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Compliance with international food safety standards as an outcome of a Nash bargaining process: a case study on Kenyan small scale green beans farms

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Abstract

This study provides a stylized model on "Exit, voice and loyalty" as alternative strategic responses taken by Kenyan green beans farmers in the context of new and more stringent international food safety standards. On the analytical side, we use the Nash bargaining theory where the exporter and a representative grower bargain over the product quality level and the premium producer price. The comparative statics analysis shows that the producer bargaining power unlike the compliance costs has, ceteris paribus, a positive effect on the equilibrium quality level while these exogenous variables have ambiguous effects on producer price at equilibrium. Empirical results from logit model estimation with survey data at farm-level in Kenya show that households with highly educated members, access to credit and relatively large-size farms are more likely to participate in the certified supply chain. Off-farm income, live assets and distance of public services from the farm do not influence the compliance. In terms of policy implications, education and credit access could play an important role in the capacity-building of small-scale growers associations through public-private partnership.

Keywords: *bargaining, small-scale farm, voice*

JEL codes: D18, O17, O33, Q13, Q17

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1 INTRODUCTION

Developed countries food safety standards (DCFSS) are becoming a more prominent issue for global trade in agricultural and food products (Henson and Jaffe, 2008). Food safety scandals and the ensuing consumer concerns with food contamination by microorganisms and pesticides in the European Union (EU) over the past decade have led governments to enact stringent food safety regulations (Jaffee, 2003; Mungai, 2004 in Okello, 2006). Beside these mandatory regulations, supermarkets adopted voluntary private standards which are even more stringent and beyond the world trade organization (WTO) scope. Private standards such those of GlobalGAP pursue a mix of goals covering consumer confidence in food quality and safety, market transparency, social and environmental issues, etc. (Baghasa, 2008).

The governance of international food safety standards (IFSS) becomes particularly interesting when the export supply chain involves developing countries producers and developed countries retailers. Large retailers in Europe play an important role in structuring the production and processing of fresh vegetables exported from Africa (Dolan and Humphrey, 2001). In such situation, supermarkets pass their requirements to foreign suppliers via importers and exporters. However, there is a concern emerging through the literature that less efficient farmers could be marginalized and excluded from the export supply business. Small-scale farmers who do not attain economies of scale could be the first victims of the development of stricter food safety standards in developed countries markets.

This study focuses more specifically on private standards prevailing in United Kingdom (UK) supermarkets that source their green beans essentially from Kenya. Before 1990, the major quality concerns for Kenyan growers were physical attributes of green beans such as size, shape and spotlessness that were easily met by applying large quantities of pesticides without adequate protection Okado (2001) in Okello (2006). After 1990, however, the green beans export supply is strongly regulated and the share of small-scale growers is declining. According to Kimenye (1994) in Okello and Sindi (2006) smallholders contributed to more than 70 percent of green bean production in the early 1990s. Recently, they account for less than 40 percent of green beans grown for fresh export market (Jaffee, 2003).

The study addresses the following research question. How small-scale farms are being excluded from the green beans exports supply? In other words, what are the determinants of small-scale farms decision-making on their participation in export supply to UK supermarkets *versus* alternative markets with less stringent requirements? We hypothesize that when the IFSS become more stringent, only growers of high efficiency remain in the export supply. In other words, the size of compliant group decreases with the stringency of food standards.

We first provide an analytical stylized model using the Nash bargaining theory to understand the decision-making phenomenon at farm-level. The analytical model is followed by an empirical exercise made not to test the entire analytical model but rather to understand what represent the unobservable producer's efficiency that is governing the participation of the small-scale farm in certified product channel *versus* alternative markets. Moreover, the analytical framework is based on 'exit', 'voice' and 'loyalty' as alternative strategic responses developed Hirschman (1970). We assume that compliance and exit are alternative outcomes following the voice process. Moreover we take into account the fact that these strategic responses could be adopted proactively *versus* reactively according to Henson and Jaffee (2008) and the World Bank (2005).

The Hirschman's framework was initially developed to examine economic and political behaviour as responses to the decline in firms, organizations and states but has been since extended to different contexts. In agricultural applied studies, Henson and Jaffee (2008) and the World Bank (2005) highlight the exit, voice and loyalty concepts at international levels

and dress the factors that influence the availability and choice of strategic options. Okello (2006) uses the 'exit', 'voice' and 'loyalty' or 'compliance' concepts in his study on strategic responses adopted by Kenyan smallholder family green beans farms. Moreover, many other empirical studies are made on the determinants and impacts of participation of small farmers in supermarkets *versus* traditional markets (Hernández et al, 2006) and on the adoption of private standards (Asfaw *et al*, 2007). At our knowledge however, there is no analytical and empirical study on exit, voice and loyalty applied to agricultural and food products' supply.

The remaining of the paper is organized as follows. Section 2 dresses the historical context of green bean supply chain in Kenya regarding the emergence of international food safety standards and the strategic responses adopted accordingly at farm-level. Section 3 develops the analytical model. Section 4 presents and discusses empirical results while section 5 brings the concluding remarks.

2 KENYAN GREEN BEANS EXPORT SUPPLY, EMERGENCE OF INTERNATIONAL FOOD STANDARDS AND FARMERS' STRATEGIC RESPONSES

According to Jaffee (1990) in Jaffee (2003) 14,500 smallholder farmers were participating in the fresh produce export trade in the mid-1980s. About 7,000 of them grew beans, Asian vegetables or other vegetables for export, while the remaining 7,500 grew mangoes, avocadoes or other fruits which were exported. At that time, it was estimated that smallholders accounted for 45 percent of the volume of export vegetables and about 50 percent of the combined export volume for fruit and vegetables. Kimenye (1994) in Okello and Sindi (2006) indicates that smallholders contributed to more that 70 percent of green bean production in the early 1990s. This dominance of smallholders has since changed. Recent studies (Dolan and Humprey, 1999 and 2000; Jaffee, 2003) show that the share of smallholders has diminished while that of large-scale growers has risen. Jaffee (2003) suggest that small-scale family farms currently account for less than 40 percent of green beans grown for fresh export market.

The decline in the share of small-scale family farms is largely attributed to the challenges posed by DCFSS which were developed to address the food safety scandals of the 1980s and 1990s. Indeed, 1990 could be taken as the "baseline" situation of the fresh produce industry. In the pre-DCFSS era, the major quality concerns were physical attributes of green beans such as size, shape and spotlessness. These physical attributes were easily met by applying large quantities of pesticides without adequate protection Okado (2001) in Okello (2006).

Since 1990, significant events in external regulatory environment take place. Jaffee (2003) underlines that Food safety Act in United Kingdom (UK), EU directive on pesticide residues and EU directive on food hygiene were developed in 1990 while EU Harmonized Framework of Pesticides was initiated in 1993. Other well-known regulations like Euro-Retailer Produce Working Group-Good Agricultural practises (EUREPGAP) actual known as GlobalGAP, the British Retailer Consortium (BRC) food technical standard were created in the mid 1990s. Actually, a mix of both public and private standards set at national and international levels makes a pressure on Kenyan growers and exporters.

Hence, in this context of evolving regulatory external environment, strategic responses emerge from suppliers of exportable greens beans. Indeed, complying with DCFSS requires human, physical and social capital that is not always available to small grower. The latter may exit, that is, abandon the green beans business and switch to markets with less stringent requirements or other commodities if he fails to comply. Some small growers succeed to comply with DCFSS by forming farmers' groups to overcome idiosyncratic market failure and attain economies of scale (Okello, 2006). Moreover farmers organized in groups can

voice or lobby the government to provide the facilities needed to meet EU FSS. The next section provides the analytical development of voice using a bargaining theory. We assume that exit and loyalty are alternative outcomes of a voice process hereby understood as a Nash bargaining process.

3. THE ANALYTICAL MODEL

We conceptualise a Nash bargaining problem where Kenyan green beans growers organised into groups and exporter bargain over the producer price and the quality level of the exportable product to UK supermarkets. We define first utility function for each actor before defining the Nash bargaining product whose maximisation yields the optimal producer price and optimal quality level. The model considers only small-scale farms of less than one hectare according the definition of Okello *et al.* (2007). Green beans growers react to DCFSS and especially UK supermarkets requirements according to household's assets. We assume also that the exporter himself reflects to growers the UK supermarket requirements. We know from Dolan and Humphrey (2000) that there other actors in the export supply chain such as importers, retailers and consumers. We assume they are not directly involved in the bargaining process between growers and exporters.

3.1. Pay-offs of the players

We follow Fontaine *et al.* (2008) in specifying the utility function of the players. Assume that the exporter is a delegate of UK supermarket. We assume that the buyer-exporter X buys green beans from grower g for a price P_g and sells them to consumers for a unitary price P_c. The price received by the producer is taken as a premium price to remunerate the quality level θ of his product. As shown in Fontaine *et al.* (2008), $P_C = \theta(1-q)$; the exporter utility function U_x^c in contract is then given by $U_x^c = P_c - P_g = \theta(1-q) - P_g$. (1)

Let $U_x^o = 0$ be the utility of the exporter outside the contract, in order words, his margins when bargaining fails. We don't know much about U_x^o but it is off course lower than the utility under contract. If the bargaining process fails indeed, the supermarket could loose customers who will switch to other stores. This could be the case when products are not available at the time they go shopping (Dolan and Humphrey, 2000). Supermarkets could then bear additional transaction costs to identify other SMOs ready to contract and then ensure reliability of supply. However, in this study we consider a cooperative bargaining case and then set the exit option to zero. In other words both actors gain more if they stay both, farmers who voice or bargain then comply with DCFSS.

On the supply side, we consider farmers organised into groups. When they are able to comply with the DCFSS, they are linked to the exporter through a contract specifying the volume of supply, the quality of product, the price to receive and the related calendar. Moreover, their agricultural operations are monitored by exporter or his delegate. If not, they sell their product in alternative less demanding markets such as domestic or Asian markets. However, suppliers of high quality product must bear additional costs named costs of compliance to DCFSS. The large share of these costs is fixed costs that relate to physical infrastructures (charcoal cooler, grading shed …) that could be shared through collective action (Okello, 2006). Moreover, high costs of monitoring individual smallholder farmers will motivate the exporter to contract with smallholder farmers groups or associations rather than individual growers (Okello, 2006).

Following Fontaine *et al.* (2008), the pay-off U_g^c of a contracting-grower organised in group is: $U_g^c = P_g - \theta^{a+1}(1-i) - (c - d(1-\underline{i}))$ with $c > 0; d > 0; c - d > 0$ (2)

The parameter a is exacerbates changes in θ and is such that $a > 1$, i is a production efficiency parameter[1]. Producers with $i = 1$ are likely to remain in green bean business. Indeed, in theses conditions, it does not cost anything to supply quality level θ. In contrast, the more i tends to 0, the more it is costly to produce the quality level required. Producers with such characteristic are very likely to exit high demanding markets such as UK supermarkets. The parameter c represents the cost of certification for the producer group, d is the slope of the compliance costs curve and $(1-\underline{i})$ is the size of the contracting group within which the compliance cost is shared. It is also assumed that every compliant grower supplies only 1 unity of the product.

In this analysis however we modify the original utility function adopted by Fontaine *et al*, (2008). We make the specification less complex to provide a solution to the Nash bargaining problem. We adopt a simple utility function decreasing in compliance costs and increasing in the size of compliant group. This means that compliance borne by a producer in a group of compliant growers decrease when the size of group increases as highlighted in figure 1. The above curve is the ideal specification adopted by Fontaine *et al.* (2008) unfortunately it provides a cumbersome solution in $(1-\underline{i})$ that is very hard to work out in this case. To provide a solution to the bargaining process, we adopt instead a simple linear decreasing function of compliance costs in the size of the compliant group (curve below). Particularly, when there is a single compliant producer, c becomes the individual compliance costs.

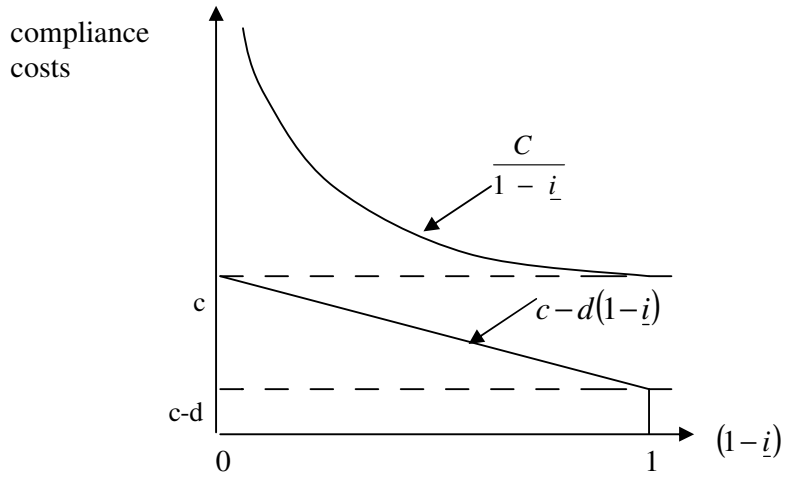

Figure 1: Relation between compliance costs and the size of the compliant group

Farmers organised into groups without complying with UK supermarket food safety standards, will not be obliged to bear high investment in quality. However, they will miss the premium price offered in high quality product market channel and still support the cost of the collective action. They will instead obtain a price P_O lower than P_g of alternative markets. For the same reasons of a cooperative bargaining, we set to zero the exit option, that is, the producer utility outside the contract $U_g^o = 0$

[1] Fontaine *et al.* (2008) find that the parameter a must be higher than one to solve for price and quantity of equilibrium from demand and supply curves intersection.

Logically, a given farmer produces under contract if the expected utility exceeds the margins outside the contract. In order words, farmer will contract with an exporter if:

$U_g^c = P_g - \theta^{a+1}(1-i) - c + d(1-\underline{i}) \geq 0$ where $\underline{i}$ is the type of producer who is indifferent to supply the certified product or produce for less demanding markets.

For this particular producer $\underline{i}$ the utility is null. We can then solve relation (2) for $(1-\underline{i})$ as follows: $1-\underline{i} = \dfrac{P_g - c}{\theta^{1+a} - d}$ (3)

There is a unique equilibrium for the compliant group or the quantity produced. Moreover, this equilibrium is stable as the compliant group increases with the premium but decreases with compliance costs and the product quality level. Indeed, *ceteris paribus*, an increasing producer price is attractive to growers who will decide to be monitored and contract to supply the required quality product. However when the total compliance costs or the quality standards go up less efficient growers exit the green beans business. In situation of economies of scale, average costs decrease with the volume of output. That's why the third derivate is somewhat surprising:

$\dfrac{\partial(1-\underline{i})}{\partial P_g} = \dfrac{1}{\theta^{1+a} - d} > 0$; $\dfrac{\partial(1-\underline{i})}{\partial c} = -\dfrac{1}{\theta^{1+a} - d} < 0$; $\dfrac{\partial(1-\underline{i})}{\partial d} = \dfrac{P_g - c}{(\theta^{1+a} - d)^2} > 0$ and

$\dfrac{\partial(1-\underline{i})}{\partial \theta} = -\dfrac{(1+a)(P_g - c)\theta^a}{(\theta^{1+a} - d)^2} < 0$.

However, as the grower efficiency ranges between 0 and 1 depends on the type of grower, it is relevant to use in the Nash product, one value of i, for example the median or the mean value which is the half of the size of compliant group that is, $\dfrac{1-\underline{i}}{2}$; this assumption leads the representative production efficiency parameter to be $i = \underline{i} + \dfrac{1-\underline{i}}{2} = \dfrac{1+\underline{i}}{2}$.

The payoffs of the players in the contract become respectively:

$$U_g^c(P_g, \theta) = \frac{\theta^{1+a}(P_g - c)}{2(\theta^{1+a} - d)};\ U_x^c(P_g, \theta) = \theta - \frac{(P_g - c)\theta}{\theta^{1+a} - d} - P_g \quad (4)$$

3.2. Analytical results

We can now construct the Nash bargaining product (NBP) Ω as follows:

$\Omega = \left[U_g^c(P_g, \theta) - U_g^o\right]^{\beta} . \left[U_x^c(P_g, \theta) - U_x^o\right]^{1-\beta}$. Ω is then the function to optimize with respect to the premium price P_g and the product quality level θ, $\beta \in [0,1]$ is the bargaining power of a grower pertaining to a supplier market organization (SMO) while $1-\beta$ is the bargaining power of the buyer-exporter. The unique Nash solution (P_p^*, θ^*) maximizes the Nash bargaining product. We assume it satisfies the four axioms of Nash (1950).

$$(P_g^*, \theta^*) = \arg\max Log\left\{\left[\frac{\theta^{1+a}(P_g - c)}{2(\theta^{1+a} - d)}\right]^{\beta}\left[\theta - \frac{(P_g - c)\theta}{\theta^{1+a} - d} - P_g\right]^{1-\beta}\right\} \quad (5)$$

The solution satisfies two conditions of maximization. The first derivate is null while the second is negative.

From the first-order condition (F.O.C) of maximization of NBP w.r.t to the producer price we get: $P_g^* = c(1-\beta) + \frac{\beta\theta\left(\theta^{1+a} + c - d\right)}{\left(\theta^{1+a} + \theta - d\right)}$ (6)

Moreover, the second-order condition (SOC) to the maximization process with respect to P_g is obviously satisfied:

$$\frac{\partial^2 \Omega}{\partial P_g^2} = -\frac{\beta}{\left(P_g - c\right)^2} + \frac{(\beta - 1)\left(d - \theta\left(1 + \theta^a\right)\right)^2}{\left(d\left(P_g - \theta\right) + \theta\left(\theta^{1+a} + c - P_g\left(1 + \theta^a\right)\right)\right)^2} < 0 \quad (7)$$

The solution in θ is more complex to establish. Even for P_g^*, it is not possible to make direct comparative static analysis as the premium price is still expressed into the endogenous variable quality level. To deal with this situation we have to use the implicit function theorem. We follow Ferrier (2003) to apply the theorem on the FOC of the NBP maximization w.r.t. to the quality level:

$$F\left(P_g^*, \theta^*, \beta, c, d\right) = \frac{\partial Log\Omega}{\partial \theta} = \frac{1}{\theta^* - c} + \frac{-(1+a)d\beta + a\beta\theta^*}{\theta^*\left(\theta^{*1+a} + \theta^* - d\right)} = 0 \quad (8)$$

We can only determine the sign but not the intensity of the comparative statics:

$$dF = \frac{\partial F}{\partial \theta^*} d\theta^* + \frac{\partial F}{\partial \beta} d\beta = 0 \Rightarrow \frac{d\theta^*}{d\beta} = -\frac{\frac{-(1+a)d + a\theta^*}{\theta^*\left(\theta^{*1+a} + \theta^* - d\right)}}{\partial F / \partial \theta^*} > 0 \text{ if } \theta^* > \frac{1+a}{a} d; < 0 \text{ otherwise} \quad (9)$$

Clearly, the sign of the relation (9) depends on whether or not the equilibrium quality level is higher than $\frac{1+a}{a} d$. The denominator is always negative because it is the SOC to the NBP maximization.

Producers with high bargaining power are empowered enough to supply a product of required quality. Indeed, the bargaining power of suppliers increases when they are well organised. They become more likely to supply high quality and are in the same time in good position to negotiate with the exporter on quality issues. On the other hand however, one can think that producers with high or enough bargaining power can easily voice anticipatively and reject rigorous or more stringent than necessary requirements. In this case, bargaining power should undermine quality level.

We make likewise the comparative statics analysis on the quality level at equilibrium with respect to parameter c that yields the following result:

$$dF = \frac{\partial F}{\partial \theta^*} d\theta^* + \frac{\partial F}{\partial c} dc = 0 \Rightarrow \frac{d\theta^*}{dc} = -\frac{\partial F / \partial c}{\partial F / \partial \theta^*} = -\frac{\frac{1}{\left(\theta^* - c\right)^2}}{\partial F / \partial \theta^*} > 0 \quad (10)$$

The sign of the differential in relation (10) is clearly positive as the numerator is positive while the denominator is the SOC to the NBP maximization. This means that to meet high quality standards need to bear important compliance costs and *vice-versa.*

As we are interested in compliance within farmers' groups, it is better to compute to following derivate:

$$dF = \frac{\partial F}{\partial \theta^*} d\theta^* + \frac{\partial F}{\partial d} dd = 0 \Rightarrow \frac{d\theta^*}{dd} = -\frac{\partial F / \partial d}{\partial F / \partial \theta^*} = -\frac{-\beta \dfrac{\left(1+(1+a)\theta^a\right)}{\left(\theta^{1+a}+\theta-d\right)^2}}{\partial F / \partial \theta^*} < 0 \qquad (11)$$

When the average fixed costs increase (decrease) the equilibrium quality level decreases (increases). It can be expected that when costs of compliance are increasingly high, suppliers will struggle hardly to provide a product of a required quality, sometimes they will be unable to do so. In their welfare-analysis on the effects of certification costs on quality level, Fontaine *et al.* (2008) nuance that when producers share the certification costs, an increase in certification cost may induce a decrease in their optimal quality level, which diminishes the optimal quality for the society as a whole.

In extending this comparative static analysis to P_g^*, we have to take into account both direct and indirect effects from the equilibrium producer price relationship on one hand and the implicit function F where θ is expected to be expressed in exogenous parameters β and C on the other hand. In doing so, we have:

$$\frac{dP_g^*}{d\beta} = f_\beta^{'}\left(\theta^*,\beta,c,d\right) + f_\theta^{'}\left(\theta^*,\beta,c,d\right)\frac{d\theta^*}{d\beta} = \frac{(\theta-c)\left(\theta^{1+a}-d\right)}{\theta^{1+a}+\theta-d} +$$
$$\frac{\beta\left(d\left(-c+d\right)+\theta^{2+2a}+\theta^{1+a}\left(-2d+\theta+a\left(-c+\theta\right)\right)\right)}{\left(d-\theta\left(1+\theta^a\right)\right)^2} * \left(-\frac{-(1+a)d+a\theta}{\dfrac{\theta\left(\theta^{1+a}+\theta-d\right)}{\partial F / \partial \theta^*}} \right) \qquad (12)$$

The first term of the differential in relation (12) has a positive sign. The entire differential is unambiguously signed if the second term is also positive. Assuming that $a=1$, the sign (12) is positive if $0<\theta\le -1+\sqrt{1+c+2d}$ and if $0<\theta<2d$. Under these conditions, an increase (a decrease) in the producer bargaining power implies an increase (a decrease) in the equilibrium producer price. In such situation, we expect that when producers are in a good position to negotiate with the buyer-exporter, they are likely to get an interesting remuneration. Without these assumptions, we are not able to say how the producer bargaining power does affect the equilibrium producer price.

To determine how an increase or a decrease in compliance costs does affect the producer price, we compute the following differentials:

$$\frac{dP_g^*}{dc} = f_c^{'}(\theta,\beta,c,d) + f_\theta^{'}(\theta,\beta,c,d) * \frac{d\theta}{dc}$$
$$= (1-\beta) + \frac{\beta\theta}{\theta^{1+a}+\theta-d} + \frac{\beta\left(d\left(-c+d\right)+\theta^{2+2a}+\theta^{1+a}\left(-2d+\theta+a\left(-c+\theta\right)\right)\right)}{\left(d-\theta\left(1+\theta^a\right)\right)^2}\frac{d\theta}{dc} \qquad (13)$$

The first and the second terms of the differential of relation (13) are both positive. The sign of the entire differential cannot be signed unambiguously because we don't know exactly when the third term is positive.

$$\frac{dP_g^*}{dd} = f_d'(\theta,\beta,c,d) + f_\theta'(\theta,\beta,c,d)\frac{d\theta^*}{dd}$$
$$= \frac{\beta(c-\theta)\theta}{\left(d-\theta-\theta^{a+1}\right)^2} + \frac{\beta\left(d(-c+d)+\theta^{2+2a}+\theta^{1+a}(-2d+\theta+d(\theta-c))\right)}{\left(d-\theta-\theta^{a+1}\right)^2} * \frac{d\theta^*}{dd} \quad (14)$$

Once again, the entire differential of relation (14) cannot be signed unambiguously despite the assumption $a = 1$. Indeed, the first term is negative and the second factor of the second term is also negative. The first factor of the second term must be positive to yield a negative sign to the overall differential. This could be so if $\theta > -1 + \sqrt{1 + c + 2d}$ but as $-c + d < 0$, the overall sign is unknown. One can however expect that bearing high compliance costs could lead to the supply of a high quality but this could not be always the case. A less efficient grower could face high compliance costs without getting necessary best prices. Moreover, when compliance costs are increasingly high, growers must struggle much or sometimes they could fail to supply the required quality, then they miss the premium price.

We can also extend the comparative statics analysis to the technical parameter a that influences the costliness of supplying a high quality product. Indeed the parameter a can be included in the implicit function as an additional exogenous variable. Then, we can compute as above the following differentials:

$$\frac{d\theta^*}{da} = -\frac{\partial F / \partial a}{\partial F / \partial \theta^*} = -\frac{\dfrac{\beta\left(\left(d-\theta^*\right)^2 + \theta^{*1+a}\left(-d+\theta^* + \left(d+ad-a\theta^*\right)Log\,\theta^*\right)\right)}{\theta^*\left(-d+\theta^*+\theta^{*1+a}\right)^2}}{\partial F / \partial \theta^*} \quad (15)$$

The sign of this differential is only determined by the numerator while the denominator is the SOC to the NBP maximization with respect to quality level. The sign will be positive when $\frac{1+a}{a}d < \theta^* < 1$; in this case, the technical parameter a and the equilibrium quality level vary in the same direction. Otherwise, the differential is ambiguously signed.

Likewise, the total effect of the technical parameter a on the equilibrium producer price is assessed through the following differential:

$$\frac{dP_g^*}{da} = \frac{\partial P_g^*}{\partial a} + \frac{\partial P_g^*}{\partial \theta^*}\frac{d\theta^*}{da} = \frac{\beta\theta^{2+a}\left(\theta^* - c\right)Log\,\theta^*}{\left(-d+\theta^*+\theta^{*1+a}\right)^2} +$$
$$\frac{\beta\left(d\left(-c+d\right)+\theta^{*2+2a}+\theta^{*1+a}\left(-2d+\theta^*+a\left(\theta^*-c\right)\right)\right)}{\left(d-\theta\left(1+\theta^{*a}\right)\right)^2}\frac{d\theta^*}{da} \quad (16)$$

The first term is positively signed if $\theta^* > 1$ in which case $\frac{d\theta^*}{da} < 0$. All what we have developed till now relates to the proactive behaviour where growers lobby governments to voice internationally and anticipate the standards by voice. Quid the reactive behaviour where growers face a "take-it leave-it situation" with standards set unilaterally by the supermarkets? In this situation, the Nash bargaining product is reduced to the sole utility of the exporter as the producer bargaining power is equal to zero while that of the buyer-exporter is at its maximum. Unfortunately there is no solution for the equilibrium producer price while that of product quality level is still complex. We cannot in such situation construct an implicit

function to make the required comparative statics analysis. Because of the adjustment made on compliance costs in the producer utility function, we are unable to deal with this particular case of reactive strategic response from farmers.

In the following section, we specify an empirical model to discover factors that influence the efficiency parameter i of the green bean grower. Essentially, the efficiency is reflected in the farm characteristics which affect the decision taken by growers of green beans to supply or not certified green beans.

4 EMPIRICAL MODEL AND RESULTS

4.1Empirical model

In this section we use survey data collected by Okello of Nairobi University on 181 green bean smallholders at farm-level. From the analytical development, we know variables that influence the supply of certified product. The utility to participate in a contract increases with the producer price and the producer bargaining power and decreases with compliance costs. A compliant farmer signs a contract and his agricultural operations are monitored. A non-compliant supplies freely alternative markets. Then our dependent variable *Contract* is qualitative and could be modelled according a logit model which is less complicated to work out than probit approach:

$$Contract_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + u_i \qquad (17)$$

Where $Contract_i$ is the kind of contract adopted by each green bean grower, X_i are explanatory variables, while u_i is the disturbance. The explanatory variables are demographic (i) households characteristics (age, gender, education level, household size, etc.), assets holding and household wealth (land size, livestock ownership, both farm and off-farm incomes, type of agricultural assets (ox-plough, oxen, sprayer, bathroom, grading shed, etc.), (iii) access to services (credit, dispensaries, irrigation, training, markets, etc.) and (iv) price incentives (price of fine and extra fine green beans).

The probability of signing a contract $P_i = \Pr(Contract_i = 1)$ in a logistic model is expressed as follows (Thomas, 1997):

$$P_i = \frac{1}{1+\exp\left[-\left(\beta_0 + \sum_{i=1}^{n} \beta_i X_i + u_i\right)\right]} \text{ for all } i \text{ ; then, } 1 - P_i = \frac{\exp\left[-\left(\beta_0 + \sum_{i=1}^{n} \beta_i X_i + u_i\right)\right]}{1+\exp\left[-\left(\beta_0 + \sum_{i=1}^{n} \beta_i X_i + u_i\right)\right]}$$

$$\text{Finally, } \ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + u_i \qquad (18)$$

We can then explicitly express the relation (10) as follows:

$\ln\left(\frac{P_i}{1-P_i}\right) = f(X_i)$ Where the qualitative dependent variable is *CONTRACT* that takes the value 1 when the household is involved in green beans business through a contract and 0 otherwise. All the explanatory variables are listed and defined in table 2.

4.2 Results and discussion

Based on the t-statistic computed by using the central limit theorem on population means (table 2a), we realize that monitored households' heads are in average slightly older (years 39.687) than unmonitored (years 37.494). There no however any significant difference related to household head's education or highest level of education in the household. The monitored households have the advantage to have the largest plot sizes (acres 0.545) comparatively to unmonitored households (acres 0.465). That's why they produce also more than two times the quantities of fine and extra fine beans got by unmonitored farmers (Kg 315.4 and Kg 658 against Kg 223.6 and Kg 287 respectively). However, monitored households are not better endowed in farm size than unmonitored. Moreover, no any significant difference is observed between these two kinds of households in terms of main assets.

Surprisingly, unmonitored households get the highest prices for both fine and extra fine beans, respectively Ksh 43.653 and Ksh 46.838 per kilogram against Ksh 28.831 and Ksh 38.444 per kilogram for monitored households[2]. Figure 2 highlights the relative importance the mains reasons evoked in supplying certified product.

Table 1

Definition of variables used in the model

Variable name	Variable definition
***Dependent variable*:**	
Contract	Dummy variable =1 when the households produces under contract and 0 otherwise
Explanatory variables:	
Household's characteristics	
Age	The age in years the household's head
Gender	The gender of the household's head (=1 for male and = 0 otherwise)
Education	The education level of household's head in years spent to school
High education	The highest education level in the household
Household's assets & wealth	
Farm size	The size of the farm in acres
Plot size	The size in acres of the plot of green beans
Yield_fine_beans	The yield of fine beans in Kg/acres
Yield_extra_fine_beans	The yield of extra fine beans Kg/acres
Mechanization	A dummy equals 1 if farmer has an ox-plough, oxen or tractor
Specific investments	A dummy equals 1 if farmer has a chemical store or a grading shed
Total revenue	Total revenue from beans
Price incentives	
Price_fine_beans	Price of fine beans in Kshs/Kg
Price_extra_fine_beans	Price of extra fine beans in Kshs/Kg
Access to services	
Market	Distance of the nearest market from the farm in walking minutes
Bean_collection	Distance of the nearest bean collection centre from the farm in walking minutes
Dispensary	Distance of the nearest dispensary from the farm in walking minutes
Credit_dummy	Dummy variable = 1 if the household receives an agricultural credit and 0 otherwise
Credit	The amount received in Kshs as agricultural credit
- Good hygienic and agricultural practises	
Records	Dummy variable=1 if the household keeps records of his farm operations for the last crop; =0 if not

[2] Either the variance of prices under and outside the contract does not differ significantly. The related chi-square test statistic is 59.18 and 19.23 respectively for extra fine and fine beans.

We notice that the main reason that leads farmers to conclude a contract with exporter is to get an assured market (60.8%) in order to protect their investments. The size of farmers who expect to get stable prices is about 13.5% while those who hope to get high prices through contract represents only 12.36%.

Unstable prices are a considerable concern. Even in formal contracts, Okello and Sindi (2007) using the principal-agent theory, underscore that the contract will induce the buyer to share risks (from opportunistic behaviour and market price) with the farmer(s) by paying variable prices. Further, price could vary because of brokers' activities (Okello and Sindi, 2007). Out of the contract, the price varies more substantially. It can rise to six times higher especially in the period of high demand for beans in the United Kingdom. Non compliant farmers target then such periods. This explains why the mean price could be higher out of the contract than in contract. Another possible explanation of lower prices in contracts could the fact monitored some households are still paying the loan received from the buyer-exporter. Farmers pay the loan with the price they receive.

Table 2a

Descriptive statistics and test statistic on means of continuous explanatory variables

Variable name	Mean		Test statistic	p-value
	Compliant households (n = 96)	Non-compliant households (n = 85)		
Households' demographic characteristics				
age	39.7	37.5	1.89*	0.058
education	8.3	8.9	-1.59	0.112
high education	2.4	2.5	-0.42	0.672
Households' assets & income				
Farm size	3.4	2.7	1.58	0.112
Plot size	0.5	0.46	2.07**	0.038
Yield_fine_beans	478.83	334.81	1.89*	0.058
Yiled_extra_fine_beans	1204.86	432.31	6.75***	0.000
Total revenue	28,039	16,474	3.96***	0.000
Prices incentives				
Price_fine_beans	29	44	-9.07***	0.000
Price_extra_fine_beans	38.4	47	-4.07***	0.000
Access to services				
Market	34	35.5	-0.73	0.467
Bean_collection	30.4	30	0.15	0.878
Dispensary	36	37.5	-0.66	0.506

*,**,*** denote statistical significance at 0.10; 0.05 and 0.001 probability level respectively

On the other hand, we do not find significant differences between monitored and unmonitored households in terms of access to services. Indeed, the average distance in walking minutes of the nearest market, bean collection or dispensary from the farm is roughly the same whether or not the farm produces under contract. However, there is significant difference in the amount of credit received by monitored (Ksh 10,969) and unmonitored households (Ksh 952.5).

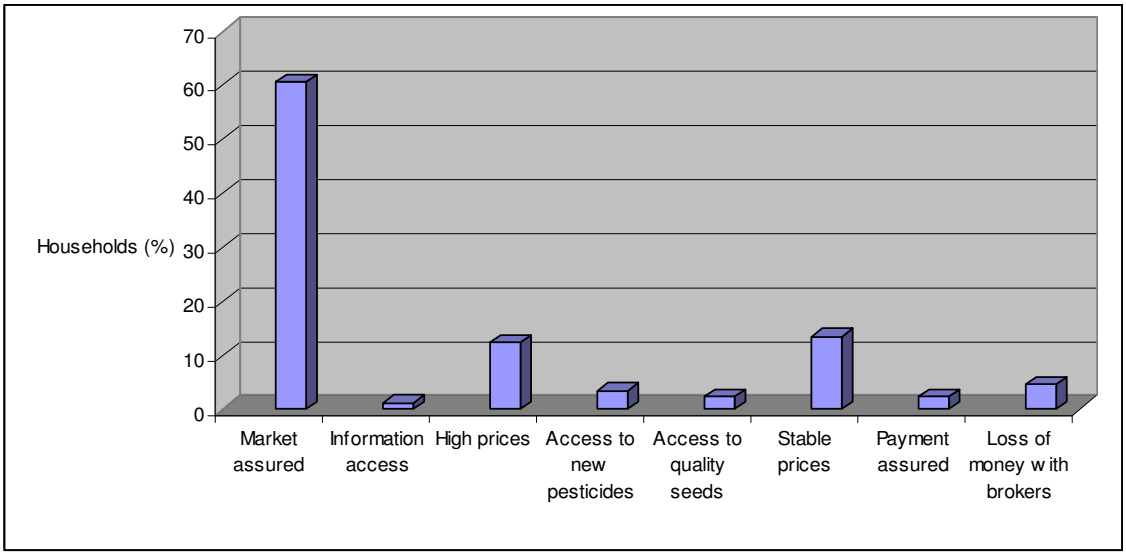

Figure 2. Relative importance of the main first reasons for producing under contract

Table 2b presents the results on t-test of Chi-square cumulative distribution function using frequencies on discrete variables. The main significant difference between unmonitored and monitored households relates to access to credit where the test statistic (57.347) is greater than $\chi^2_{0.001}$ with a degree of freedom equals 1. Mechanization is significant at 0.10 probability level respectively.

Table 3 reports the results of a logit estimation of the dependent dummy variable on selected continuous and discrete explanatory variables. Producer price for both fine and extra fine beans are withdrawn because they are determined by the bargaining process, they do not reflect the producer efficiency.

Table 2b

Descriptive statistics and chi-square test analysis on variances of discrete explanatory variables

Variable name	Monitored households (n = 96)		Unmonitored households (n = 85)		Chi-square statistic test	p-value
	Sample size	%	Sample size	%		
Gender						
Male	77	80.208	68	80.000	0.12E-02	0.972
Female	19	19.792	17	20.000		
Credit_dummy						
Yes	77	80.208	20	23.810	57.347***	0.000
No	19	19.792	64	76.190		
Records						
Yes	30	31.250	20	23.810	1.236	0.266
No	66	68.750	64	76.190		
Mechanization						
Yes	51	53.125	34	40.00	3.118*	0.077
No	45	46.875	51	60.00		
Specific investments						
Yes	9	9.375	7	8.235	0.073	0.787
No	87	90.625	78	91.765		

Legend: ** denotes statistical significance at 0.05 level of probability

The log likelihood provides the significance of the logit model, suggesting that a relationship exits between the probabilities of producing under contract the suggested explanatory variables. Further, the model correctly predicts 80% (140 out of 175) of the responses. Only five affect significantly at 10% level the probability of producing under contract: the age of the household head (age), the size of the plot of green beans (plot size), the yield of fine beans (yield_fine_beans) and extra-fine beans (yield_extra_fine_beans) and the dummy of access to agricultural credit (credit_dummy).

The access to agricultural credit plays the most important role in explaining the likelihood of supplying green bean under contracts. Farmers who access to credit are 31.01% more likely to adopt a contract. Such result is easily understandable and there is a strong expectation concerning the sign of this variable. Farmers in developing countries face indeed severe capital constraints. Accessing to credit drops these constraints and enables quality investments required to comply with DCFSS. Here, there is no risk of endogeneity bias as the more important source of credit is the farmers group even though in some cases, the exporter can also provide a credit to finance the purchase of inputs.

The age of the household' head positively affects the decision of the household to produce under contract even though its marginal effect (0.5%) is slightly low. There is no strong prior expectation concerning the sign of this variable. However, old farmers might be more willing to produce under contract than younger ones, considering that age reflects experience and enough knowledge on market requirements. Old farmers could have also sufficiently invested in green beans business and are then more likely to bargain to safeguard their investments.

The plot size of green beans positively influences the likelihood to adopt contract. Farmers with larger green beans plots are 16.20% more likely to produce under contract. According to Okello and Swinton (2007), volume of green beans, price, quality level and calendar scheduling the delivery plan are key elements mentioned in written contract. It is expected that growers with large size of plots will be more ready to meet the volume required by the contract.

The yield of fine beans and especially that of extra-fine beans are also significantly positive. However their marginal effects of 0.008 and 0.02% respectively are very low. Farmers with high yield have also high profits than their neighbours facing low yields. They are able to support investments such improved seeds, new and expensive pesticides, chemical fertilisers, etc. However, there could be a possible endogeneity bias vis-à-vis this variable. Indeed, monitored households could get high yields because of training and extension services provided under contract.

Table 3
Logit estimation results for CONTRACT adoption

Variable (X)	Estimate	Test statistic	p-value	dP/dX (%)
Constant	-4.61***	-3.52	0.000	-63.17
Households' demographic characteristics				
Age	0.04*	1.86	0.062	0.51
Gender	-0.23	-0.42	0.674	-3.18
High education	$-0.17.10^{-2}$	-0.01	0.991	0.02
Households assets& income				
Farm size	0.01	0.19	0.843	0.14
Plot size	1.18*	-1.75	0.078	16.20
Yield_fine_beans	$0.60.10^{-3}$*	1.78	0.075	$8.24.10^{-3}$
Yield_extra_fine_beans	$0.15.10^{-3}$***	4.10	0.000	0.02
Mechanization	0.06	0.14	0.886	0.88
Specific_investment	-0.02	-0.03	0.972	0.35
Good agricultural practises				
Records	0.35	0.72	0.473	4.75
Access to Services				
Market	$-0.32.10^{-2}$	-0.31	0.753	0.04
Bean_collection	0.01	1.21	0.227	0.16
Credit	2.26***	5.39	0.000	31.01
Number of observations		175		
R-squared		44.75%		
Model prediction		80.57%		
Likelihood ratio (zero slopes)		91.65***		
Log-likelihood		-75.13		

Legend: *;**;*** denote statistical significance at 0.10; 0.05 and 0.001 probability level respectively

5 CONCLUSIONS

This paper is built on two complementary analytical and empirical approaches. In the analytical model, we have considered that compliance with private food standards follows a kind of voice, here understood as a cooperative and bilateral Nash bargaining process. The main results from the comparative statics analysis show that bargaining power has a positive effect on the quality level for some specific values of other exogenous parameters. The average costs have a negative effect on the quality level while these exogenous parameters have ambiguous effects on the producer price. In the ongoing version, we take into account monitoring and enforcement costs to reduce information asymmetry between the players.

We thereafter make an empirical analysis using survey data collected at farm-level for 181 households in Kenya to discover variables which influence the efficiency of producers. Results from multinomial logit estimation show that the age of the household, the plot size of green beans and their average yield and access to credit increase the likelihood to produce under contract. Age by reflecting the experience could also be taken as a proxy of the bargaining power. Large size plots and access to credit also contribute to the strength of bargaining power while access to credit could mean the ability to finance compliance costs.

However, it is worthy to note that the empirical analysis is not a test of the analytical model. Rather, it is a complementary analysis made to know better what influence the producer efficiency before entering in a voice process.

These results may have some policy implications. First, the concept of small-scale farm is still very relative. The only size of the farm is not sufficiently informative. We need to know how this agricultural area is affected to different crops. The farm size is indeed not statistically different from zero while the plot size has a significant coefficient estimate.

Second, access to credit has the highest marginal effect on the likelihood to produce under contract. Then, this variable could be taken as a key parameter in capacity-building of farmers groups. Both public and private actors who intend to help small growers to remain in the green bean business must focus on this variable.

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