

# **Knowing the Value of Coffee:**

## **Institutional Design and the Value of Information**

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### **Abstract**

Lower prices on the world market due to declining quality of coffee production in Mexico are quickly eroding the value of Mexican coffee. This study examines four traditional market-based institutions used to improve signaling for quality improving agronomic practices to smaller producers when most of the gains to improving quality of production accrue to large producers. The economic benefits of vertical integration, lateral integration, cooperative formation, and direct contracts are examined.

### **1. Introduction**

Agricultural economics has typically proceeded from the notion that agriculture represented the last bastion of pure competition. The discipline touted the fact that large numbers of producers offering homogeneous product to a large number of consumers could characterize production agriculture. However, recent trends in agriculture have eroded this perception. On the demand side, the ultimate market for agricultural produce as food or fiber may be characterized by large numbers of consumers. On the supply side, significant concentration has occurred in the agribusinesses that process farm output into consumer products. This concentration has raised the specter of monopsonistic behavior in the market for farm output. In addition, recent advances in genetic engineering have led to the development of designer outputs such as waxy corn. Thus, the assumption of product homogeneity can now be questioned. Some evidence suggests that the

combination of concentration in the agribusiness sector and the rise of designer products have contributed to the increase in vertical integration of agricultural production in the United States. Agribusinesses may invest in a market niche based on quality characteristics or cost savings in processing. However, in order to fully exploit this niche they require specific characteristics in their agricultural inputs. Following the discussion of Grossman and Hart (1986), I assume that producing agricultural products that meet this niche is costly and requires a relationship specific investment. The question posed in Grossman and Hart then becomes “should the farm own the agribusiness, the agribusiness own the farm, or can they use some form of long-term contract?”

In order to focus attention on these questions, I depart from the high-tech world of domestic agricultural production and examine the coffee market in Mexico. Historically, Mexican coffee production represented a profitable alternative crop in the state of Veracruz in southeastern Mexico. The city of Coatepec maintains grand houses built by the coffee trade in colonial times. However, the current state of the coffee industry in the province is somewhat more tenuous. Land redistributions during the twentieth century reduced the average size of each farm to 5 hectares. My conjecture is that smaller units eliminated the incentive structure that allowed for return to quality. Further, I conjecture that this lack of returns to quality has contributed to a general decline in the Mexican industry. The policy question that arises from this scenario involves the economic benefit of reversing this trend and the potential modifications of this industry that may be used to reward quality.

## 2. The Value of Quality To Processors and Producers

In agriculture, the value of quality is typically addressed within the framework of commodity grades. Tomek and Robinson (1981) raise the issue of quality within the context of grades for agricultural produce. Tomek and Robinson describe how grades can be defined for agricultural commodities based on observable characteristics that are related to consumer preferences. Thus, consumer preferences on vegetable quality can be used to signal producers regarding the appropriate size of grapefruit, finish on beef cattle, etc. This exposition, however, is highly stylistic and abstracts away from significant questions of the value of grading to an industry in general and the timing implications of grades.

In order to formalize the value of quality, consider the optimization problem facing coffee processors:

$$\begin{aligned}\pi &= p_1x_1 + p_2x_2 + p_3x_3 - wE \\ \text{st } x_1 + x_2 + x_3 &= x_T \\ \{x_1, x_2\} &= F(x_T, E, z_1) \\ \frac{x_1}{x_1 + x_2} &= \theta(z_1)\end{aligned}\tag{1}$$

where  $\pi$  is processor profit,  $x_1$  is high quality coffee and  $p_1$  is the price of high quality coffee,  $x_2$  is low quality coffee and  $p_2$  is the price of low quality coffee,  $x_3$  is ungraded coffee (domestic market coffee) and  $p_3$  is the price of ungraded coffee,  $w$  is the cost of effort used to grade coffee,  $E$  is the level of effort used to grade coffee,  $x_T$  is total coffee produced,  $z_1$  are those agronomic factors that effect the grade of coffee, and  $\theta(z_1)$  is that fraction of coffee that grades high. In this model, the total quantity of coffee available to the processors is fixed. The processor simply chooses how much coffee to grade by

choosing the level of effort. However, the grading effort simply sorts coffee into two groups  $x_1$  and  $x_2$ . The share of coffee that is high quality is determined by agronomic factors  $z_1$ . Assuming that effort in grading is expended efficiently, this formulation becomes

$$\begin{aligned} \max \pi &= p_1 x_G \theta(z_1) + p_2 x_G (1 - \theta(z_1)) + p_3 x_3 - C(x_G) \\ \text{st } x_G + x_3 &= x_T \end{aligned} \quad (2)$$

This reformulation simplifies the problem to the selection of the amount of coffee graded and that sold in the ungraded market. Forming the Lagrangian for the constrained optimization problem yields:

$$\max L = p_1 x_G \theta(z_1) + p_2 x_G (1 - \theta(z_1)) + p_3 x_3 - C(x_G) + \lambda (x_T - x_G - x_3) \quad (3)$$

The first-order conditions for this problem with respect to each quantity then becomes

$$\begin{aligned} \frac{\partial L}{\partial x_G} &= p_1 \theta(z_1) + p_2 (1 - \theta(z_1)) - \frac{\partial C(x_G)}{\partial x_G} - \lambda = 0 \\ \frac{\partial L}{\partial x_3} &= p_3 - \lambda = 0 \end{aligned} \quad (4)$$

Solving each first order condition for  $\lambda$  and equating the results yields

$$p_1 \theta(z_1) + p_2 (1 - \theta(z_1)) - \frac{\partial C(x_G)}{\partial x_G} = p_3 \quad (5)$$

which states that at optimum the valued weighted return to knowing the quality of coffee adjusted for the marginal cost of grading has to equal the price in the ungraded market.

The above scenario is rather simplistic in that it assumes that all the prices are fixed. Next, I expand the model by considering the specifics around coffee production in Mexico. Specifically, I replace  $p_3$  with a downward sloping demand relationship for the domestic demand for coffee. In addition, consider the formulation where  $p_1$  is the

international price of robust coffee and  $p_2$  is some discard price. Reverting to the first order conditions in equation 4, I want to focus on the marginal value of coffee as

$$\begin{aligned}\lambda^G &= p_1\theta(z_1) + p_2(1-\theta(z_1)) - \frac{\partial C(x_G)}{\partial x_G} \\ \lambda^U &= p_2(x_T - x_G)\end{aligned}\tag{6}$$

where  $\lambda^G$  is the value of graded coffee and  $\lambda^U$  is the value of ungraded coffee. Also note that  $p_2(x_T - x_G)$  is the traditional downward sloping demand curve for ungraded coffee. The equilibrium amount of coffee graded can then be depicted graphically in figure 1. An increase in the international price of coffee increases the quantity of coffee graded while an increase in the domestic demand for coffee decreases the quantity of coffee graded.

This representation yields two ways to increase the quantity of coffee marketed on the international market and, hence, the price received for coffee in the Mexican market. The first possibility is to improve agronomic practices leading to an increased share of coffee graded high quality ( $\theta(z_1)$ ). The second possibility is to decrease the cost of grading coffee.

The possibility of increased access to the international market through better agronomic practices brings the producers into the puzzle. Specifically, while the processors may be able to allocate coffee between markets, the producers choose agronomic practices. In order to incorporate these effects, I expand the original profit formulation:

$$\begin{aligned}\pi &= p_1x_G\theta(z_1) + p_2x_G(1-\theta(z_1)) + p_3x_3 - C(x_G) - w_1^*z_1 - w_2^*z_2 \\ st \quad &x_3 + x_G = x_T(z_1, z_2)\end{aligned}\tag{7}$$

where  $z_1$  are factors of production that affect quality of coffee and the level of production,  $z_2$  are factors of production that only affect the quantity of coffee,  $w_1^*$  is the price of  $z_1$  and  $w_2^*$  is the price of  $z_2$ . Again, the Lagrange form of this problem then becomes

$$L = p_1 x_G \theta(z_1) + p_2 x_G \theta(z_1) + p_3 x_3 - C(x_G) - w_1^* z_1 - w_2^* z_2 + \lambda (x_T(z_1, z_2) - x_G - x_3) \quad (8)$$

Taking the derivatives of this function with respect to  $z_1$  and  $z_2$  yields

$$\begin{aligned} \frac{\partial x_T(z_1, z_2)}{\partial z_1} &= \frac{w_1 - (p_1 - p_2) \frac{\partial \theta(z_1)}{\partial z_1} x_G}{\lambda} \\ \frac{\partial x_T(z_1, z_2)}{\partial z_2} &= \frac{w_2}{\lambda} \end{aligned} \quad (9)$$

Given that  $\lambda$  is the marginal value of coffee in both markets, these expressions follow the traditional result that inputs should be increased to the point where the value of marginal product equals the price of the input. The implication for quality enhancing inputs is presented in figure 2. Specifically, if an input increases the share of the coffee that grades into the high quality market, the optimal level of that input increases. This result is strengthened since  $\lambda$  is an increasing function of  $z_1$  (see equation 6).

Thus, the general results seem to be consistent with economic intuition: (1) the optimal level of grading equates the price in the domestic market with the gain in the foreign market net of the cost of grading, and (2) producers have an incentive to produce quality coffee through higher average prices. Following this intuition, the observed fact of declining quality in the Mexican coffee market could be the result of (1) declining world prices for export coffee, (2) increased domestic demand for ungraded coffee, or (3) increased prices of quality enhancing inputs. However, other factors relating to market

structure may also contribute to the decline in quality. Rewriting the first order conditions for the quality input yields:

$$\frac{\partial x_T(z_1, z_2)}{\partial z_1} = \frac{w_1^*}{\lambda} - \frac{(p_1 - p_2) \frac{\partial \theta(z_1)}{\partial z_1} x_G}{\lambda} \quad (10)$$

The first term on the right hand side is the direct effect of  $z_1$  on the producer's production level while the second term is the marginal effect of  $z_1$  on the price received through the quality of output.

Up to this point, I have left the exact specification of the decision maker a little vague. Intuitively, these conditions hold for producers in aggregate. However, the results may be very different for a small producer. Specifically, in the case of a single small producer, his choice of  $z_1$  will have little effect on the overall price received for coffee.

Rewriting equation 10 for an individual producer yields

$$\frac{\partial x_T(z_{i1}, z_{i2})}{\partial z_{i1}} = \frac{w_1^*}{\lambda} - \frac{(p_1 - p_2) x_G}{\lambda} \frac{\partial \theta(z_{11}, z_{21}, \dots, z_{m1})}{\partial z_{i1}} \quad (11)$$

where  $z_{i1}$  denotes the amount of input 1 used by individual  $i$ . Intuitively, if all the producers are of approximately the same size

$$\lim_{m \rightarrow \text{large}} \frac{\partial \theta(z_{11}, z_{21}, \dots, z_{m1})}{\partial z_{i1}} = 0 \Rightarrow \frac{\partial x_T(z_{i1}, z_{i2})}{\partial z_{i1}} = \frac{w_1^*}{\lambda} \quad (12)$$

or the incentive to improve quality vanishes.

### 3. Market Based Institutions to Improve Quality Signals

Coffee production in Mexico follows a pattern common in agriculture throughout the world at the current time. Specifically, the sector is composed to two components. The

first component is the small farmers who farm less than 3.5 hectares, but represent 78 percent of the producers. The second component is composed of larger farmers who account for 80 percent of the coffee production in Mexico. Following the results of equations 11 and 12, the smaller farmers sell their output through a series of middlemen called *coyotes* who then sell coffee to large processors. This market channel can be contrasted with the large farmers who sell directly to processors (or more typically undertake the first stage of processing themselves) to garner higher prices. Thus, existing market channels provide less incentive for small farmers to increase quality than for large farmers. An important question is then whether traditional market based institutions could improve the signals to smaller producers.

The alternative market channels are depicted in figure 3. In marketing channel A, farmers are large enough to pay for the cost of sorting coffee. As a result, they directly receive a price premium for the value of their coffee and have an economic incentive for the use of inputs to enhance quality. Market channel B depicts those producers that are not individually large enough to sort their coffee. While these producers receive a price that reflects the average benefit for sorting coffee, they do not receive a direct incentive for quality. Thus, they are affected by the quality of the coffee, but do not have the ability to respond. Finally, market channel C depicts the scenario where there is no return to sorting coffee by quality.

In this analysis, I focus on four possible market based institutions that will produce a market channel somewhere between A and B. The primary emphasis is on market-based institutions, which is to say institutions that could exist without government sponsorship. The institutions examined in this study are (1) vertical integration, (2) lateral

integration, (3) cooperatives, and (4) integration by contracts. While this list is not exhaustive, each form represents a viable alternative for integration currently observed in agriculture. In the United States, vertical integration by direct ownership is a frequently used alternative in the livestock industry, particularly in poultry and pork production, while lateral integration has been a fact of life for Midwestern corn and soybean producers for some time. The use of cooperatives, especially in the areas of marketing cooperatives, has been a mainstay of production agriculture, especially in the marketing of cotton and grains in the plains. Finally, integration by contracts either formal or informal allows sugarcane producers in Louisiana to operate sugar mills efficiently.

In defining these as market alternatives, I differentiate possible institutions requiring a minor government role with the market institutions that require major government involvement. For example, the Capper-Volestead Act aided the establishment of cooperatives by reducing tax effects. However, other than tax considerations under this act, farmer cooperatives are corporations similar to any other. Similarly, vertical integration through the use of contracts may rely implicitly on governmental enforcement of contracts. Such enforcement is common to most industries. These types of government involvement can be contrasted with the establishment of state trading enterprises (STEs) such as the Canadian Wheat Board. These institutions are chartered by some government entity with the express mission of enhancing the price of agricultural output. Of course, my classification may not be terribly rigorous. Admittedly, federal involvement in the Farm Credit System in the United States goes beyond enabling its existence. Also, the Canadian Wheat Board uses standard market mechanisms to increase the price of wheat.

Further, STEs may eventually become private corporations if the government decides to sever its ties with the entity.

Returning to the potential for improving quality signals through market-based institutions, vertical integration in the Mexican coffee industry would represent a step backward in time. Large landlords who rented land to large tenant farmers that managed around 100 hectares each dominated coffee production in and around Coatepec in the state of Vera Cruz before the 1920s. However, land reform in Mexico during the 1920s redistributed the land to smaller landholders. Thus, strictly speaking, vertical integration may not be a feasible alternative due to other policy considerations. However, these basic results can be used to interpret some of the other forms of integration.

The economics of vertical integration must compare the efficiency gains to the integrated firm with the increased cost of managing a larger enterprise. The potential gain from integration can be expressed as:

$$\begin{aligned}
\pi^* &= \left[ p_1 x_G^* \theta(z_1^*) + p_2 x_G^* (1 - \theta(z_1^*)) + p_3 x_3^* - w_1 z_1^* - w_2 z_2^* - C(x_G^*) \right] - \\
&\quad \left[ p_1 \tilde{x}_G \theta(\tilde{z}_1) + p_2 \tilde{x}_G (1 - \theta(\tilde{z}_1)) + p_3 \tilde{x}_3 - w_1 \tilde{z}_1 - w_2 \tilde{z}_2 - C(\tilde{x}_G) \right] \\
st \quad x_G^*, x_3^*, z_1^*, z_2^* &\Leftrightarrow \frac{\partial x_T(z_1, z_2)}{\partial z_1} = \frac{w_1}{\lambda} - \frac{(p_1 - p_2)x_G}{\lambda} \frac{\partial \theta(z_1)}{\partial z_1} \\
\tilde{x}_G, \tilde{x}_3, \tilde{z}_1, \tilde{z}_2 &\Leftrightarrow \frac{\partial x_T(z_1, z_2)}{\partial z_1} = \frac{w_1}{\lambda}
\end{aligned} \tag{13}$$

under this scenario, we know that  $\pi^* \geq 0$  since  $x_G^* \geq x_G$ ,  $x_3^* \leq x_3$ ,  $z_1^* \geq z_1$  by the internalization of market failure. In addition, I conjecture that  $\lambda^* \geq \lambda$  since more product is sold in the higher priced market and, since  $\lambda^* \geq \lambda$ ,  $z_2^* \geq z_2$ .

In order to model the gain to vertical integration, I assume that the coffee producers purchase the farms. However, this purchase comes at a cost. Specifically, I assume that the cost of applying variable inputs is higher for the integrated firm. Thus,

$$\begin{aligned}\hat{w}_1 &= w_1 + \delta_1 \\ \hat{w}_2 &= w_2 + \delta_2\end{aligned}\tag{14}$$

where  $\delta_1$  and  $\delta_2$  are the increased application cost for each input. Following the formulation in equation 13, the increased profit due to vertical integration is

$$\begin{aligned}\hat{\pi} &= \left[ p_1 \hat{x}_G \theta(\hat{z}_1) + p_2 \hat{x}_G (1 - \theta(\hat{z}_1)) + p_3 \hat{x}_3 - \hat{w}_1 \hat{z}_1 - \hat{w}_2 \hat{z}_2 - C(\hat{x}_G) \right] - \\ &\quad \left[ p_1 \tilde{x}_G \theta(\tilde{z}_1) + p_2 \tilde{x}_G (1 - \theta(\tilde{z}_1)) + p_3 \tilde{x}_3 - w_1 \tilde{z}_1 - w_2 \tilde{z}_2 - C(\tilde{x}_G) \right] \\ st \ \hat{x}_G, \hat{x}_3, \hat{z}_1, \hat{z}_2 &\Leftrightarrow \frac{\partial x_T(z_1, z_2)}{\partial z_1} = \frac{w_1 + \delta_1}{\lambda} - \frac{(p_1 - p_2)x_G}{\lambda} \frac{\partial \theta(z_1)}{\partial z_1} \\ \tilde{x}_G, \tilde{x}_3, \tilde{z}_1, \tilde{z}_2 &\Leftrightarrow \frac{\partial x_T(z_1, z_2)}{\partial z_1} = \frac{w_1}{\lambda}\end{aligned}\tag{15}$$

under typical assumptions  $\pi^* \geq \pi$  due to the additional cost<sup>1</sup>. Examining the results of equation 15, it is obvious that the gain to coffee production depends on the relationship

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<sup>1</sup> The formulation can be complicated by the inclusions of quasi-fixed inputs such as farm labor. Intuitively,  $z_1$  could be a vector of inputs. Within this formulation,  $z_{11}$  would equal the labor used and  $z_{12}$  would be a vector representing all other quality inputs. Within this formulation labor is fixed in production. This fixity may result from the lack of other profitable opportunities for the producer's time. Whatever the reason, the introduction of quasi-fixity changes the economic benefit to vertical integration. The quality formulation would then become

$$\begin{aligned}\pi &= p_1 x_G \theta(z_{11}, z_{12}) + p_2 x_G (1 - \theta(z_{11}, z_{12})) + p_3 x_3 - w_{12}' z_{12} - w_2 z_2 - C(x_G) \\ st \ x_T(z_{11}, z_{12}, z_2) &= x_G + x_3 \\ z_{11} &= z_{11}^0\end{aligned}$$

where  $z_{11}^0 z_{11}^0$  is the fixed level of labor. The gain to vertical integration under this formulation includes the change in the value of producer labor. If producers are not currently earning a market rate of return, integration could increase the implicit wage rate. However, this gain must be contrasted with opportunities of labor freed from coffee

between the value of quality and the incremental cost to each input. Focusing on the quality input first, we see that quality will increase if and only if

$$\delta_1 < (p_1 - p_2) x_G \frac{\partial \theta(z_1)}{\partial z_1} \quad (16)$$

Thus, vertical integration will yield increased profits to the sector if the direct value of sorting coffee is greater than the incremental cost of managing the input under vertical integration. The results on  $z_2$  are less straightforward. While  $z_2$  does not affect the quality of coffee, it does affect the overall quantity of production. As the monitoring cost of input 2 increases, the overall quantity of coffee produced falls. Thus, the economic gains to increased quality must be compared with the loss of output.

The gains to lateral integration depend on the factors that currently constrain farm size. To demonstrate the effect of lateral integration, I will assume that farm size is currently constrained by hectares available to each farmer. The production decision then becomes:

$$\begin{aligned} \pi &= p_1 x_G \theta(z_1) + p_2 x_G (1 - \theta(z_1)) + x_3 p_3 - w_1 z_1 - w_2 z_2 - C(x_G) \\ \text{st } x_T(z_1, z_2, z_3) &= x_G + x_3 \\ z_3 &= z_3^0 \end{aligned} \quad (17)$$

where  $z_3$  is the quantity of land available to the farmer. I assume that the quantity of land does not directly affect the quality of the coffee. This formulation can be expressed in Lagrange form as

$$\begin{aligned} L &= p_1 x_G \theta(z_1) + p_2 x_G (1 - \theta(z_1)) + p_3 x_3 - p_1 z_1 - p_2 z_2 - C(x_G) + \\ &\quad \lambda (x_T(z_1, z_2, z_3) - x_G - x_3) + \mu (z_3^0 - z_3) \end{aligned} \quad (18)$$

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production. If these producers take employment at wages below the market return it is possible that this change will not benefit the economy.

where  $\mu$  is the marginal value of land in production. The first order conditions for this problem then yield

$$\mu = \frac{\partial x_T(z_1, z_2, z_3)}{\partial z_3} \lambda \quad (19)$$

If the market price of land per hectare is greater than the value of land in production, then lateral integration through the purchase of land would represent a cost

$$\delta_3 = w_3 - \frac{\partial x_T(z_1, z_2, z_3)}{\partial z_3} \lambda \quad (20)$$

where  $w_3$  is the prevailing price of land. This cost could be treated in a similar manner as the added cost to each input under vertical integration.

Strictly speaking, the disequilibrium between the cost of expansion and benefits to farmers are likely to rise due to the cost of credit, availability of farmland, etc. However, the potential for expansion does raise some interesting points. If the policy goal were to reduce the market failure using lateral integration, say through providing farm credit, what value would the Mexican economy place on the freed labor. Specifically, lateral integration implies the loss of farmers. The feasibility of this scenario is then dependent on the difference between the wages earned by the displaced farmers who find employment in other activities, and the return to their labor on the farm. This result must be weighted, however, against the fact that most small coffee producers now must work off the farm to supplement their income in farming.

As previously stated, a typical response to issues of scale in agriculture has been the formation of cooperatives. This is especially true in the marketing channel. Cooperatives in the United States have formed to market grain and cotton. The most common form of these cooperatives is to provide some service such as a cotton gin. Thus,

the use of cooperatives in this case seems to be consistent with history. Developing the conditions for cooperatives, we now posit a new maximization problem

$$L = p_1 x_G (1 - \theta_i(z_1)) + p_2 x_G (1 - \theta_i(z_1)) + p_3 x_3 - C_i(x_G) - (w_1 + \delta_1) z_1 - w_2 z_2 + \lambda (x_T(z_1, z_2) - x_G - x_3) \quad (21)$$

where  $\theta_i(z_1)$  represents the effect of  $z_1$  on the value of the pooled output given that there are  $i$  farmers in the pool and  $C_i(x_G)$  is the cost of sorting coffee given that there are  $i$  farmers in the pool. Pooling producers in this fashion yields a lower minimum pooling level, but the effect on quality may be less than desired. Specifically, focusing on  $\theta_m(z_1)$  and  $\theta_n(z_1)$  where  $m < n$ . We conclude that it may be economically possible to sort coffee for the smaller pool. However, focusing on the quality reaction by the farmers we see that

$$\frac{\partial \theta(z_1)}{\partial z_1} > \frac{\partial \theta_m(z_1)}{\partial z_1} = \frac{\partial \theta(z_{11}, \dots, z_{m1})}{\partial z_{i1}} > \frac{\partial \theta_n(z_1)}{\partial z_1} = \frac{\partial \theta(z_{11}, \dots, z_{n1})}{\partial z_{i1}} \quad (22)$$

Thus, the pooling problem still occurs at a smaller level. I conjecture that the effect of quality on input choice is a decreasing function of the number of farms required to form the pool. Relatively more of the quality signal is preserved aggregating four farmers into a cooperative than five farmers. An additional result is that the gains to cooperation may be offset by increased cost. In equation 21, like equation 15, I assume that cooperation may add a cost to the quality input.

$$\begin{aligned} \frac{\partial \tilde{x}_T(\tilde{z}_1, \tilde{z}_2)}{\partial \tilde{z}_1} - \frac{\partial \tilde{x}_T(\tilde{z}_1, \tilde{z}_2)}{\partial \tilde{z}_1} &= \frac{\delta_1}{\lambda} - \frac{(p_1 - p_2) x_G}{\lambda} \left[ \frac{\partial \theta_m(z_1)}{\partial z_1} - \frac{\partial \theta_n(z_1)}{\partial z_1} \right] < 0 \\ \Rightarrow \delta_1 &< (p_1 - p_2) x_G \left[ \frac{\partial \theta_m(z_1)}{\partial z_1} - \frac{\partial \theta_n(z_1)}{\partial z_1} \right] \end{aligned} \quad (23)$$

Equation 23 is similar to the derivation in equation 16. It shows that the gains to cooperation may be offset by this direct cost.

Contracts have many similarities with vertical integration. Specifically, in a contract the processor could agree to pay the farmer a premium for his coffee if the farmer follows certain agronomic practices. If the processor knows what the optimum economic actions are for a given farmer to obtain the desired quality, this level can be specified in the contract. The gain to the processor is then the same as specified under the vertical integration scenario in equations 14 and 15. The additional cost is the cost of monitoring input use. The question here is that a farmer may agree to apply a stated level of fertilizer, and then renege on this commitment after the contract is signed. More specifically, given the dichotomy between the effects of the input, once the contract is signed the farmer has an incentive to apply more  $z_2$  and less  $z_1$  since their incentives are now based on the quantity of output. The additional cost  $\delta_1$  and  $\delta_2$  then involve the cost of monitoring the contract. Like the case of the cooperatives, I conjecture that the monitoring cost increases as the farm size falls. Thus, quality improvement through contracts will also work better for larger farmers.

#### **4. Conclusions**

This study examines the potential for increased quality of Mexican coffee under existing and potential market mechanisms. The results show that dominance of small farms in the sector leads to a decreased quality, income, and domestic price of coffee. The critical factor in the development of these results is the ability of producers to obtain a higher price for quality output. The result is developed within the context of separating the output into high quality coffee for the export market and ungraded coffee for the

domestic market. In the case of coffee, quality grading is costly since most coffee is sold in cherry form. Processing to pergamino or parchment coffee allows for the assessment of quality. However, processing to this level is costly. As a result, small producers sell their coffee in an undifferentiated market. They receive a higher average price since the processors find it economically viable to grade the coffee. However, the average quality declines since the farmer does not receive direct remuneration for quality.

Given the inability of the traditional market to reward quality, I examine four possible market-based institutions to decrease the economic loss. The first scenario is vertical integration. Under this scenario, processors would buy the coffee groves and operate them using hired labor. The critical factor determining the economic benefit to this marketing opportunity is the added cost of each input in the integrated firm. The second scenario involves lateral integration where coffee farms expand to obtain direct quality incentives. Like the case of vertical integration, the gains to this scenario depend on the incremental cost of inputs under lateral integration. Specifically, if I assume that the primary limiting input is land available to the farmer, the cost of expanding the land base must be included when computing the returns to quality. Third, a common practice in agriculture when faced with this type of limitation has been to form cooperatives to reduce the cost of marketing. While cooperatives may increase the value of quality to the farmer, the number of farmers required to form a viable pool limits this increase. In addition, the direct cost of forming the cooperative must be factored against the gain in quality. Finally, quality may be rewarded through direct contracts with the producer. Under this scenario, the processor will agree to pay the farmer a premium price if the farmer follows a stated set of agronomic practices that increase the quality of the output.

This scenario faces some of the same problems of vertical integration. Specifically, the processor must verify that the farmer has followed the agronomic practices for the contract to be viable. Since this verification will be costly, the advantages and disadvantages are similar to vertical integration.

## References

- Grossman, S. and Hart, O., 1986, 'The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration' *Journal of Political Economy*, 94, 691-719.
- Tomek, W. G. and Robinson, K. L., 1981. *Agricultural Product Prices* Second Edition, Ithaca, NY: Cornell University Press.

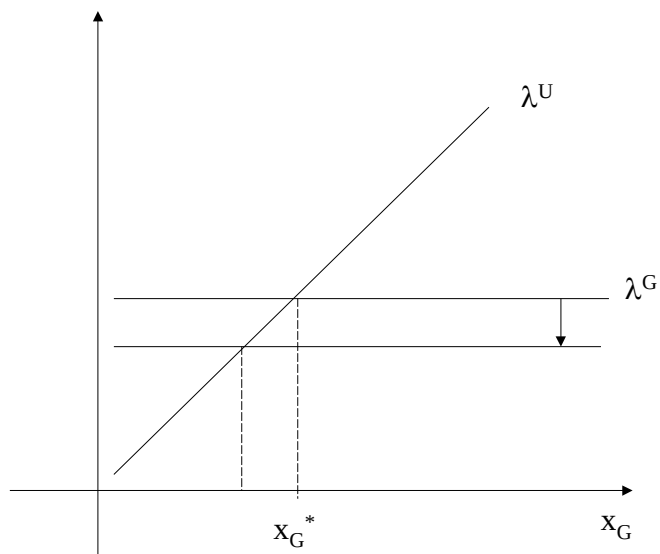


**Figure 1. Graphical Representation of the Quantity of Coffee Graded**

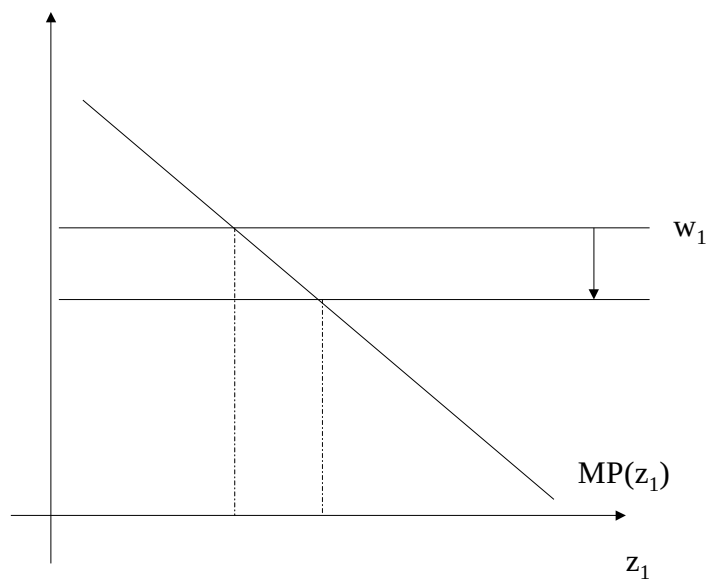


**Figure 2. Use of Quality Enhancing Input**

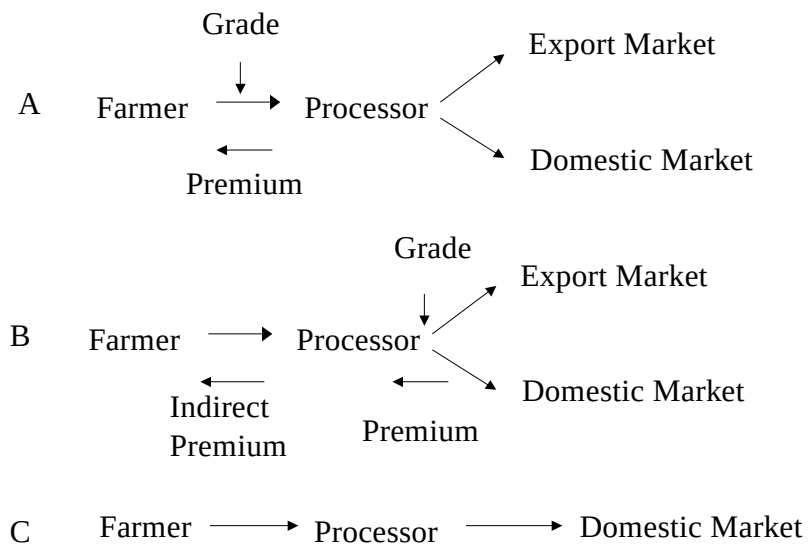


**Figure 3. Alternative Marketing Channels for Mexican Coffee**