley, Poulton and Labaste, 2009) and these implications should thus be taken into account when designing competition policies in the Sub-Saharan cash-crop sector.



5.2.2 Other case studies

5.2.2.1 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.

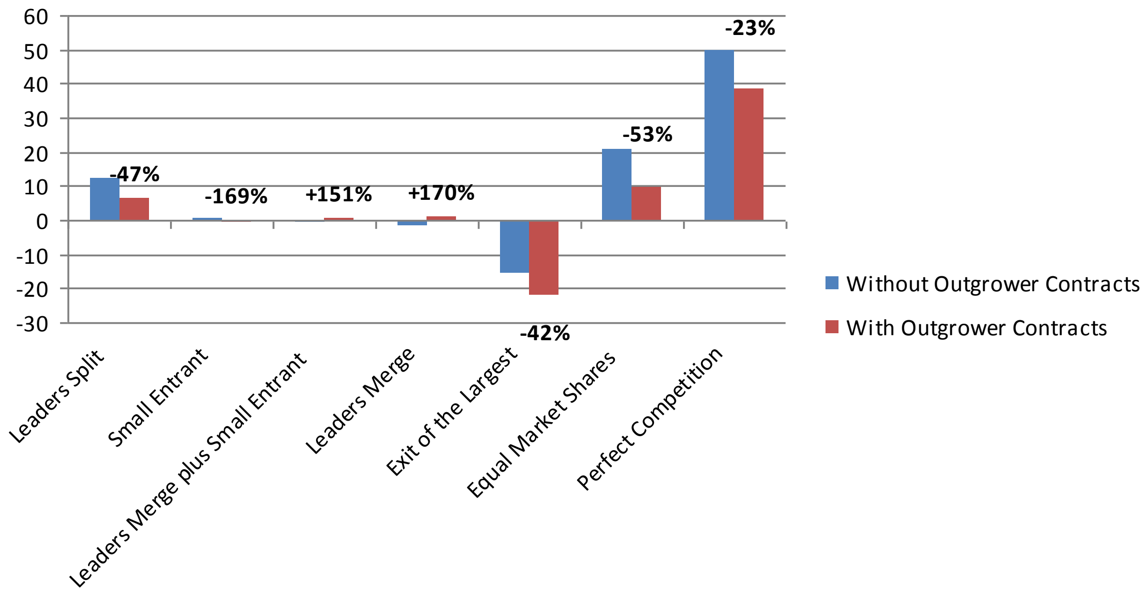


Figure 5.3: Income Effect in Basic Model with and without Outgrower Contracts in Cotton-Burkina Faso

5.2.2.2 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. In our standard scenario, equal market shares would lead to an increase in income of 10.5 percent in Cote d'Ivoire and 7.3 percent 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. The only significant difference with the cotton cases reviewed above is observed in the leader splits case, where the interest rate decreases rather than increases. As a result, households enjoy larger (net) income gains in the model with outgrower contracts. This difference is somehow important in the case of Ghana.

5.2.2.2 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. The interested reader could check the specific results in Table 5.2b.

5.2.2.2 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.

5.3. Summary of findings

In this section we studied the effects on households' income of increasing competition among processors in twelve case studies covering four cash crops in eight Sub-Saharan African countries. 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. Take for instance the case where the firm with the largest market shares splits. This would lead to an average income increase for producing households of 2.8 percent in our case studies. This average however masks a great variability with cotton producing households as the top earners and the smallholders in the coffee sector with the lowest gains. For instance, in our baseline model, the leader split simulation would increase average households' income in cotton in Burkina Faso by 12.4 percent but only 0.1 percent in coffee in Uganda. This does not come as a surprise however, as the leading firm in cotton in Burkina Faso controls 85 percent of the market but only 14.3 percent of the market in the case of coffee in Uganda. Another interesting simulation showing an increase in competition is the case of "equal market shares". This would give us the upper bound increase in income under imperfect competition. Here the average effect is much larger than in the case of leader split. The average producing household in our study would see their income grow by 9.1 percent with cotton in Burkina Faso once again the largest impact with 20.9 percent followed by Benin with 20.1 percent and Cote d'Ivoire 14 percent increase, both in cotton. At the other end of the spectrum, the average household gains less than 1 percent in the equal market shares simulation in coffee in Uganda and Rwanda.

The conclusion from the previous paragraph that an increase in competition among processors is good for the farmers needs to be put into perspective. One of the findings from our simulations is that small changes to the level of competition are unlikely to have significant effects on farmers' livelihood. This is capture by the small entrant simulation. Under this scenario, households' income only increases by an average of a quarter of a percentage point for our cases studies. The largest effects for this simulation are observed in cotton in Malawi (0.94 percent) and tobacco in Zambia (0.74 percent).

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. In the first simulation, the average lost for producing households is 1.3 percent of their income, with the largest lost registered in the case of cotton in Cote d'Ivoire (3.8 percent) where the new firm would control three quarters of the market. In the exit of the largest firm simulation, the worst income lost for producing households would take place in the cotton sector of Burkina Faso where the disappearance of SOFITEX that controls 85 percent of the market would lead to a decrease in their income of 15.4 percent. On the other hand, the reduction in competition coming from these two simulations would affect the least the average producing household in the coffee sector in Uganda where the lost would be only around a tenth of a percentage point in both simulations.

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. 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. 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. The largest differences among genders were registered in Burkina Faso cotton were male-headed households received 217 percent more income increase than female-headed households and in Benin cotton were female-headed households received a 57 percent more than the male equivalent. 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. In this last case study, the merging of the largest two firms would reduce farmers' income by 1.8 percent in the basic model without outgrower contracts but it would actually increase it by 1.3 percent in the model with these types of contracts. This is an atypical case where less competition is better for smallholders.

Three of the countries in our study have more than one case study. In Cote d'Ivoire we study cotton, coffee, and cocoa. In Malawi and Zambia we cover both cotton and tobacco. It is interesting then to describe how the same scenario and simulation has different effects across crops in the same country. For instance, in Cote d'Ivoire, an increase in competition has a larger effect on producing households' income in cotton than in cocoa and coffee. If the leader firm in cotton, cocoa, and coffee were to split, the effect on income would be a 4.6, 1.1, and 0.6 percent increase respectively. In the case of equal market shares, the increase in households' income would be 14, 10.5, and 5.4 percent respectively. The effect is also different for poor versus non poor household and across gender depending on the crop. Competition in coffee benefits more poor and male-headed households while in cotton female-headed and non poor households are the ones that obtain larger gains. In cocoa, competition benefits male-headed households slightly more while the effect is about the same among poor and non poor households. In Malawi we cannot directly compare the results from the cotton and tobacco simulations, since the latter are slightly different to the standard simulation we run for all the other case studies. However, the overall effects seems to be about the same magnitude and in both crops male and non poor households benefit the most from the increase in competition. Finally, in Zambia, the effect of competition has similar quantitative effects in cotton and tobacco. The leader split case would increase households' income 2.4 percent in cotton and 3.2 percent in tobacco, while the equal market share case would generate a growth in income of 7.3 percent in cotton and 7.2 percent in tobacco. In both crops male-headed households benefit the most, though only slightly in the case of cotton. Poor producing households gain more in cotton while non poor benefit more in the case of increasing competition among tobacco exporters.

6. Conclusions

In this paper we developed a game-theory model of supply chains in cash crop agriculture between many atomistic smallholders and a few exporters to study how the internal structure of export markets and the level of competition affect poverty and welfare in remote rural areas in Africa. The model allows us to predict, among other variables, farm gate prices for cash crops under different competition scenarios. We combine those price changes with household data to estimate income effects at the farm level. We investigate 12 case studies covering four crops and eight Sub Saharan African countries. We study 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.

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 (for example, the entry of a new small firm) 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.

Most of the issues discussed in the previous paragraph could be somehow incorporated in a richer model. However a further difficulty will have to do with the availability of detailed data to be able to run those complex simulations. We hope to address some of these issues in future work.

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