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Measuring the Impact of a Change in the Price of Cashew Received by Exporters on Farmgate Prices and Poverty in Guinea-Bissau

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Abstract

This paper assesses the impact of a change in the price of cashew received by exporters in general—and by FUNPI, a fund to promote the industrialization of agricultural products, in particular—on farmgate prices and poverty in Guinea-Bissau. The analysis builds a theoretical model of supply chains in export agriculture that includes exporters, traders, and farmers competing in a bilateral oligopoly fashion. The model is adapted to data from the country's cashew sector and a household survey. Given the market structure, a shock on export prices or the introduction of an export tax, such as the FUNPI contribution, has a strong effect on farmgate prices, as farmers absorb about 80 percent of the tax (while exporters take up 13 percent and traders absorb the remaining 7 percent). The effect is uneven across households, as poor rural households are more exposed to price volatility and most cashew farmers are poor. It is estimated that their income falls by 12 percent as a result of the FUNPI contribution. Complementary policies can overcome the effect of the FUNPI surcharge on farmgate prices by aiming for reductions in transport, infrastructure, and transaction costs for traders and exporters. Fostering cashew processing would create added value through a displacement of volume from exporters to processors. The analysis finds it implausible that, under reasonable assumtions, a subsidy would overturn the welfare costs of the FUNPI contribution.

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Produced by the Research Support Team

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1. Introduction

In a context of high global cashew prices and tight budget constraints, the Government of Guinea-Bissau introduced a surcharge on raw cashew exports, which came into effect in early May of 2011. This surcharge is designed to generate revenue for a concurrently-created Fund to Promote the Industrialization of Agricultural Products (*Fundo de Promoção à Industrialização de Produtos Agricolas,* FUNPI). The main objective of FUNPI is the support of the agro-industry, and specifically of the cashew processing industry. As argued in the 2011 draft Country Economic Memorandum, Guinea-Bissau needs to find efficient instruments to promote cashew processing as a way to promote value-added, to create jobs and to reduce poverty. However, the current surcharge can negatively affect poor farmers through lower farm-gate prices (while generating a large fund outside the budget with uncertain governance mechanisms). While the nominal farm-gate prices rose during recent years due to extremely high world prices, there is a general concern about the potential poverty impact of the tax in the presence of reduced world prices.

This paper assesses the impact of a change in the price of cashew received by exporters in general –and FUNPI in particular– on farm-gate prices and on poverty in Guinea-Bissau. In order to pursue this, we design a theoretical model of supply chains in export agriculture with three players – exporters, traders, and farmers– competing in a bilateral oligopoly fashion, adapted so that cashew processors interact as buyers in the final stage of the value chain. Then, we calibrate the model with data from the Bissau-Guinean cashew sector (to represent the market) and micro-level surveys (to study poverty). We use this model to answer four questions. First, we analyze the effect of i) a standard shock to export prices and ii) a tax on cashew exports on margins along the value chain, and within farmers along the income distribution. Second, we simulate the effects of increasing prices (either because of global shocks or of a tax like FUNPI), combined with improvements in competition in cashew trading. Third, given that one of the government's goals is to stimulate cashew processing in Guinea-Bissau by using part of the raw cashews export tax revenues, we explore the impacts of an interaction between the FUNPI contribution and an increase in processing capacity. Fourth, we investigate the impacts an interaction between the FUNPI tax and the provision of services to farmers (for example, cash transfers to finance inputs such as seeds, fertilizers, etc.).

The paper is organized as follows. Section 2 presents some details on the cashew sector in Guinea-Bissau. Section 3 introduces a new model that captures interactions of bilateral oligopoly-like transactions among farmers, traders and exporters. This model is calibrated to the cashew sector in Guinea-Bissau and is used to run simulations, which are presented in Section 4. Section 5 analyzes the effects of FUNPI contribution and complementary policies on poverty using household survey data. Finally, Section 6 summarizes our findings and presents the policy implications.

2. The cashew sector in Guinea-Bissau

Guinea-Bissau (GNB) is a tropical country located in West Africa, bordering Senegal (north) and Guinea (east and south). It covers 36,125 sq km with a population of over 1.5 million inhabitants (42 people/sq km). The country is one of the largest world producers of raw cashew, together with India, Vietnam, Brazil and Côte d'Ivoire. Raw cashew products represent about 90 percent of total exports, and are destined to India, Vietnam and Brazil. About 80 percent of the population is linked to this sector.

According to Comissão Nacional de Caju - CNC (2012), annual production capacity is estimated at 200,000 tons of cashew nuts and 1.5 million tons of cashew apples. Production is scattered throughout the country (small producers represent 85 percent of total production). On the other hand, raw cashew nuts can be processed to get cashew almonds, with an approximate yield of 20-28 percent for kernels and 72-80 percent for shells. But the activity is underdeveloped in GNB. In 2011, the processing activity restarted operations after a shut-down period but still could not take off. Only 2,000 tons of raw cashew nuts were processed in 2013.

Table 1 summarizes the situation in the cashew sector as of 2013. GNB exported 138,000 tons of cashews, which together with the reserved stock for processing (2,000 tons) represented about 70 percent of total estimated production of 200,000 tons. The remaining 60,000 tons were traded in the informal market (smuggling) or correspond to missed market opportunities.

Table 1. Summary of cashew sector, year 2013 (in '000 tons)

Estimated production	200.0
Exports	138.0
Stock for local processing	2.0
Exports + local processing	140.0
Estimated illegal trade – missed opportunities	60.0

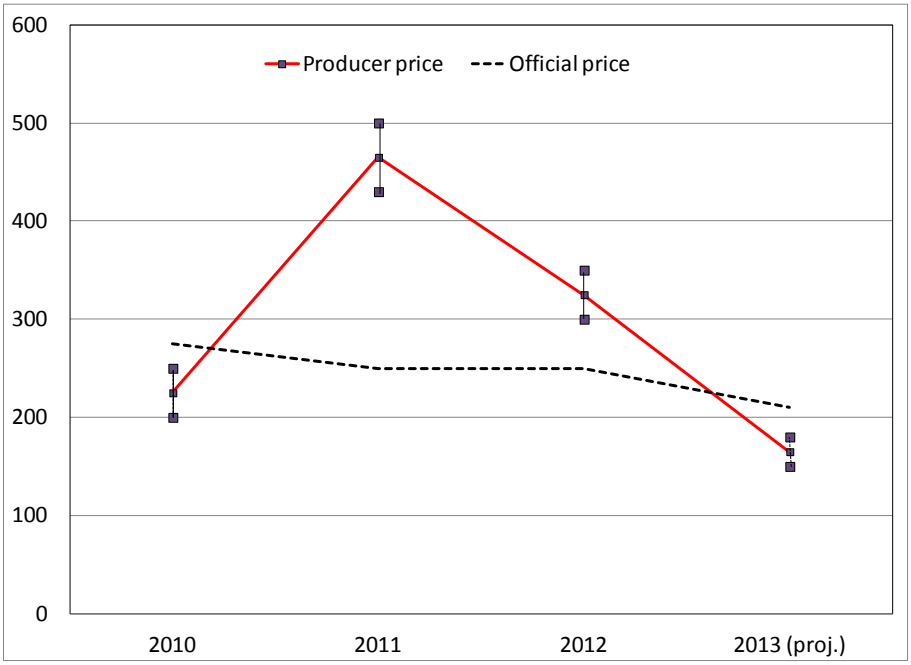
Source: ANCA (2014) and World Bank.

There are five main actors in the cashew supply chain: producers, sub-brokers, traders, exporters and cashew processors. Next, we provide a brief description of each of them.

Producers: Production of raw cashews is atomized, as 85 percent of producers are small units. In 2013, they received approximately 165 XOF/kg of cashews (about 351 USD/ton, using an exchange rate of 470 XOF/USD). Total revenue linked to formal activities reached USD 49.1 millions (USD 48.4 millions from exportable cashews and USD 0.7 millions from cashews sold for processing).

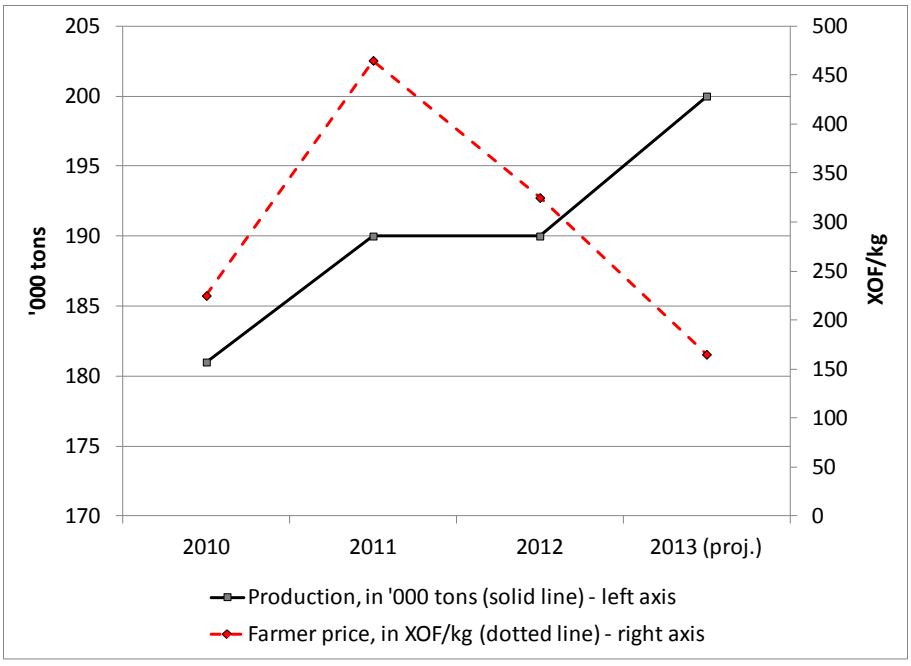
In 2013, the government set a reference price of 210 XOF/kg, which was not binding (unlike the case in 2010). In fact, farm-gate prices went down with international prices in 2012 and 2013, from record levels achieved in 2011 (430-500 XOF/kg).

Figure 1. Evolution of producer price, 2010-2013 (XOF/kg)



Source: World Bank.

Figure 2. Evolution of production, in '000 tons, and producer price, in XOF / kg, 2008-2013



Source: World Bank and IMF.

It should be pointed out that the Agencia Nacional de Cajú - ANCA (2014) expressed concerns about the age of the average plantation (a significant fraction of the cashew trees being over 25 years old) and the presence of pests in some plantations (in Quidamel, Prabis and in the South).

Indeed, pests affected cashew plantations in 2007 but did not affect the 2013 harvest. In this context, access of farmers to inputs (such as seeds and fertilizers) may be important for the development and maintenance of stocks.

Sub-brokers: Sub-brokers (or intermediate traders) are local producers or agents who have established business networks with the producers, to facilitate interaction with traders. There are no statistics on sub-brokers, but the number is large enough not to pose competition concerns (it may range between 1,000 agents and over 5,000 agents depending on the source).

Traders: These agents buy cashew nuts from producers or intermediate traders to sell them to exporters and processors. There are 39 traders in GNB, small in size according to local sources. Assuming an even distribution of market shares among traders (about 2.56 percent each) the concentration in this segment can be summarized by value of the Herfindahl-Hirschmann Index (HHI) equal to 256.

Box 2.1. The Herfindahl-Hirschmann Index (HHI)

The Herfindahl-Hirschman Index (HHI) is a measure of market concentration, equal to the sum of the square of market shares of each firm competing in a market, which is multiplied times 10,000. This way, the index ranges between 0 and 10,000. That is, let s_i be the market share of firm *i*, for *i=1,…,n*. Then

$$HHI = 10{,}000 \times \sum_{i=1}^{n} s_i^2$$

Assume homogeneous goods. For a given demand and cost structure, when there are n symmetric firms, market share is 1/n and HHI =10,000/n. Then, HHI = 10,000 in the case of a monopoly; 2,500 in the case of 4 symmetric firms; 500 in the case of 20 symmetric firms, and so on. In a perfectly competitive market, HHI tends to zero.

When costs are asymmetric, firms with lower marginal cost get higher market share and HHI tend to reflect a concentrated market. To understand this result, assume two symmetric firms, so that their market share is 50 percent and HHI =5,000. Then reduce marginal cost of firm 1 and increase marginal cost of firm 2. Firm 1 will produce more and get a share over 50 percent, while firm 2 will produce less and get a share under 50 percent. HHI will go over 5,000.

A proportional reduction in marginal cost, or a demand increase for a given cost structure, does not change HHI in the symmetric case, but tends to decrease HHI in the asymmetric case because cost differences relative to the market size shrink.

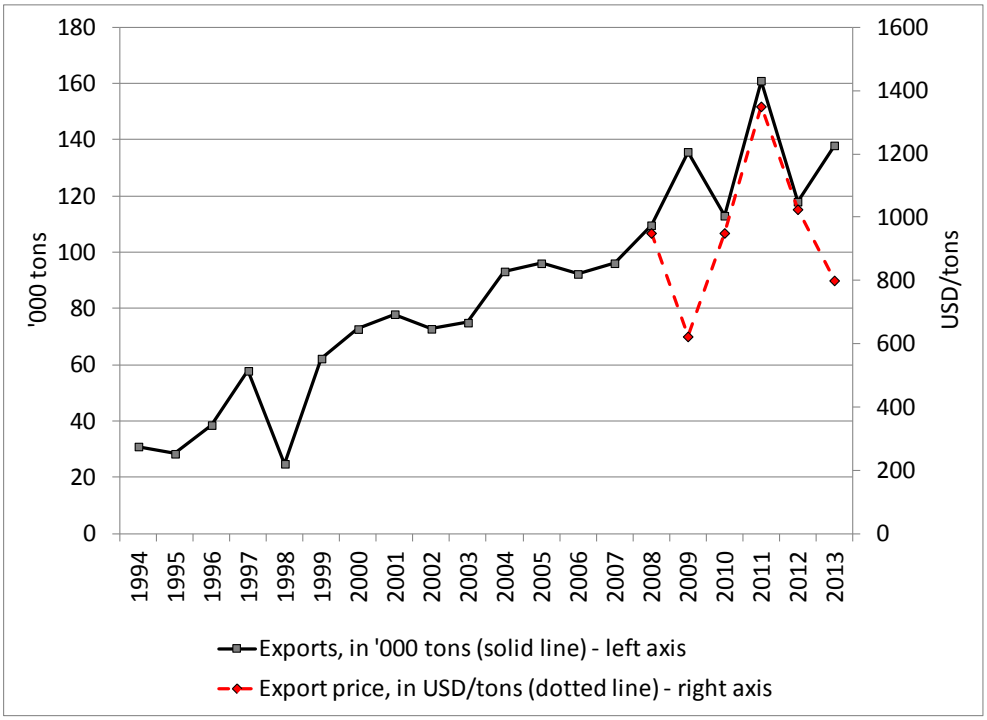
Source: Tirole (1990).

Exports and exporters: Total exports of raw cashews showed a positive trend during the last 15 years (see Figure 3) to reach 138,000 tons in 2013 (after peaking at 160,000 tons in 2011, when international prices also reached record levels).

The export segment of the raw-cashew value chain is relatively fragmented although it is dominated by Indians. There have been between 51 and 49 active exporters in the period 2011 -

2013. The market share of the largest exporter was 13 percent in 2013, while the market share of the four largest exporters (the C4 index) was over 36 percent. The Herfindahl-Hirschmann Index (HHI) was 513, which is low and equivalent to a setting with 20 symmetric exporters trading 5 percent each (see Table 2). The figures indicate that concentration increased slightly between 2011 and 2013, but nevertheless it remains low.

Figure 3. Evolution of total exports (in thousand tons), 1994-2013, and export price (in USD / ton), 2008 - 2013



Source: CNC (2012) and World Bank.

Table 2. Summary of exporters (years 2011 and 2013)

	2011	2013
Number of exporters	51	49
C1	9.1%	12.7%
Number with share over 5%	5	3
C4	27.4%	35.9%
Cashew processors market share	1.2%	1.5%
HHI	382	513
Equivalent to symmetric exporters	~25	~20

Source: own elaboration based on CNC (2012) and World Bank. C1 is the market share of the largest exporter. C4 is the cumulated share of the 4 largest exporters. HHI is Herfindahl-Hirschmann Index defined in Box 2.1.

Processors: Decree 3 /2005 provided for the development of industrialization of cashews. In was in this context that the government created FUNPI (see below).

The CNC (2012) lists existing plants with a total capacity of 6,000 ton/year (which could increase to nearly 30,000 tons if the projects identified by the CNC were fulfilled). But the processing activity has been underdeveloped and remained in low scale because of lack of financial resources, financial guarantees, and many other contributing factors. In 2013, about 2,000 tons of raw cashews were being reserved for processed-cashew production, representing a market share of between 1.2 percent and 1.5 percent (see Table 2).[1] Blute and Lopes da Veiga Nanque (2011) refer to an international price of processed cashew of 1560 USD/ton, and processing costs (excluding inputs) of 692 USD/ton. These figures are used in the simulations.

The World Bank is active in this segment, helping to implement a pilot project in which four additional cashew processing facilities will be set up over the next three years. These plants will require about 800 tons of raw cashew nuts (i.e., 200 tons per facility per year). Processing costs (other than inputs) are assumed to be 858 USD/ton (from World Bank sources), which still makes processing more profitable than exporting raw cashews.

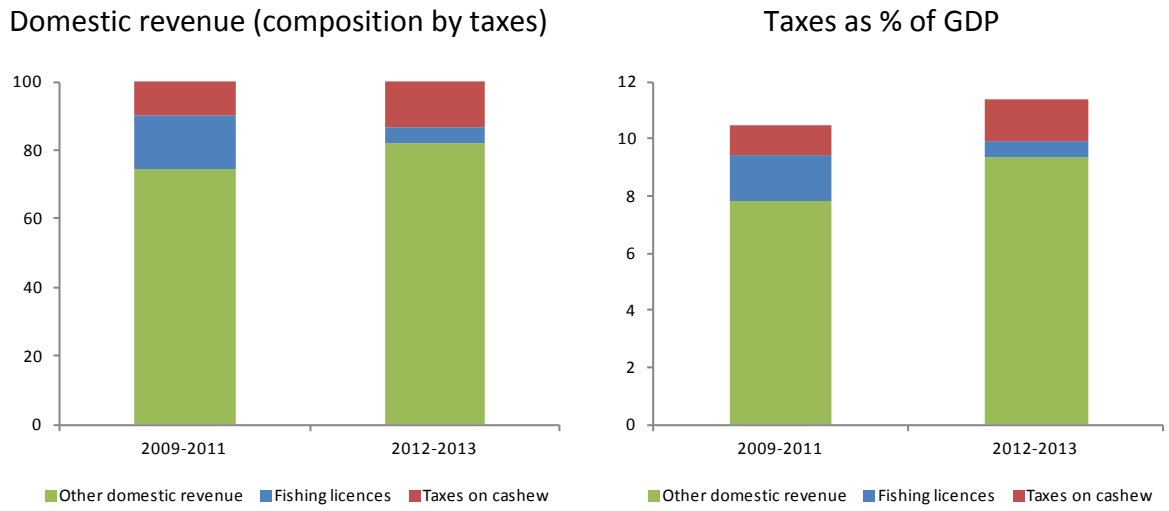
Taxes on trade: exports of raw cashews are subject to taxes. There is an industrial tax, ACI, with a rate of 3 percent of the FOB reference price. Other export taxes add up to another 8 percent of the FOB reference price. In both cases the FOB reference price is defined by the government every export season. The third tax corresponds to the Fund to Promote the Industrialization of Agricultural Products (FUNPI), created through Decree 19/2011, with a contribution of 50 XOF/kg –approximately USD 100/ton– of exportable cashew.[2] Given that export tax rates are percentages of a reference price, not real prices, and FUNPI is a per-unit tax, the whole export tax can best be understood on a per unit basis.

Taxes related to cashew have been growing in relevance during recent years. Government revenues (as percentage of GDP) from such taxes increased from 1 percent in 2009-2011 to 1.5 percent in 2012-2013, surpassing the share of revenues from fishing licenses (and representing 13 percent of domestic revenue). However, it should be stressed that the FUNPI contribution revenues do not enter the budget but rather are assigned to a special account.

[1] The storage of volume for value-added processing did not take place in 2013, and a total of 140 thousand tons were exported. Notwithstanding, we simulate this allocation of 2,000 tons for illustration purposes. Results do not change significantly with this assumption.

[2] There has recently been a debate over whether to charge a FUNPI contribution of 40-50 XOF / kg (ANCA's position) or 10 XOF / kg (see ANCA, 2014, p.1).

Figure 4. Government revenues (composition and percentage of GDP)



Source: IMF and World Bank.

Cost break-down: Table C1 in Appendix C shows the theoretical cost break down of raw cashews presented by ANCA for 2014. Table 3 extracts and summarizes the relevant components, which are used later on in the simulations adapted to data from 2013. First, exporter costs must be at least 101.28 USD/ton, while trader costs must be at least 21.28 USD/ton (they may be higher if additional labor costs, financial costs, etc., are taken into account). Second, the FOB price is set at 800 USD/ton and the farm-gate price is estimated to be 351 USD/ton (the average for 2013). Third, taxes are 199 USD/ton (11 percent of the reference FOB price plus FUNPI). These three conditions put bounds on costs and margins of market players, and also on the trade price.

Table 3. Simplified price structure of raw cashews. Adaptation to prices 2013

	Estimated campaign 2014		Adapted to 2013 prices	
Summary	**XOF / kg**	**USD / ton**	**XOF / kg**	**USD / ton**
Producer prices	250.00	531.91	165.00	351.06
Intermediary (identified) costs	10.00	21.28	10.00	21.28
Intermediary margin	10.00	21.28		
Intermediate Bissau prices	270.00	574.47		
Exporter (identified) costs	47.60	101.28	47.60	101.28
Exporter margin	30.00	63.83		
Export taxes	93.95	199.88	93.95	199.88
EXPORT PRICE - FOB PORT BISSAU	**441.55**	**939.46***	**376.00**	**800.00**
FOB Reference price: 850 USD/ton. Exchange rate: 470 XOF /USD. * Recently updated export prices for 2014 season round 1050-1100 USD/ton.				

Source: own elaboration based on ANCA (2014) and World Bank. See details in Appendix C.

Summary of the cashew value chain: Table 4 summarizes the data on the total volume produced by farmers, which is traded through formal channels (138,000 tons are exported and 2,000 tons are sold for processing, totaling 140,000 tons). Production valued at farmer prices gives a total

farmer revenue of US$ 49 million; exports valued at FOB prices give a total export revenue of USD 110 million; and exports valued at current tax rates give USD 13 million of taxes (ex FUNPI) and USD 15 million from the FUNPI contribution. The difference between exports, taxes, farmer revenues and traders and exporters identified costs leave a difference of USD 17 million, which has to be distributed between unidentified costs and margins of traders and exporters.

Table 4. Summary Cashews value chain for year 2013

Value chain of 2011	tons	USD million	USD/ton
Production	140,000		
- for exports	138,000		
- local processing*	2,000		
Exports (FOB price)		110.40	800.00
FOB reference price			850.00
Tax revenues on exports (excluding FUNPI)		12.90	93.50
FUNPI		14.68	106.38
Producers revenues		49.15	351.06
Traders and exporters (identified) costs		16.91	122.56
Traders and exporters unidentified costs and margins		17.46	126.49

Source: own elaboration based on ANCA (2014) and World Bank. *See comments on this allocation in footnote 2.

Next section introduces the model we use to calibrate the data summarized here and simulate the policy questions.

3. The model

Assume a one-period production economy with three players along the supply chain: farmers, traders and exporters. Farmers produce crops (X_F) and sell them to traders taking prices as given. Traders re-sell crops to exporters (X_T), while exporters sell them (X_E) to the international market a given price p^*. There are n_T (≥ 2) traders and n_E (≥ 2) exporters. Traders have oligopoly power facing exporters and oligopsony power facing farmers. Exporters have oligopsony power facing traders. This way, the supply chain is characterized by an oligopsony in the farmer-trader link and a bilateral oligopoly in the trader-exporter link. We rule out collusion in our model, and note that this can bias up the impacts of prices and on household welfare estimated in Sections 4 and 5.

The literature on bilateral oligopoly departs from the standard oligolpoly models (see Tirole, 1988) in the way goods and strategies are depicted. Assume that there is a physical (or consumption) commodity x and a money commodity b (to be considered as the numeraire). Sellers are endowed with the physical good (it can be an endowment or the output from production) and buyers are endowed with money. Sellers offer quantities of the physical good x, which results in aggregate offer $X=\Sigma x$. Buyers bid amounts of money b, which end up in aggregate bid $B=\Sigma b$. A (strategic) price is calculated at the trading post as the ratio between the aggregate bid to aggregate offer, $p=B/X$, and allocations are determined by executing trades at this rate of exchange. This way of

rephrasing a one-good competition model into a two-good competition was introduced by the ground-breaking paper Shapley and Shubik (1977), who extended work from Shubik (1973), and continued with Gabszewicz and Michel (1997), Bloch and Ghosal (1997) and Bloch and Ferrer (2001a, 2001b). More recently, Dickson and Hartley (2008), followed by Dickson (2013) and Dickson and Hartley (2013), brought the topic to new attention.[3] However, all these papers are focused in studying imperfect competition in a single market. We build a state-of-the-arts model with two-tier competition among three links of a given supply chain (producer-trader-exporter).[4]

Specifically, in the case under study, exporters trade quantities x_E^j in the international market (superscript: exporter *j*) at a price p^* ("export price", henceforth) and bid b_E^j when facing traders. If total bids are $B_E = \Sigma_j b_E^j$ and total quantities supplied by traders is X_T (defined below), the trading price between exporters and traders is $p_T = B_E/X_T$ ("intermediate price", henceforth). Exporters receive a share $\sigma_E^j = b_E^j/B_E$ of total quantity X_T and traders receive a share $s_T^i = x_T^i/X_T$ of total bid B_E. The link between exporters purchases to traders and sales to international market comes from $x_E^j = b_E^j/p_T = b_E^j X_T/B_E = \sigma_E^j X_T$. When exporters are symmetric, $b_E^j = b_E = B_E/n_E$ and $\sigma_E^j = \sigma_E = 1/n_E$.

Traders offer quantities x_T^i to exporters (superscript: trader *i*), where $X_T = \Sigma_i x_T^i$, and get a share s_T^i. When facing farmers, traders bid b_T^i. If total bids are $B_T = \Sigma_i b_T^i$ and total quantity supplied by farmers is X_F, the trading price between traders and farmers is $p_F = B_T/X_F$ ("farm-gate price", henceforth). Traders get a share $\sigma_T^i = b_T^i/B_T$ of the total quantity X_F. The link between traders purchases to farmers and sales to exporters comes from $x_T^i = b_T^i/p_F = b_T^i X_F/B_T = \sigma_T^i X_F$. When traders are symmetric, $b_T^i = b_T = B_T/n_T$, $x_T^i = x_T = X_T/n_T$, $\sigma_T^i = \sigma_T = 1/n_T$, and $s_T^i = s_T = 1/n_T$.

3.1. Exporters

Exporters place bids b_E^j to traders and sell quantities x_E^j in the international market, with exporter-specific transaction costs

$$c_E\left(x_E^j\right) = c_E^j x_E^j + \gamma_E^j \frac{(x_E^j)^2}{2} \quad \text{for } j = 1 \dots n_E$$

Costs are assumed convex functions of quantities to avoid indeterminacy problems in the trader-exporter relationship.[5] Parameters (c_E^j, γ_E^j) summarize their cost structure. Exporters profits are

[3] See also the lit reviews of Dubey (1994) and Giraud (2003). It is worth to notice that the limiting result of a bilateral oligopoly as one side becomes perfectly competitive (i.e., a one-side oligopoly / oligopsony) does not necessarily converges to the Cournot (1897) solution. Dickson and Hartley (2013) provide conditions under which a limiting bilateral oligopoly is more, equal or less competitive than the Cournot solution. Also, it is worth to notice that these games always have a no-trade Nash equilibrium. Throughout the paper we focus on non-autarkic equilibrium, as it is standard in the literature.

[4] The literature on vertical relationships (Tirole, 1988, chapter 4) studies problems like this in a context where the producer and retailer are monopolies in their respective markets –the successive-monopoly problem– and also several extensions, like a successive-oligopoly. Typically, the buyer side of any partial market is assumed to be price taker.

[5] The linear components of cost functions (c_E^j and c_T^i) could be 0, but γ_E^j and γ_T^i must be positive, otherwise

$$\pi_E^j = p^* x_E^j - c_E^j x_E^j - \gamma_E^j \frac{(x_E^j)^2}{2} - b_E^j$$

where p^* is the export price. Exporters (and also traders) preferences are concave in quantities (restricting quantities to those with non-negative marginal profit) and linear in money bids. This is a special case of bi-normal preferences (even more, quasi-linear in commodity money),[6] which ensures that the non-autarkic equilibrium exists and is unique (Dickson and Hartley, 2008).

Taking into consideration the link between quantities and bids ($x_E^j = b_E^j X_T/B_E$ and $B_E = \Sigma_j b_E^j$), profit maximization leads to the first-order condition

$$\left(p^* - c_E^j - \gamma_E^j x_E^j\right) \frac{X_T(B_E - b_E^j)}{B_E^2} = 1$$

which, replacing $p_T = B_E/X_T$ and $\sigma_E^j = b_E^j/B_E$, simplifies to

$$\left(p^* - c_E^j - \gamma_E^j \sigma_E^j X_T\right)(1 - \sigma_E^j) = p_T$$

This condition is well defined for $p^* \geq c_E^j + p_T$. Given (p^*, X_T, p_T), this equation solves for the exporters share in products offered by traders (σ_E^j):

$$\sigma_E^j = \frac{(\gamma_E^j X_T + p^* - c_E^j) - \sqrt{(\gamma_E^j X_T + p^* - c_E^j)^2 - 4\gamma_E^j X_T (p^* - c_E^j - p_T)}}{2\gamma_E^j X_T} \qquad (1)$$

The condition $\Sigma_j \sigma_E^j = 1$ defines the equation for strategic demand $D_E(p_T)$:

$$D_E(p_T): \quad \sum_{j=1}^{n_E} \left(\frac{(\gamma_E^j X_T + p^* - c_E^j) - \sqrt{(\gamma_E^j X_T + p^* - c_E^j)^2 - 4\gamma_E^j X_T (p^* - c_E^j - p_T)}}{2\gamma_E^j X_T} \right) = 1 \qquad (2)$$

In sum, equation (2) represents the exporters' product demand and equation (1) defines the exporters' share of products offered by traders.

3.2. Traders

Traders place bids b_T^i to farmers and sell quantities x_T^i to exporters, with trader-specific transaction costs

$$c_T\left(x_T^i\right) = c_T^i x_T^i + \gamma_T^i \frac{(x_T^i)^2}{2} \quad \text{for } i = 1 \ldots n_T$$

Assumptions on $c_T(.)$ are similar to those on $c_E(.)$. Parameters (c_T^i, γ_T^i) summarize their cost structure. Traders profits are

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the maximization problem of exporters collapses. If γ_E^j and γ_T^i tend to zero (but positive), this specification would resemble the constant-marginal-cost case. Similar conditions apply to traders' cost functions.

[6] Assume a utility function $U(x,e-b)$, where e is money endowment. Under bi-normal preferences, x and $(e-b)$ are normal goods; i.e., marginal rate of substitution increases as either x or b decreases. Moreover, U(.) is quasi-linear if it can be written as $U(x)+e-b$. These conditions hold in profit functions π_E^j and π_T^i.

$$\pi_T^i = \frac{B_E}{X_T}\, x_T^i - c_T^i\, x_T^i - \gamma_T^i \frac{(x_T^i)^2}{2} - b_T^i$$

Traders take into consideration the links between (i) their quantities and exporters bids (the intermediate price is $p_T = B_E/X_T$ and quantities are $X_T = \Sigma_i\, x_T^i$), when facing exporters, and (ii) their bids and farmers supply (farm-gate price is $p_F = B_T/X_F$ and $B_T = \Sigma_i\, b_T^i$), to maximize profits. Notice the link $b_T^i = x_T^i B_T/X_F$, which after algebra simplifies to $b_T^i = x_T^i B_{-i}/(X_F - x_T^i)$ and $B_{-i} = \Sigma_{k\neq i}\, b_T^k$. Facing exporters, traders choose x_T^i to maximize

$$\pi_T^i = \left(\frac{B_E}{X_T} - c_T^i\right) x_T^i - \gamma_T^i \frac{(x_T^i)^2}{2} - \frac{B_{-i}}{X_F - x_T^i} x_T^i$$

which leads to the first-order condition

$$\frac{B_E(X_T - x_T^i)}{X_T^2} = c_T^i + \gamma_T^i x_T^i + \frac{B_{-i} X_F}{(X_F - x_T^i)^2}$$

Replacing $p_T = B_E/X_T$, $p_F = B_T/X_F$ and $s_T^i = x_T^i/X_T$, this condition simplifies to

$$p_T(1 - s_T^i) = c_T^i + \gamma_T^i s_T^i X_T + \frac{p_F}{1 - s_T^i}$$

which is well defined for $p_T \geq c_T^i + p_F$. Given (p_T, X_T, p_F), this equation solves for the traders share in money bid by exporters (s_T^i):

$$s_T^i = \frac{(\gamma_T^i X_T + 2p_T - c_T^i) - \sqrt{(\gamma_T^i X_T + 2p_T - c_T^i)^2 - 4(\gamma_T^i X_T + p_T)(p_T - p_F - c_T^i)}}{2(\gamma_T^i X_T + p_T)} \qquad (3)$$

The condition $\Sigma_j s_T^i = 1$ defines the equation for strategic supply $X_T(p_T)$:

$$X_T(p_T):\ \sum_{i=1}^{n_T} \left(\frac{(\gamma_T^i X_T + 2p_T - c_T^i) - \sqrt{(\gamma_T^i X_T + 2p_T - c_T^i)^2 - 4(\gamma_T^i X_T + p_T)(p_T - p_F - c_T^i)}}{2(\gamma_T^i X_T + p_T)} \right) = 1 \qquad (4)$$

On the other hand, when facing farmers, traders maximize the profits choosing b_T^i, leading to the first-order condition is

$$\left(\frac{B_E}{X_T}\frac{X_T - x_T^i}{X_T} - c_T^i - \gamma_T^i x_T^i\right)\frac{X_F(B_T - b_T^i)}{B_T^2} = 1$$

Replacing $p_T = B_E/X_T$, $p_F = B_T/X_F$ and $\sigma_T^i = b_T^i/B_T$, this condition simplifies to

$$\left(p_T(1 - \sigma_T^i) - c_T^i - \gamma_T^i \sigma_T^i X_F\right)(1 - \sigma_T^i) = p_F$$

which is well defined for $p_T \geq c_T^i + p_F$. Notice that this condition mirrors the first-order condition choosing x_T^i. Given (p_T, X_T, p_F), this equation solves for the traders share in products offerd by farmers (σ_T^i):

$$\sigma_T^i = \frac{(\gamma_T^i X_F + 2p_T - c_T^i) - \sqrt{(\gamma_T^i X_F + 2p_T - c_T^i)^2 - 4(\gamma_T^i X_F + p_T)(p_T - p_F - c_T^i)}}{2(\gamma_T^i X_F + p_T)} \qquad (5)$$

The condition $\Sigma_j \sigma_T^j = 1$ defines the equation for strategic demand $D_T(p_F)$:

$$D_T(p_F): \sum_{i=1}^{n_T} \left(\frac{(\gamma_T^i X_F + 2p_T - c_T^i) - \sqrt{(\gamma_T^i X_F + 2p_T - c_T^i)^2 - 4(\gamma_T^i X_F + p_T)(p_T - p_F - c_T^i)}}{2(\gamma_T^i X_F + p_T)} \right) = 1 \quad (6)$$

3.3. Farmers

Farmers are characterized by a competitive supply

$$X_F(p_F) = A p_F^{\varepsilon} \quad (7)$$

with price-elasticity of supply equal to ε. Producer surplus is $Ap_F^{1+\varepsilon}/(1+\varepsilon)$ for a given p_F. This supply function is simpler than the function $S(p)$ used by Porto *et al*. (2011), but preserves the properties of concavity if $\varepsilon<1$, that is, if supply is inelastic. Moreover, the constant A is a summary measure of cost components (production technology and input prices).

3.4. Cashew processors

Suppose that there are n_P plants of processed cashew. Assume that processed cashew can be sold in the international market at a price p^{P*} and that the cost structure is

$$c_P(x_P^k) = c_P^k x_P^K + \gamma_P^k \frac{(x_P^k)^2}{2} \text{ for } k = 1 \dots n_P$$

where x_P^k is the quantity of raw cashew used for processing (with, say, yield α_P). Moreover, assume that the processing activity creates more value than exports of raw cashew. That is, if

$$\pi_P^k = p^{P*} \alpha_P x_P^k - c_P^k x_P^k - \gamma_P^k \frac{(x_P^k)^2}{2} - b_P^k$$

then $\pi_P^k(x_P^k, b_P^k; c_P^k, \gamma_P^k) > \pi_E^j(x_E^j, b_E^j; c_{E1}^j, \gamma_{E1}^j)$, for $(x_P^k, b_P^k)=(x_E^j, b_E^j)$ and $(c_{E1}^j, \gamma_{E1}^j)$ being the most efficient exporter.

Then the processed-cashew plants demands will enter the base of exporters strategic demand. In an interior solution, profit maximization leads to the first-order condition

$$\left(p^{P*}\alpha_P - c_P^k - \gamma_P^K x_P^k\right) \frac{X_T(B_{EP} - b_P^k)}{B_{EP}^2} = 1$$

where $B_{EP} = \Sigma_j b_E^j + \Sigma_k b_P^k$. Replacing $p_T = B_{EP}/X_T$ and $\sigma_P^k = b_P^k/B_{EP}$, this condition simplifies to

$$\left(p^{P*}\alpha_P - c_P^k - \gamma_P^k \sigma_P^k X_T\right)(1 - \sigma_P^k) = p_T$$

This condition is well defined for $p^* \geq c_P^k + p_T$, which is true because we already assumed ($p^* \geq c_E^j + p_T$). Given (p^{P*}, X_T, p_T), the equation solves for the processed cashew share in products offered by traders (σ_P^k):

$$\sigma_P^k = \frac{(\gamma_P^k X_T + p^{P*}\alpha_P - c_P^k) - \sqrt{(\gamma_P^k X_T + p^{P*}\alpha_P - c_P^k)^2 - 4\gamma_P^k X_T (p^{P*}\alpha_P - c_P^k - p_T)}}{2\gamma_P^k X_T} \quad (8)$$

Now, the strategic demand by exporters and traders $D_{EP}(p_T)$ builds from individual demands such that $\Sigma_j \sigma_E^j + \Sigma_k \sigma_P^k = 1$, where σ_E^j comes from (1) and σ_P^k comes from (8):

$$D_{EP}(p_T): \quad \sum_{j=1}^{n_E} \left(\frac{\left(\gamma_E^j X_T + p^* - c_E^j\right) - \sqrt{(\gamma_E^j X_T + p^* - c_E^j)^2 - 4\gamma_E^j X_T (p^* - c_E^j - p_T)}}{2\gamma_E^j X_T} \right) +$$

$$\sum_{j=1}^{n_P} \left(\frac{(\gamma_P^k X_T + p^{P*}\alpha_P - c_P^k) - \sqrt{(\gamma_P^k X_T + p^{P*}\alpha_P - c_P^k)^2 - 4\gamma_P^k X_T (p^{P*}\alpha_P - c_P^k - p_T)}}{2\gamma_P^k X_T} \right) = 1 \qquad (9)$$

In sum, equation (9) replaces (2) as the exporters-processors demand, equation (1) defines the exporters share and equation (8) defines the processors share of products supplied by traders.

3.5. Equilibrium

3.5.1. Equilibrium with exporters

The joint resolution of equations (2), (4), (6) and (7), together with the condition $X_F=X_T$, solves for the equilibrium in this problem, which is summarized by the equilibrium values of quantity, farm-gate price and intermediate price (X_F, p_F, p_T) as a function of (i) farmers elasticity of supply or supply parameters (A,ε), (ii) the number of traders and their technology (n_T, c_T^i, γ_T^i), (iii) the number of exporters and their technology (n_E, c_E^j, γ_E^j), and (iv) export price (p^*).

The solution to this equilibrium, applied to the cashew market in Guinea-Bissau, has to be found numerically.

3.5.2. Equilibrium with exporters and cashew processors

When cashew processors are active, the equilibrium is solved from the joint solution of equations (9), (4), (6) and (7) together with condition $X_F=X_T$. Given that the simulations with cashew processors consider small processing plants we have to develop a special case.

Since x_P^k is at the base of the strategic demand $D_{EP}(p_T)$, if for some reason (say, capacity constraint) the quantity consumed by processors is less than the quantity that would solve their optimization without capacity constraints, the solution is easier to obtain. In this case, equilibrium is solved by equating the quantity x_P^k plus $D_E(p_T)$ from (2) with strategic supply from (4), i.e., $X_T(p_T) = x_P^k + D_E(p_T)$.

3.5.3. The competitive solution (exporters only)

If the different links of the supply chain were competitive, exporters would trade equating export price with marginal cost ($p^* = c_E^j + \gamma_E^j x_E^j + p_T$), which leads to a volume $X_E=\Sigma_j(p^*-c_E^j-p_T)/\gamma_E^j$. Traders would also trade equating intermediate price with marginal cost ($p_T = c_T^i + \gamma_T^i x_T^i + p_F$), which leads to a volume $X_T=\Sigma_i(p_T-c_T^i-p_F)/\gamma_T^i$. And farmers would produce according to competitive supply $X_F=Ap_F^{\varepsilon}$. Given that $X_F = X_T = X_E$, the following equation

$$Ap_F^{\varepsilon} = \sum_{i=1}^{n_T} \left(\frac{p_T - c_T^i - p_F}{\gamma_T^i} \right) \qquad (10)$$

would solve for $p_T=f(p_F)$ and equation

$$Ap_F^{\varepsilon} = \sum_{j=1}^{n_E} \left(\frac{p^* - c_E^j - f(p_F)}{\gamma_E^j} \right) \quad (11)$$

would solve for $p_F=g(p^*)$. The competitive solution would be characterized by

$$\{p^*, p_F = g(p^*), p_T = f(p_F), X = A[g(p^*)]^{\varepsilon}\}$$

Appendix A expands this solution and the successive bilateral oligopoly one to the symmetric case.

4. Calibration to the GNB case and simulations

4.1. Calibration to the GNB case

Given the inherent limitations of the available data, we work with a simple calibration of the parameters of the model. With more data, a more ambitious calibration exercise could be envisioned and even a simulation method of moment (SMM) could be implemented. We leave this exercise for future work. We nevertheless provide, in appendices, some sensitivity analysis.

The calibration of farmer supply (7) is straightforward. We assume a continuous supply to avoid discontinuities, and let the price elasticity be less than one, so that the model satisfies the concavity condition assumed by Porto *et al*. (2011). Througouth the paper we assume $\varepsilon=0.5$ and fit the value of A such that the quantity X_F equals 140,000 tons (see Table 4) of production to marketeable oportunities. Appendix B shows sensitivity analysis to the price-elasticity of supply: a more (less) intelastic supply such that $\varepsilon=0.25$ ($\varepsilon=0.75$) magnifies price (quantity) effects.

Exporters are asymmetric due to their different market shares and incur different costs (c_E^j, γ_E^j),[7] while traders are assumed to be symmetric with similar cost parameters and (c_T, γ_T). Also, cashew processors are assumed to be more (relatively) efficient than exporters and to consume $x_P=2{,}000$.[8]

Given (X, p^*, p_T, p_F) market shares differ across exporters and are the same among traders. While $X=140{,}000$, $p^*=600$ and $p_F=351$, p_T is unknown and must be found as part of the calibration.

At this moment, it is impotant to point out a limitation of the analysis. As it is clear, we assume that traders and exporters compete in a single national auction. There is, in fact, only one equilibrium intermediate price. However, it is likely that trader markets are segmented regionally. If so, then there would be one intermediate price per regional market. More importantly, the high number of traders in the data makes the trading segment of our model very competitive. With segmented markets, trader markets can become more imperfect, thus giving rise to a bigger role

[7] In order to simplify the analysis we pool the 49 exporters into six groups according on size. We preserve the size of the largest exporter (C1) and the largest four exporters (C4) from original data, and also replicate the concentration (HHI) shown in Table 2.

[8] See footnote 2 for comments on this allocation. We keep control that processors purchases are indeed truncated at production capacity in both calibration and simulations (see Section 3.5.2).

for competition forces at this level in our model. As before, this feature of the model could potentially be improved with more data on regional traders (such as numbers of traders per region, their approximate market shares, and so on). Given the unavailability of these data, we work with the simpler version of the model presented here. But, for future work, the model could in principle accommodate regionally segmented trader markets.

We search for intermediate price p_T and cost structures that fit the number of market participants (n_E and n_T) and the distribution of market shares (1), (3)-(5) and (8) to real data (for both exporters and traders, as detailed in Section 2). The solution for each type of exporter involves finding (c_E^j, γ_E^j). We calibrate parameters such that the fixed and variable components of marginal cost represent 50 percent each.

This procedure delivers the relevant parameters (the set of c_E, c_T, γ_E and γ_T) and equilibrium variables (in this case, p_T), which are summarized in Table 5. We use these parameters to simulate comparative static results numerically.

Table 5. Cost parameters and equilibrium variables used for simulation

Exporters	Number	Market Share	Average Cost	Average Profit	c_E	γ_E
n_{CP}	1	1.43	692.2	441.1	692.20	-
n_{E1}	2	12.66	83.3	90.0	55.17	0.003
n_{E2}	3	5.11	112.6	60.7	74.84	0.011
n_{E3}	7	2.97	120.0	53.4	79.66	0.019
n_{E4}	9	1.77	124.1	49.3	82.46	0.034
n_{E5}	11	1.21	125.9	47.4	83.76	0.050
n_{E6}	17	0.47	128.4	44.9	85.49	0.131
n_E	50*	100	119.9	67.2		
HHI		510				
Traders	**Number**	**Market Share**	**Average Cost**	**Average Profit**	c_T	γ_T
n_{T1}	39	2.56	41.0	34.7	26.51	0.008
n_T	39	100	41.0	34.7		
HHI		256				
p*	600	1560				
p_T	427					
p_F	351					
X	140,000					

* There are 49 exporters. Cashew processors are summarized as one agent.

Appendix B shows sensitivity results to (i) cost structures (75-25 percent of constant an variable marginal cost, and almost-constant marginal cost), and (ii) competition in the trading segment (asymmetric competition and symmetric, but more concentrated, competition).

In sum, in all cases the calibration procedure involves the following steps:

1. Identify market shares for each participant and total quantity, in order to determine individual quantitites.

2. Jointly solve for cost parameters and intermediate price p_T using strategic supplies and demands by traders and exporters-processors.

4.2. Results

4.2.1. Simulation: FUNPI contribution

We start from a simulated situation of absence of FUNPI contribution, so that the introduction of this tax brings the equilibrium back to the situation in 2013. Columns I and II of Table 6 show the effects of the introduction of FUNPI tax in the cashew market.

The introduction of FUNPI tax reduces the net-of-tax export price by 15.1 percent (by approximately 106 USD/ton) and is passed through to intermediate (traders') price (-17.9 percent) and farm-gate price (-19.5 percent). As a consequence, exporters' profits decrease by 19 percent (of which, 9 percent is due to exporters assuming part of the tax burden, and 10 percent is due to a reduction in quantities associated with higher prices). As the activity is less profitable for exporters, concentration increases (HHI index goes up from 487 to 510). But the segment becomes more concentrated as a result of reordering of quantities (the two largest exporters increase their market share by 0.6 percent, and the other 37 exporters reduce their share). The number of exporters remains the same as the assumed cost structures (in Table 5) allows individual firms make profits in the new equilibrium.[9] Traders' profits decrease by 24 percent (of which, 14 percent is per ton and 10 percent is due to a reduction in quantities). Farmers absorb the largest share of the tax.

Another way to interpret the results is that exporter price decreases in 106.38 USD/ton, intermediate price decreases in 92.88 USD/ton and farm-gate price decreases in 84.95 USD/ton. This way, farmers absorb 80 percent of the tax, exporters absorb 13 percent of the tax (13.50 USD/ton, or the difference between 106.38 USD/ton and 92.88 USD/ton) and traders absorb 7 percent of the tax (7.93 USD/ton, or the difference between 92.88 USD/ton and 84.95 USD/ton). These results are consistent with the fact that the exporters' segment is a bit more concentrated than the traders' segment (see more details in Appendix A, section A.1.1.).

Finally, although it is not shown in the Table, the new FUNPI tax has two different effects on tax revenues: on the one hand, a new tax is collected (raising USD 14.9 million), and on the other hand, revenues on other export taxes decrease with the reduction in quantities (USD 1.5 million). Also, the FUNPI tax may induce an increasing smuggling activity, posing a further drag on revenues (but this effect cannot be quantified).

[9] We defer the analysis of cashew processors to the part of simulations that involves them. Meanwhile, both production and capacity remain fixed at 2,000 tons, while profit changes with the assumptions made on international prices and the resulting intermediate prices.

Table 6. Base Scenario – Introduction of FUNPI contribution and sensitivity to international price

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	% change (vs I)	(III) = (II) + max intn'l price	% change (vs II)	(IV) = (II) + average intn'l price	% change (vs II)
International Price (USD/ton)	799.88	799.88		1350.00		950.00	
Trade taxes (USD/ton)	93.50	199.88		199.88		199.88	
International Price net of taxes (USD/ton)	706.38	600.00	-15.1%	1150.12	91.7%	750.12	25.0%
Intermediate Price (USD/ton)	519.54	426.66	-17.9%	913.92	114.2%	557.97	30.8%
Farm-gate Price (USD/ton)	435.95	351.00	-19.5%	799.23	127.7%	471.18	34.2%
Exporters + cashew processors profit (USD/ton)	73.80	67.20	-8.9%	108.09	60.8%	79.21	17.9%
of which, exporters (USD/ton)	70.23	61.78	-12.0%	101.87	64.9%	73.59	19.1%
of which, cashew processors (USD/ton)	348.26	441.14	26.7%	758.25	71.9%	529.21	20.0%
HHI exporters and cashew processors	487	510		430		479	
Traders profit (USD/ton)	40.94	34.66	-15.3%	66.33	91.3%	43.49	25.5%
HHI traders	256	256		256		256	
Quantity (tons)	156024	140000	-10.3%	211257	50.9%	162207	15.9%

4.2.2. Simulation: Change in international prices

Next, we analyze the effect of changes in international prices on domestic prices and profitability along the supply chain. Starting from the current situation with the FUNPI tax (column II of Table 6) we select an international price of 950 USD/ton –the average price between 2008 and 2013– and 1350 USD/ton –maximum international price, in 2011 (see Figure 3). Results are shown in columns III and IV of Table 6.

The increase of international price from the current value to 950 USD/ton, keeping the base price for export taxes constant, represents a 25 percent increase in net-of-tax export price, and passes through intermediate (30.8 percent) and farm-gate prices (34.2 percent). Exporters profits increase 37 percent (18 percent per ton and 16 percent due to quantities). Given exporters' cost structure, as the activity becomes more profitable for exporters, individual quantities increase more in medium- and small-size exporters, and therefore concentration decreases (HHI index goes down from 510 to 479).[10] Traders' profits increase 45 percent (25 percent per ton and 16 percent due to quantities). Farmers take up the largest share of the price increase (absorbing 80 percent of the increase in international price, that is 120 USD/ton out of 150 USD/ton). An increase of international price to 1350 USD/ton generates the same qualitative, but stronger quantitative, results. Tax revenues increase proportionally with quantities. If the government raises the base price for export taxes with an expected increase in international price there is an additional effect on revenues.

From Table 6, we can infer the rate at which changes in international prices (net of taxes) pass through farm-gate prices. This rate is approximately 1.35-1.40 in the current context. For higher (lower) price-elasticity of supply pass-through rates are a little bit lower (higher). These rates can

[10] This result assumes that cost structures for existing exporters do no change and no entry takes place.

be retrieved using results from Tables B1 and B4 in Appendix B.

4.2.3. Simulation: FUNPI contribution and competitive policies

As stated in the introduction, the current FUNPI contribution negatively affects farmers through lower farm-gate prices, and this is quantified in the exercise shown in Table 6. This negative effect could, in principle, be overcome by using public funds to improve competition in cashew trading. As a general idea, complementary policies should aim for reductions in transport and transaction costs. Some examples are improvements in roads and communications, measures that reduce banking and credit costs for traders, or measures that reduce border costs for exporters (ports, customs, procedures, paperwork, and so on). We show several simulations in Table 7 to Table 10.

Table 7. Base Scenario – FUNPI contribution and complementary policies on costs (1)

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	% change (vs I)	(V) = (I) + FUNPI + 10% reduction in exporters costs	% change (vs I)	(VI) = (I) + FUNPI + 10% reduction in traders costs	% change (vs I)
International Price (USD/ton)	799.88	799.88		799.88		799.88	
Trade taxes (USD/ton)	93.50	199.88		199.88		199.88	
International Price net of taxes (USD/ton)	706.38	600.00	-15.1%	600.00	-15.1%	600.00	-15.1%
Intermediate Price (USD/ton)	519.54	426.66	-17.9%	440.04	-15.3%	426.16	-18.0%
Farm-gate Price (USD/ton)	435.95	351.00	-19.5%	363.22	-16.7%	355.76	-18.4%
Exporters + cashew processors profit (USD/ton)	73.80	67.20	-8.9%	63.60	-13.8%	67.44	-8.6%
of which, exporters (USD/ton)	70.23	61.78	-12.0%	58.42	-16.8%	62.05	-11.7%
of which, cashew processors (USD/ton)	348.26	441.14	26.7%	427.76	22.8%	441.64	26.8%
HHI exporters and cashew processors	487	510		488		511	
Traders profit (USD/ton)	40.94	34.66	-15.3%	35.58	-13.1%	33.41	-18.4%
HHI traders	256	256		256		256	
Quantity (tons)	156024	140000	-10.3%	142416	-8.7%	140946	-9.7%

Columns V and VI in Table 7 simulate the joint effect of introducing the FUNPI contribution and a complementary policy that reduces by 10 percent the marginal costs of exporters and traders, respectively. The joint effect of the government action –FUNPI contribution plus complementary policy– is a reduction on farm-gate prices between 17.7 percent (reduction in exporters costs) and 18.4 percent (reduction in traders costs), compensating partially the initial reduction of 19.5 percent caused by the surcharge.

When the complementary policy aims at the export segment of the value chain, exporters' per-ton profits decline by 5 percent (in addition to the 9 percent reduction caused by the FUNPI contribution), because the change in equilibrium trader price p_T overcomes the cost reduction.[11] Traders, on the other hand, benefit from such complementary policy (through improved margins –

[11] We show in Appendix A (section A.1.2) that a reduction in exporters costs increases intermediate price as a result of trade between traders and exporters. Intuitively, for a given final price, exporters with lower costs have more capacity to absorb increases in intermediate prices than exporters with higher costs. To understand the negative effect on exporters' profits one should recall from Table 4 that exporters' average cost is 120 and intermediate price is 420. A 10 percent reduction of exporters' costs ends up in lower exporter's profits if p_T increases by more than 3 percent. The bottom line is that p_T must increase as a consequence of the policies we simulate here in order to give room for p_F to increase.

difference between p_T and p_F – and higher traded volumes), as per-ton profits decrease by 13.1 percent rather than by 15.3 percent. When the complementary policy aims the trader segment, the results revert (traders' per-ton profits fall more while exporters' fall less than those with FUNPI contribution).

Instead, when the complementary policy aims both segments of the supply chain the net effect is a more competitive environment, which benefits farmers (see Table 8). Nevertheless, a 10 percent cost reduction is insufficient to recover farm-gate prices to pre-FUNPI tax levels, which fall short by 15.6 percent.

A full recovery in the farm-gate price could be achieved with a reduction in intermediation costs of 47 percent (as shown in scenario VIII in Table 8). Comparing ex ante and ex post equilibria, the channels through which the cost reducing policy brings the farm-gate price to ex ante level are (i) a recovery in intermediate price (it ends up 5.4 percent below the ex-ante level) and a tightening of exporters and traders margins (27 percent and 6 percent, respectively). In short, given a structural situation in the cashew sector, the complementary policy should strongly aim for cost reductions, which pass through to farm-gate prices throughout (albeit imperfect) competition.

Table 8. Base Scenario – FUNPI contribution and complementary policies on costs (2)

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	% change (vs I)	(VII) = (I) + FUNPI + 10% reduction in exporters and traders costs	% change (vs I)	(VIII) = (I) + FUNPI + 47% reduction in exporters and traders costs	% change (vs I)
International Price (USD/ton)	799.88	799.88		799.88		799.88	
Trade taxes (USD/ton)	93.50	199.88		199.88		199.88	
International Price net of taxes (USD/ton)	706.38	600.00	-15.1%	600.00	-15.1%	600.00	-15.1%
Intermediate Price (USD/ton)	519.54	426.66	-17.9%	439.58	-15.4%	491.33	-5.4%
Farm-gate Price (USD/ton)	435.95	351.00	-19.5%	368.07	-15.6%	435.97	0.0%
Exporters + cashew processors profit (USD/ton)	73.80	67.20	-8.9%	63.81	-13.5%	48.99	-33.6%
of which, exporters (USD/ton)	70.23	61.78	-12.0%	58.66	-16.5%	44.73	-36.3%
of which, cashew processors (USD/ton)	348.26	441.14	26.7%	428.22	23.0%	376.47	8.1%
HHI exporters and cashew processors	487	510		489		397	
Traders profit (USD/ton)	40.94	34.66	-15.3%	34.31	-16.2%	32.66	-20.2%
HHI traders	256	256		256		256	
Quantity (tons)	156024	140000	-10.3%	143363	-8.1%	156029	0.0%

Columns IX to X in Table 9 simulate the joint effect of the FUNPI contribution and a complementary policy that levels the playing field at the export link, by reducing costs of a given number of inefficient exporters. An unambitious policy (say, improving the competitive condition of 2 out of 47 inefficient exporters) helps with the recovery of the farm-gate price, which would fall 15.7 percent (rather than 19.5 percent caused by FUNPI).

Table 9. Base Scenario – FUNPI contribution and complementary policies on costs (3)

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	% change (vs I)	(IX) = (I) + FUNPI + 2 efficent exporters	% change (vs I)	(X) = (I) + FUNPI + 38 efficent exporters	% change (vs I)
International Price (USD/ton)	799.88	799.88		799.88		799.88	
Trade taxes (USD/ton)	93.50	199.88		199.88		199.88	
International Price net of taxes (USD/ton)	706.38	600.00	-15.1%	600.00	-15.1%	600.00	-15.1%
Intermediate Price (USD/ton)	519.54	426.66	-17.9%	444.92	-14.4%	519.66	0.0%
Farm-gate Price (USD/ton)	435.95	351.00	-19.5%	367.68	-15.7%	436.06	0.0%
Exporters + cashew processors profit (USD/ton)	73.80	67.20	-8.9%	61.57	-16.6%	23.17	-68.6%
of which, exporters (USD/ton)	70.23	61.78	-12.0%	56.45	-19.6%	18.96	-73.0%
of which, cashew processors (USD/ton)	348.26	441.14	26.7%	422.88	21.4%	348.14	0.0%
HHI exporters and cashew processors	487	510		558		241	
Traders profit (USD/ton)	40.94	34.66	-15.3%	35.91	-12.3%	40.95	0.0%
HHI traders	256	256		256		256	
Quantity (tons)	156024	140000	-10.3%	143287	-8.2%	156045	0.0%

For leveling the playing field of high-cost exporters to be an effective instrument in recovering farmer prices to pre-FUNPI levels, the policy must be aggressive (in the simulation, bringing 38 exporters to the efficient cost structure). Balancing the export segment in the direction of more efficient players intensifies competition and reduces exporters' profits, while at the same time de-concentrates the segment (HHI goes from 510 without complementary policy to 241 with an aggressive policy).

Columns XI to XIII in Table 10 simulate the joint effect of the FUNPI contribution and a complementary policy that fosters competition by 10 percent at the exporter segment, trader segment and both segments, respectively. The main difference with exercises V to X is that the number of competitors increases but cost structures remain unaltered. Qualitative results are similar as those in Table 7 and Table 8. An important result, however, is the need to reduce costs (at the exporter or trader segment of the value chain) as the after-FUNPI contribution perfectly competitive solution would take the farmer price to 393 USD/ton (still below the pre tax level of 435.95 USD/ton under the current competitive conditions).

Table 10. Base Scenario – FUNPI contribution and complementary policies on entry

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	% change (vs I)	(XI) = (I) + FUNPI + 10% additional exporters	% change (vs I)	(XII) = (I) + FUNPI + 10% additional traders	% change (vs I)	(XIII) = (I) + FUNPI + 10% additional exporters and traders	% change (vs I)
International Price (USD/ton)	799.88	799.88		799.88		799.88		799.88	
Trade taxes (USD/ton)	93.50	199.88		199.88		199.88		199.88	
International Price net of taxes (USD/ton)	706.38	600.00	-15.1%	600.00	-15.1%	600.00	-15.1%	600.00	-15.1%
Intermediate Price (USD/ton)	519.54	426.66	-17.9%	434.63	-16.3%	426.25	-18.0%	434.26	-16.4%
Farm-gate Price (USD/ton)	435.95	351.00	-19.5%	358.28	-17.8%	354.85	-18.6%	362.22	-16.9%
Exporters + cashew processors profit (USD/ton)	73.80	67.20	-8.9%	62.40	-15.4%	67.39	-8.7%	62.57	-15.2%
of which, exporters (USD/ton)	70.23	61.78	-12.0%	57.08	-18.7%	62.00	-11.7%	57.28	-18.4%
of which, cashew processors (USD/ton)	348.26	441.14	26.7%	433.17	24.4%	441.55	26.8%	433.54	24.5%
HHI exporters and cashew processors	487	510		473		511		473	
Traders profit (USD/ton)	40.94	34.66	-15.3%	35.21	-14.0%	31.65	-22.7%	32.15	-21.5%
HHI traders	256	256		256		233		233	
Quantity (tons)	156024	140000	-10.3%	141444	-9.3%	140766	-9.8%	142221	-8.8%

4.2.4. Simulation: FUNPI contribution and cashew processing

Another goal of the government is to stimulate cashew processing in Guinea-Bissau by using part of the tax revenue on the export of raw cashew for this. In Table 11 we simulate an interaction between FUNPI contribution and increasing capacity of processed cashews. The cost structure of new processors was provided by the World Bank.[12]

Scenario XIV in Table 11 adds 4 processing plants of 200 ton each. The new equilibrium does not change significantly from the equilibrium with FUNPI contribution (II). We only emphasize that in the new equilibrium, 12 percent of the extra volume would come from additional production (92 out of 800 tons) while 88 percent (708 out of 800 tons) would come from reduced raw cashew export opportunities.

Table 11. Base Scenario – FUNPI contribution and cashew processing

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	% change (vs I)	(XIV) = (I) + FUNPI + 4 cashew processors (200 ton each)	% change (vs I)	(XV) = (I) + FUNPI + 1 cashew processor (20,000 ton)	% change (vs I)
International Price (USD/ton)	799.88	799.88		799.88		799.88	
Trade taxes (USD/ton)	93.50	199.88		199.88		199.88	
International Price net of taxes (USD/ton)	706.38	600.00	-15.1%	600.00	-15.1%	600.00	-15.1%
Intermediate Price (USD/ton)	519.54	426.66	-17.9%	427.16	-17.8%	439.24	-15.5%
Farm-gate Price (USD/ton)	435.95	351.00	-19.5%	351.46	-19.4%	362.49	-16.9%
Exporters + cashew processors profit (USD/ton)	73.80	67.20	-8.9%	68.21	-7.6%	88.92	20.5%
of which, exporters (USD/ton)	70.23	61.78	-12.0%	61.48	-12.5%	54.37	-22.6%
of which, cashew processors (USD/ton)	348.26	441.14	26.7%	440.64	26.5%	428.56	23.1%
HHI exporters and cashew processors	487	510		505		585	
Traders profit (USD/ton)	40.94	34.66	-15.3%	34.70	-15.2%	35.52	-13.2%
HHI traders	256	256		256		256	
Quantity (tons)	156024	140000	-10.3%	140092	-10.2%	142272	-8.8%

For the simulation to be meaningful, we run a stretch scenario in which processing capacity increases from the actual 2,000 tons to 20,000 tons (see Scenario XV in Table 11). Besides being a theoretical exercise, the grounds for this exercise are the expectations expressed in CNC (2012), mentioned in Section 2. Such an increase in processing capacity would affect positively intermediate and farm-gate prices, partially compensating the effect of the FUNPI tax. Specifically, farmer prices would decrease by 16.9 percent (rather than 19.5 percent with FUNPI contribution alone) while trader prices would decrease by 15.5 percent (rather than 17.9 percent with FUNPI tax alone). The new demand of raw cashews for processing would induce additional production (which would contribute 13 percent, or 2,272 out of 18,000 tons), but most significantly would substitute for export opportunities (87 percent of additional raw cashews). The reduction of almost 16,000 tons, formerly available for exports, would affect negatively exporters' market share and their profitability (12 percent in addition to the reduction from FUNPI tax). But the increase in intermediate price still allows for individual firms to make profits in the new

[12] Inasmuch quantities of raw cashews bought by processors are subject by capacity constraints the relative profitability of new vs. old processors is irrelevant for the equilibrium.

equilibrium.

Fostering cashew processing would also create value in this segment: 18 thousand tons would become profitable at an approximately 374 USD/ton conversion rate (428.56 – 54.37 USD/ton).[13]

4.2.5. Simulation: FUNPI contribution and subsidies to farmer inputs

Our last simulation involves the interaction between the FUNPI contribution and a complementary policy that reduce farmers' costs, such as subsidies to finance seeds, fertilizers, or other inputs by 10 percent. Such policy represents 2 percent of revenues.[14] Scenario XVI in Table 12 shows the results.

Table 12. Base Scenario – FUNPI contribution and subsidy to farmer inputs

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	% change (vs I)	(XVI) = (I) + FUNPI + 10% reduction in cost of farmer services	% change (vs I)
International Price (USD/ton)	799.88	799.88		799.88	
Trade taxes (USD/ton)	93.50	199.88		199.88	
International Price net of taxes (USD/ton)	706.38	600.00	-15.1%	600.00	-15.1%
Intermediate Price (USD/ton)	519.54	426.66	-17.9%	424.72	-18.3%
Farm-gate Price (USD/ton)	435.95	351.00	-19.5%	348.42	-20.1%
Exporters + cashew processors profit (USD/ton)	73.80	67.20	-8.9%	68.10	-7.7%
of which, exporters (USD/ton)	70.23	61.78	-12.0%	62.81	-10.6%
of which, cashew processors (USD/ton)	348.26	441.14	26.7%	443.08	27.2%
HHI exporters and cashew processors	487	510		512	
Traders profit (USD/ton)	40.94	34.66	-15.3%	34.92	-14.7%
HHI traders	256	256		256	
Quantity (tons)	156024	140000	-10.3%	143668	-7.9%

We assume that inputs or services subject to the subsidy (of 10 percent of cost) represent 60 percent of total farmer inputs. Other assumptions that are necessary to convert the subsidy in a change in parameter *A* are subsumed in the value of price elasticity (ε).

Lower input costs (or instruments that raise farmers' productivity) would translate in equilibrium to a lower decrease in quantity (vs the scenario with FUNPI contribution) and also an additional reduction in farmer and trader prices. Facing higher farmers' supply, profitability of both exporters and traders increase, but not enough to compensate the reduced oportunities created by the tax.

Differently from previous simulations, complementary policies that affect farmers costs induce a positive supply response. Given the conditions in the trade and export segments, the subsidy would induce additional reduction in farm-gate prices. However, this reduction in price should be balanced with reductions in farmers' costs to assess whether the complementary policy compensates farmers' utility or not (this point is analyzed in Section 5).

[13] In this simulation, the most efficient exporters get a per-ton profit of approximately USD 80.

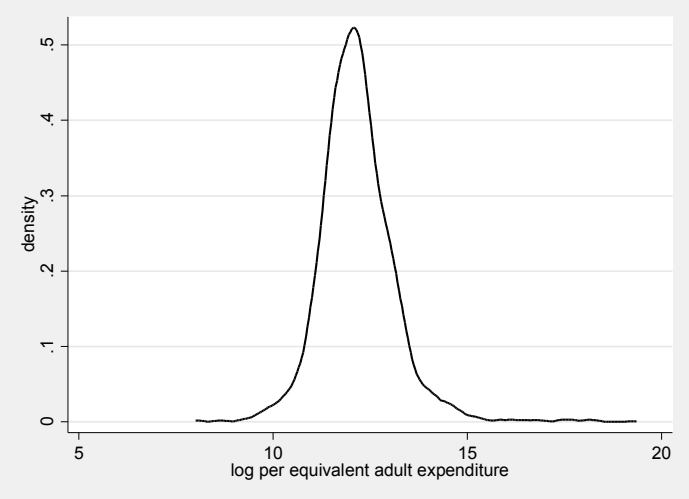
[14] We assume a subsidy equivalent to a 10 percent reduction in the costs of subsidized inputs, which account for around 60 percent of the total cost of cashew production. The cost-price margin implied by our supply function specification is 1/3. Therefore, the subsidy to inputs represents 2 percent of revenues.

5. Welfare simulation impacts

In this section, we report simulations results to assess the welfare impacts of the different shocks affecting cashew farm-gate prices that we studied above. The underlying theory builds on Deaton (1989, 1997) and Nicita, Olarrega and Porto (2014). Provided cashew sales are an important source of income for Guinea-Bissau, changes in cashew prices can have potentially large effects on household welfare. As it is well-known, these welfare effects can be well approximated by multiplying the size of the price shock and the share of cashew income in total household income. This quantity gives the proportional change in real income, or expenditures, caused by a change in cashew prices.[15]

We begin with a brief description of the variables needed for the analysis. The data used here come from the Guinea-Bissau household survey, the QUIBB, *Questionário de Indicadores Básicos de Bem-estar*, 2010. Figure 5 plots the density of the log of per equivalent adult expenditure in the country. This is the measure of household welfare typically adopted in studies of this type. As expected, the density has an approximate Normal shape. It is noteworthy that the tails are long, indicating the presence of potential outliers. Figure 6 plots the densities for the rural and the urban populations. The urban density lies to the right of the rural density, thus indicating that urban households tend to enjoy higher levels of living, on average, than rural households. This is a standard observation from household survey data.

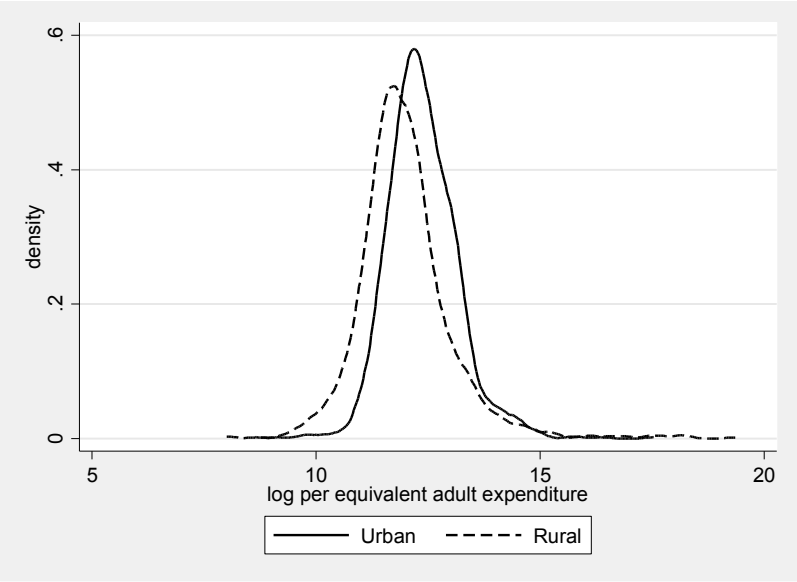
Figure 5. Density of log per equivalent adult expenditure



Source: QUIBB 2010.

[15] This kind of first order approximation often works very well in giving a short-run assessment of the impact of a price shock. To measure farmer adjustments, a second order approximation can be done but, in practice, these second-order terms are generally very small. With distortions and imperfections, the first order approximation can be inaccurate but the estimation of such a model imposes very heavy data and modeling burdens.

Figure 6. Density of log per equivalent adult expenditure
Urban-Rural

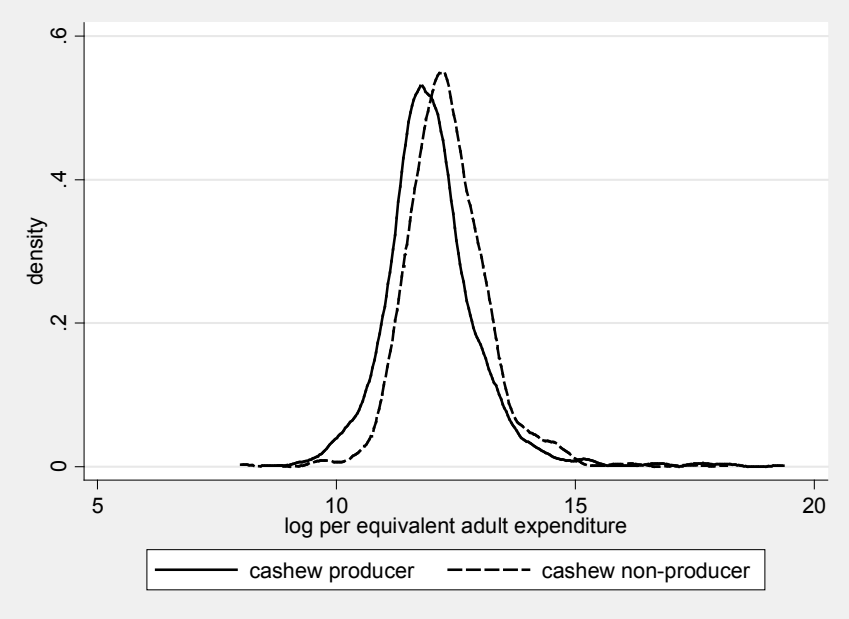


Source: QUIBB 2010.

In Figures 7 and 8, we compare the distribution of income across cashew producers and cashew non-producers. Interestingly, cashew producers are poorer than cashew non-producers. In Figure 7, the density of the producers lies to the left of the density of the non-producers. In part, this is because non-producers include urban households, which, as we showed, tend to be richer in general. In Figure 8, thus, we compare cashew producers and non-producers in rural areas only. This comparison thus involves mostly agricultural households that choose to produce cashews vis-à-vis households that self-select into other crops. In this case, the densities are very much alike, and there is a lot of overlap between them. This indicates that the distribution of well-being is more or less the same across cashew producers and cashew non-producers.

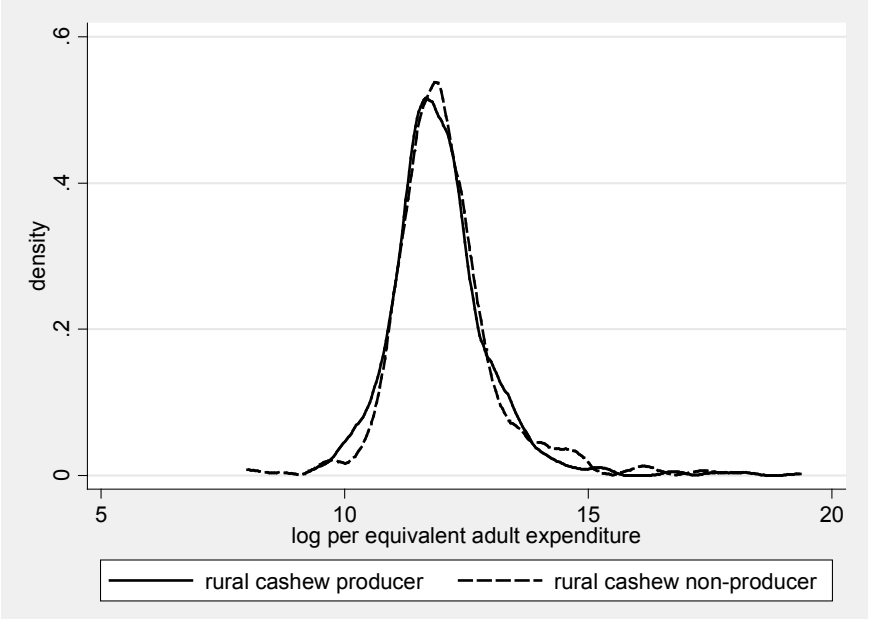
We now turn to the share of cashew income, which is our measure of exposure of different households to the change in cashew prices. The average share derived from cashews is 27.2 percent. This means that, for instance, a 10 percent increase in farm-gate prices would create income gains of 2.72 percent of initial household welfare. In other words, the average Bissau-Guinean household would be 2.72 percent better-off. Given the reported pass-through rates above, a 10 percent increase in international prices would translate into a 14-percent increase in farm-gate prices, and the average welfare effect would thus be 3.8 percent. The share of income derived from cashews is much higher in rural areas – 43.4 percent – than in urban areas – 8.4 percent. A given cashew price change will thus have a much larger welfare effect on rural areas than on urban areas. This is expected, since cashew farming is an inherent rural phenomenon, but it is nevertheless useful information for our analysis.

Figure 7. Density of log per equivalent adult expenditure
Cashew Producers – Cashew Non-Producers



Source: QUIBB 2010.

Figure 8. Density of log per equivalent adult expenditure
Rural Cashew Producer – Rural Cashew Non-Producer



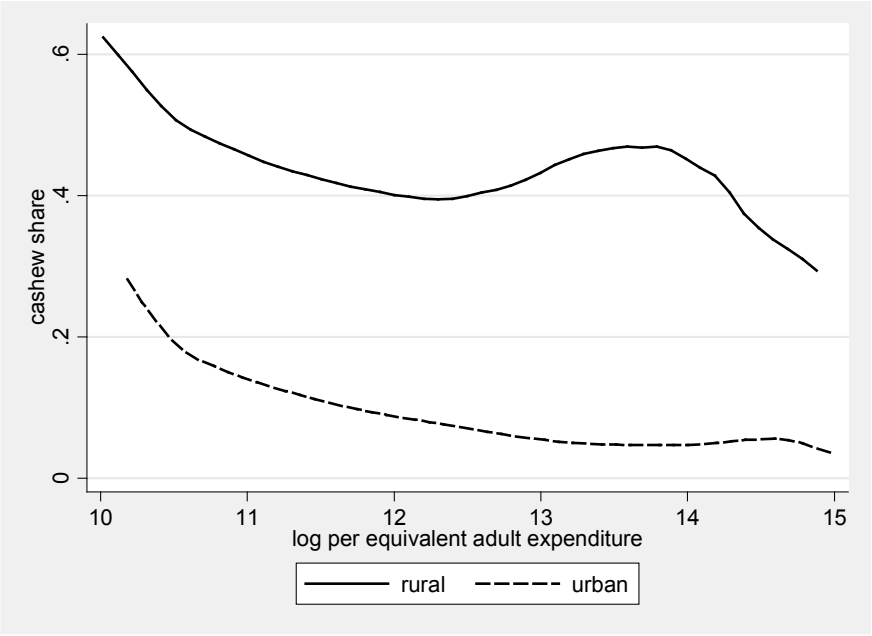
Source: QUIBB 2010.

The cashew shares, and thus the welfare effects from price changes, are likely to vary across the distribution of income. Poor farmers may have higher relative cashew production, and are thus more exposed to price changes. Maybe the beneficiaries of price increases are instead the middle-income households or the more well-off households. To explore this issue, descriptively for the

moment, we estimate non-parametric regressions of cashew shares on the log of per equivalent adult expenditures.

Figure 9 shows the average cashew share at different levels of income for rural and urban Bissau-Guinean households. In rural areas, the curve slopes down steeply. This means that poor households would tend to benefit more from price increases than richer households would. For instance, at the bottom left of the log per equivalent adult spectrum, the average cashew share is around 50 percent. On the top right side of the distribution, the average share drops to 40 percent. For urban households, we find that the average cashew share is also higher for poor than for rich households. In this case, differences are much deeper. For example, poorer urban households derive on average about 20 percent of their income from cashews. The average share for richer households is much lower, around 5 percent.

Figure 9. Average cashew share: Rural and Urban Households



Source: QUIBB 2010.

From this descriptive analysis, we can make some inferences about the potential welfare effects of cashew price changes. Concretely, the average Bissau-Guinean household will gain from higher cashew prices, ceteris paribus. The gains are likely to be much higher for rural households than for urban households. Further, the gains are likely to be larger for poor households than for richer households. Finally, the gains are likely to be larger for the rural poor, they are likely to be comparable for the rural rich and for the poorest urban households, and they are going to be small for richer urban households.

Our simulation results, reported in Tables 13 to 16, indeed confirm these intuitions. They also provide a quantification of the magnitudes involve. For instance, in Table 13 we compare the current situation with FUNPI to a baseline situation without FUNPI (column 2). As we showed

above, the implementation of the FUNPI contribution at constant international prices entails a reduction in farm-gate prices. The export tax creates in effect a wedge between international and farm-gate prices. Lower prices imply welfare losses. For the average Bissau-Guinean household, the welfare loss is equivalent to 5.3 percent of the initial level of well-being. As expected, there is heterogeneity in the losses. Rural households lose 8.46 percent, urban households lose only 1.65 percent. The welfare loss of the average poor household is larger than the welfare loss of the average non-poor household (7.89 and 4.4 percent, respectively). The rural poor suffers the largest losses, 9.39 percent, followed by the rural non-poor (7.92 percent), the urban poor (3.24 percent) and, finally, the urban non-poor (1.39 percent). Overall, FUNPI results in an increase of 2 percentage point to an absolute poverty rate of 71.12 percent and of a 3 percentage point increase in extreme poverty to 36.47 percent.

All these impacts are calculated for the average household in different categories. Note, however, that we are considering only the direct impacts of cashew farm-gate prices, thus in fact ignoring spillovers (to rice markets, for example). In fact, the direct welfare loss of cashew producers is very large, of around 11.03 percent of their initial level of welfare. The losses are slightly larger for the poor cashew producers, 12.28 percent, than the non-poor cashew producers.

It is important to understand the difference between the unconditional impact for the average household and the impact on cashew producers. The latter quantity reveals the impacts of the FUNPI contribution on the welfare of the average cashew producer. The former reveals the impact of the FUNPI contribution on the average Bissau-Guinean household. The impact on the producer uncovers who is affected differently. But if there are few of affected households, then the impact on the producers may be disproportionately large compared to the impacts for the average Bissau-Guinean. Both estimates are important, and they should be carefully assessed.

Columns 3 and 4 report results for the case of the implementation of FUNPI contribution in a setting with higher international prices. Higher international prices pass through to farm-gate prices, even in the presence of an export tax, and the end result is a higher farm-gate price and welfare gains. To avoid too much repetition, we compare the impacts on the average household and on the average producer. Should international prices increase up to the maximum price for the period, the welfare gains of the average household would be equivalent to 34.70 percent of the average welfare of Guinea Bissau. By contrast, the welfare gain for the average cashew producer would be equivalent to 72.26 percent of the initial welfare of cashew producers. This would imply a decline of the extreme poverty count to approximately 16.1 percent and a decline of the absolute poverty count to roughly 49 percent. These are large impacts.

If, instead, we consider a more conservative scenario where prices increase to the average international price during the period of analysis, the welfare impacts would be 9.3 percent for the average household and 19.37 percent for the average cashew household. The extreme poverty rate would decrease to 22 percent, and the absolute poverty rate to 57.6 percent.

Table 13. Welfare Effects in Guinea-Bissau: Baseline

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	(III) = (II) + max intn'l price	(IV) = (II) + average intn'l price
All Households	--	-5.30	34.70	9.30
Urban Households	--	-1.65	10.78	2.89
Rural Households	--	-8.46	55.42	14.86
Poor Households	--	-7.89	51.67	13.85
Non-Poor Households	--	-4.40	28.86	7.74
Urban Poor Households	--	-3.24	21.25	5.70
Rural Poor Households	--	-9.39	61.51	16.49
Urban Non-Poor Households	--	-1.39	9.12	2.44
Rural Non-Poor Households	--	-7.92	51.91	13.92
Cashew Producers	--	-11.03	72.26	19.37
Poor Cashew Producers	--	-12.28	80.48	21.58
Non-Poor Cashew Producers	--	-10.38	68.00	18.23

Source: QUIBB 2010 and price changes from the simulations of Section 4. The numbers are expressed in percent.

In Tables 14 and 15, we compare the current situation with the FUNPI contribution with different scenarios where the tax is complemented with various additional policies/shocks. The tax implies a lower farm-gate price and entails welfare losses for the farmers. The complementarities investigated here are intended to shed some light on potential ways to ameliorate, or revert, the lower cashew prices. As we have seen, all the scenarios with conservative complementarities are preferred to the baseline scenario of the FUNPI and the export tax. This is because farm-gate prices are higher in the equilibrium with complementary policies. But, in all instances, the simulations find lower farm-gate prices than in the baseline which, consequently, lead to welfare losses. For instance, in Scenario V (FUNPI with export tax coupled by a 10 percent reduction in export costs), the welfare loss for the average household is 4.53 percent, which is lower than the loss without the cost reduction simulation (5.30 percent loss in the baseline with FUNPI and export tax). For the average cashew producer, there is loss of 9.44 percent with the complementarities, as opposed to a larger loss of 11.03 percent with the FUNPI. These results are not surprising given our discussion in Section 4. In fact, our simulation analysis explored thresholds for the complementary policies that would leave farmers indifferent and we here refer to the discussion in Tables 7-10 of Section 5.

Table 14. Welfare Effects in Guinea-Bissau: Complementarities

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	(V) = (I) + FUNPI + 10% reduction in exporters costs	(VI) = (I) + FUNPI + 10% reduction in traders costs	(VII) = (I) + FUNPI + 10% reduction in exporters and traders costs	(IX) = (I) + FUNPI + 2 efficent exporters
All Households	--	-5.30	-4.53	-5.00	-4.23	-4.26
Urban Households	--	-1.65	-1.41	-1.55	-1.32	-1.32
Rural Households	--	-8.46	-7.24	-7.98	-6.76	-6.80
Poor Households	--	-7.89	-6.75	-7.44	-6.30	-6.34
Non-Poor Households	--	-4.40	-3.77	-4.16	-3.52	-3.54
Urban Poor Households	--	-3.24	-2.78	-3.06	-2.59	-2.61
Rural Poor Households	--	-9.39	-8.04	-8.86	-7.50	-7.54
Urban Non-Poor Households	--	-1.39	-1.19	-1.31	-1.11	-1.12
Rural Non-Poor Households	--	-7.92	-6.78	-7.48	-6.33	-6.37
Cashew Producers	--	-11.03	-9.44	-10.41	-8.81	-8.86
Poor Cashew Producers	--	-12.28	-10.51	-11.59	-9.81	-9.87
Non-Poor Cashew Producers	--	-10.38	-8.88	-9.79	-8.29	-8.34

Source: QUIBB 2010 and price changes from the simulations of Section 4. The numbers are expressed in percent.

Table 15. Welfare Effects in Guinea-Bissau: Complementarities

Policy	(II) = (I) + FUNPI	(XI) = (I) + FUNPI + 10% additional exporters	(XII) = (I) + FUNPI + 10% additional traders	(XIII) = (I) + FUNPI + 10% additional exporters and traders
All Households	-5.30	-4.84	-5.06	-4.60
Urban Households	-1.65	-1.50	-1.57	-1.43
Rural Households	-8.46	-7.73	-8.07	-7.34
Poor Households	-7.89	-7.21	-7.53	-6.84
Non-Poor Households	-4.40	-4.03	-4.20	-3.82
Urban Poor Households	-3.24	-2.96	-3.10	-2.81
Rural Poor Households	-9.39	-8.58	-8.96	-8.15
Urban Non-Poor Households	-1.39	-1.27	-1.33	-1.21
Rural Non-Poor Households	-7.92	-7.24	-7.56	-6.87
Cashew Producers	-11.03	-10.08	-10.53	-9.57
Poor Cashew Producers	-12.28	-11.23	-11.72	-10.66
Non-Poor Cashew Producers	-10.38	-9.49	-9.91	-9.01

Source: QUIBB 2010 and price changes from the simulations of Section 4. The numbers are expressed in percent.

Finally, similar conclusions emerge from the results in Table 16, where we compare the FUNPI contribution coupled with increases in the cashew processing capacity as well as with policies oriented to reduce farmer producing costs. An increase of cashew processing capacity of 200 tons in 4 processing plants has negligible impacts on prices. In fact, the welfare losses are almost the same as in the baseline. Clearly, the introduction of one large processor (20,000 tons) has larger impacts on the welfare effects. Farm-gate prices still decline, but the decline is lower than in the baseline (FUNPI with tax). The loss for the average household is 4.58 percent (5.30 in the baseline) and the loss for the cashew producers is 9.53 percent (11.03 in the baseline). Note that these impacts are similar to those reported in Scenario XIII which consisted of FUNPI coupled with an increase of 10 percent in the number of exporters and traders simultaneously. Once again, in the

scenarios considered here, there are welfare costs associated with the FUNPI. Finally, note also that these results depend on the assumption of an integrated national market for cashews. With segmented regional markets, the role of competition policies can become much more relevant. Also, there might be collusion between exporters and traders, and this can lead to more severe poverty impacts.

Table 16. Welfare Effect in Guinea-Bissau: Processors and Farmer Assistance

Policy	(II) = (I) + FUNPI	(XIV) = (I) + FUNPI + 4 cashew processors (200 ton each)	(XV) = (I) + FUNPI + 1 cashew processor (20,000 ton)	(XVI) = (I) + FUNPI + 10% reduction in cost of farmer services
All Households	-5.30	-5.27	-4.58	-5.46
Urban Households	-1.65	-1.64	-1.42	-1.70
Rural Households	-8.46	-8.41	-7.31	-8.71
Poor Households	-7.89	-7.84	-6.82	-8.12
Non-Poor Households	-4.40	-4.38	-3.81	-4.54
Urban Poor Households	-3.24	-3.22	-2.80	-3.34
Rural Poor Households	-9.39	-9.33	-8.12	-9.67
Urban Non-Poor Households	-1.39	-1.38	-1.20	-1.43
Rural Non-Poor Households	-7.92	-7.88	-6.85	-8.16
Cashew Producers	-11.03	-10.97	-9.53	-11.36
Poor Cashew Producers	-12.28	-12.21	-10.62	-12.65
Non-Poor Cashew Producers	-10.38	-10.32	-8.97	-10.69

Source: QUIBB 2010 and price changes from the simulations of Section 4. The numbers are expressed in percent.

The last column of Table 16 shows the impacts of complementing FUNPI with assistance to farmers. This assistance is modeled via a decline in the cost of producing cashews. The decline in costs implies, ceteris paribus, an increase in the supply of raw cashews and, consequently, a reduction in equilibrium prices. This would translate into a further reduction welfare (compared to the baseline). These differences are very small. For instance, the welfare effect for the average household would be 5.46 percent while the welfare effect for the average cashew producer would be 11.36 percent. Note, however, that these welfare effects do not take into account the welfare impact of the reduction in costs. These impacts can be (crudely) included as follows. Our experiment assumes a subsidy equivalent to a 10 percent reduction in the costs of subsidized inputs. In turn, these inputs account for around 60 percent of the total cost of cashew production. Finally, noting that the cost-price margin implied by our supply function specification is 0.333 (the price is roughly three times higher than the average cost), we can conclude that the subsidy to inputs creates a welfare effect similar to the welfare effect that would be created by an increase of cashew prices of 2 percent. Under these assumptions, we find it implausible to believe that the subsidy can overturn the welfare costs of the FUNPI contribution. Indeed, the FUNPI contribution implies, in the baseline scenario, a decline in cashew prices of 20 percent. If a subsidy of 10 percent is approximately equivalent to a price increase of 2 percent, it follows that the total

welfare losses from the FUNPI contribution could also be compensated by a 100 percent subsidy. While this seems unfeasible, the exercise at least quantifies the scenario and can be perhaps complemented with other interventions (maybe in other links of the supply chain) and assistance programs to the farmers so that, even if they are individually difficult to implement, they can be jointly beneficial.

6. Conclusions and recomendations

This paper explored the impact of changes in cashew prices received by exporters on farm-gate prices and welfare in Guinea-Bissau. We built a theoretical model of supply chains in export agriculture to capture interaction between exporters, traders, and farmers, and adapted it to the GNB case. We used the model and the Guinea-Bissau household survey data to address several issues.

First, we analyzed the effect of a standard shock to export prices and the introduction of a new tax on cashew exports on margins along the value chain, and within farmers along the income distribution. Given the current competitive conditions in the cashew sector in GNB, the introduction of the FUNPI contribution has strong effects on farm-gate prices, as farmers absorb about 80 percent of the tax (while exporters take up 13 percent and traders absorb the remaining 7 percent). Symmetrically, farmers benefit the most from increases in international prices and also are mostly exposed to world uncertainties (and also taxes). But this effect is uneven across households: poor rural households are more exposed than rich rural and poor urban households, while the least exposed are richer urban households.

Second, we simulated the combined effect of the FUNPI contribution and improvements in competition in cashew trading. Complementary policies aimed to reduce costs at the export and trader links of the supply chain do help in softening the farm-price reduction, and hence welfare of farmers, caused by the FUNPI contribution. Therefore, they are all preferred to the baseline scenario of the FUNPI contribution because farm-gate prices are higher in the equilibrium with complementary policies. Farm-gate price full recovery is possible if policies reduce intermediation costs, which pass through to farm-gate prices throughout (albeit imperfect) competition. We provided two examples, one that reduces costs at both segments of the supply chain and another that levels the playing field in a specific segment (exporters). On the other hand, cost-reducing policies are more effective than entry-inducing ones, as pushing the sector to perfect competition (for existing cost structures) is insufficient to recover pre-tax farm-gate prices and farmers' welfare.

Third, we simulated an interaction between the FUNPI contribution and an increase in value-added processing capacity. Fostering cashew processing creates added value through a displacement of volume from exporters to processors. A significant displacement (in size) reflects on farm-gate prices and farmers' welfare, although not enough to revert them.

Lastly, we simulated an interaction the FUNPI contribution and the provision of services to farmers (for example, cash transfers to finance inputs such as seeds, fertilizers, etc.). Differently from previous cases, complementary policies that affect farmers costs would induce a positive supply response that would translate in equilibrium to additional reductions in farmer and trader prices, although compensated by lower decrease in quantities. But we find it implausible to believe that, under reasonable assumtions, the subsidy can overturn the welfare costs of the FUNPI contribution. Nevertheless, they can be part of a wider set of interventions and assistance programs to the farmers that can be jointly beneficial.

Appendix A. The model with symmetric players

The strategic demand and supplies, and the equilibrium conditions, detailed in Section 3 are implicit functions given the asymmetries assumed in the model. We develop this technical appendix with symmetric agents and arrive at specific functional forms for strategic supply and demand functions, and also for equilibrium intermediate and farm-gate prices.

A.1. Bilateral oligopoly

Assume symmetric exporters, i.e., $(c_E^j, \gamma_E^j) = (c_E, \gamma_E)$. Equation (2) becomes

$$D_E(p_T) = \frac{(p^* - c_E)n_E}{\gamma_E} - \frac{n_E^2}{\gamma_E(n_E - 1)}p_T \tag{A.2}$$

With symmetric traders, i.e., $(c_T^i, \gamma_T^i) = (c_T, \gamma_T)$, equation (4) simplifies to

$$X_T(p_T) = -\frac{n_T}{\gamma_T}c_T - \frac{n_T^2}{(n_T - 1)\gamma_T}p_F + \frac{n_T - 1}{\gamma_T}p_T \tag{A.4}$$

Equation (6) of strategic demand $D_T(p_F)$ becomes

$$D_T(p_F) = \frac{n_T - 1}{\gamma_T}p_T - \frac{n_T}{\gamma_T}c_T - \frac{n_T^2}{(n_T - 1)\gamma_T}p_F \tag{A.6}$$

As in the main text, farmers supply is

$$X_F(p_F) = Ap_F^{\varepsilon} \tag{A.7}$$

Equations (A.2) and (A.4) solve for the intermediate price p_T as a function of export price p^* and farm-gate price p_F.

$$p_T = \frac{(n_E - 1)[n_E(n_T - 1)\gamma_T(p^* - c_E) + n_T\gamma_E(n_T p_F + (n_T - 1)c_T)]}{(n_T - 1)[n_E^2\gamma_T + (n_E - 1)(n_T - 1)\gamma_E]} \tag{A.8}$$

Equations (A.6) and (A.7) depict the relationship between farm-gate price p_F and intermediate price p_T:

$$p_T = \frac{n_T}{n_T - 1}c_T + \frac{n_T^2}{(n_T - 1)^2}p_F + \frac{\gamma_T}{n_T - 1}\mathrm{A}p_F^{\varepsilon} \tag{A.9}$$

Conditions (A.8) and (A.9) define the equilibrium farm-gate price as a function of fundamental parameters

$$(n_E - 1)n_E(n_T - 1)(p^* - c_E) - n_E^2 n_T c_T = \frac{n_T^2 n_E^2}{(n_T - 1)}p_F + [n_E^2\gamma_T + (n_E - 1)(n_T - 1)\gamma_E]\mathrm{A}p_F^{\varepsilon} \tag{A.10}$$

and, together with equation (A.8), characterize the equilibrium prices.

A.1.1. Comparative statics (export tax – change in exporters' costs).

Assume that the government introduces a per unit tax. This can be represented by a change in export costs Δc_E. From (A.10), the effect on farm-gate price is

$$\Delta p_F = -\frac{1}{\frac{n_T^2}{(n_T-1)^2 n_E - 1} + \frac{n_E}{n_E(n_E-1)(n_T-1)} + \frac{[n_E^2\gamma_T + (n_E-1)(n_T-1)\gamma_E]}{n_E(n_E-1)(n_T-1)} A\varepsilon p_F^{\varepsilon-1}} \Delta c_E \quad \text{(A.11)}$$

The ratio $\Delta p_F/\Delta c_E$ is negative and less than 1 (in absolute value). Notice however, that the second term in the denominator is smaller the lower are ($\gamma_E, \gamma_T, \varepsilon$), and therefore farmers absorb a higher share of the tax. Moreover, starting at an equilibrium price (say p_F^0), this ratio is lower the lower n_T and n_E. In words, there is a negative relationship between the share of the tax absorbed by farmers and the level of concentration in the exporters' and traders's segment.

From (A.8) the effect on intermediate price is

$$\Delta p_T = -\frac{n_E(n_E-1)(n_T-1)\gamma_T}{n_E^2\gamma_T + (n_E-1)(n_T-1)\gamma_E}\Delta c_E + \frac{(n_E-1)n_T^2\gamma_E}{n_E^2\gamma_T + (n_E-1)(n_T-1)\gamma_E}\Delta p_F$$

which is also negative. In order to get a grasp of magnitude of the effect of the tax on exporters' and traders' margins (valued at the equilibrium), assume *A=7,473* (this is the constant that fits the quantity *X=140,000* with $p_F=351$ and $\varepsilon=0.5$). We can use information from Table 4 ($n_T=39$, $\gamma_T = 0.008$ and $\gamma_E \approx 0.011$, which is the average value of γ_E's) and Table 2 (given that this appendix builds on the assumption of symmetric exporters, assume $n_E=20$).

If $\Delta c_E=100$, then $Dp_T=-87$ and $Dp_F=-79$. Exporters' margin change in $\Delta M_E=-\Delta c_E-\Delta p_T = -100+87=-13$; traders' margin changes in $\Delta M_T=\Delta p_T-\Delta p_F=-87+79=-8$; and farmers' margin changes in $\Delta M_F=Dp_F=-79$.

Now assume that $n_E=39$ and $n_T=20$ (that is, traders are more concentrated than exporters) and let other parameters be the same. If $\Delta c_E=100$, then $Dp_T=-93$ and $Dp_F=-78$. Exporters' margin change in $\Delta M_E=-\Delta c_E-\Delta p_T = -100+93=-7$; traders' margin changes in $\Delta M_T=\Delta p_T-\Delta p_F=-93+78=-15$; and farmers' margin changes in $\Delta M_F=Dp_F=-78$.

In both cases, farmers absorb approximately 80 percent of the tax. But the distribution of the remaining 20 percent is absorbed by exporters or traders depending on their level of concentration, with the more concentrated link assuming the largest share.

A.1.2. Special case: Unit farmer's supply elasticity $\varepsilon=1$.

If the price-elasticity of farmers supply is $\varepsilon=1$, the problem develops straightforwardly. Equations (A.8) and (A.10) turn out to be

$$p_F = \frac{n_E(n_E-1)(n_T-1)^2(p^*-c_E) - n_T(n_T-1)n_E^2 c_T}{n_T^2 n_E^2 + (n_T-1)[n_E^2\gamma_T + (n_E-1)(n_T-1)\gamma_E]A} \quad \text{(A.12)}$$

$$p_T = \frac{n_E(n_E-1)n_T^2 + (n_E-1)(n_T-1)n_E\gamma_T A}{n_T^2 n_E^2 + (n_T-1)[n_E^2\gamma_T + (n_E-1)(n_T-1)\gamma_E]A}(p^* - c_E) + \frac{(n_E-1)(n_T-1)n_T\gamma_E A}{n_T^2 n_E^2 + (n_T-1)[n_E^2\gamma_T + (n_E-1)(n_T-1)\gamma_E]A} c_T \quad \text{(A.13)}$$

Even simpler, if $c_E = 0$ and $c_T = 0$,

$$p_F = \frac{n_E(n_E-1)(n_T-1)^2}{n_T^2 n_E^2 + (n_T-1)[n_E^2\gamma_T + (n_E-1)(n_T-1)\gamma_E]A} p^*$$

$$p_T = \frac{n_E(n_E-1)[n_T^2 + (n_T-1)A\gamma_T]}{n_T^2 n_E^2 + (n_T-1)[n_E^2\gamma_T + (n_E-1)(n_T-1)\gamma_E]A} p^*$$

with relative prices equal to

$\frac{p^*}{p_T} = \frac{n_T^2 n_E^2 + (n_T-1)[n_E^2\gamma_T + (n_E-1)(n_T-1)\gamma_E]A}{n_E(n_E-1)[n_T^2 + (n_T-1)A\gamma_T]}$ and $\frac{p_T}{p_F} = \frac{A\gamma_T}{n_T-1} + \frac{n_T^2}{(n_T-1)^2}$

Both ratios exceed 1, as a result of imperfect competition at the export and trade links of the supply chain.

A.2. Competitive equilibrium

In a perfectly competitive setting with symmetric traders, equation (11) becomes

$$p_T = p^* - c_E - \frac{\gamma_E X_E}{n_E}$$

while equation (10) simplifies to

$$p_F = p^* - c_E - c_T - \frac{\gamma_E X_E}{n_E} - \frac{\gamma_T X_T}{n_T}$$

and total quantity solves

$$A' X^{\frac{1}{\varepsilon}} = p^* - c_E - c_T - \left(\frac{\gamma_E}{n_E} + \frac{\gamma_T}{n_T}\right) X$$

Where $A' = (1/A)^{1/\varepsilon}$.

Example: Unit farmer's supply elasticity $\varepsilon = 1$.

The competitive prices with unit elasticity of supply is

$$p_F = \frac{A'(p^* - c_E - c_T)}{A' + \frac{\gamma_E}{n_E} + \frac{\gamma_T}{n_T}}, p_T = \frac{\left(A' + \frac{\gamma_T}{n_T}\right)(p^* - c_E - c_T)}{A' + \frac{\gamma_E}{n_E} + \frac{\gamma_T}{n_T}} + c_T$$

and quantities are

$$X = \frac{p^* - c_E - c_T}{A' + \frac{\gamma_E}{n_E} + \frac{\gamma_T}{n_T}}$$

If $c_E = 0$ and $c_T = 0$, intermediate and farm-gate prices simplify to

$$p_F = \frac{1}{1 + \left(\frac{\gamma_E}{n_E} + \frac{\gamma_T}{n_T}\right)A} p^*, p_T = \frac{\left(1 + \frac{\gamma_T}{n_T}A\right)}{1 + \left(\frac{\gamma_E}{n_E} + \frac{\gamma_T}{n_T}\right)A} p^*$$

Appendix B. Simulations - Sensitivity analysis

Section 4 of this paper presents several simulations based on a set of assumptions, namely, the magnitude of the price-elasticity of supply, the constant-variable mix of marginal costs, and the level of concentration at the traders segment. In this Appendix, we present and discuss the robustness of our results to each assumption.

Sensitivity to price elasticity of supply

Tables B1 to B3 repeat the simulations presented in Section 4, with the exception of Scenarios XI to XIII assuming a price-elasticity of supply equal to $\varepsilon=0.75$. Tables B4 to B6 do the same assuming $\varepsilon=0.25$. The stretch scenarios for cost reduction (VIII) and efficient exporters (X) are adapted so that farm-gate prices reach the pre-FUNPI tax level.

The assumption of a higher price elasticity ($\varepsilon=0.75$) reduce price fluctuations and magnifies quantity and per-ton profit fluctuations (as compared with $\varepsilon=0.50$). For example, an increase in international price from 799 USD/ton to 950 USD/ton is accompanied by increases in farm-gate prices of 32 percent (rather than 34 percent) and by increases in quantities of 23 percent (rather than 16 percent). A complementary policy that reduces exporters and traders costs by 10 percent imply farm-gate prices that go down by 14.8 percent (rather than 15.6 percent) and quantities that go down by 11 percent (rather than 8 percent).

On the other hand, the assumption of a lower price elasticity ($\varepsilon=0.25$) magnifies price fluctuations and buffers quantity and per-ton profit fluctuations. For example, an increase in international price from 799 USD/ton to 950 USD/ton is accompanied by increases in farm-gate prices of 36 percent (rather than 34 percent) and by increases in quantities of 8 percent (rather than 16 percent). A complementary policy that reduces exporters and traders costs by 10 percent imply farm-gate prices that go down by 16.4 percent (rather than 15.6 percent) and quantities that go down by 4 percent (rather than 8 percent).

Sensitivity to cost structure and concentration in the trade segment

Then we return back to the base case and make assumptions on cost parameters and competition in the traders segment. Specifically, we test the base model by modifying the calibrated solution as follows:

- Cost parameters such the constant component of the marginal cost is twice the variable component. For example, for exporter j, $c_E^j = 2\,\gamma_E^j\,x_E^j$, versus $c_E^j = \gamma_E^j\,x_E^j$ assumed in the base case (a similar assumption applies to traders).
- Marginal cost is almost constant, i.e., γ_E^j and γ_T^j tend to 0.

- The trading segment is more concentrated and asymmetric. We suppose that 5 traders have 9 percent of market share each, and the remaining 34 traders have 1.62 percent of market share each.
- The trading segment is more concentrated and symmetric. We suppose that concentration is similar to 12 traders with 8.33 percent of market share each.

  The last two cases are built on the basis that the market data summarized in Table 3, together with the possible prices that may arise in equilibrium, are consistent with a maximum market share of traders of approximately 9 percent.

For each case, we calibrate the model to the new assumptions and simulate the effect of the introduction of the FUNPI contribution (see Table B7).

Results are as expected. As the model assumes "more constant" marginal costs, pre-tax exporters' and traders' profit are lower (in the exporters case, from 74 USD/ton to 28 USD/ton; in the traders case from 41 USD/ton to 24 USD/ton) because marginal costs tend to equate average costs; hence strategic bids and offers, based on marginal costs, tend to align with average costs, and average margins decrease. Consequently, taking international prices and farmer supply as given, farmer prices should be higher (435.95 USD/ton in the base case vs. 450 USD/ton in the almost-constant-marginal-cost case).

On the other hand, as concentration in the traders segment is higher, traders earn higher profits (from 41 USD/ton to 60 or 84 USD/ton), partly because of lower farm-gate prices (from 436 USD/ton to 429-433 USD/ton) and higher intermediate prices (from 520 USD/ton to 522-536 USD/ton). Moreover, exporter costs must be lower in order to be compatible with a more concentrated segment at the traders' link.

Once the new calibrated case is set, however, the simulation results do not differ significantly. The introduction of FUNPI reduces farm-gate prices by 18-22 percent, and quantity goes down by 10-12 percent.

Table B1. Simulations – Introduction of FUNPI and sensitivity to international price (*ε=0.75*)

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	(III) = (II) + max intn'l price	(IV) = (II) + average intn'l price
International Price (USD/ton)	799.88	799.88	1350.00	950.00
Trade taxes (USD/ton)	93.50	199.88	199.88	199.88
International Price net of taxes (USD/ton)	706.38	600.00	1150.12	750.12
Intermediate Price (USD/ton)	515.67	426.66	891.45	552.42
Farm-gate Price (USD/ton)	430.82	351.00	769.62	463.83
Exporters + cashew processors profit (USD/ton)	75.72	67.20	119.29	81.85
of which, exporters (USD/ton)	72.29	61.78	114.00	76.54
of which, cashew processors (USD/ton)	352.13	441.14	780.73	534.76
HHI exporters and cashew processors	493	510	453	487
Traders profit (USD/ton)	41.45	34.66	69.21	44.23
HHI traders	256	256	256	256
Quantity (tons)	163255	140000	252265	172551

Table B2. Simulations – FUNPI and complementary policies (*ε=0.75*)

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	(V) = (I) + FUNPI + 10% reduction in exporters costs	(VI) = (I) + FUNPI + 10% reduction in traders costs	(VII) = (I) + FUNPI + 10% reduction in exporters and traders costs	(VIII) = (I) + FUNPI + 46% reduction in exporters and traders costs	(IX) = (I) + FUNPI + 2 efficent exporters	(X) = (I) + FUNPI + 33 efficent exporters
International Price (USD/ton)	799.88	799.88	799.88	799.88	799.88	799.88	799.88	799.88
Trade taxes (USD/ton)	93.50	199.88	199.88	199.88	199.88	199.88	199.88	199.88
International Price net of taxes (USD/ton)	706.38	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Intermediate Price (USD/ton)	515.67	426.66	439.55	425.95	438.89	487.40	444.35	515.87
Farm-gate Price (USD/ton)	430.82	351.00	362.54	355.49	367.15	430.85	366.85	430.99
Exporters + cashew processors profit (USD/ton)	75.72	67.20	63.83	67.53	64.14	50.59	61.83	25.46
of which, exporters (USD/ton)	72.29	61.78	58.68	62.16	59.03	46.50	56.76	21.41
of which, cashew processors (USD/ton)	352.13	441.14	428.25	441.85	428.91	380.40	423.45	351.93
HHI exporters and cashew processors	493	510	489	512	490	406	559	269
Traders profit (USD/ton)	41.45	34.66	35.65	33.44	34.40	33.00	36.02	41.47
HHI traders	256	256	256	256	256	256	256	256
Quantity (tons)	163255	140000	143439	141340	144803	163265	144714	163305

Table B3. Simulations – FUNPI with cashew processing or subsidies to farmer inputs (*ε=0.75*)

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	(XIV) = (I) + FUNPI + 4 cashew processors (200 ton each)	(XV) = (I) + FUNPI + 1 cashew processor (20,000 ton)	(XVI) = (I) + FUNPI + 10% reduction in cost of farmer services
International Price (USD/ton)	799.88	799.88	799.88	799.88	799.88
Trade taxes (USD/ton)	93.50	199.88	199.88	199.88	199.88
International Price net of taxes (USD/ton)	706.38	600.00	600.00	600.00	600.00
Intermediate Price (USD/ton)	515.67	426.66	427.14	438.72	424.53
Farm-gate Price (USD/ton)	430.82	351.00	351.43	361.80	348.17
Exporters + cashew processors profit (USD/ton)	75.72	67.20	68.12	89.01	68.19
of which, exporters (USD/ton)	72.29	61.78	61.49	54.65	62.91
of which, cashew processors (USD/ton)	352.13	441.14	440.66	429.08	443.27
HHI exporters and cashew processors	493	510	505	584	512
Traders profit (USD/ton)	41.45	34.66	34.70	35.59	34.95
HHI traders	256	256	256	256	256
Quantity (tons)	163255	140000	140129	143218	144022

Table B4. Simulations – Introduction of FUNPI and sensitivity to international price (*ε=0.25*)

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	(III) = (II) + max intn'l price	(IV) = (II) + average intn'l price
International Price (USD/ton)	799.88	799.88	1350.00	950.00
Trade taxes (USD/ton)	93.50	199.88	199.88	199.88
International Price net of taxes (USD/ton)	706.38	600.00	1150.12	750.12
Intermediate Price (USD/ton)	523.71	426.66	935.08	563.84
Farm-gate Price (USD/ton)	441.47	351.00	826.94	478.96
Exporters + cashew processors profit (USD/ton)	71.73	67.20	97.74	76.42
of which, exporters (USD/ton)	68.00	61.78	90.28	70.44
of which, cashew processors (USD/ton)	344.09	441.14	737.10	523.33
HHI exporters and cashew processors	480	510	406	470
Traders profit (USD/ton)	40.39	34.66	63.69	42.72
HHI traders	256	256	256	256
Quantity (tons)	148261	140000	173448	151313

Table B5. Simulations – FUNPI and complementary policies (ε=0.25)

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	(V) = (I) + FUNPI + 10% reduction in exporters costs	(VI) = (I) + FUNPI + 10% reduction in traders costs	(VII) = (I) + FUNPI + 10% reduction in exporters and traders costs	(VIII) = (I) + FUNPI + 48% reduction in exporters and traders costs	(IX) = (I) + FUNPI + 2 efficent exporters	(X) = (I) + FUNPI + 45 efficent exporters
International Price (USD/ton)	799.88	799.88	799.88	799.88	799.88	799.88	799.88	799.88
Trade taxes (USD/ton)	93.50	199.88	199.88	199.88	199.88	199.88	199.88	199.88
International Price net of taxes (USD/ton)	706.38	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Intermediate Price (USD/ton)	523.71	426.66	440.59	426.39	440.35	495.59	445.55	523.74
Farm-gate Price (USD/ton)	441.47	351.00	363.97	356.06	369.09	441.53	368.59	441.50
Exporters + cashew processors profit (USD/ton)	71.73	67.20	63.35	67.33	63.46	47.26	61.29	20.56
of which, exporters (USD/ton)	68.00	61.78	58.12	61.93	58.25	42.82	56.12	16.13
of which, cashew processors (USD/ton)	344.09	441.14	427.21	441.41	427.45	372.21	422.25	344.06
HHI exporters and cashew processors	480	510	487	511	487	388	557	208
Traders profit (USD/ton)	40.39	34.66	35.49	33.39	34.21	32.30	35.79	40.39
HHI traders	256	256	256	256	256	256	256	256
Quantity (tons)	148261	140000	141276	140502	141770	148266	141722	148263

Table B6. Simulations – FUNPI with cashew processing or subsidies to farmer inputs (ε=0.25)

Policy	(I) Base Scenario - no FUNPI	(II) = (I) + FUNPI	(XIV) = (I) + FUNPI + 4 cashew processors (200 ton each)	(XV) = (I) + FUNPI + 1 cashew processor (20,000 ton)	(XVI) = (I) + FUNPI + 10% reduction in cost of farmer services
International Price (USD/ton)	799.88	799.88	799.88	799.88	799.88
Trade taxes (USD/ton)	93.50	199.88	199.88	199.88	199.88
International Price net of taxes (USD/ton)	706.38	600.00	600.00	600.00	600.00
Intermediate Price (USD/ton)	523.71	426.66	427.18	439.83	424.93
Farm-gate Price (USD/ton)	441.47	351.00	351.49	363.26	348.70
Exporters + cashew processors profit (USD/ton)	71.73	67.20	68.20	88.82	68.00
of which, exporters (USD/ton)	68.00	61.78	61.47	54.05	62.70
of which, cashew processors (USD/ton)	344.09	441.14	440.62	427.97	442.87
HHI exporters and cashew processors	480	510	505	586	511
Traders profit (USD/ton)	40.39	34.66	34.69	35.45	34.90
HHI traders	256	256	256	256	256
Quantity (tons)	148261	140000	140049	141207	143264

Table B7. Base Scenario and FUNPI: Sensitivity to alternative cost structures and competition among traders (*ε=0.50*)

Scenario	Base Case		More constant marginal cost		Constant marginal cost		Base Case + concentrated asymmetric traders		Base Case + concentrated symmetric traders	
Competition Policy (current situation, 2013)	**Base Scenario**	**FUNPI**	**Base Scenario**	**FUNPI**	**Base Scenario**	**FUNPI**	**Base Scenario**	**FUNPI**	**Base Scenario**	**FUNPI**
International Price (USD/ton)	799.88	799.88	799.88	799.88	799.88	799.88	799.88	799.88	799.88	799.88
Trade taxes (USD/ton)	93.50	199.88	93.50	199.88	93.50	199.88	93.50	199.88	93.50	199.88
International Price net of taxes (USD/ton)	706.38	600.00	706.38	600.00	706.38	600.00	706.38	600.00	706.38	600.00
Intermediate Price (USD/ton)	519.54	426.66	527.42	431.44	542.91	438.63	521.99	428.95	536.27	442.86
Farm-gate Price (USD/ton)	435.95	351.00	439.69	351.00	450.00	351.00	433.07	351.00	429.38	351.00
Exporters + cashew processors profit (USD/ton)	73.80	67.20	58.85	54.25	28.07	30.77	74.35	67.82	74.75	68.40
of which, exporters (USD/ton)	70.23	61.78	55.21	48.71	24.28	24.99	70.82	62.44	71.39	63.23
of which, cashew processors (USD/ton)	348.26	441.14	340.38	436.36	324.89	429.17	345.81	438.85	331.53	424.94
HHI exporters and cashew processors	487	510	477	510	409	510	487	510	486	510
Traders profit (USD/ton)	40.94	34.66	36.76	30.72	25.76	20.48	60.30	52.51	84.37	69.40
HHI traders	256	256	256	256	256	256	456	494	833	833
Quantity (tons)	156024	140000	156693	140000	158518	140000	155509	140000	154844	140000

Appendix C. Raw cashews cost break - down

Table C1 presents a theoretical cost break down of raw cashews presented by ANCA for year 2014. This structure shows identified exporters' costs (such as transport, loading, scale, financial and other costs), export taxes (FUNPI, ACI and other export taxes) and traders' costs (transport costs), and includes theoretical margins for both exporters and traders, but it excludes other cost components (such as labor costs, capital costs, and so on).

Table C1. Raw cashews cost break-down (estimated 2014)

Description	XOF / kg	USD / ton
Producer prices	250.00	531.91
Intermediaries purchase price	250.00	531.91
Intermediaries margin	10.00	21.28
Transport within the country to Bissau	10.00	21.28
Intermediate Bissau prices	270.00	574.47
Acquisition price by exporter	270.00	574.47
Extraordinary Tax / Customs (6% of FOB/ MT - Bissau)	23.97	51.00
CPR / DGCI (2% FOB value Bissau)	7.99	17.00
ACI / DGCI (3% FOB value Bissau)	11.99	25.50
FUNPI	50.00	106.38
APGB	4.65	9.89
Transport Warehouse – Port	3.16	6.72
Loading and Unloading	2.50	5.32
Scale, pre-shipping (APGB)	0.26	0.55
Banking Cost	19.00	40.43
Bags (packaging)	8.75	18.62
Certificate of Origin	0.00	0.00
Phytosanitary certificate	0.05	0.11
Fees and displacement	4.00	8.51
Customs broker fees	0.41	0.88
SGS	1.50	3.19
Warehouse leasing	1.50	3.19
Exporter costs (1)	**409.73**	**871.76**
Administrative costs	0.02	0.05
Losses	1.30	2.76
Unexpected	0.50	1.06
Exporter margin	30.00	63.83
Other exporter costs and margins (2)	**31.82**	**67.70**
EXPORT PRICE - FOB PORT BISSAU (1)+(2)	**441.55**	**939.46***

Source: ANCA (2014). Export reference price is set at 850 USD/ton. Exchange rate is 470 XOF / ton.

* Recently updated export prices for 2014 season round 1050-1100 USD/ton.

References

ANCA - Agencia Nacional de Cajú (2014), "Proposta para fixação da base tributária, preço de referência e o FUNPI", República de Guiné-Bissau.

Bloch, F. and Ferrer, H. (2001a), "Trade fragmentation and coordination in strategic market games", *Journal of Economic Theory*, 101:301-316.

Bloch, F. and Ferrer, H. (2001b), "Strategic complements and substitutes in bilateral oligopolies", *Economics Letters*, 70:83-87.

Bloch, F. and Ghosal, S. (1997), "Stable trading structures in bilateral oligopolies", *Journal of Economic Theory*, 74: 368-384.

Blute, V. and A. Lopes da Veiga Nanque (2011), "Rapport Sur l'Evaluation de l'Introduction de 50 F. CFA au Kg de la noix de cajou à exporter", World Bank report.

CNC (2012), "Relatório da Campanha de Comercialização e Exportação da Castanha de Caju 2011", Comissão Nacional de Caju/Direcção Geral do Comércio e da Concorrência, Ministério do Comércio, Turismo e Artesanato, República da Guiné-Bissau (2012).

Cournot, A. (1897), "Researches into the Mathematical Principles of the Theory of Wealth", (1838). English translation by Bacon, N. Macmillan, New York.

Deaton, A. (1989), "Household survey data and pricing policies in developing countries", *The World Bank Economic Review*, 3:183-210.

Deaton, A. (1997), *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*, Johns Hopkins University Press for the World Bank.

Dickson, A. (2013), "The effects of entry in bilateral oligopoly", *Games*, 4:283-303.

Dickson, A. and Hartley, R. (2008), "The strategic Marshallian cross", *Games and Economic Behavior*, 64:514-532.

Dickson, A. and Hartley, R. (2013), "Bilateral oligopoly and quantity competition", *Economic Theory*, 52:979-1004.

Dubey, P. (1994), "Strategic market games: A survey of some results", in Mertens, F. and Sorin, S. (eds.), *Game-Theoretic Methods in General Equilibrium Analysis*. Kluwer, Amsterdam, pp. 209-224.

Gabszewicz, J. and Michel, P. (1997), "Oligopoly equilibrium in exchange economies", in Eaton, B. and Harris, R. (eds.), *Trade, Technology and Economics: Essays in Honor of Richard G. Lipsey*, Elgar: Cheltenham, UK, pp. 217-240.

Giraud, G. (2003), "Strategic market games: An introduction", *Journal of Mathematical Economics*, 39:355-375.

Nicita, A., Olarrega, M. and Porto, G. (2014), “Pro-poor trade policy in Sub-Saharan Africa”, *Journal of International Economics*, 92:252-265.

Porto, G., N. Depetris-Chauvin, and M. Olarreaga (2011). *Supply Chains in Export Agriculture, Competition, and Poverty in Sub-Saharan Africa*, CEPR and World Bank, January 2011.

Shapley, L. and Shubik, M. (1977), “Trade using one commodity as a means of payment”, *Journal of Political Economy*, 85:937-968.

Shubik, M. (1973), “Commodity money, oligopoly, credit and bankruptcy in a general equilibrium model”, *Western Economic Journal*, 11:24-38.

Tirole, J. (1990), *The Theory of Industrial Organization*. The MIT Press.