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Partial Vertical Integration, Risk Shifting, and Product Rejection in the High-Value Export Supply Chain: The Ghana Pineapple Sector

AYA SUZUKI
Foundation for Advanced Studies on International Development, Tokyo, Japan
National Graduate Institute for Policy Studies, Tokyo, Japan

and

LOVELL S. JARVIS and RICHARD J. SEXTON *
University of California, Davis, CA, USA
Giannini Foundation of Agricultural Economics, University of California, CA, USA

Summary. — High-value export supply chains hold potential to improve smallholders' welfare, but their relative production inefficiency and moral hazard problems can cause exporters to prefer vertically integrated plantation production. However, pineapple exporters in Ghana produce both for their own account and purchase from smallholders. We hypothesize that vertical integration is only partial because exporters face large market risks that smallholders, surprisingly, are better able to absorb. We show empirically that exporters' average rejection rate of export-quality fruit is high and varies in response to unanticipated fluctuations in European demand. These results support the hypothesis and are consistent with theories of partial vertical integration but not the standard principal-agent paradigm.

Key words — high-value supply chain, risk, smallholders, vertical integration, Ghana, Africa

1. INTRODUCTION

Production of high-value horticultural products in Africa has received considerable attention recently due to its perceived potential to improve poor farmers' economic welfare by providing access to export markets (Danielou & Ravry, 2005; Dolan & Humphrey, 2000; Jaffee, 2003; Jaffee & Morton, 1995; Minot & Ngigi, 2004; Negri & Porto, 2008; World Bank, 2008). Examples include fresh fruit and vegetables in Kenya (Jaffee, 2003), vanilla beans in Madagascar (Cadot, Dutoit, & de Melo, 2009), and cut flowers in Ethiopia (Yamano, Suzuki, & Matsumoto, 2008). Horticultural products differ from the staple crops smallholders have traditionally cultivated, especially in the required level of product quality, types of production inputs, perishability, and limited marketing channels (Henson *et al.*, 2008; World Bank 2008).

Contract farming, where a downstream processor/marketer provides inputs and technical advice to producers, has been a key approach to incorporating smallholders into high-quality export supply chains (Glover, 1984; Hayami, 2002; Key & Runsten, 1999; Minten, Randrianarison, & Swinnen, 2009; Mukras, Ayako, & Glover, 1989; Singh, 2002; Takane, 2004; Winters, Simmons, & Patrick, 2005). However, contract farming has suffered from systematic moral hazard problems. Defaults by both producers and marketers are often reported (Glover, 1987; Kirsten & Satorius, 2002; Poulton *et al.*, 2004) and have even caused decline of the sector (Ashraf, Giné & Karlan, 2008; Tschirley, Zulu, & Shaffer, 2004). Producers may default by selling output to other marketers who offer higher prices (so-called "side-selling"), reselling marketer-provided inputs, or simply shirking on contractual responsibilities. Marketers may default by arbitrarily rejecting the product or failing to pay a price that reflects the quality of product, the classic "hold-up" problem (Klein, Crawford, & Alchian, 1978).

The recent trends toward higher food safety standards and traceability requirements in key importing countries further enhance the magnitude of information asymmetry between buyers and producers, potentially exacerbating moral hazard problems and raising the bar for smallholders to enter this market due to high cost of compliance with these standards. These trends have induced a shift in some cases from smallholder-based contract production to large-scale integrated plantation production (Maertens & Swinnen, 2009), a quintessential response to moral hazard. These large-scale, integrated production systems typically produce at lower costs than smallholders depending upon the nature of crop production and processing needs (Binswanger & Rosenzweig, 1986; Hayami, 2002; Suzuki, 2008).

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Nonetheless, there are also cases where marketers produce for their own account and also purchase output from smallholders. Although many studies have focused on the characteristics of smallholder participants or the reasons why smallholders participate in contracts (e.g., Masakure & Henson, 2005; Simmons, Winters, & Patrick, 2005), to our knowledge no study has examined the reasons why marketers both engage in internal production and also purchase from smallholders. The existence of partial vertical integration (also known as the "core-satellite" system) raises additional questions that are crucial to understanding smallholders' role in these supply chains. What are the benefits of sourcing product from smallholders relative to undertaking production internally? What factors determine the extent of internal production?

We seek answers to these questions by examining and drawing inferences from the pineapple industry in Ghana. Understanding the economic rationales of both smallholders and downstream buyers to participate in these arrangements may help develop agreements that will better allow production of high-value export commodities to improve smallholder welfare in developing countries.

In Ghana, 18 of 20 exporters of fresh pineapples are partially vertically integrated, producing fruit on their plantation farms and also purchasing it from smallholders. [1] According to our estimates, the plantation farms are considerably more cost-efficient than smallholders in producing export-quality pineapples. Why then do exporters purchase some product from the smallholders instead of becoming fully integrated? In interviews, managing directors of Ghanaian exporting companies offered three explanations: physical constraints on access to inputs, such as land and water, the "social purpose" of maintaining good relationships with neighboring communities which lease lands to the exporters, and concern about market risk due to fluctuations in demand from the European Union.

Each of these reasons may play a role, but we focus on the importance of market risks and find a perhaps surprising ability of smallholders to better absorb those risks relative to the exporters to whom they sell. As we explain subsequently in detail, market risk in selling to the European Union is high and manifest in the form of exporters being constrained in the amount of fruit they are able to sell to EU buyers. Orders from EU buyers are finalized only at the last moment. Fruit that cannot be exported must be sold domestically at sharply reduced prices or destroyed.

Our conceptual framework integrates the theory of vertical integration under demand uncertainty developed by Carlton (1979) with a contract-theory model of asymmetric information and producer moral hazard. We argue based upon this framework that smallholders have two advantages in coping with uncertain export demand for pineapples: they are better positioned to divert pineapples that cannot be sold on the export market to the domestic market, and have other lower-cost risk-diversification mechanisms than exporters.

Most exporters engage in large-scale monoculture production and do not sell pineapples on the domestic market where smallholders regularly market most of their output. Due to the small scale of their production and regular sales to local itinerant traders, smallholders can efficiently transfer fruit that is not saleable for export into the domestic market. Smallholders diversify additionally by planting multiple crops and utilizing social network assets. Risk-bearing attributes are distributed heterogeneously across smallholders, meaning that those who engage in pineapple production are likely to have the best social network assets and diversification opportunities, because their participation can be elicited at a lower cost to the exporter.

The empirical approach is structured to test this hypothesis, asking specifically whether exporters use a variable rejection rate that is a function of unanticipated fluctuations in European demand for Ghanaian pineapples to shift market risk to smallholders. Estimates support this hypothesis, showing that a one standard deviation fluctuation in the expected EU demand translates to a six percentage point change in the mean rejection rate at the time of harvest. [2] Given a mean rejection rate of 34% at harvest for export-quality fruit and assuming a normal distribution in the demand shocks, the rejection rate would fluctuate between 28% and 40% in approximately two-thirds of the years and more than that in one-third of the years.

A rejection rate this high is remarkable in its own right because, as we explain subsequently, the pineapples have already been vetted for quality prior to the time of harvest. Thus, under the alternative explanations for exporter partial vertical integration, the rejection rate at harvest should be near zero, and, indeed, rejection at this time imposes higher costs on smallholders than rejection at an earlier stage of the production process. Demonstrating that the rejection rate varies with demand conditions in the European Union is further evidence that rejections are at least partially due to exporters using smallholder purchases as buffers to avoid market risks.

While this result is consistent with Carlton's theory of partial vertical integration, it contradicts the standard paradigm of efficient risk sharing between a risk-neutral principal (exporter) and a risk-averse agent (smallholder). To our knowledge, the relative superiority of smallholders in risk bearing has not been considered in the literature as a marketable asset to enable them to secure their participation in high-value export supply chains. Thus, this paper suggests a new and perhaps unexpected rationale for smallholder participation in high-value export sectors.

The next section provides the theoretical background and defines the research questions in greater detail. Section 3 discusses data to be used, and section 4 describes exporter marketing, smallholder production, contracts, and buyer default in detail. Section 5 presents the methodology used to test the hypothesis posed, and Section 6 presents the estimation results. Finally, the findings are discussed, followed by a conclusion.

2. THEORETICAL FRAMEWORK

Carlton (1979) argued that most markets do not adjust instantaneously to market conditions and, thus, do not clear. Sellers run the risk of having unsold inventory and buyers, in turn, may be unable to purchase the product from particular sellers. Expanding upon this intuition, he developed a model where market price is set at the beginning of the production period and competitive downstream firms face market uncertainty in the quantity of the final product demanded from them at that price. Downstream firms pass on demand fluctuations to upstream firms by not purchasing inputs from them that the downstream firms cannot convert into final product and sell. Upstream firms incur costs of unsold inventory because the inputs they produce before the realization of demand are discarded in the event they are not purchased by downstream firms to produce the final product. To compensate for the cost of unsold inputs, upstream firms must charge a price for inputs that exceeds marginal cost.