Contracts, Quality, and Default: Endogenizing a Buyer's Rejection Rate

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Introduction

Over the last two decades there has been explosive growth in agroindustry in the developing world. This process mimics that in the industrialized world, with the growth of agroprocessing, new distribution systems, and changes in product composition, technologies, and market structures. One way these changes are manifested is in the rise of supermarkets, which followed changes in demand and supply systems. The impact of supermarkets on farmers in developing countries has been a popular topic in the development literature partly because this phenomenal growth has necessitated changes in procurement systems, including an increasing use of specialized wholesalers and contracting directly with farmers, which help to ensure the timing and quality of the product delivered.

While these changes have paralleled an increased demand for higher quality and higher value products, which can yield a financial gain to producers, there have been complaints that the spread of these new procurement systems takes advantage of farmers has well. One common complaint among farmers in developing countries is that contracts are not enforceable, large quantities of produce are rejected on quality grounds, and that quality standards change or are not well defined (Boselie et al, 2003; Reardon and Berdegue, 2002). If the buyers use a rejection rate that is not only dependent on quality, but on the market conditions they face or their capacity, they may be able to benefit by influencing the price the farmer receives in both the contract and spot markets.

Literature Review

While many of the issues addressed in this paper are applicable to markets in both developed and developing countries, it is interesting to nest this problem within the scope of the rapidly changing supply chains in developing countries. While many exported agricultural products have moved through modern supply chains for decades, supermarkets represent a much larger market for many crops, especially higher value crops like produce, meat, and dairy. Streamlining procurement practices goes hand in hand with the diffusion of supermarkets because it allows large retailers to cut costs and compete with local retailers, make strategic investments in new regions, and to differentiate their products based on quality, not price (Reardon and Berdegue, 2002; Reardon et al, 2007).

More so than traditional retailers, supermarkets demand products with specific attributes (e.g., quality, time of delivery, volume).[1] Farmers who had previously supplied traditional retailers or wholesalers may not be able to meet these standards and thus be denied access a new potentially lucrative sales outlet. In fact, supermarkets generally avoid contracting with general wholesalers because they have bargaining power and lack standards, or with individual farmers who produce relatively small quantities, and prefer to use specialized wholesalers or preferred suppliers (Reardon and Berdegue, 2002).

Contracts with farmers have emerged as one solution to meeting cost, volume, quality, and timing demands of large retailers such as supermarkets or specialized wholesalers such as exporters, and may be the most common mechanism of coordination of agroindustry (Echanove, 2001). The form of the contracts employed range from formal to informal and vary greatly by product and country. Contracts can involve the

[1] These standards are similar to those used by processors, exporters, and other large buyers who use some type of vertical coordination and do not rely mainly on the traditional spot market for their supply.

provision of inputs or specify product quality or a particular management practices in production. In addition to their role in helping buyers vertically coordinate, contracts are an institutional innovation promoted in many developing countries as a possible method to help small farmers benefit in the face of globalization; in several countries contracting schemes involve international donors and aid organizations (Reardon et al., 2007; Glover, 1984 and 1987).

There is a large industrial organization literature on contracts focusing on developed country agriculture, specifically for cattle, hogs, and broilers (for example, see Azzam, 1998 and Love and Burton, 1999). In addition, there are several qualitative studies in the development literature that have focused on the effects of contracts on small farmers in developing countries, and on determining which farmers receive contracts (e.g., Key and Runsten, 1999).

I have already discussed ways in which supermarkets can benefit from vertical coordination and contracts with farmers, such as coordinating supply and obtaining products of a desired quality. Love and Burton (1999) provide a brief theoretical rationale for why buying firms might benefit from contracting. Many firms process or pack crops where the local market is thin or missing; it may be hard to obtain what they want, when they want it, unless they use contracts (Key and Runsten, 1999). This is a transaction cost argument; compared to buying on the spot market, contracts can minimize a buyer's search and transfer costs in purchasing a product of the desired quality at a specific time (though contracts require other costs like monitoring, negotiation, and screening potential growers). Contacts can also give a wholesaler or farmer incentives to make costly and specific investments that improve product quality or

the efficiency of the supply chain (Reardon et al., 2007). Finally, buyers can use contracts to lower risk by diversifying geographically, and they bear less of the production risk than they would if they completely integrated production vertically.

Farmers also have economic incentive to seek out contracts for their production, an idea that has been analyzed qualitatively in the developing world. Most of these incentives stem from missing market and risk arguments. For example, contracts can involve provision of credit and inputs, the markets for which are rarely perfect in the developing world. In fact, producing some types of products may only be possible for smaller farmers if they receive credit or inputs from the buyer (Key and Runsten, 1999). Markets for non-staple crops are often thin, so contracts can remove some of the risk in marketing the product and can also remove some of the price risk associated with spot markets, since price can be set before harvest. If contracting involves shifting to a more labor-intensive crop, there can be positive multiplier effects for employment (Warning and Key, 2002). Firms may also provide extension services to farmers with whom they contract to ensure farmers meet standards; farmers can benefit from traininglasses even if they don't continue to contract in the future.

The literature in fact supports several of these diverse motives for farmers accepting contracts. Singh (2002) conducted a qualitative study on contracts for multiple crops in the Indian Punjab and found that farmers wanted contracts to get higher and more reliable incomes, learn farming and soil management skills, and find a bulk sales outlet. Masakure and Henson (2005) found several motives for farmers to sign vegetable production contracts in Zimbabwe. They included the nature of local markets (no access to inputs, transport, and protection from fluctuations in demand and price), learning and

receiving advice on agricultural practices, and pride. Importantly, they also note that different types of farmers (based on farm size, market access, and other income) have different motivations for seeking contracts.

One major focus of the development literature has been on how contracts can go wrong for farmers, especially smallholders. These downsides fall under a few main categories: exploitation, risk and information, and enforcement. One question often posed is whether or not agroindustrial firms exploit unequal power relationships. In many cases growers are heterogeneous and do not necessarily have the same goals, and so do not organize (Glover, 1987). One can also assume that the buying firms, not producers, would have any bargaining power that might exist since there are relatively few buyers and many potential producers. Farmers can also become dependent on the contract over time, and thus cannot afford to switch to another crop, especially if production assets are costly and crop specific (Key and Runsten, 1999). The non-traditional crops that are often contracted tend to be riskier, with more variable yields than traditional crops. Smaller farmers are sometimes challenged by the cost and management skills necessary in coordinating the quantities demanded as well (Boselie et al., 2003; Reardon and Berdegue, 2002). In addition, farmers need information about proper practices and information to be able to adjust to the market, and this information is not necessarily provided (in a timely fashion) by buyers.

A final downside for producers is the variability of enforcement of contracts. In developing countries legal mechanisms can be imperfect, or in extreme cases, nonexistent (Reardon and Barrett, 2002; Reardon and Berdegue, 2002). Most contracts have a quality component, and in general the supplier bears the burden of product not meeting quality

standards. Farmers can find it difficult to cope with risk from poor quality, and large amounts of produce are rejected by buyers on quality grounds (Boselie, et al., 2003; Reardon and Berdegue, 2002). In general, buyers always retain the right to reject substandard product, and are alleged to sometimes reject product by raising quality standards, either to manipulate the spot market price or to control the volume when production is large. This is a common complaint among farmers both in the developed and developing world (Echanove, 2001; Glover 1984 and 1987; Singh, 2002), and is an especially significant problem when the spot market is thin and there are not other outlets for the farmers.

In theory, farmers could renege on their contracts too, but since contracts are generally renewable, farmers who renege on the contract (or produce bad quality product in general) will not get a contract in the next period of this repeated game where there are more sellers than buyers(Warning and Key, 2002; Singh, 2002). In some cases, buyer default can be moderated by input provision, since inputs will act as a sunk cost for the buyers (Gow and Swinnin, 2001). However, this is not always the case and, while buyers can generally prevent producer default, it is more difficult for producers to prevent buyer default; legal threats are not credible, and the market for contracts is generally assumed to be competitive (Key and Runsten, 1999). Thus changing quality standards are likely to continue to represent a problem for producers and it is interesting to study a contracting environment with this possibility in order to investigate the effects of potential buyer default on producer welfare.

In order to model the effects of contracts with the possibility of default it is helpful to consider the industrial organization literature dealing with the relationship

between contracts, quality, and the spot market price. Several papers show empirically that the use of contracts can depress that spot market price (Love and Burton, 1999; Ward et al, 1998; Azzam, 1998), and Azzam shows that this may not be due to noncompetitive conduct. Zhang and Sexton (2000) use a spatial duopsony model to show that contracts can reduce competition between buyers in the spot market, depressing the price. Xia and Sexton (2004) model top-of-the-market contracts where buyers have market power in both the contract and spot market, and they show that there are reduced incentives to compete in the spot market. Significantly, they show that even though these contracts may not be in the producers' collective interest, rational sellers will still sign contracts with no financial inducement.

Wang and Jaenicke (2006) show that spot price decreases as producer risk aversion increases, and that an increase in contracts decreases the variability of the spot price. Finally, Hueth and Ligon (1999) show that imperfect quality measurement leads to a moral hazard problem, and an efficient contract doesn't shield growers from idiosyncratic price risk. Wu (2006) discusses how incomplete contracts for quality can lead to lower prices for producers. Thus there is a precedent that buyers' actions in the contract market can affect the spot market price. It may be realistic to expect a buyer's actions to not only affect spot price, but also the effective contract price, via the buyer's use of an endogenous product rejection rate.

Model

We study a situation with two qualities of an agricultural product, for example, a produce commodity. There is an "export" market that accepts only high-quality product. This

demand may represent actual exports or, equivalently, it could be the demand of a large retailer such as a supermarket chain, where quality traits such a size, blemishes, or shape are important to the buyer. In addition there is a local traditional market, called the spot market, where quality is unimportant to buyers.[2]

We assume a linear demand for the high-quality product, $P^E = A - Q^E$ and a linear demand in the spot market, $P^S = a - Q^S$. We assume the same slope in both markets for simplicity's sake, and without further loss of generality set it to 1.0. In the spot market there is no premium paid for quality. Only average quality of the product is observed by the buyer in the spot market, so the equilibrium in the spot market is pooling. We assume that A > a, indicating higher demand in the export market.

The fraction of production that is high quality is represented by the parameter ρ, where ρ is a function of effort, $e \in \{0,1\}$, and of the state of nature $\theta \in \{\theta_L, \theta_H\}$, such that $\rho = \rho(\theta, e)$. Effort is chosen by producers, and represents actual effort as well as choices of cultural practices, while the state of nature is stochastic and reflects local growing conditions and, thus, is the same for each producer. For a given state of nature, θ, choosing high effort yields a higher fraction of high-quality produce than does choosing low effort, yielding the distribution;

$$\rho_{HH}=\rho(\theta_H,e_H) > \rho_{HL}=\rho(\theta_H,e_L),\ \rho_{LH}=\rho(\theta_L,e_H) > \rho_{LL}=\rho(\theta_L,e_L)$$

In this market there is one buyer of high-quality produce, called the "exporter". The exporter is also a monopolist in sales to the export market. Consistent with many developing-country settings, the exporter is partially vertically integrated and produces

[2] This may be true for various reasons. For example, local buyers may not care about the aesthetic appearance of the product in the same way as consumers in the U.S. or Europe, or the spot market product may be for a processing use where dimensions important in the fresh market do not matter.

$\bar{Q}$ total units, $\rho(\theta, e)\bar{Q}$ of which are high quality and can be sold in the export market. $\bar{Q}$ is given exogenously because, for example, the amount of land available to the exporter could be determined by local customs or regulations or other inputs such as labor could be limited.[3] The exporter can procure additional product from the spot market or directly from producers through contracts. While he can buy in the spot market, we assume he never sells his own production there, be it low or high quality; an outcome which could be due to high transaction costs of spot exchange.

There are also N identical farmers, each of whom produce 1 unit of the product, and can sell in the spot market or directly to the exporter if they sign a contract. The quality of their product is dependent on the effort level they choose, and the state of nature, θ. I assume the farmers are risk neutral and their utility function is given by $U = R - e$, where R is the revenue from crop sales selling either to the exporter or in the spot market, and e is the effort exerted in production.

Baseline Scenario

We model a baseline scenario in order to provide a comparison between the different contracting scenarios. This scenario models a social planner's decisions in two stages. In the first stage, the planner chooses the portion of the farmer's production, ω, that is produced with high effort, where $\omega \in \{0,1\}$, in order to maximize the social surplus. In the second stage, the planner maximizes social surplus by allocating the high-quality production between the spot and export markets.

[3] For example, there are sometimes bans on foreign land ownership, or on the size of landholdings. It may also be the case that a labor market does not exist in certain seasons if people must work on their own plots.

The social surplus in this problem includes the profits earned in both the spot and export markets. Defining the surplus in this way will allow us to compare how different contracting scenarios affect the total surplus available to producers, including both the farmers and an integrated exporter/producer. In this case, we might think about the integrated production, $\overline{Q}$, as that produced by a cooperative, while N is the production from individual farmers plots. The social planner then could be a cooperative that plans and markets its own production as well as that from its members.[4]

This problem is solved by backward induction beginning in the second stage, after θ has been revealed. Thus, at this point, effort has been chosen and $\rho(\theta, e)$ is known. Since the export market only accepts high-quality product, all the low-quality product will be allocated for sale in the spot market. As in the following scenarios, the low-quality portion of the integrated production is discarded. The planner's decision at this point is to maximize the surplus by allocating all the high-quality product between the export market and spot market by considering the export demand and the residual demand in the spot market.

This problem unfolds like a 3rd-degree price discrimination problem, where the export market has a higher demand for the high-quality product. The total amount of low quality product on the market is $Q_L = N(\omega(1 - \rho_{H\theta}) + (1 - \omega)(1 - \rho_{L\theta}))$, since we assume that the poor-quality integrated production can be discarded, as in the other 3 scenarios. The total amount of high-quality product on the market is

[4] In another possible scenario a social planner might maximize a surplus that again includes the profits earned by the producers and exporter, and also includes the consumer surplus in the spot (local) market. We do not model this here first because we are most concerned with the allocation of profits among producers, and secondly because in modeling produce where much is exported, this consumer surplus is likely to be relatively small.

$Q_H = \bar{Q}\rho_H + N(w\rho_H + (1 - w)\rho_L)$, since the integrated production is all produced with high effort but the planner will chose the portion of the farmer's production that is produced with high effort. The equilibrium allocation of the high-quality production to the two markets is

$$Q^S = \frac{1}{4}(a - A + \bar{Q}(3+2\rho_H) + (2N-3\bar{Q})(\omega(\rho_H - \rho_L) - \rho_L))$$

$$Q^E = \frac{1}{4}(A-a + \bar{Q}(1+\rho_H) + (2N-\bar{Q})(\omega(\rho_H - \rho_L) - \rho_L))$$

In the first stage, the planner maximizes the social welfare function by choosing ω, the portion of product N produced with high effort. In this case, only the expected value of θ is known. The optimization problem is $\text{Max } P^E Q^E + P^S Q^S - \omega N$. Derivating this expression with respect to ω allows us to solve for the optimal portion of product produced with high effort, where

$$\omega^* = \frac{(4N^2 + \bar{Q}^2 - 4N\bar{Q})(\bar{\rho}_H - \bar{\rho}_L)(\bar{\rho}_L - 1) + 4N}{(2N-\bar{Q})^2(\bar{\rho}_H - \bar{\rho}_L)^2}.$$

Substituting the optimal choice of ω into the social welfare function yields the social welfare, conditional on the realized value of θ.

Scenario 1: Spot Sales Only

We first consider a scenario where there are no contracts, e.g., they are prohibited by law, and the exporter must meet the demand in the export market through internal production and purchases in the spot market. Since the spot market has a pooling equilibrium, only average quality is observed, meaning that producers have no incentive to exert high effort, so there is a lower fraction of high-quality produce sold on the spot market than if effort were high. We assume the exporter can monitor his own production and that it is

efficient for him to elicit high effort, e=1, for his own production. The exporter's quality is thus ρ(θ, e=1). The exporter must meet demand beyond his production by buying on the spot market and discarding unacceptable product.[5] The exporter is one of many buyers on the spot market, and acts as a price taker with respect to his spot purchases.

This problem is solved by backward induction, first by deriving the spot market equilibrium for any level of purchases by the exporter, and then finding the exporter's profit-maximizing quantity of produce, n, to purchase from farmers. We find the total demand in the spot market by aggregating the spot and export demands while accounting for the exporter's integrated production. The quantity demanded by the exporter in the spot market is $Q_E^S = (A - \rho_{H,\theta}\bar{Q}) - P^S / 2\rho_{L,\theta}$, where $\rho_{L,\theta}$ = (e=0, θ) is the quality in the spot market given that effort is low, and $\rho_{H,\theta}$ = (e=1, θ) is the quality of the integrated production, when effort is high. We add the export demand to the local (spot) demand to get the total quantity demanded in equilibrium.[6] Since supply to the spot market is equal to N, the number of producers, setting supply equal to demand yields the spot market price:

$$P^{SPOT}(\theta) = \frac{2\rho_{L,\theta}(a + A/2 - N - \rho_{H,\theta}\bar{Q})}{(2\rho_{L,\theta} + 1)}$$

In the first stage, the exporter chooses the volume, n, to purchase in the spot market to maximize his profit. At the time he makes his decision, θ has been revealed, so

[5] This is a strong, but plausible assumption and might reflect that the transactions costs recovering low-quality product and bringing it (back) to the spot market are prohibitively high, e.g., due to spoilage. Our qualitative results would be unaffected by allowing the exporter to resell low-quality product, but he would incur a transaction cost (e.g., sorting cost) in doing so.

[6] The exporter's residual demand is $P = A - Q - \rho_H \bar{Q}$, which we deflate by the expected quality in the spot market.

average quality in the spot market, $\rho_{L\theta}$, is known. Price is determined by the market clearing condition as shown above, so the exporter's optimization problem is as follows:

$$\text{Max}\{n\} \quad (A - (\rho_{L,\theta} n_1 + \rho_{H,\theta} \bar{Q}))*(\rho_{L,\theta} n_1 + \rho_{H,\theta} \bar{Q}) - P^{SPOT} * n_1$$

Differentiating the maximization problem by n and solving the first order condition yields the exporter's optimal purchase volume in the spot market. In this baseline scenario,

$$n^*_1 = \frac{2N(\rho_{H,\theta} - \rho_{L,\theta}) + 2\rho_{H,\theta}\rho_{L,\theta}(2N - \bar{Q}) + 2\rho_{L,\theta}a - A(1 - \rho_{L,\theta})}{\rho_{H,\theta}(2\rho_{L,\theta} + 1)}$$

The spot-market solution is subject to two potential inefficiencies. First the producers are never induced to exert high effort in the spot market and increase the incidence of high-quality product, and, second the demander of high-quality product, the exporter, has to buy both high and low qualities in the spot market and must sort and discard the poor quality he cannot sell in the export market. The exporter would be better off if he could differentiate product quality in the spot market, since in this scenario he must spend money acquiring and sorting at least some product he can not sell. These inefficiencies give the exporter an incentive to use a contract market if he can find a contract that will eliminate these problems by inducing high effort from the producers, and/or by eliminating the need to buy any low-quality produce.

Scenario 2: Contracts with no Rejection of High-Quality Production

We now consider a scenario where the exporter contracts some production, n_1, directly from the producers, and accepts all high-quality production; the exporter doesn't purchase any low-quality product, but the producers can sell it in the spot market. This type of scenario could emerge if there were an independent testing or regulatory

organization that enforced the quality standards and contracts. We assume for simplicity that the exporter does not utilize the spot market at all in this scenario; this assumption is a simplification for modeling but reflects the reality that, due to low quality in the spot market, it will often not be in the exporter's best interest to participate.[7]

The spot market equilibrium is important nonetheless in this scenario because it determines the contract price that is necessary to meet the individual rationality and incentive compatibility constraints faced by the exporter to induce farmers to sign contracts and exert the desired high effort. Both constraints are met by a contract that pays contract producers the expected spot price plus a bonus to compensate for exerting high effort.

We solve this model by backward induction, beginning with stage 2 and the spot market equilibrium after θ is revealed. Then in stage 1 the exporter's decisions regarding the number of producers to contract, n_2, and the contract price are made, conditional on the expected spot market equilibrium. The total quantity supplied in the spot market is the non-contracted production plus the rejected contracted production. Since the spot market clears, $Q^S = N-\rho_{H,\theta}*n_2$, and $P^S = a - (N-\rho_{H,\theta}*n_2)$, where $\rho_{H,\theta}$ is the realized quality of contracted produce, given that contract producers expend high effort.

When the producers make their decision of which level of effort to exert, θ has not been revealed, thus ρ is unknown and decisions must be made based on the expected value of ρ, given e. The producers will only be induced to choose high effort, if their expected utility under contract is at least as great as if they produce for the spot market and expend low effort. Thus the contract price must compensate contract producers for

[7] Alternatively, the spot market may still serve as an insurance device for the exporter to utilize in bad realizations of θ. Incorporating possible exporter participation in the spot market in this setting is a subject of ongoing work.

expending high effort. In order to satisfy the producers' individual rationality constraint, the expected utility from contracting production and exerting high effort must be greater than or equal to the expected utility in the spot market. It will be optimal for the exporter to meet this constraint at equality, and thus, $P^C = EP^S + \frac{1}{\bar{\rho}_H}$, where $EP^S = a - (N - \bar{\rho}_H n)$ is the expected price at the time of contracting in the spot market and $\bar{\rho}_H = 0.5[(\rho(\theta_H, e_H) + \rho(\theta_L, e_H)]$ is the expected proportion of high-quality output produced by contract farmers.[8] Contract producers are compensated exactly for expending high effort, e=1.

When the exporter chooses n_2 to maximize his profit, he knows the contract price that will induce high effort, as well as the expected spot price, but does not know ρ. His optimization problem is

$$Max\{n_2\} \quad (A - (\bar{\rho}_H \bar{Q} + \bar{\rho}_H n_2))*(\bar{\rho}_H \bar{Q} + \bar{\rho}_H n_2) - (a - (N - \bar{\rho}_H n_2) + 1/\bar{\rho}_H)*\bar{\rho}_H n_2$$

Solving the first-order condition yields the optimal number of contracted producers:

$$n^*_2 = \frac{A - a + N - 1/\bar{\rho}_H - 2\bar{\rho}_H \bar{Q}}{4\bar{\rho}_H}$$

There are several important observations about this solution. First, n^*_2 decreases as $\bar{\rho}_H$ increases because exporters have to contract to satisfy demand given their expected own production of high-quality produce, and the expected production of high-quality produce by each of n producers; if they expect higher quality, they can contract less. The inefficiency of this solution results from the fact that quality is stochastic, and the actual quality is not observed until after contracting decisions are made. Thus, the actual

[8] A producer's expected utility if he exerts high effort, e=1, is EU= ER – 1, where ER is expected revenue and ER = $\bar{\rho}_H P^C + (1-\bar{\rho}_H) EP^S$. The contract price must be such that his expected utility from exerting high effort under the contract is equal to the expected utility from selling only to the spot market.

amount of high-quality product produced and purchased by the exporter will not be the same as what the profit-maximizing quantity would have been if quality were known throughout the decision-making process. Whether or not this quantity is lower or higher depends on the realized value of ρ.

Thus, due to the stochastic nature of production of high-quality product, the exporter is unable to contract ex ante the optimal amount of purchases. Further, the fact that the exporter is willing to purchase only the production of the contract farmers that is high quality reduces the average quality of product in the spot market relative to scenario 1, making the spot market particularly unattractive as a procurement source for the exporter. These observations motivate investigation of whether it can be in the exporter's interest to reject some high-quality product, in addition to all low-quality product, depending upon the realization of θ. The intuition is that rejection of high-quality product when θ_H is realized enables the exporter to contract with more farmers, providing insurance against having too little high-quality product to sell when θ_L is realized. Rejection of high-quality product in effect provides the exporter with another tool to balance the tradeoff between selling too much relative to the monopoly optimum in periods of high θ, and too little when θ is low.

Scenario 3: Contracts with Possible Rejection of High-Quality Production

In this scenario, the exporter contracts production ex ante, but may reject some high-quality product. The rejection rate for high-quality product is denoted by $\delta \geq 0$. As in scenario 2, the producers can sell all rejected product not purchased by the exporter in the spot market. A key simplifying feature of this scenario is that neither the exporter nor the

producers consider the effect of δ on the spot market price. We develop this "myopic" scenario to provide a benchmark for the more general case when the exporter can chose the rejection rate strategically to influence the spot price and, thus, the contract price through the farmers' participation constraints.[9]

The realized quality affects the spot price as in scenario 2, and no compensation is needed for the possibility that $\delta \geq 0$ because we assume that neither the producers nor the exporter takes this into account when forming their expectations about the spot price and realized quality. This model is also solved by backwards induction, beginning with the spot market clearing. The exporter chooses δ after he signs producers to contracts and after the realization of θ, but before the spot market clears. In this case, the spot price and expected spot price will differ, since the expected spot price is not a function of δ. Thus $Q^S = N-\rho_{H,\theta}(1-\delta)n_3$, and $P^S = a - (N- \rho_{H,\theta}(1-\delta)*n_3)$, while $EQ^S = N - \bar{\rho}_H n_3$, and $EP^S = a - (N - \bar{\rho}_H n_3)$.

In the second stage of the model, θ, and thus ρ, is revealed, and the exporter maximizes his profit by choosing δ. Once again, $\rho_{H,\theta}$ is the same for the contract producers and exporter because all choose high effort. In this stage, the exporter maximizes his profit by choosing δ; contract price and n are exogenous at this stage.

$$\text{Max}\{\delta\} \ (A - (\rho_{H,\theta}\bar{Q} + \rho_{H,\theta}n_3(1-\delta)))*(\rho_{H,\theta}\bar{Q} + \rho_{H,\theta}n_3(1-\delta)) - \rho_{H,\theta}n_3(1-\delta)P^C + \lambda\delta$$

The optimal rejection rate δ, given quality, is:

[9] However, this myopic case may be descriptive of developing-country scenarios where rejection of production by buyers is a major complaint. If producers were able to anticipate buyer rejection, then they would be able to insist on compensation for the rejection of high-quality product.

$$\delta^* = 0 \quad \text{if} \quad A - P^C \geq 2\rho_{H,\theta}(n_3 + \bar{Q})$$

$$\delta^* = \frac{2\rho_{H,\theta}(n_3 + \bar{Q}) - A + P^C}{2\rho_{H,\theta} n_3} \quad \text{otherwise}$$

This result implies that the exporter won't reject any high-quality product when there are poor realizations of θ.

Since there are no costs to the exporter for rejecting contracted product, then it may be best for him to over-contract; in this way, he can achieve the monopoly quantity and obtain the maximum possible profit. Thus, since he can't perfectly predict the realized quality he will over-contract to be ensured he can obtain the profit-maximizing quantity of high-quality produce.

The producers can be induced to exert high effort by a contract

where $P^C = EP^S + \frac{1}{\bar{\rho}_H}$, just as in scenario 2. When the exporter chooses n to maximize his expected profit in stage I of this model, he must take into account that he may choose δ>0 later. It is important to note that in this scenario, δ will not change the contract price or the expectation of the spot price, but the exporter knows that he can choose δ>0. His maximization problem is:

$$\text{Max}\{n_3\} \ (A - (\bar{\rho}_H \bar{Q} + \bar{\rho}_H n_3(1-\delta^*)))^*(\bar{\rho}_H \bar{Q} + \bar{\rho}_H n_3(1-\delta^*)) - \bar{\rho}_H n_3(1-\delta^*)P^C$$

Solving this equation yields the optimal number of contracts, n_3^*:

$$n^*_3 = \frac{3(N + 1/\bar{\rho}_H - A + a) + 2\bar{Q}(2\bar{\rho}_H - 1)}{2(1 + \bar{\rho}_H)}$$

As predicted, as $\bar{\rho}_H$ increases, n_3* decreases, meaning the exporter will contract less if he expects quality to be higher.

Discussion

This paper represents a first attempt to examine within an analytical framework the issue of endogenous rejection of contracted production by buyers, a phenomenon of considerable concern in developing countries, as rapid industrialization of the agricultural sector increases the incidence of contract production in these countries. The ability to acquire and sell high-quality production is important both to exporters selling to developed-country consumers and to multinational retail chains, who are assuming increased prominence in developing countries.

Buyers' incentives to contract in these settings are straightforward to establish, as in our scenario 1. The spot market often does not provide incentives for high-quality production due to pooling and resulting adverse selection problems. Buyers who seek to acquire exclusively high-quality production will incur transactions costs of sorting production acquired in the spot market and from wastage of product that does not meet the necessary standard.

We showed in scenario 2 that the spot market remains important in a setting with contracting because it determines the contract price needed to meet producers' participation constraints. However, stochastic production of high-quality products is problematic for buyers in this setting because the buyer cannot determine ex ante the amount of contracts needed to maximize profits ex post. Of course, the optimizing buyer can choose contract production to maximize profits on expectation, but ex post profits will never be maximized in this model setting.

Although it is intuitive that the spot market can act as an insurance market to purchase high-quality production during bad realizations of the state of nature, we

showed that the advent of contracting for high-quality production actually makes the spot market an increasingly inappropriate outlet for acquisition of high-quality product because contracted producers sell exclusively low-quality production in the spot market, reducing the share of high-quality production available there, relative to an equilibrium with only the spot market.

The ability to reject high-quality product ex post, after the realization of the state of nature is, thus, potentially an important tool for buyers of high-quality product because it enables them to maximize profits in terms of actual market conditions, not just based upon ex ante expectations. In this paper, we studied a setting with myopic sellers who did not anticipate ex post rejection. In ongoing work, we are studying rejection with rational sellers, who must be compensated ex ante for the expected rate of rejection. Although we did not model it in this paper, rejection may also be used strategically to influence the spot price because rejecting product that then must be sold on the spot market relaxes the participation constraint faced by a buyer. This, too, is the subject of ongoing work.

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