Rejection of Purchase: An Empirical Study on Contract Farming in the Pineapple Industry in Ghana

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Abstract

One common way of integrating smallholders in the global supply chain is contract farming. Despite its increasing importance, defaults by producers and buyers in these contracts are often reported but have not been empirically examined using microeconomic data. We take a case of pineapple industry in Ghana and examine the motivations of exporters to engage in both their own production and outside purchase from smallholders, in relation to Carlton's theory of partially vertically integrated firms. Posing a hypothesis that the partially vertically integrated exporters use outside purchase to dampen the risks from demand fluctuation, we tested whether the rejection of purchase by exporters can be explained by the unexpected fluctuation of EU demand. We obtain the result that exporters indeed vary rejection of purchase according to the unexpected demand fluctuation. We then discuss why exporters shift risks to smallholders, which seems to contradict the basic concept of contract theory, taking into account each actor's working environment.

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1. Introduction

Horticulture industry is of interest for development (Jaffe and Morton, 1995; Minot and Ngigi, 2004; Dolan and Humphrey, 2000; Jaffee, 2003; Danielou and Ravry, 2005). Meeting standard requires quality, which often requires inputs that smallholder farmers do not have. Contract farming, where larger entity provides inputs to smallholder and markets the output produced, has been one approach toward incorporating smallholders as producers for a high quality export market (Glover, 1984; Mukras, Ayako, and Glover, 1989; Key and Runsten, 1999; Singh, 2002; Takane, 2004; Minten, Randrianarison, and Swinnen, 2005; Winters, Simmons, and Patrick, 2005).

However, contract farming also suffers from certain systematic moral hazard problems; defaults on contract agreements by both producers and buyers are often reported (Glover, 1987; Kirsten and Satorius, 2002; Poulton *et al.*, 2004; Tschirley, Zulu, and Shaffer, 2004). Producers may default by selling the output to other buyers who offer higher prices or by not using enough inputs provided by the contracted buyers (often referred to as "side-selling"). Buyers may default by not purchasing the amount promised. Buyer default is valid as long as it is based on the quality of output. In fact, it is typical for the Principal to write a contract based on the output in order to avoid the opportunistic behavior of the Agent when monitoring is incomplete. However, the difficulty in reality is that this quality inspection is often done by the buyers, leaving room for buyer default for reasons other than quality of output.

One such example is found in the pineapple industry in Ghana, which consists of partially vertically integrated exporters who produce pineapples on their plantation and purchase additional pineapples from smallholders. We observed that smallholders often complain that the buyers do not purchase the amount promised even when the fruit is of adequate quality. Are exporters rejecting fruit due to reasons other than quality? One puzzle that seems to relate to this question is the fact that they also produce pineapples on their own, i.e., they are "partially" vertically integrated. Our production cost study showed that on average, the exporters are more efficient producers of export pineapples than smallholders. Why, then, do they also purchase from smallholders at the same time?

This paper empirically analyzes the motivation of exporters to partially integrate production activity, or to put in another way, the motivation of exporters to offer contract farming to smallholders in the pineapple sector in Ghana. In particular, it considers whether the rejection of purchase can be explained by the market conditions, i.e., unexpected fluctuation of outside demand. If so, it means that the exporters are at least partially shifting risks onto these smallholders. In fact, this behavior is explained theoretically by Carlton (1979) in his classic paper that in the presence of variable demand, partially vertically integrated firms attempt to shift some of the market risk faced onto secondary suppliers. We test whether his theory can explain the buyer default in Ghanaian pineapple sector.

Our results support the null hypothesis. Changes in the rejection rate are systematically and negatively related to the changes in the current level of unanticipated net EU demand. By adjusting the amount purchased from smallholders, the exporters are able to take advantage of opportunities to export more than they can produce and can also reduce purchases without great cost if an expected component of the export demand fails to materialize. Accordingly, exporters purchase a significant amount of pineapples from smallholders and work with them to improve the quality and timeliness of their output. To our knowledge, no study to date has empirically analyzed the reasons for contract farming in such a way, and our results contribute to deepening our understanding on the mechanism of contract farming.

One final question that we raise is that, insofar as exporters consistently rely on smallholders to produce an important amount of the fruit exported, they should be interested in reducing smallholders' cost of production, and it is not immediate why exporters should behave in a way that increases their cost. The potential reason is that the smallholders are able to defray market risks at lower cost than larger exporter firms. While exporters only produce pineapples, most smallholders produce multiple crops, and this allows them to hedge some of the risks from pineapple production. Their customs of having separate income sources between spouses also work to diversify risks within households. Their local network assets also help them defray the risks within communities. Smallholders appear to have a role to play in the

Ghanaian pineapple export industry because, although they have somewhat higher costs of production, they have various ways to absorb the risks.

The next section defines the research questions in greater detail. Section 3 explains the data to be used, and section 4 presents an overview of the Ghanaian pineapple industry. Section 5 presents the methodology used to test the hypothesis posed. Section 6 presents the estimation results, and the findings are interpreted and discussed in section 7. Finally, a conclusion follows.

2. Research Questions

Figure 1 provides a simplified view of the structure of the Ghanaian pineapple industry. Pineapples are produced both on large-scale plantation farms owned by exporting companies and on small-scale farms owned by individual farmers. We divide smallholders into those who have contracts and those who do not.[1] Most exporters integrate marketing and production activities, but also purchase from smallholders through contracts or in the spot market ("partial vertical integration"). Only two of more than twenty active exporting companies are fully vertically integrated, i.e., export only on their own production. One of these two firms is the only multinational exporting company operating in the pineapple sector in Ghana, and the other is a farmer cooperative-owned exporter established through a World Bank-funded initiative.

[1] Although "outgrower" is the term usually used in the Ghanaian context, we use the term "contracted farmer" in this paper due to its familiarity in the literature.

Except for these two companies, partial vertical integration is the dominant form of production in Ghana.

This situation seems to present a puzzle. First, why are there two dominant forms of production organizations coexisting, namely large-scale plantation production and smallholder production? If one is more efficient over the other, we expect that the inefficient production organization will be outcompeted. Second, why do most exporters engage in outsourcing since they also engage in production? Indeed, our production cost study revealed that on average, large-scale production is more cost efficient than production on smallholder farms (Table 1). This is also true when we do not impute farmers' own labor and land. Average farm-gate price for export pineapples observed is $1,086.4 per ten metric tons, which is higher than the production cost of the same amount by any types of producers. Then why do most exporters satisfy a small proportion of their exports by purchasing from smallholders instead of expanding their own plantation farms?

From the interviews, the managing directors of exporting companies mentioned that they do so because of a) market risks from the EU, b) constraints to expand production (land, water, finance), and c) social purposes (i.e., they lease land from the communities nearby). While all these reasons are probably valid, in this paper we focus on the potential role of market risk.

The concept of partial vertical integration is of course not new, and indeed a

theoretical rationale was provided by Carlton in his well known 1979 paper. He established that partially vertically integrated firms satisfy the more certain portion of demand, or "high-probability demand" in his terminology, with their own production and use outside purchases for "low-probability demand." In other words, partially vertically integrated firms minimize the risks from fluctuating demand by relying partly on outside supply. The empirical studies that have tested this theory have used aggregate data to form a consolidation index, but have not directly tested the behavior of each firm (e.g., MacDonald, 1985; Lieberman, 1991). We developed a unique database that allows us to test Carlton's theory directly in the context of the Ghanaian pineapple industry.

To empirically test this hypothesis, we focus on the rejection rate. Rejection is both a serious risk for smallholders and an important right for exporters because smallholders' efforts are not observable. In contract farming, an exporter provides the farmers with agricultural inputs such as seed, fertilizers, pesticides, and sometimes credit in return for the farmer's promise to sell his/her harvest to the exporter. The exporter deducts these input costs from the purchase price without charging (explicit) interest, but demands the right to reject any unqualified produce to induce smallholder compliance with the contract. Smallholders can cheat by not using enough of the chemicals the exporters have provided and by selling the unused inputs on local markets, or simply by not providing sufficient effort to the crop. Such behavior

should lead to lower quality fruit, providing a reason for buyer default. This is a typical moral hazard problem when monitoring is incomplete. However, some of the smallholders we interviewed claimed that exporters reject even high-quality produce when demand is low, making smallholders at least partially responsible for bearing the risks from external demand fluctuation. Such behavior would be consistent with Carlton's theory. We analyze buyer default by testing whether the rejection rate for each smallholder is related to unexpected fluctuation in external pineapple demand, taking account of predicted fruit quality. If we find that the rejection rate is related to external demand, we have evidence supporting Carlton's theory.

3. Data

We use primary data collected during three visits to Ghana in January- February 2006, August-September 2006, and February-April 2007. The first visit was used to achieve an overview of the industry, identify production sites, and develop research questions. During the second visit, we refined the research questions and pretested the household survey. During the third visit, we conducted the household survey. Exporter interviews took place during all the three visits.

In lieu of a complete list of export pineapple farmers in Ghana, we first identified the areas where export pineapple production occurs and selected seventeen villages for

study that had different geographical features, thus ensuring that villages of various types were included (Figure 2). The author interviewed the chief in each village through a translator. Household surveys were carried out randomly by enumerators fluent in the local languages (Twi, Ewe, and Ga), working under the author's guidance. The author conducted interviews with the managing director of each exporting company in English.

We interviewed 153 pineapple smallholders, 47 of whom had contracts with exporters and 106 who did not. We also collected data from 100 non-pineapple farmers. We interviewed 15 exporting firms of approximately 20 active exporting companies. The datasets include information on the socio-economic characteristics of households, land use and tenure situation, production cost and sales details, household assets, non-farming labor, and non-pineapple production.

Apart from this primary data, we also used secondary datasets such as climatic data obtained from the Department of Meteorology, weekly shipment data from the Seafreight Pineapple Exporters Ghana (SPEG), geographical data from the Trade and Investment Program for a Competitive Export Economy (TIPCEE), Population and Housing Census from the Ministry of Finance, Ghana Living Standards Survey, export data from the Ghana Export Promotion Center, as well as trade and general economic indicator data from EUROSTAT and FAOSTAT.

4. Overview of Pineapple Industry

Geography and Village Profiles

In Ghana, export pineapples are produced in the southern belt near the port of Tema (Figure 2).[2] The two principle production areas are Nsawam in the Eastern Region and Bawjiasee in the Central Region. Table 2 reports the characteristics of surveyed villages. Both areas are within a 65km radius from the Tema port. The international airport is also located within this radius.

The production of export pineapples started in Nsawam around 1945 in the village of Samsam-Odumase when a farmer named Mr. Oko brought suckers from the Aburi Botanical Garden and planted in the village.[3] Pineapple production then spread among villagers in the area, particularly after the Nsawam Cannery was established by Kwame Nkruma, Ghana's first president, to boost the economy after Ghana's independence in 1957. The cannery processed pineapples and other fruits and sought to export these to neighboring West African countries as well as to the EU. The company also organized extension workers and developed a model farm to transfer technology and good agricultural practices to farmers in the region. According to one agricultural officer in the district assembly, currently about 3,500 smallholders are engaged and 4,000 hectares are used for pineapple production in this area altogether.

[2] "Export pineapples" refer to varieties of Smooth Cayenne, MD2, and Queen in Ghana. Local variety (Sugar Loaf) is not considered in this study, as it is mostly targeted at domestic markets.
[3] "Suckers" are the name for a secondary shoot. These are cut and then planted to grow a new pineapple plant.

In contrast, export pineapple production in the Bawjiasee area was initiated by large-scale exporters. As exports expanded in the early 1990s, the exporters sought more land and chose this area. The soil quality and rainfall are not as good here as the Nsawam area, but the land is flatter and thus easier to develop. In addition, the road network is more developed than in the Nsawam area. The smallholders residing in the Bawjiasee area were hired to work on the exporters' plantations and many brought back pineapple suckers to initiate production in their villages, forming another cluster of pineapple smallholder producers in this area.

Production of Pineapples

Pineapple production takes about 14 months from planting to harvest (Figure 3). Ten months after planting suckers, chemicals or calcium carbide is applied to the plants to force flowering. The forcing is intended to ensure that the pineapples mature at the same time and thus facilitate scheduling the harvest. After forcing, the pineapples continue to grow, becoming close to ripe in four months. Then each fruit is inspected for its sweetness, shape, color, and size, and if it satisfies the quality standard, ethylene is sprayed to degreen the fruit. After one week, the fruit that passes inspection is harvested, packed and shipped to the EU on the same day, either by ship or air. The fruit that is not purchased by exporters is left on the plant, but must be harvested soon. That fruit is then sold in local markets to itinerant traders called "market women"

(Figure 1), who sell the pineapples by the roadside or in urban markets. After the fruit is harvested, the pineapple plants are left to produce suckers that will be used for planting for the next cycle of production. Then, after the suckers are harvested, plots are usually fallowed for one to two years. Some farmers plant rotation crops such as peas and beans instead. Because considerable land is needed for sucker production and fallowing, pineapple production requires a total land area that is much larger than the size of the plots that are actually yielding fruit at any point in time.

Exporter Marketing and Production

Ghana is the third-largest supplier of fresh pineapples to the EU (Figure 4). As shown, Costa Rica dramatically increased its pineapple exports after 2004 when it began to produce the new variety called the MD2 cultivar. This varietal shift was initiated by Del Monte, which modified the existing MD2 cultivar in Costa Rica (Danielou and Ravry, 2005). MD2 is sweeter, more yellow in color, less acidic, and has longer shelf-life than the traditional Smooth Cayenne variety, but it also requires considerably more inputs and greater care. Ghana is now in the process of converting to the MD2 variety (Voisard and Jaeger, 2003), but it has lost market share in recent years.

In Ghana, the number of active pineapple exporters is about twenty, with the top three firms having controlled thirty to sixty percent of the sea-freight export volume in

recent years (Table 3). The largest exporters have increased their market share in 2006 and 2007 due to the varietal shift to MD2. These larger exporters replanted their plots with this variety shortly after it became popular in the EU in 2004. Not all exporters were able to replant due to the high initial cost of replanting. As it takes over a year to produce pineapples, the effect from the varietal shift was reflected in the shares after 2005. Indeed, the top exporter produced as much as 40 percent of the total pineapple sea-freight export volume in 2007.

According to interviews, most exporters started their business by purchasing fruit from smallholders, but later initiated production on their own plantation farms in order to guarantee volume, achieve a consistent supply, and control fruit quality and the timing of harvest. On average, exporters have been in business for more than fifteen years. Most managing directors are Ghanaian. They have different managerial experience, including government, trading companies, fruit processing, and pharmaceutical companies. The pineapple plantations average about 1,200 acres, all of which are leased from local communities for fifty years with advanced payment, though there is considerable size variation among them. Most exporters sell exclusively to the EU wholesalers, but a few also sell to the Middle East. The vessel for exporting is arranged by an exporter association called the Sea-freight Pineapple Exporters of Ghana (SPEG), which was established in 1995 with support of the USAID (TechnoServe, 2004). Through SPEG, the exporters meet regularly to discuss

and coordinate shipping plans. SPEG receives orders from each member exporter months ahead and finalizes the exact volume one week before actual shipment. If an exporter fails to meet the reserved volume, the cost of the full shipment is still charged.

Exporters normally receive orders from the EU several months to a year ahead of the planned export date and produce pineapples based on this schedule. These orders are revised by EU importers as the planned export date nears. Pineapples are paid on an FOB basis, so the transportation cost is paid by the EU importers. However, importantly, the Ghanaian exporters in most cases sell pineapples on a contingent basis, i.e., they do not know the exact price they will be paid when they ship fruit from Ghana. After the fruit is sold, EU importers inform Ghanaian exporters what prices were received. The EU importers deduct the handling costs and their marketing commission from the sales proceeds in the EU, and pay the difference to the Ghanaian exporters. While some exporters bargain for assurance of a minimum price, the EU importers normally have the power to decide the price. In this sense, the Ghanaian exporters face considerable risk from the downstream market because they do not know how much they will receive from exported fruit when they send the fruit, though they have already committed to pay a certain per-unit price to smallholders.

Smallholder Production, Contracts, and Sales

Table 4 provides the socio-economic characteristics of smallholders. For comparison

purpose, characteristics of non-pineapple farmers are also presented. On average, pineapple farmers have better ability, network, credit access, and wealth. These findings are consistent with those of Goldstein and Udry (1999), who studied both pineapple and non-pineapple smallholders in Ghana. Their study surveyed approximately four hundred smallholders in four villages in Nsawam area repeatedly over two-year period. They study various topics, such as innovation and social learning, land property rights and incentives to invest in land, impact of gender on pineapple production, and how risks affect profits both from pineapple and non-pineapple crops.

Typically, husband and wives have separate plots and income accounts, partly due to the tradition of polygamy. Within households, wives usually produce staple crops while the husbands are engaged in pineapple production on different plots. Udry and Anagol (2006) calculate the internal rate of return to investment that include agricultural inputs and labor on each pineapple plot, which was as large as 150 percent per annum for the smallest plots in the sample and 250 percent per annum for median-sized plots. This is very large compared to their estimated rate of return on traditional crops, which was about 30 to 50 percent. This high rate of return motivates farmers to engage in pineapple production, but the high cost of production and the inherent risks in marketing the perishable fruit present a barrier to entry by many poor smallholders. Entry costs have been increased by the recent introduction

of the new variety.

Table 5 shows the relationship between exporters and smallholders in detail. In the Ghanaian pineapple industry, contracts are framed rather loosely. Written contracts are rare and farmers and exporters do not state the volume of purchase at the time of planting. Nonetheless, contracts do exist and there is a a clear pre-harvest relationship among exporters and contracted farmers that is different from the relationship between the exporters and non-contracted farmers (See Table 5). Exporters commonly provide a variety of chemical inputs, such as fertilizer, pesticide/herbicide, and carbide/ethylene, and sometimes credit is also provided. Recently, to minimize transactions costs, exporters have become the guarantors for associations of contracted farmers to enable them to obtain bank loans. Spraying and harvesting are almost always performed by exporters, both for contracted and non-contracted farmers. These costs are not directly charged to smallholders although they may be implicitly charged in the farm prices offered. As later discussed, this spraying activity is an important step that also allows exporters to inspect the quality of fruit before harvesting occurs.

Farm-gate prices are generally agreed upon between exporters and smallholders at some point in a year and stay fairly consistent. More or less the same farm-gate price is offered by all exporters. If the EU market situation becomes exceptionally bad and there is a need for a significant price reduction, then the exporters and smallholders

renegotiate. At each harvest, the smallholders are given vouchers which specify the volume purchased and the per-unit price to be paid. In a few months, they are able to pick up the checks at the exporters' farms in return for this voucher. In this payment system, which is common in Ghana, smallholders are in effect providing exporters credit, again without explicit interest (Remember that exporters are also providing credit to EU importers, who sell the output and then pay the exporters.).

The production schedule is often specified by the exporter, but this specification ranges from a general indication of the "peak season" to a specific instruction on which month to plant or force. All contracted farmers inform the exporters of the date they force pineapples, and most non-contracted farmers also do the same. Thirteen percent of contracted farmers are certified by the EU as good agricultural practitioners or "Eurepgap" farmers. These certifications were made possible with the help of exporters who not only taught them the requirements for certification, but also paid to invite private inspectors to smallholders' farms.

Table 6 shows the details of harvest, rejection, and sales for the smallholder production. The share of fruit that is sold to export market is higher for contracted farmers than for non-contracted farmers. Further, exporters reject a lower share of fruit from the contracted farmers. We examine this variable in more detail in the following section. Per acre revenue is also higher for contracted farmers, although the revenue difference is not large.

Rejection of Purchase

Before going into further analysis, the precise meaning of rejection should be defined. As mentioned earlier, the schedule of pineapple production is controlled mainly at two stages, at planting and at forcing. Forcing is more important because subsequently fruit maturation cannot be stopped and fruit becomes ripe in four to five months. Without forcing, plants can remain on the plant longer without spoiling. Growers inform exporters when their plants are forced, and exporters record these dates and thus can predict with high accuracy when fruit will be available.

About four months after forcing, exporters send workers to the smallholder's farm to check fruit quality, e.g., size, sugar level, and shape. They apply ethylene to the fruit that passes the quality standard in order to change the fruit's color from green to yellow, both on the surface as well as inside. Yellow color adds value to pineapples sold in EU markets, but not to those sold in the domestic market as Ghanaian consumers tend to prefer their traditional variety, which is green on the surface and white inside. The exporters do not spray fruit that does not show indication of meeting the export standard. One week after spraying, the workers are sent again to harvest. Often, however, some of the sprayed fruit is left unpurchased and unharvested, and the reasons given to smallholders are oversize, sunburn, too much water content, injury, and no availability of ships to export. It is costly for the

smallholder because this fruit must be sold rapidly on the domestic market at a discount to even the traditional variety. Smallholders understand that some sprayed fruit may, at harvest, fail to meet the export quality standard. However, it appears that a significant fraction of sprayed fruit is rejected for reasons other than quality. This is the issue that we examine here.

From observation and interviews, we find that exporters reject fruit at three stages. First, exporters reject some fruit when they come to spray the fruits--they only spray the ones that appear to meet export quality. Second, exporters reject more fruit when they harvest the fruits, approximately one week after spraying. Third, the exporters reject additional fruit at the packing house when the fruit go through the final inspection. As seen in Table 6, the reported rejection rates at the first and second stages seem quite high. We hypothesize that fluctuation in EU market demand is an important determinant of the rejection rate at the first and second stages. Exporters have different incentives at each stage. We can consider that exporters can save different types of costs at each rejection, namely, a) cost of spraying (labor, chemical), b) cost of harvesting (labor), and c) cost of transport to EU ports.

In determining whether to spray or reject (first rejection), the exporters will consider EU demand and the amount of flexibility that they would like to have at the time of harvesting to adjust for the realized demand. Exporters send the fruit to EU according to the orders they receive from the importers, which are not fixed.

Although the EU importers update the order as the shipping day nears, it is reasonable to assume that by this time the exporters have a good idea on the amount required by their importers. If the exporters decide not to spray more than what seems required at this stage, they can save all of the costs above. In fact, during the interviews, smallholders mentioned that how much exporters spray varies depending on the time, and they cannot ask exporters to spray more than they do. Sometimes they may spray a lot; other times they do not even come to their farms. For smallholders, rejection at this stage is better than rejection at the second stage because the unsprayed fruits can stay on the plots longer than the sprayed fruits, which gives them more time to look for local traders, reducing the number of pineapples left unsold. This is in part also beneficial for exporters as they may face fewer complaints from smallholders about unpurchased fruits being spoiled.

After spraying, exporters obtain information on the volume and quality of harvests from smallholders. They also finalize orders from the EU importers and also know the quality and volume of harvests from their own production. This additional information seems to help them in deciding how much to harvest from smallholders' plots (second rejection). By rejecting at this stage (i.e., harvesting time), they can save the costs of b) and c) above. According to interviews with workers that collect harvests from smallholders' plots, fruit quality does not change within the one week between spraying and harvesting. Since the sprayed fruit has already passed the

quality test at spraying stage, the rejection at harvest is the best evidence that exporters are using market conditions in determining how much to reject. Importantly, one worker also mentioned that before they go to smallholders' plots to harvest, they are told by supervisors how much fruit to purchase on that day. This information again suggests the degree of rejection is closely tied to market conditions at this stage. Exporters are also supposed to finalize the reservation for vessel space one week before the shipment.

At the packing house, there may still be a few rejections (third rejection). This saves the exporters c) the cost of transport to EU ports. From packing to shipping, it usually takes only one day, and the exporters do not gain much information during packing stage. Thus, this rejection is most likely because the fruit is damaged while transporting to packing house and/or is deemed likely to spoil during the shipment to the EU.

From these considerations, demand-side condition seems to influence the first and second rejections the most. We use these rejection rates in the next section to test whether exporters vary their purchases so as to buffer unexpected changes in external demand.

5. Methodology

In order to test if Carlton's theory can explain the high and variable rate of fruit

rejection at the spraying and at the harvesting stages, we examine whether the unexpected demand fluctuation is significant in explaining the proportion of fruit rejected by exporters when purchasing from smallholders. In the simplest form, we are interested in estimating:

(1) $$R_i = \beta_0 + \beta_1 x_i + \mathbf{w}_i' \phi + u_i,$$

where R_i is the rejection rate for a particular harvest for smallholder i, x_i is a variable that measures the unexpected fluctuation of EU pineapple demand at the time that smallholder i sold to exporters, and $\boldsymbol{w_i}$ is a vector of control variables, and u_i is the error term.

For the rejection variable (R_i), we use the first and second rejection rates of each farmer explained in the previous section as dependent variables in separate regressions. The first rejection rate is constructed as the percentage of fruit that is not sprayed in one particular harvest, i.e., (Total – Sprayed)/Total. At this first rejection, exporters also consider fruit quality in determining rejection. We would ideally want to include a control variable that captures the quality of each harvest in order to have unbiased estimates on EU demand variable from the above regression. Since it was not possible to obtain quality data of the past harvests, we try to control the quality by including a proxy, specifically, the percentage of export from the previous harvest. Note that this proxy may introduce a problem of identification due to endogeneity because it may be affected by the unobserved ability of smallholder i, that also affects

the dependent variable at the same time. If there is such kind of unobserved ability, that effect is captured in the residual *u* and violates one of the ordinary least square assumptions of orthogonality between independent variables and residual, leading to inconsistent estimation of all the variables. In order to correct this, we rely on a two-stage least square estimator using the instrumental variables as follows:

(2) $R_i = \beta_0 + \beta_1 x + \beta_{2i}\hat{q}_i + \mathbf{w}_i'\phi + u_i$ (second-stage equation)

(3) $q_i = \gamma_0 + \gamma_1 z_i + \gamma_2 x_i + \mathbf{w}_i'\delta + e_i,$ (first-stage equation)

where q_i is the quality proxy, z_i is the instrumental variable, e_i is the error term, and the rest are the same as in the equation (1).

The second rejection rate is constructed as the percentage of fruit that is not purchased from the fruit that has been sprayed, i.e., (Sprayed-Purchased)/Sprayed. Note that rejection at the second stage occurs after fruit quality has already been approved at the prior time of spraying one week earlier, so we do not include a quality variable in this regression. The systematic existence of (more than negligible) rejection at this stage can be considered as evidence that exporters are systematically spraying more than they intend to purchase, presumably to obtain an option to export more if the opportunity presents itself. We also test whether unexpected fluctuations in EU demand can explain the variation in the rate of rejection at the second stage, which is a direct test of the Carlton hypothesis.

To measure unexpected changes in EU demand, we constructed a variable that

measures the unanticipated fluctuation of EU demand for Ghanaian pineapples using time-series data between January 2000 and April 2007 from EUROSTAT and FAOSTAT. For simplicity, we defined the reduced-form demand for pineapples in EU (D_{EU}) as a function of GDP per capita, EU population, EU pineapple price lagged one month, and monthly dummy variables, and the supply of pineapples by the major competitors (S_{COMP}) as a function of their export volume lagged one month, their pineapple yield and producer price, and monthly dummy variables. Then we constructed the net demand function that Ghanaian exporters face ($DNET_{EU}$) using these functions. For D_{EU}, the dependent variable used was the total imported volume of pineapples to EU. For $S_{COMP,}$ it was the total exports from Costa Rica and Cote d'Ivoire, and for $DNET_{EU}$ it was the difference between the total imported volume to EU and the exports from these two competitors.[4]

$DNET_{EU}$ was estimated using the Newey-West heteroskedascitity robust standard error as heteroskedasticity may become a concern when we use the lagged independent variable. Monthly dummy variables were included in order to take care of the seasonality of demand in a year. In testing for multicollinearity, EU population variable had to be dropped from the equation to avoid high collinearity among the independent variables. Once we estimated this equation, we used the difference between the predicted $DNET_{EU}$ and the actual $DNET_{EU}$ as the unanticipated fluctuation of EU demand for pineapples that the Ghanaian exporters face. Note that using this

[4] No pineapples are produced in the EU.

difference as the exporters' error in forecasting EU demand assumes that the exporters do have similar information and good knowledge about the demand fluctuation. This is reasonable considering that we estimated this variable using the publicly available data and the experiences they have over years. The actual and predicted demand and their difference are illustrated in the Figure 5.

6. Estimation Results

Table 7 shows the results of the regression analysis on the determinants of purchase rejection. We tested for the presence of multicollinearity in the estimated model and reject the possibility of high multicollinearity among the control variables. The first and second models estimate the determinants of the first rejection by ordinary least squares without controlling for fruit quality (equation (1)). The independent variables included in model (1) are to control for the relation between exporter and smallholder and village characteristics, which may influence rejection. The size of a pineapple farm may also be a concern for the exporter because the transaction cost of harvesting from one large farm is cheaper for them than harvesting from many small farms. Model (2) excludes some control variables from model (1) because these excluded variables may be endogenous to the model. If the unobserved ability of the farmer simultaneously affects these control variables and the rejection rate, ordinary least squares estimation may be inconsistent. These variables are excluded in model (2) in

an attempt to avoid these problems. The result from these models is that the unanticipated demand fluctuation is not statistically significant in explaining the first rejection. However, it is important to note that the coefficients of this variable in both models have negative signs, suggesting the possible inverse relation between rejection and unanticipated demand fluctuation.

In model three, we tried to control for fruit quality that may also be the determinant for first rejection by using two-stage least squares (equation (2)). A valid instrument must satisfy two conditions: i) it should not be significant in explaining the dependent variable in second-stage regression directly, and ii) it must be significant in explaining the instrumented variable, which is the quality proxy in this case. We tested which variables satisfy these requirements and used two instruments, which were whether the farmer has received the Best Farmer Award from the Ministry of Agriculture in the past and the value of farm equipment. The result was again that the unanticipated demand fluctuation was insignificant but is negative in explaining rejection.

Models (4) and (5) analyze the determinants of rejection at the second stage, using the same set of control variables as was used in estimating the determinants of rejection at the first stage. Recall that fruit quality should not be a determinant of rejection at the second stage because all the fruit sprayed a week before harvest was determined to be of export quality. The striking result is that the unanticipated

fluctuation in the EU demand has a negative and statistically significant effect in explaining second stage rejection. The same significant result is obtained in both model (4), which controls for relationship effects between exporters and smallholders and in model (5), which excludes potentially endogenous control variables. Both models find that the second stage rejection rate is inversely correlated with errors in forecasting EU pineapple demand. This result supports the hypothesis that Ghanaian exporters choose to purchase pineapples from smallholders to satisfy a variable portion of EU demand rather than expand their own large-scale production to satisfy total EU demand. While their own plantations appear to produce fruit at lower cost and of more reliable quality, the exporters prefer purchasing a certain amount from smallholders to avoid the risk from unexpected demand fluctuation. Exporters appear to prefer paying a higher per-unit price to obtain pineapples from smallholders to shouldering the risks from unexpected demand fluctuation. This is consistent with the Carlton hypothesis that partially vertically integrated firms vary the amount of outside purchase depending on market conditions.

The coefficient of unexpected demand fluctuation tells how much the rejection rate changes due to a one unit change in unexpected demand. When demand changes unexpectedly by one unit (10 mt), the average rejection rate at the second stage changes in the opposite direction by 0.03 percent. To determine the effect of demand changes on the rejection rate, we must consider the magnitude of observed changes in

unexpected demand.

The average second-stage rejection rate for all the smallholders is 28.6 percent (12.3 percent for contracted farmers and 35.8 percent for non-contracted farmers; Table 6). During the period of our observations, we find that the largest positive difference between anticipated and actual demand (i.e., the unexpected increase in demand) was 4,228 mt. According to our estimates, this maximum unexpected increase in EU demand should reduce the average second-stage rejection rate from 28.6 percent to 15.9 percent. On the other hand, the maximum unexpected decrease in EU demand (-3,281 mt), would increase the average second-stage rejection rate from 28.6 percent to 38.4 percent. Thus, within the observed periods, changes in the magnitude of unexpected demand caused the average second-stage rejection rate to vary about 22 percentage points around the mean, sufficient to significantly affect smallholder economic welfare. As mentioned, the presence of a non-zero second-stage rejection rate is itself a sign that the exporters are rejecting fruit for reasons other than fruit quality. Our result confirms that exporters are using the second rejection rate to adjust to unexpected demand fluctuation.

In order to study whether having a contract influences the variation in rejection at the second stage, we formed the following equation and tested the joint significance of restrictions such that both the contracted and non-contracted farmers have the same coefficients:

$$R_i = \alpha + \beta_{1C} X_1 * D_C + \beta_{1N} X_1 * D_N + \beta_{2C} X_2 * D_C + \beta_{2N} X_2 * D_N + \cdots + u_i ,$$

where R_i is the second rejection rate, $X_i s$ are the independent variables, D_C is 1 if the farmer has a contract, D_N is 1 if the farmer does not have a contract, and u_i is the residual. Our null hypothesis is that contracted and non-contracted farmers have the same coefficients, i.e., $\beta_{1C} = \beta_{1N}$, $\beta_{2C} = \beta_{2N}$ etc. The F-statistics obtained was 3.12 while the critical value was 0.0447. Thus we reject of the null hypothesis that the effects of demand fluctuation is the same for both contracted and non-contracted farmers. The coefficient of the unanticipated demand fluctuation for contracted farmers was -0.003 while that of the non-contracted farmers was -0.02. It means that the exporters vary the second rejection rate for pineapples grown by non-contracted farmers even more than they do for pineapples grown by contracted farmers when adjusting to unexpected changes in demand. This is plausible behavior as the exporters would want to keep a good relation with their contracted farmers to guarantee the supply of good fruit in times of need.

7. Discussion

Why do exporters shift risks?

From the previous regression analysis, we obtain the result that the exporters vary their rejection rate at the second stage according to the error in their estimation of EU demand. This behavior is consistent with Carlton's theory that partially vertically

integrated firms use outside producers to dampen the damage from unexpected demand fluctuation.

But this behavior seems to contradict the basic contract theory that it is more efficient for risk-neutral Principal (exporters) to absorb risks than to shift risks to risk-averse Agents (smallholders) and pay them the appropriate risk premiums. Exporters are of larger scale and are wealthier than the smallholders. Usually wealth is considered to be inversely associated with risk-averseness. Why are exporters shifting the risks instead of bearing them on their own? A possible explanation may be that a) the exporters are also risk-averse and b) smallholders who are engaged in contracts have various ways to diversify risks. These are explained in detail.

Risk-neutrality of the Principal is usually assumed in many models, justified normally "by assuming that the Principal faces many independent risks and thus can diversify the risks associated to his relationship with the Agent" (Salanié, 1997). Thus, this assumption is appropriate only if they have a mechanism to defray the risks. However, this is not always true when we consider the business environment in reality, especially the one in a developing country setting. In the case of Ghana, types of risks that the exporters face are many, such as the EU market prices, frequent land right disputes, unreliable infrastructure and transportation system, and the general risk of large-scale intensive mono-cultural crop production such as fast and wide spread of diseases. However, these inherent risks are not necessarily negatively correlated with

each other such that they can rely on one activity to diversify the risk of the other nor is there adequate environment such that they can develop ways to diversify risks, for example by starting another crop production or fruit processing, due to the difficulty of accessing credit and more land. Processing sector is not yet well developed in Ghana, which can absorb the fruit that does not meet export standard. Another reason that these exporters are not well diversified is because most of these exporters are of sole-proprietorship, or owned by one or a few individuals. If the company is owned by many shareholders or controlled by large corporations, they have more ways to mitigate the risks. But this is not true for most of these exporters.

Their poor risk-coping business environment can be illustrated well when we compare them with the sole multinational fresh pineapple exporting company in Ghana, which does not purchase from smallholders at all. This company is a subsidiary of the large French company called *Company Fruitier*, whose large share is owned by *Dole*, and are fully vertically integrated from production sites in Western Africa to marketing outlets in EU. According to their export director, they receive the EU market information (price, volume, location, variety, size, etc.) from their marketing section in EU on weekly basis. This certainly makes their demand forecast more precise, reducing the risks of unexpected demand fluctuation. They also have large-scale production sites in Cote d'Ivoire and Cameroon where they produce pineapples with exactly the same technology, and these alternative sites help them

dampen the production risk in one country using the production in another country. This can defray not only the climatic risk, but also the risk of political instability. In addition, this company is the owner of the vessel which is used by all the pineapple exporters in Ghana, and this allows them to have more flexibility to secure the transportation to meet their needs. Moreover, they are fully vertically integrated to the extent of downstream EU markets. Thus, the exporter ships all the fresh pineapples to its own company in France, and no rejection at the EU port is expected. Indeed, they have numerous ways that mitigate the risks along the supply chain, and thus they can afford to fully vertically integrate, i.e., they do not have to purchase from smallholders. We may assume that this exporter is risk-neutral, but the majority of other exporters in Ghana operate in a very different setting, and from these observations, it is more realistic to assume that they are also risk-averse.

Secondly, that smallholders have various ways to diversify risks is also reasonable if we consider how they operate in villages. For most smallholders, pineapple is not the only crop they produce. As seen in Table 4, most smallholders also produce other crops such as maize, cassava, and other vegetables. Since there is no reason that these traditional crop markets are correlated with the factors that affect the unexpected fluctuations of EU pineapple demand, it is most likely that the covariance in returns between pineapples and the traditional crops is negatively correlated. Thus, this crop mix gives them flexibility to dampen the demand-side risks. This argument is also

supported by the findings in Goldstein and Udry's study (1999), which compared the impact of risks on profits both on pineapple and non-pineapple plots.[5] They find that this type of shock, such as rejection by exporters, is "a significant source of additional risk faced by those who chose to cultivate pineapple," while it is negligible for the non-pineapple crops, indicating that these market risks are not related. By engaging in multi-crop production, smallholders are able to reduce the damage from risks that originate in the demand fluctuation in EU pineapple markets.

In addition to demand-side risks from local markets, having multiple crops helps smallholders reduce supply-side risks. Traditional crops are in general resistant to harsh environment such as lack of rainfall or sunshine compared to pineapples. Also, these crops require almost no chemical inputs compared to what is required for pineapples. Thus, even when smallholders are not able to afford purchasing these costly inputs for pineapples, they can still produce traditional crops to ease the damage of reduced profits from the pineapple production. Longer shelf-life and shorter production cycle of these traditional crops also offer smallholders rooms to adjust their production plan and smooth their income over time.

Moreover, as the husband and wife usually have different income sources in their customs, the pineapple farmer (who is usually the husband) can diversify the risk

[5] The risks they consider are self-reported risks, such as pests, disease, flood, lack of rain, and theft, and not the EU market demand fluctuations as in our study. Note that they did not find significant difference on the impact of these self-reported shocks on resulting profits between pineapple and non-pineapple plots. However, they admit that these self-reported shocks need to be improved to provide a meaningful conclusion on impact of shocks on profits.

within household to some extent. In our study of who participates in pineapple production, we find that pineapple farmers have greater experience, ability, and a more extensive support network than non-pineapple farmers, which may also help them to diversify risks. Many of the villages also have cooperatives, which could be an alternative risk-sharing mechanism.

Among smallholders, non-pineapple farmers tend to have less wealth and network assets (Table 4), and it may be that they do not participate in pineapple production because they are more risk-averse than the pineapple farmers. Their reservation utilities are so high that the risk premium offered by exporters is not enough to attract them to accept the risk of producing pineapples for that market.

Do exporters shift all the risks to smallholders? One variable that we could not obtain was the production data on plantation farms. Thus we do not have ways to determine whether the exporters are also absorbing some risks from the unexpected demand fluctuations on their own. However, it is more plausible to think that the exporter shares the risks with a number of contracted farmers since if the risk-sharing burden is too much for smallholders such that the risk premium offered is not enough to guarantee their reservation utility, the exporter cannot attract smallholders' participation.

Thus, it is likely that the equilibrium rejection rate and risk share is determined taking into account all of these conditions. An exporter offers a contract with a risk

premium that is just enough to attract the "mildly" risk-averse smallholders to participate and induce their efforts to produce high-quality pineapples. These smallholders pay efforts to produce high-quality pineapples that yield the expected income just above their reservation utility considering both the production and market risks that they are to bear. The final allocation of risk between the exporter and the smallholder depends upon the degree of risk aversion of both parties. In the face of high degree of uncertainty, such as in the export pineapple industry in Ghana, the exporters and the smallholders coordinate in such a way to create a mechanism that is beneficial to both parties. The exporters, who operate on large-scales and do not have flexibility to diversify risks, are purchasing insurance from a number of smallholders, each of whom has his own way to diversify risks within the village or household, across plots, or over time.

8. Conclusion

In this essay, we examined why exporters produce their own pineapples and purchase pineapples from smallholders, consistent with Carlton's theory of partially vertically integrated firms. We posed the hypothesis that the partially vertically integrated exporters use outside purchases to dampen the risks from demand fluctuation, and then tested whether the rejection of previously planned fruit purchases by exporters can be explained by the unanticipated fluctuation of EU demand. We used the difference

between the predicted and actual EU pineapple demand, net of competitor's supply, as the unanticipated fluctuation and tested if that fluctuation is related to observed changes in fruit rejection rates at the first and second stages of final fruit purchase. The results showed that exporters do reject more fruit when there is an unexpected decline in EU demand, and vice-versa. This supports the hypothesis developed by Carlton.

Because exporters are larger, wealthier economic agents than smallholder producers, this result seems to contradict the basic contract theory that the risk-neutral Principal absorbs risks from risk-averse Agents. We argued that the potential explanation is that the exporters are also risk averse and that the smallholders who participate have various ways to diversify risks less expensively than can the exporters so that the risk premium offered by the exporters is enough to guarantee smallholders' reservation utility. We discussed that because of the lack of mechanisms to diversify risks, the exporters are purchasing insurance from a group of smallholders that are equipped with various ways to diversify risks across different crops, among the community, and within households more cheaply than the exporters themselves can do so. Whether this hypothesis is true must be analyzed in future research. If it is, it suggests a new and perhaps unexpected rationale for contract farming, i.e., that smallholders can, in some circumstances, defray market risks more cheaply than can larger processors/distributors.

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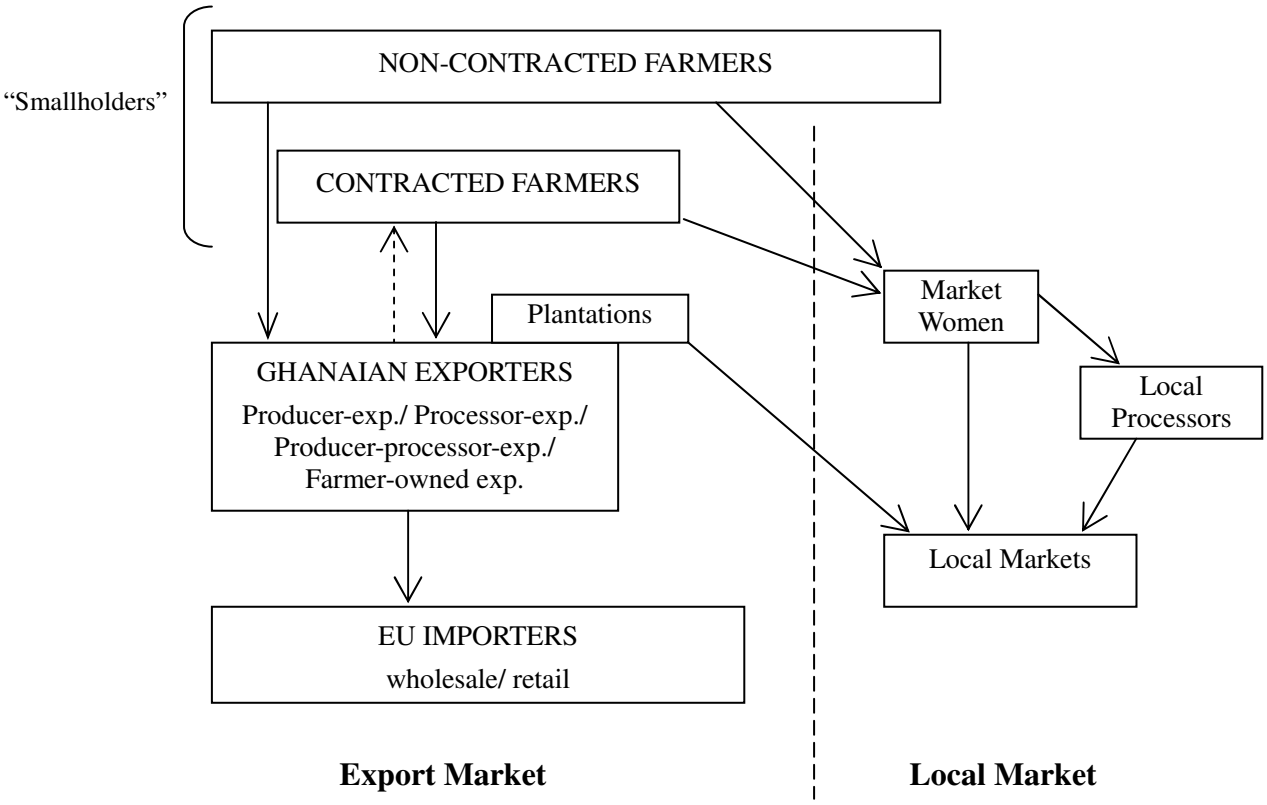
Tables & Figures

Figure 1: Structure of the Pineapple Industry in Ghana



Source: Author's survey

Figure 2: Map of Export Pineapple Production Area

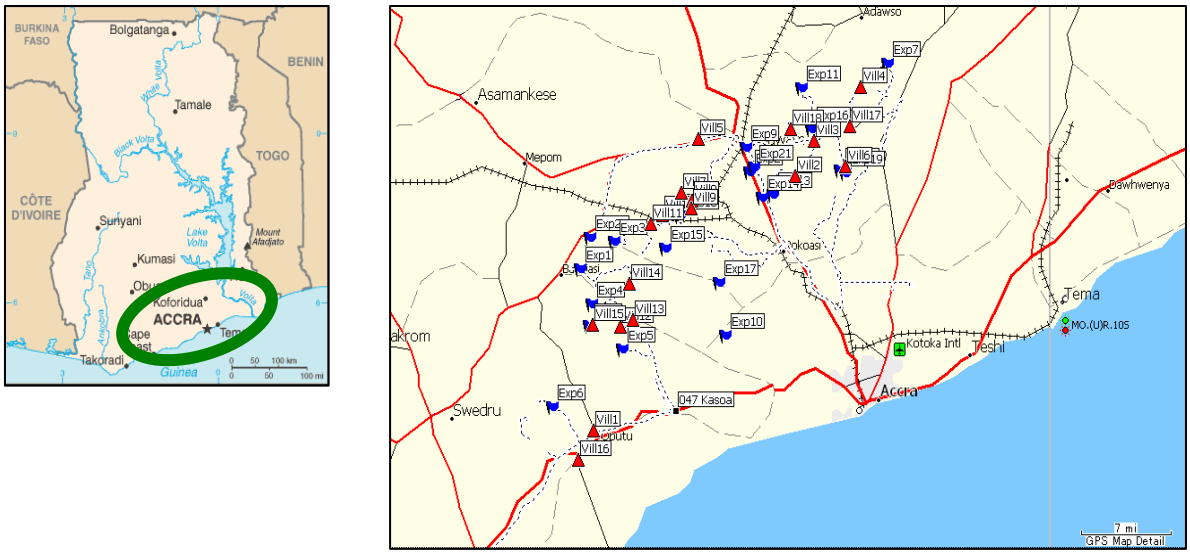


Figure 3: Production of Pineapples

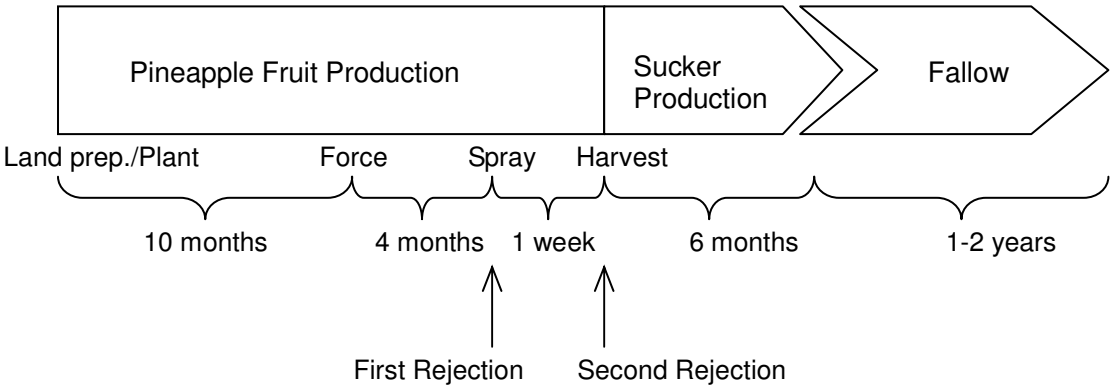
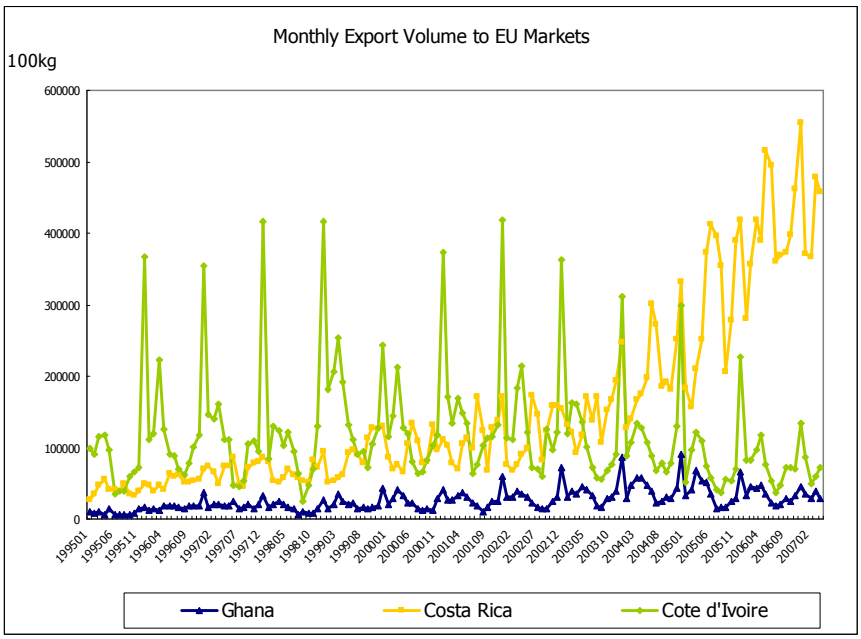
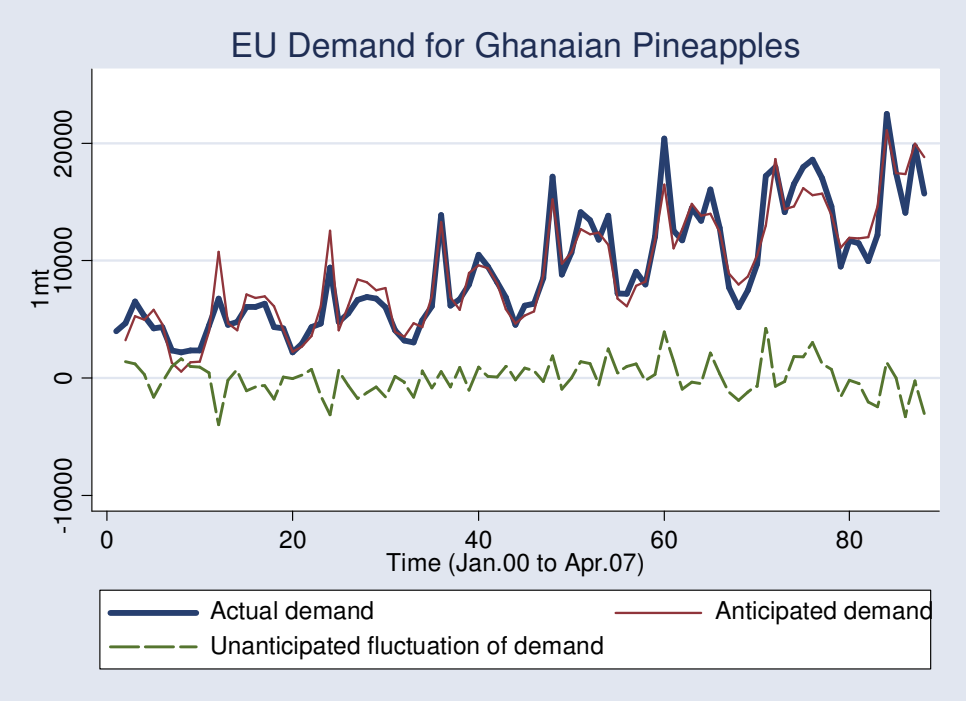


Figure 4: Performance of the Top Three Exporters of Pineapples to EU



Source: EUROSTAT

Figure 5: Actual and Predicted EU Pineapple Demand



Source: Estimated using data from EUROSTAT and FAOSTAT

Table 1: Production Cost by Different Types of Producers (10mt Export-Pineapple Equivalent)

		Plantation farms		Smallholders			
				w Contract		w/o Contract	
		n=6		n=46		n=105	
		mean	s.d.	mean	s.d.	mean	s.d.
Total Production Cost	$	495.4	93.4	1026.7	1157.4	791.0	706.1
Current Inputs	$	368.3	39.0	398.9	593.0	215.8	194.7
Land Rent [a]	$	8.7	3.8	121.9	313.3	93.8	87.2
Labor Inputs [a]	$	111.4	59.8	506.0	562.5	481.4	528.5
Capital Inputs [b]	$	7.0	3.2	0.001	0.002	0.001	0.002
Current Inputs	%	75.4	7.7	37.7	18.4	28.8	14.2
Land Rent	%	1.9	0.9	10.5	13.4	13.7	11.1
Labor Inputs	%	21.3	8.2	51.7	18.1	57.6	16.5
Capital Inputs	%	1.4	0.4	0.0	0.0	0.0	0.0
Among Labor							
Family labor (incl. self)	%			19.4	16.6	42.5	30.4
Permanent workers	%	61.4	20.9	16.3	21.5	6.4	14.6
Casual workers	%	1.3	1.5	64.3	22.5	51.1	29.8
Others on farm [c]	%	37.3	20.2				

Source: Author's survey

a) Cost of own land and family labor are imputed using market rate.

b) Capital costs are depreciated according to the number of years that equipment can be used.

c) Includes supervisors, tractor operators, drivers, and farm managers.

Table 2: Village Profiles

		Villages N=17			
		mean	s.d.	max	min
Population[a]	#	1171.8	1246.8	4990	68
Male[a]	%	49.1	4.2	58.8	43.6
Households[a]	#	263.1	290.1	1192	19
Members of housholds[a]	#	4.4	0.6	6	4
Farm size per household	acre	9.3	13.6	50	1
Share of pineapple farmers in village	%	32.7	29.3	90	1
Years of pineapple production in village	years	20.6	13.8	60	8
Years of exporting pineapples in village	years	16.4	8.8	35	7
Have cooperatives in village	%	41.2	-	-	-
Have community farms in village	%	29.4	-	-	-
Sharecropping system exists in village	%	64.7	-	-	-
Frequency of MOFA extension staff visits	#/month	3.3	4.2	15	0
Have markets in village	%	17.6	-	-	-
If no markets, distance to nearest markets	km	8.3	2.3	12	4.4
Share of households that have electricity at home	%	20.6	33.9	95	0
Have schools in village	%	76.5	-	-	-
Have health clinic in village	%	35.3	-	-	-
Have telecommunication center in village[a]	%	11.8	-	-	-

Source: a) Ghana Statistical Service, and the rest are from the author's survey.

Table 3: Share of Pineapple Export Volume among Top Exporters (Sea-freight)

(%)

	top1	top3	top5	top10
2002	18.5	48.3	62.1	77.6
2003	13.5	35.7	52.4	68.8
2004	13.9	33.9	48.4	67.3
2005	15.5	34.8	49.2	71.6
2006	23.5	51.4	64.6	82.8
2007	41.0	61.6	71.8	88.7

Source: SPEG

Table 4: Socio-economic Characteristics of Smallholders

		Pineapple farmers n = 153		Non-Pineapple farmers n = 100	
		mean	s.d.	mean	s.d.
Age	years	41.5	11.5	44.9	13.1
Male	%	94.8	-	76.0	-
Land holdings	acre	26.0	5.9	6.0	0.7
Ability					
Years of schooling					
self	years	9.2	3.7	6.8	4.2
father	years	3.1	4.7	2.9	4.7
mother	years	1.3	3.0	1.3	3.2
Awarded best farmer before	%	13.7	-	6.1	-
Network					
Cooperative member	%	54.9	-	12.0	-
Have special role in cooperative	%	22.2	-	9.0	-
Relatives to chief	%	45.1	-	44.0	-
Play special roles in community	%	32.7	-	27.0	-
Credit Access					
Have bank account	%	57.2	-	27.0	-
Have received loans before	%	13.8	-	4.0	-
Non-pineapple/Non-farming work					
Number of crops produced	#	2.4	1.4	2.7	1.0
Are engaged in off-farming jobs	%	31.4	-	51.0	-
Wealth					
Lend land to others	%	13.8	-	14.0	-
Values of farming equipment owned	US$	636.5	1814.6	88.4	307.7
Values of household assets owned	US$	2146.5	4063.9	714.2	1002.9

Source) Author's survey

Table 5: Relation between Exporters and Smallholders

		Outgrowers n=47 mean	Independent farmers n=106 mean
Provided by exporters			
Current Inputs			
Suckers	%	27.7	0
Fertilizer	%	59.6	11.1
Pest/herbicide	%	57.4	4.0
Carbide/ethylene	%	44.7	3.0
Plastic	%	6.4	0
Land	%	0	0
Credit	%	36.2	6.1
None	%	14.9	80.8
Services			
Planting	%	0	0
Applying fertilizer	%	0	0
Applying pest/herbicide	%	0	0
Forcing	%	4.3	1.0
Spraying	%	93.6	92.9
Tractor service	%	6.4	0.0
Harvesting	%	83.0	91.9
Monitoring	%	40.4	6.1
Technical training	%	42.6	2.0
Market information	%	25.5	1.0
None	%	0	3.0
Frequencies of talking to exporters			
Once a week	%	23.4	2.8
Once in two weeks	%	8.5	3.8
Once a month	%	27.7	4.7
Every three month	%	12.8	12.3
Only when they come to harvest	%	27.7	69.8
Timing			
Do exporters instruct planting schedule			
Yes, need to follow strictly	%	60.9	-
Yes, but no need to follow	%	8.7	-
No	%	30.4	-
Inform exporters of the forcing time			
Yes, always	%	74.5	53.8
Yes, sometimes	%	23.4	24.5
No	%	0	15.1
Certification			
Certified Eurepgap	%	12.8	0
Certified Organic	%	2.1	0
Supported by Exporters	%	85.7	-
Supported by Ministry of Agriculture	%	28.6	-

Source: Author's survey

Table 6: Details of Harvests, Rejection, and Sales

		With Contract n=46		Without Contract n=105	
		mean	s.d.	mean	s.d.
Size of land/harvest	acre	1.1	1.0	0.7	0.6
Number of fruits/harvest	fruits	15860.1	13250.6	9683.8	7188.0
Share of output destination					
Sold to export market	%	47.8	19.3	36.3	21.1
Sold to local market	%	38.8	16.7	44.6	21.7
Left unsold	%	13.4	10.8	19.0	14.6
Share of rejection by exporters					
First rejection [a]	%	43.7	22.1	46.5	20.3
Second rejection [b]	%	12.3	55.4	35.8	31.5
Total revenue/acre	US$	1725.2	730.5	1679.8	1623.2
From fruit sales	US$	1675.5	692.4	1652.5	1627.1
Export sales	US$	1162.3	633.2	1129.4	1642.4
Local sales	US$	513.2	437.9	520.2	568.1
From sucker sales	US$	48.6	186.8	27.0	75.6
Timing of payment					
Exporters	months	2.4	1.6	2.8	1.7
Local traders	months	0.2	0.6	0.2	0.5

Source: Author's survey

a) Percentage of unsprayed fruit in one harvest

b) Percentage of unpurchased fruit among the sprayed fruit

Table 7: Determinants of Rejection of Pineapple Purchase

	1st Rejection: (Total - Sprayed) / Total			2nd Rejection: (Sprayed - Exported) / Sprayed	
	OLS	OLS	2SLS	OLS	OLS
	(1)	(2)	(3)	(4)	(5)
Unanticipated fluctuation of net EU demand (10mt)	-0.01	-0.01	-0.02	-0.03	-0.03
	(1.31)	(1.36)	(1.34)	(1.72)*	(1.82)*
Is a relative to chief	-2.77	-3.35	-3.17	3.89	4.38
	(0.90)	(1.28)	(1.19)	(0.54)	(0.67)
Have a role in cooperatives	-4.68			-5.8	
	(1.08)			(0.67)	
Have worked in exporters' farms	1.89			-5.04	
	(0.36)			(0.82)	
Size of pineapple farm (acre)	-0.03			-0.11	
	(0.85)			(1.46)	
Village is by the roadside	11.29	11.68	8.6	-11.53	-12.61
	(3.10)***	(3.59)***	(1.52)	(1.75)*	(1.78)*
Years of exporting in village	-0.17	-0.12	-0.16	1.08	1.14
	(0.67)	(0.47)	(0.53)	(2.55)**	(2.57)**
Quality proxy: % of local sales in previous harvest			0.29		
			(0.84)		
Constant	49.34	47.65	33.29	20.1	13.89
	(9.05)***	(9.65)***	(1.71)	(1.93)*	(1.65)
Observations	123	123	123	138	138
R-squared	0.11	0.09	0.10	0.09	0.08

Robust t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%