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Interfaces with Other Disciplines

An analysis of partially-guaranteed-price contracts between farmers and agri-food companies

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ABSTRACT

Global agri-food companies such as Barilla and SABMiller are purchasing agricultural products directly from farmers using different types of contracts to ensure stable supply. We examine one such contract with partially-guaranteed prices (PGP). Under a PGP contract, around sowing time, the buying firm agrees to purchase the crop when harvested by the farmer, offering a guaranteed unit price for any fraction of the produce and offering the commodity market price prevailing at the time of delivery for the remainder. The farmer then chooses the fraction. By analyzing a Stackelberg game, we show (1) how the PGP contract creates mutual benefits when the firm's purchase quantity is taken as being exogenous. We also analyze how the PGP contract is robust in creating value for both the firm and the farmer (2) when the firm's purchase quantity is endogenously determined; (3) when the firm provides advisory services to the farmer; and (4) when the firm offers a price premium as an incentive for farmers to exert efforts to comply with 'sustainable' agricultural practices.

1. Introduction

Farmers in both developing and developed countries face huge and possibly growing price uncertainty. For instance, the price of Arabica coffee price hit record price at over US$3 per pound in 2011, dropped to US$1 per pound in 2013 and then rebounded to US$1.80 by the of May in 2014 (Josephs, 2013; 2014 also Danby & Sellen, 2010). When the wheat price surged at end 2007, many farmers in the Emilia Romagna region of Italy focused on growing durum wheat (Formentini, Sodhi, & Tang, 2014). However, when the price of wheat collapsed in 2009, many farmers began to move away from wheat cultivation. Similarly, in 2015, many Chinese dairy farmers poured away milk and slaughtered cows as milk prices collapsed after the boom two years earlier (Yap, 2015). Dealing with price risk faced by farmers is therefore an important issue (cf. Broll, Welzel, & Wong, 2013).

Contract farming is growing as a way to mitigate demand uncertainty for the farmer and supply uncertainty for the buyers as well as a way to improve traceability in the supply chain (cf. Aiello, Enea, and Muriana, 2015 see Belavina and Girotra 2015 for relationship sourcing in general). Agri-food firms including manufacturers and retailers are increasingly purchasing directly from farmers to reduce risk and improve returns for both sides. Some of these firms also provide advisory services to farmers. One such company, Barilla, uses a particular type of contract with farmers, which we call the *Partially-Guaranteed-Price (PGP) contract* (Formentini et al., 2014); beverages giant SABMiller also has similar purchasing contracts.

This paper analyzes how such direct purchase contracts create value for the firm and the farmer. We assume the familiar setting of a buyer-seller contract between a risk-neutral buyer, i.e., the agri-food company, and a risk-averse supplier, i.e., the farmer who is typically but not always a smallholder. Under the basic PGP contract, around sowing time, the buying firm agrees to purchase the entire crop q harvested by the farmer (who has already set the production quantity in advance of signing such contracts). The firm offers a guaranteed unit price g for any proportion of his crop with the remaining quantity priced at the market price prevailing at the time of delivery; the farmer then selects this proportion α as part of the contract.

Our analysis shows that (1) the PGP contract creates extra supply chain surplus for the farmer as well as for the buying firm relative to simply using the market; this result continues to hold when the buying firm imposes an upper bound on α or when the farmer can set his production quantity q in anticipation of the PGP contract. Furthermore, we analyze the PGP contract in a variety

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of settings arising from practice, including: (2) when the firm's purchase quantity y is *endogenously* determined; (3) when the firm provides advisory services to the farmer; and (4) when the firm offers a price premium as an incentive for farmers to exert efforts to comply with certain sustainable agricultural practices. Thus, our analysis provides an economic rationale for agri-food firms like Barilla and SABMiller offering PGP contracts as well as advisory services to farmers. We show how the well-understood dynamics between risk-averse sellers and risk-neutral buyers play out in the agri-food domain, and with mutual benefits that are robust across a variety of extensions in practice.

Our paper primarily contributes to the emerging literature on *socially responsible operations* (Sodhi & Tang, 2014; Sodhi, 2015; Zhou & Tang, 2012) especially regarding large agri-food firms buying directly from farmers. Examples are Indian FMCG company, ITC, buying soya bean from farmers (cf. Devalkar, Anupindi, & Sinha, 2011), Nestle buying coffee beans (Alvarez, Pilbeam, & Wilding, 2010), Starbucks buying coffee beans (Lee, 2007; Lee, Over, & Tang, 2013) and Walmart buying fruits and vegetables (Yeh & Tang, 2013). The agri-food sector in general (cf. Ahumada & Villalobos, 2009) and contract farming in the developing world in particular is gaining considerable interest Goyal (2010). There is also a strand focusing on advisory services provided to the farmer by third parties (Berdegue & Marchant, 2002; Fafchamps & Minten, 2012; Gakuru, Winters, Stepman, Cunningham, & Cunningham, 2009; Swanson, 2008; Tang, Wang, & Zhao, 2014). Our paper contributes in three ways: (1) Purchasing is essentially transactional in this literature whereas we describe and analyze contracts (see Belavina and Girotra, 2015 for relational sourcing); (2) to our knowledge, not much analytical work has been carried out in the extant literature – (Pagell & Shevchenko, 2014) underscore the need for analytical modeling in such contexts. Our paper is a step towards meeting this need; (3) the literature thus far has not considered the use of advisory services contractually as part of contract farming as we do with PGP contracts.

The rest of the paper is organized as follows: In Section 2, we provide motivation and background based on Barilla. Section 3 provides the basic setup for our model for the case when the firm purchases directly from the farmer without partial guaranteed prices (i.e., without PGP). Section 4 presents the analysis of the basic PGP contract for the case when the purchase quantity is exogenously given. Section 5 generalizes the basic PGP contract for the case when the firm's purchase quantity is endogenously determined. In Section 6, we extend the model of the basic PGP contract to the case when the firm offers advisory services to the farmer as part of the contract. In Section 7, we discuss the firm offering an incentive to the farmer to comply with sustainable agricultural practices. We conclude with some areas for further research in Section 8. All proofs are provided in the Appendix.

2. Motivation and background

Examples of agri-food firms buying directly from farmers (as opposed to only from commodity markets) include Barilla's 'Good for you, good for the planet' initiatives, Nestlé's 'Creating Shared Value' programs, Starbucks' 'C.A.F.E.' initiative and Walmart's 'Direct Farm' initiative (Lee, 2007; Lee et al., 2013; 2015; Yeh & Tang, 2013). Moreover, many global agri-food companies offer agricultural advisory services to farmers from whom they purchase especially in developing countries. For instance, under its "creating shared value" initiative, Nestlé works with coffee farmers to help them to reduce production cost by improving their farming techniques. In the Sawi area of Thailand, Nestlé's agronomists teach farmers how to reduce the cost of fertilizers by using compost and drip irrigation. Nestlé also teaches coffee farmers how to manage soil quality and pest control in an environmentally sustainable manner (Lee et al., 2013; 2015). In Italy, Barilla provides advisory services (e.g., weather forecast, phenology, seeding, crop development, fertilization, weeding, pesticides, herbicides) to farmers to help them to reduce cost, increase yield, and reduce carbon footprint.

Barilla uses PGP contracts with farmers as described in the previous section. SABMiller uses a similar contract in Africa by agreeing to contract a certain quantity of sorghum in Africa from the smallholder farmer (or a collective) during the sowing season at a guaranteed unit price. The farmer then decides the fraction of his expected produce to pre-sell to SABMiller at this price, with the remainder to be sold to SABMiller or in the open market at the market price after harvest (Bariyo & Evans, 2015). In practice, these contracts have add-on requirements and incentives. For example, the PGP contracts adopted by Barilla come with incentives and/or price premiums for the farmer following 'sustainable' agricultural practices. Starbucks' 'C.A.F.E.' initiative offers similar incentives (Lee, 2007).

For the Italian market, Barilla used to purchase most of its durum wheat from Italy and small quantities from other European countries such as France, Greece, and Spain. Unfortunately, due to stagnant market price of wheat from 1990 to 2006, many Italian farmers stopped growing durum wheat. For instance, after a peak in wheat production in Emilia Romagna in 1991 with 490,000 tons, the overall production in that region fell below 100,000 tons in 2006, an 80 percent drop from the peak). As local supply dropped, Barilla had to increase its purchase from the international wheat market, especially from North America, to meet its sales in the Italian market. In 2013 and 2014, we conducted interviews with Barilla's purchasing managers to learn of Barilla's contracts, and with consortium managers representing farmers to understand farmers' decisions and behavior. We refer the reader to Formentini et al. (2014) for details.

Although Barilla could obtain sufficient supply of durum wheat internationally from, say, Arizona, there are concerns regarding transportation cost, carbon and water footprint, as well as regarding quality requirements on the wheat being free from GMO and having high percentage of protein. To sustain stable supply of high quality durum wheat at stable price and to encourage sustainable agricultural practices, the local government, farmer consortia and Barilla decided to work together by using incentive contracts.

In the first direct purchase contract signed in 2006, Barilla committed to purchase 30,000 tons of durum wheat from the contract farmers. This contract reduced the farmer's quantity risk and enabled Barilla to secure more supply of wheat in the local region. The basic contract price was primarily based on the local commodity market, Borsa Merci di Bologna. The durum wheat price shot up in 2007 followed by a sharp drop in 2008, forcing some farmers to exit the wheat market. In line with its strategy to procure more wheat domestically for pasta sold in the Italian market, Barilla established a new contract with the farmers to purchase 60,000 tons of durum wheat in 2009. Under the new contract, the contract price was based on the market price plus a guaranteed additional price premium as an incentive. Recognizing the fact in 2009 that the guaranteed price premium essentially transferred all the price risk to Barilla, the firm established the PGP contract.

Under the PGP contract in 2010, Barilla committed to purchase 80,000 metric tons of wheat. As part of the contract, Barilla offered a guaranteed purchase price that is known to the farmer during the sowing season (i.e., after the production quantity has already been determined by the farmer in advance). In return, the farmer could choose the percentage of the purchase quantity α to be priced at the guaranteed price and the rest $(1-\alpha)$ priced at the market price prevailing upon delivery after harvest. The PGP contract reduced price risk for the farmers. However, to limit its exposure to price risk, Barilla imposed an upper limit each year on