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Reputation, Product Quality, and Production Technology in LDC Markets

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Reputation, Product Quality, and Production Technology in LDC Markets

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Abstract

This paper is an attempt to explain the observed patterns of quality specialization in LDC markets. Empirical evidence suggests that higher qualities are produced by more capital-intensive firms and low and seemingly inefficient qualities often persist in markets where labor-intensive firms dominate. It is argued that these phenomena are not easily reconcilable with the assumptions of perfect markets, but may be explained in the context of competitive markets with asymmetric information. Capital-intensive firms are likely to have a cost disadvantage in LDCs, but they can compete with labor-intensive firms in the markets for higher quality products because they can better dispel the seller moral hazard problem that exists in markets where product quality is valuable but not fully observable by buyers at the time of purchase. In this situation, regulation of entry to high quality markets may help the more efficient labor-intensive firms become active in this range as well. Support for labor-intensive firms at the entry stage may have an adverse impact upon the range of qualities supplied by such firms.
I. Introduction

In many less developed countries (LDCs), consumers identify high quality goods with imports or with the products of modern capital-intensive firms. Indigenous labor-intensive firms, on the other hand, are often perceived to be suppliers of low quality products. Such perceptions have been recently confirmed by a number of studies that find a direct relationship between product quality and the capital intensity of production technology in a variety of markets (see, for example, Little, Mazumdar, and Page, 1987; Suri, 1988a; Rashid, 1988). These observations have raised intriguing theoretical questions concerning the reasons behind such a pattern of quality specialization and its efficiency. Moreover, since poor quality seems to have been an important problem in the local as well as the export and import-competing markets of LDCs, the above observations have also called into question the soundness of a number of popular policies in LDCs that are aimed at promoting small enterprises as a vehicle of industrial development.

A usual explanation for the above pattern of quality specialization among firms is that capital-intensive techniques have a natural cost advantage in producing high quality products (see, for example, Little et al., 1987). However, in cases such as adulterated milk, which is a widespread problem in many LDC markets dominated by small traditional producers (Rashid, 1988), the labor-intensive technology can hardly be seen as an immediate cause of low quality. Yet another well-documented example is that of laundry soap in India where the low quality supplied by labor-intensive producers is largely a matter of the nature of ingredients used rather than
the type of the production technology employed: low quality soap is found to contain large amounts of "fillers" that have no detergency value and only add to the size and weight of soap bars (Suri, 1988b). Also, one wonders why the technological factors that give capital-intensive firms cost advantage in the production of higher qualities do not also help them in the production of lower qualities as well (Mazumdar, 1988). Finally, it is not quite clear why technological factors should give capital-intensive firms a similar competitive edge in the production of higher qualities across so many different products.

In this paper, we propose an alternative explanation for the observed pattern of quality specialization based on a moral hazard model of quality determination. The basic argument is as follows. Quality is often a function of a number of product characteristics that buyers can fully observe only after use. As a result, when the costs of production increase with quality, there is a seller moral hazard in the market for higher qualities. Since for most products it is extremely costly to design and enforce complete contracts, institutions such as reputation must arise to overcome this moral hazard problem. A seller who provides low quality in the name of high quality is considered dishonest and, consequently, boycotted. Of course, for this type of buyer behavior to be effective in preventing dishonesty, sellers must expect long-term profits in their current businesses in excess of the benefits of cheating and whatever they expect to earn in alternative occupations. Since the benefits of cheating increase with the quality demanded, sellers of higher qualities must earn higher premiums to remain honest. However, in competitive markets, potential entry constrains the profits that a seller can expect to earn and, therefore, limits the range of qualities that can be supplied in equilibrium. Thus, one suspects
that the higher the sunk costs of entry, *ceteris paribus*, the higher the quality that the market can sustain. Since one associates high sunk costs with capital-intensive production technology, one expects higher qualities to be feasible only when more capital-intensive firms dominate the market. When labor-intensive firms have a cost advantage over the capital-intensive ones, as is the case in LDCs where labor is relatively cheap, they successfully compete and dominate the markets for low qualities. However, in markets for high qualities, capital-intensive firms whose costs are more sunk than recurrent may have a "moral hazard" advantage and, thus, capture the market even if they have a cost disadvantage.

The above arguments imply that when capital-intensive technologies are unavailable or too costly, the market may be dominated by labor-intensive firms that supply low qualities even though they can produce high qualities at affordable costs. This implication of our model explains the puzzling observation of clearly inefficient qualities in many seemingly competitive LDC markets. As Rashid (1988) observes, the prevalence of low quality in some markets, such as diluted milk in the milk market, cannot possibly be explained by consumer preferences. As he forcefully argues, it is difficult to believe that any consumer would want to buy diluted milk while he can add water to pure milk himself; the cleanliness of the process would be more certain and the cost may even be lower. A similar argument applies to the "filled" laundry soap mentioned above and pebble-blended rice observed by Akerlof (1970). Our explanation of such phenomena is based on the lack of exogenous, nonsalvageable entry costs in the case of cost-effective labor-intensive technologies and the costliness of alternative capital-intensive ones.4
It is interesting to note that historically, many products produced under craft guild systems by means of labor-intensive technologies did not suffer from quality problems. In most of these cases, the product quality of labor-intensive firms deteriorated only after the guilds lost their control over the market (Kuran, 1988). In light of the model developed in this paper, the success of the traditional guilds in controlling product quality can be explained by their ability to restrict entry and output. The guilds achieved these goals through methods that impeded technological and organizational innovation (Thrupp, 1971). Nowadays, capital-intensive technology serves a similar purpose as a guarantor of product quality without being as restrictive as the guild system.

The simple model developed in this paper to formally demonstrate the above arguments is in some basic respects similar to those of Klein and Leffler (1981) and Allen (1984). It is an infinite horizon model where risk-neutral sellers and buyers live forever. Sellers are endowed with twice-differentiable cost functions that depend on the quality as well as the quantity of their products. At the beginning of each period, each seller chooses the quality and the quantity that he wants to produce and announces a price and a quality. Buyers observe the prices and the sellers' claims about marketed qualities and then decide where to shop. At the end of the period, buyers realize the true qualities of the products they have purchased. If a seller markets a quality below what he announces, buyers consider him dishonest and boycott him in the future. A seller who markets a quality equal to or higher than what he announces maintains his reputation for honesty and has the opportunity to continue participating in the market in the following period.
Beyond the above basic assumptions, our model differs from that of Allen quite sharply. Allen assumes a long-term precommitment to price on the part of sellers. This assumption makes it possible for competitive equilibria to exist for all qualities as long as entrants have to bear a positive non-salvageable cost and buyers can directly or indirectly observe the volume of each firm's sales. In such equilibria, sellers produce at inefficiently small scales, but do not cut prices or expand output because these actions make cheating more profitable, and buyers—who are aware of this relationship—would not buy their products. In the model developed in this paper, it is shown that in the absence of price precommitment and output observability assumptions only a subset of the technologically feasible qualities may be produced in equilibrium. This subset depends on the relative size of non-salvageable entry costs and may reduce to the lowest possible quality if such costs are negligible. We assume that the level of output produced by each seller is not observable by buyers and that buyers choose where to shop based on the announced prices and their beliefs about the qualities supplied by various sellers. In this situation, there will not be any seller rationing. Therefore, as in Klein and Leffler (1981), sellers choose their output levels such that their profits are maximized.

Seller precommitment to price in Allen's model is a mechanism for reconciling premia necessary for maintaining high quality with limited, exogeneously given, entry costs. In Klein and Leffler (1981), positive premia and limited entry costs are reconciled by seller precommitment to the provision of "free" services that are valuable to buyers. This precommitment is achieved by sellers investing in nonsalvageable assets that render those services. However, as Allen (1984) points out, for most industries such services are either not feasible or have the nature of public goods and, therefore, are unlikely to attract buyers to the firm providing them.
In Esfahani (1989), a game-theoretic model is developed where there is no seller precommitment and endogenous entry costs arise as a result of buyers' preference to continue purchasing from the same seller as long as that seller does not cheat or make offers that are dominated by those of other sellers. Given this buyer behavior, entrants have an incentive to offer a strictly lower price than those of established sellers in order to attract customers. In equilibrium, all sellers are indifferent between cheating and maintaining their reputations. Entrants provide the high quality with a smaller frequency so that buyers remain indifferent between the offers of entrants and established sellers. Naturally, the solution of the game is always in mixed strategies.

In the model developed in this paper, only pure strategies are allowed and sunk entry costs, including all the necessary costs of initial setup and information provision, are assumed to be entirely exogenous. Changing the assumptions of the model and extending it to include endogenous entry costs does not change the main results of the paper because in that case the moral hazard disadvantage of labor-intensive firms simply translates into larger premia necessary for high qualities when produced by such firms. This gives capital-intensive firms an overall price advantage at higher ranges of product quality and, again, leads to quality specialization according to the type of technology.

The rest of this paper is organized as follows. In Section II, we develop a basic model of price and quality determination in a market with asymmetric information and with one type of production technology. In Section III, we examine the equilibrium of such a market when a range of technologies is available. Finally, in Section IV we conclude the paper with a brief summary.
II. A Model of Reputation and Product Quality in Competitive Markets

Consider a seller who has to choose the quality, \( q \in [q_0, \infty] \), and quantity, \( x \in [0, \infty] \), of his product based on a cost function \( c(q,x) \) with partial derivatives \( c_q > 0, c_x > 0, c_{xx} > 0, \) and \( c_{qx} > 0 \), for all \( q \) and \( x \), and with the Inada conditions \( \lim_{q \to \infty} c_x(q,x) = \infty \), for all \( x \), and \( \lim_{x \to 0} c(q,x) = 0 \) and \( \lim_{x \to \infty} c(q,x) = \infty \), for all \( q \). \(^8\) \( q_0 \) is the minimum feasible quality. \(^9\) Suppose that in a given period the seller believes that if he announces quality \( q \) and price \( p \), he can attract as many customers as he wishes. We assume that buyers cannot observe the level of output and, therefore, can only respond to the announced price and quality. Define \( \pi(p,q,x) = px - c(q,x) \) as the one-period profits of the seller. Note that if \( p \geq \lim_{x \to 0} c_x(q,0) \), the profit-maximizing level of output, \( x^*(p,q) \), is determined by \( p = c_x(q,x^*) \). Let \( \pi^*(p,q) = \pi(p,q,x^*) \). Since there are no recurrent fixed costs, \( \pi^*(p,q) \geq 0 \). If \( p \leq \lim_{x \to 0} c_x(q,x) \), it will not be worthwhile to produce quality \( q \) at all and, therefore, \( x^*(p,q) = 0 \) and \( \pi^*(p,q) = 0 \). In particular, if \( p \leq \lim_{x \to 0} c_x(q_0,x) \equiv p_0 \), no quality will be produced at \( p \) and \( \pi^*(p,q) = 0 \) for all \( q \). It is easy to see that when \( \pi^* \) is positive, it is increasing in \( p \) and decreasing in \( q \). For later use, let us define \( q(p) \) as the minimum quality that satisfies \( \pi^*(p,q) = 0 \) for \( p > p_0 \). Obviously, \( p = \lim_{x \to 0} c_x(q(p),x) \). Note that for each price \( p > p_0 \), the production of all qualities lower than \( q(p) \) yields positive profits.

For expositional purposes, suppose the seller announces a pair \((p,q)\) at the beginning of the period. If the seller markets a quality equal to or greater than \( q \), his reputation will be maintained. That is, in the following period buyers will be willing to consider his offer of high quality. Suppose that in this case the discounted present value of his profits in all
future periods is $V$. If, on the other hand, the seller markets a quality less than $q$, he will be considered dishonest and will be boycotted, in which case he will earn zero profits in all future periods. This is the maximum credible punishment that buyers can apply. Note that if the seller chooses the first strategy, he does best by supplying quality $q$, whereas if he chooses the second strategy he does best by supplying $q_0$. Therefore, the second strategy will not dominate the first one if

$$y(p,q,V) = \pi^*(p,q) + \frac{V}{1+r} - \pi^*(p,q_0) \geq 0,$$

where $r > 0$ is the rate of interest. It is assumed that if the seller is indifferent between the two strategies, he will choose the first one. We will refer to (1) as the seller moral hazard condition. As long as $p$ and $q$ satisfy (1), buyers can be confident that the seller will not cheat in his current offer. Therefore, it seems reasonable to assume that if (1) holds for an offer $(p,q)$, buyers will believe that the seller who makes that offer will deliver the claimed quality with certainty, while if (1) is violated by $(p,q)$, buyers will believe that the seller will cheat with certainty. It is easy to see that these are in fact rational equilibrium beliefs.

Once buyers have formed their beliefs about the qualities offered, they compare the offers of all sellers and choose the one that provides them with the highest utility. If they are indifferent among a number of sellers, they will choose one of them randomly. This type of buyer behavior allows perfect competition among sellers and brings about a unique equilibrium price for each quality in the market. To simplify the exposition, we assume that different buyers have different tastes for quality with a sufficiently wide range so that any feasible quality has a potential buyer.
Our goal in the rest of this section is to find the set of \((p,q)\) pairs that can be offered in a stationary competitive equilibrium of the model when sunk entry costs are \(S > 0\). Note that in the long-run equilibrium we must have \(V = S\), unless there has been excessive entry in the past in which case \(V < S\) and \(V\) is determined by the relative numbers of buyers and sellers in the market as well as the shapes of the cost and demand functions. Since excessive entry in most LDC markets is likely to be a temporary phenomenon, in the rest of this paper we concentrate on the case where \(V = S\) and entrants expect zero profits. This helps us avoid the specification of a particular demand function and considerably simplifies our analysis and exposition.

From (1) it is easy to see that for \(V = S > 0\) and for sufficiently small \(p\), the moral hazard condition is satisfied regardless of \(q\) since in this case \(\pi^*(p,q_0)\) is either zero or close to zero. In fact, this is true for all \(p < p^m(S)\), where \(p^m(S)\) is the smooth and increasing function implicitly defined by

\[
(2) \quad \pi^*(p^m(S), q_0) = \frac{S}{1+r}
\]

When \(p > p^m(S)\), \(\pi^*(p,q_0) > S/(1+r)\) and (1) may hold only if \(q\) is small enough for \(\pi^*(p,q)\) to become positive and sufficiently large. The following lemma shows that for \(p > p^m(S)\) and \(S > 0\), \(y(p,q,S) = 0\) has a unique solution, \(q^*(p,S)\), which is a continuous function, decreasing in \(p\) and increasing in \(S\).

**Lemma 1.** For \(S > 0\) and \(p > p^m(S)\), \(y(p,q,S) = 0\) has a unique solution \(q = q^*(p,S)\). \(q^*(p,S)\) is continuous in \(p\) and \(S\), with \(q^*_p < 0\) and \(q^*_S > 0\).

**Proof.** First, note that \(p^m(S) > p_0\). Thus, \(\tilde{q}(p) > q_0\) for all \(p > p^m(S)\). Moreover, \(y(p,q_0,S) > 0\) and \(y(p,q,S) < 0\) for all \(\tilde{q} \geq \tilde{q}(p)\). Therefore, since
y is a continuous function of $q$, $y(p,q,S) = 0$ must have a solution, $q^*$, restricted to the open interval $(q_0, \tilde{q}(p))$. However, in this interval $y$ is strictly increasing in $q$ since $y_q = c_q > 0$. Hence, $q^*$ must be unique, bounded, and continuous in $p$ and $S$. Finally, differentiation of $y(p,q^*,S) = 0$ with respect to $p$ and $S$ yields

$$(3) \quad \frac{\partial q^*}{\partial p} = \frac{x^*(p,q^*) - x^*(p,q_0)}{c_q(q^*,x^*)} < 0$$

and

$$(4) \quad \frac{\partial q^*}{\partial S} = \frac{1}{(1+r)c_q(q^*,x^*)} > 0.$$  

The sign of (3) follows from the fact that $x^*(p,q^*) < x^*(p,q_0)$. Q.E.D.

As shown in Figure 1, the graph of $q^*(p,S)$ against $p$ starts at $p^m(S)$, slopes downward, and tends toward $q = q_0$. The vertical line at $p = p^m(S)$ and $q^*(p,S)$ jointly define a boundary to the left of which the moral hazard condition is always satisfied. We will refer to this boundary as the moral hazard curve (MHC). The downward slope of MHC may seem counterintuitive since often higher prices are associated with greater incentives to produce higher qualities. However, it should be noted that it is higher prices in future that play such a role. The current price, on the other hand, has an adverse effect on quality since it increases the benefits of low quality production for which the optimal output level is larger. The impact of future prices is captured by $V$. Note that if $V = S$ increases, MHC shifts to the right and the set of $(p,q)$ offers that buyers can reliably accept from sellers expands.

Among the price-quality offers that satisfy the moral hazard condition, only those that render nonpositive, discounted, expected profits for potential entrants can prevail in a competitive market equilibrium. Therefore,
we must have $\pi^*(p,q) + V/(1+r) - S \leq 0$. Again, ruling out the case of excessive entry and setting $V = S$, we find the following zero profit condition for entrants

$$\pi^*(p,q) - \frac{r}{1+r} S = 0. \quad (5)$$

Let $p^Z(S)$ be the price level at which $\pi^*(p,q_0) = rS/(1+r)$. Note that $p^Z(S)$ is a continuous and increasing function of $S$ and $p^Z(S) > p_0$. For $p < p^Z(S)$, $\pi^*(p,q) < rS/(1+r)$ regardless of $q$. Therefore, $\pi^*(p,q) = rS/(1+r)$ can hold only for $p \geq p^Z(S)$. Let $\hat{q}(p,S)$ be the solution of $\pi^*(p,q) = rS/(1+r)$ for $p \geq p^Z(S)$. We will refer to $\hat{q}(p,S)$ as the zero profit curve (ZPC).

Obviously, $\hat{q}(p,S)$ is a continuous function which is increasing in $p$ and decreasing in $S$. Figure 1 shows the graph of $\hat{q}(p,S)$ against $p$. As shown in this figure and proven in Proposition 1 below, $\hat{q}(p,S)$ intersects $q^*(p,S)$ only once to the right of both $p = p^M(S)$ and $p = p^Z(S)$. The curve segment AB of the ZPC that lies below the MHC represents the set of equilibrium offers. Note that sellers who offer higher qualities charge higher prices, but all sellers make the same profits. No individual seller has an incentive to deviate from this set of equilibrium offers because offering a quality lower than $\hat{q}(p,S)$ at price $p$ leads to a total loss of customers, while offering a quality higher than $\hat{q}(p,S)$ reduces current profits.

**Proposition 1.** For $S > 0$, the equation $\hat{q}(p,S) = q^*(p,S)$ has a unique solution, $p^*(S)$. $p^*(S) > p^M(S)$ and $p^*(S) > p^Z(S)$. Moreover, for $p < p^*(S)$, $\hat{q}(p,S) < q^*(p,S)$.

**Proof.** At the intersection of $\hat{q}(p,S)$ and $q^*(p,S)$ we must have $y(p,q,S) = \pi^*(p,q) - rS/(1+r) = 0$, which implies
(6) \( \pi^*(p,q_0) = S > 0 \).

Since \( \pi^*(p,q_0) \) is equal to zero when \( p = p_0 \) and is strictly increasing in \( p \geq p_0 \) without bound, equation (6) always has a unique solution. The solution, \( p^*(S) \), must be greater than \( p^m(S) \) since \( \pi^*[p^m(S),q_0] = S/(1+r) < S = \pi^*(p^*,q_0) \). Similarly, \( p^* > p^z(S) \) since \( \pi^*[p^z(S),q_0] = rS/(1+r) < S = \pi^*(p^*,q_0) \). Finally, since for \( p < p^*(S) \), \( \pi^*(p,q_0) < S = \pi^*[p,q(p,S)] + S/(1+r) \), we must have \( y[p,q(p,S),S] > 0 \), which implies \( q(p,S) < q^*(p,S) \).

Q.E.D.

In equilibrium, buyers face the price-quality pairs represented by the curve segment AB in Figure 1 and choose the one they prefer most. Naturally, buyers with stronger tastes for quality choose higher points on AB. However, \( q^M(S) = \hat{q}(p^*,S) \) is the highest quality available in the market and buyers will not be able to find qualities above \( q^M(S) \) at any price regardless of their tastes for quality.\(^{11}\) Note that as \( S \to 0 \), \( p^*(S) \to p_0 \) and \( q^M(S) \to q_0 \). That is, when the market becomes perfectly "contestable," no quality higher than the minimum one, \( q_0 \), can exist in equilibrium. Therefore, the presence of positive sunk entry costs is necessary for the existence of a market for higher quality products.

Note that as \( S \) increases, both MHC and ZPC shift to the right (see Figure 2), and the maximum price in the market increases. But the maximum quality may increase or decrease depending on the relative movements of the two curves. If the MHC shifts more than the ZPC, then \( q^M \) rises, while if the ZPC shifts more than the MHC, \( q^M \) declines. The reason for this ambiguity is rooted in the fact that while an increase in \( S \) raises the benefits of maintaining reputation and tends to support higher qualities in the market, at the same time it increases the benefits of cheating by raising the current
price. The latter effect may outweigh the former only if at price \( p^* \) the optimal scale of production is significantly larger when quality \( q_0 \), rather than \( q^M \), is produced. This point can be analyzed more formally by examining the derivative of \( q^M \) with respect to \( S \):

\[
\frac{dq^M}{dS} = \frac{x^*(p^*,q^M)}{x^*(p^*,q_0)} - \frac{r}{1+r}
\]

Note that when \( S \) is small, \( x^*(p^*,q^M) \) is close to \( x^*(p^*,q_0) \) since \( q^M \) is close to \( q_0 \). Therefore, according to (7), for the sufficiently small \( S \), \( dq^M/dS \) is always positive since \( r/(1+r) < 1 \). However, for larger \( S \)'s, it is possible that \( x^*(p^*,q^M) \) may be much smaller than \( x^*(p^*,q_0) \) and result in \( dq^M/dS < 0 \). This possibility can be ruled out if the derivative of \( dq^M/dS \) with respect to \( S \) always remains positive. It is easy to show that a sufficient condition for \( d^2q^M/dS^2 > 0 \) is

\[
(8) \quad c_{xx}[q_0, x^*(p^*,q_0)] > \frac{r}{1+r} c_{xx}[q^M, \frac{r}{1+r} x^*(p^*,q_0)].
\]

Condition (8) is likely to hold if \( r \) is relatively small and \( c_{xx}(q,x) \) does not increase too sharply with \( q \) or decline too rapidly with \( x \). In light of this observation, cases in which \( q^M \) increases with \( S \) seem more plausible and will be the focus of our analysis in the rest of this paper.

The above results provide an explanation for the puzzling persistence of quality problems in many LDC markets with a multiplicity of small, labor-intensive producers. Such firms are likely to have relatively small sunk costs and find it easy to enter the market, especially when buyers and sellers are numerous and their relationships are impersonal. Historically, many societies had overcome this problem through their traditional guild systems, which restricted entry, kept profits high, and made quality maintenance feasible. However, with the disintegration of the guild system
in modern times, increased competition squeezed profits and eroded the incentives of labor-intensive firms to produce high quality products.

The above results also may explain why quality problems tend to wither away as markets become more concentrated under modern, capital-intensive firms (Rashid, 1988). Such firms have relatively large sunk costs and, thus, are more likely to sustain higher qualities when they manage to dominate the market.

In the following section, we explore the conditions under which capital-intensive firms can compete with the labor-intensive ones at different ranges of product quality.

III. Quality Specialization and Production Technology in Competitive LDC Markets

In this section we employ the model developed above to examine the relationship between a firm's technology and its product quality in a market where more than one type of technology is available. The type of each firm's technology is assumed to be common knowledge. Suppose that there is a family of technologies indexed by \( b \in [\underline{b}, \overline{b}] \) with associated sunk cost, \( S(b) \), and recurrent cost, \( c(q,x;b) \), such that \( S_b > 0 \) and \( c_b < 0 \). In the context of our model, labor-intensive technologies are associated with low \( b \)'s and capital-intensive technologies with high \( b \)'s. In order to capture the cost disadvantage of capital-intensive firms in LDCs, we assume that for the relevant range of \( q \) and \( x \)

\[
(9) \quad \frac{r}{1+r} S_b + c_b > 0.
\]

We demonstrate that this assumption implies equilibrium specialization in high qualities by capital-intensive firms and in low qualities by labor-intensive firms. If, as claimed by some authors, more capital-intensive
technologies have cost advantage in higher qualities, then our result will only be strengthened.

The moral hazard and zero profit conditions for each technology obviously depend on the parameter b of that technology. Assumption (9) implies that the ZPC shifts down and to the right as b increases (see Figure 2):

\[ \frac{\partial q}{\partial b} = \frac{r}{1+r} S_b + \frac{c_b}{q(q^*,x^*)} < 0. \]

For the MHC, we have

\[ \frac{\partial q^*}{\partial b} = -\frac{c_b(q^*,x^*(p,q^*);b) + c_b(q_0,x^*(p,q_0);b)}{c(q^*,x^*)} + \frac{1}{1+r} S_b, \]

and \( \partial p^m/\partial b = \frac{S_b}{(1+r)x^*(p^m,q_0)} > 0 \). If \( r \) is substantially greater than 1 and \( c_b(q_0,x^*(p,q_0);b) - c_b(q^*,x^*(p,q^*);b) \) is negative and large, then \( \partial q^*/\partial b \) may become negative, otherwise \( \partial q^*/\partial b > 0 \). Thus, in the more likely cases where the rate of interest is not too high or capital-intensive technologies are not strongly biased in favor of lower qualities, the MHC will shift up and to the right as b increases.

Irrespective of the direction in which the MHC shifts, the price of the maximum quality in the market, \( p^* \), increases with b since \( dp^*/db = [S_b + c_b(q_0,x^*(p^*,q_0);b)]/x^*(p^*,q_0) > 0 \), which is obtained by differentiating (6) with respect to b. However, the maximum quality itself, \( q^M \), may increase or decrease according to the relative shifts of the MHC and ZPC. Differentiation of \( q^M = \hat{q}(p^*,S) = q^*(p^*,S) \) with respect to b and some rearrangement results in

\[ \frac{dq^M}{db} = \alpha \frac{\partial q^*}{\partial b} + (1-\alpha) \frac{\partial q}{\partial b}, \]
where \( a = \frac{\partial \hat{q}/\partial p}{\partial q/\partial p - \partial q^*/\partial p} \). Obviously, \( 0 \leq a \leq 1 \) since \( \partial \hat{q}/\partial p > 0 \) and \( \partial q^*/\partial p < 0 \). Equation (12) shows that the change in \( q^M \) as a result of a change in \( b \) is a weighted average of the shifts in \( q^* \) and \( \hat{q} \), with the weights depending on the relative slopes of the two curves. The first term on the right-hand side of (12) reflects the increase in \( q^M \) due to the gain in the moral hazard advantage as \( b \) increases, while the second term captures the loss due to the cost disadvantage. Since \( \partial \hat{q}/\partial b < 0 \), \( q^M \) will rise with \( b \) if \( \partial q^*/\partial b \) is positive and sufficiently large. Clearly, if the MHC shifts down, \( q^M \) will decline.

Using (10) and (11) it is easy to show that \( dq^M/db > 0 \) iff

\[
S_b + c_b(q_0, x^*(p^*, q_0); b) \frac{r}{1+r} S_b + c_b(q^M, x^*(p^*, q^M); b) > \frac{r}{1+r} S_b + c_b(q^M, x^*(p^*, q^M); b) \frac{r}{1+r} x^*(p^*, q^M)
\]

Condition (13) simply states that \( q^M \) will increase with \( b \) if the average increase in the total cost of production is greater in case of cheating than in case of honesty when quality \( q^M \) is being offered. Note that the per-period fixed cost in case of cheating is \( S \) while in case of honesty it is only \( rS/(1+r) \). Condition (13) is likely to hold if \( r \) is relatively small, \( c_b(q_0, x^*(p^*, q_0); b) \) is not too small relative to \( c_b(q^M, x^*(p^*, q^M); b) \), or \( x^*(p^*, q_0) \) is not too large relative to \( x^*(p^*, q^M) \).

Let us now consider the market equilibrium with two distinct technologies, \( b_1 \) and \( b_2 \), with \( b_2 > b_1 \). Let \( q^M_1 \) and \( q^M_2 \) respectively be the maximum qualities that technologies \( b_1 \) and \( b_2 \) can support in equilibrium when each one is the sole technology available. Depending on the relative values of \( q^M_1 \) and \( q^M_2 \), two situations can be distinguished. If \( q^M_2 < q^M_1 \), as in Figure 2, then capital-intensive firms will not produce in equilibrium, while labor-intensive firms will supply the entire range of qualities between \( q_0 \) and \( q_1 \).
The reason is that in this case every quality that \( b_2 \)-type firms can offer without a moral hazard problem can also be reliably supplied by \( b_1 \)-type firms at a lower price. If \( q_2^M > q_1^M \), as in Figure 3, then capital-intensive firms will produce at the range of qualities \( [q_1^M, q_2^M] \), while labor-intensive firms will dominate the \( [q_0, q_1^M] \) range as before. The reason for this pattern of specialization is rather simple. In the \( [q_0, q_1^M] \) range, labor-intensive firms have cost advantage and can make competitive offers without any moral hazard problem. However, for qualities above \( q_1^M \), the prices that convince buyers about the quality of labor-intensive firms' products are too low to make production by such firms profitable. Therefore, in this range, capital-intensive firms can compete because of their moral hazard advantage, and despite their cost disadvantage. This shows that in general either capital-intensive firms do not produce at all or, if they do, they specialize in higher qualities, while labor-intensive firms produce lower qualities. In equilibrium, capital-intensive firms can only produce at those points on their ZPC that lie above \( q_1^M \) but below their own MHC (see Figure 3).

If capital-intensive technologies have cost advantage at high qualities, as shown in Figure 4, their ZPC will be more vertical and their MHC will lie above the MHC of labor-intensive firms. Therefore, the pattern of specialization will be reinforced. Note that if \( q_3 \) is the quality at which the zero profit curves of the two technologies cross, in equilibrium labor-intensive firms produce only in the \( [q_0, q_3] \) range, while capital-intensive firms produce in the \( [q_3^M, q_2^M] \) range. The only case where there may be reverse specialization is when capital-intensive firms have cost advantage at lower quality levels. However, in LDCs capital-intensive firms are likely to have higher costs for the entire range of feasible qualities.
By extending the above arguments, it is easy to see that when more than two technologies are present, each one will specialize in a different range of qualities, with the range being higher the greater is the capital intensity of the technology.

Note that if the government provides subsidies for labor-intensive firms to enter the market, their fixed entry cost, $S$, declines and their zero profit and moral hazard curves shift to the left. Thus, in the likely situation where $dq^M/dS > 0$, such a policy reduces the range of qualities produced by these firms. This outcome can be quite inefficient since a range of desirable qualities may be either eliminated from the market or produced by less efficient capital-intensive firms. In fact, in this situation, regulation of entry by both labor- and capital-intensive firms to the high quality markets may be a means of supporting high quality production by the more efficient labor-intensive firms.

In the last few decades, many LDC governments have started support programs for small, labor-intensive enterprises. A popular genre of such programs, sometimes called the "Indian model" (Kilby, forthcoming), emphasizes aid to small enterprises at the entry stage based on an infant-industry-type argument. Little et al. (1987) and Kilby (forthcoming) heavily criticize this aspect of the LDC small enterprise programs from an adverse selection point view. The present model points to a further inefficiency that may follow from these programs as a result of moral hazard.

IV. Conclusion

The low quality of products observed in LDC markets is often attributed to the preferences of low income consumers who consider quality to be a luxury. This benign view of quality problems in less developed countries has prevented economists from paying greater attention to low product
quality as a source of inefficiency and sluggish growth. In fact, upon
closer look one finds patterns and phenomena that are not easily explicable
by consumer preferences. In many local LDC markets, higher qualities seem
desirable but not always available (e.g. pure milk and clean rice) and in
export and import-competing markets, some LDC products lose customers
because of low quality, despite their low prices. In fact, in LDCs high
quality is often closely associated with the products imported from devel-
oped countries or produced by modern capital-intensive firms. If indeed
low quality is a reflection of market failures, then understanding its
causes and consequences may have profound implications for all aspects of
industrial policy in LDCs. In particular, one needs to evaluate policies
towards export promotion, import substitution, technology transfer, and
small enterprises in light of the nature of the failures present in the
product as well as factor markets.

This paper is an attempt to show that many quality-related phenomena in
LDCs that are not easily reconcilable with the assumptions of perfect mar-
kets may be explained in the context of competitive markets with asymmetric
information. The model developed in this paper shows that in LDCs, capital-
 intensive technologies are associated with higher qualities because firms
with such technologies can more easily dispel the seller moral hazard
problem that exists in markets where some product characteristics cannot be
observed before use. An important implication of this model is that the
current support policies in many LDCs for small, labor-intensive enterprises
at the start-up stage may in fact lower the range of qualities that such
firms produce and cause inefficiency. These policies are intended to help
solve various problems that inexperienced entreprenuers face in their input
and output markets. However, the inefficiency that such policies may
generate in the product markets has to be weighed against their benefits in other respects.

Our analysis shows that the markets for high quality products may benefit from a regulation that makes it more costly for both labor-intensive and capital-intensive firms to enter. This will reduce the seller moral hazard problem of labor-intensive firms and allow them to compete with the more costly capital-intensive firms. The traditional guild systems achieved this goal in the past, but at the cost of prohibiting innovation and impeding development. Modern regulation needs to be designed with greater care to address the moral hazard and adverse selection problems with as little repercussion for technological and organizational innovation as possible. Of course, when such regulations are not feasible, capital-intensive technologies may be a quite economical means of solving product quality problems, even though they may seem inappropriate for LDCs from a factor-price point of view.
Notes

1 For an interesting discussion of consumer attitudes in LDCs towards imports and products of firms with foreign technology see Bardhan and Kletzer (1984).

2 There are, of course, exceptions to this rule, e.g., certain handicrafts and objets d'art. However, the rule seems to apply to many products that are not primarily demanded for their artistic value.

3 For detailed descriptions and critiques of LDC policies toward small enterprises, see Little, Mazumdar, and Page (1987), Little (1987), and Kilby (forthcoming). Accounts of the problems faced by LDCs because of the poor quality of their exports can be found in Morawetz (1981) and Chiang and Masson (1988).

4 Quality problems in some markets may persist if buyers are not fully rational and follow advertising (Schmalensee, 1978) or market share (Smallwood and Conlisk, 1979), rather than sellers incentives to provide high quality. Also, some buyers may fall victim to dishonest sellers if they remain uninformed about seller reputations (Salop and Stiglitz, 1977; Grossman and Stiglitz, 1980; Chan and Leland, 1982; Cooper and Ross, 1984; Schwartz and Wilde, 1985). In such models, uninformed buyers take a risk and avoid the cost of information gathering by trying to free ride on the information gathered by others. While useful in other contexts, the assumption of information asymmetry among buyers seems inappropriate for the purpose of explaining quality problems in competitive markets.

5 In Allen's model, the equilibrium price is equal to average cost but greater than marginal cost. Buyers choose among sellers randomly and, thus, all sellers end up with the same number of customers. In equilibrium, the number of firms in the market is such that the sales of each firm are just sufficient to provide entrants with zero discounted long-term profits. However, established sellers earn sufficient premiums over their recurrent average costs to have the necessary incentives to provide high quality. The assumption of seller precommitment to price is crucial here because if the absence of a seller can claim that he is reducing his price and expanding his output only for one period and will go back to the "equilibrium" path thereafter. If buyers believe that such an equilibrium exists, it becomes possible to deviate in this way without violating the seller moral hazard condition, since it is only the future profits that provide the seller with the necessary incentive to maintain his reputation. Therefore, the deviating strategy has the potential to make the seller as well as his customers better off. Obviously, this possibility encourages deviation from the equilibrium path in each period by every seller and ultimately upsets the equilibrium.

6 Shapiro (1983) discusses an alternative mechanism for generating endogenous entry costs. He builds an "adaptive expectations" model in which buyers expect entrants to offer low introductory prices while providing high quality. Shapiro shows that the entry costs endogenously determined in this way may be sufficient to maintain a high output price and, thus, support a high quality equilibrium. However, if buyers are rational about the quality of entrants' products, no equilibrium exists.
Another endogenous entry barrier is analyzed by Farrell (1986). He argues that if firms are large, entry by each single firm has a nonnegligible impact on the market. In this case, entry with the promise of high product quality may not be credible if buyers do not find switching sellers worthwhile or anticipate effective reactions by incumbents.

In the present model, there is no adverse selection problem and no signalling costs à la Kihlstrom and Riordan (1984) and Milgrom and Roberts (1986). However, the costs of information provision may include the necessary signalling costs if adverse selection is present.

These Inada assumptions seem reasonable and are made to simplify the analysis. They are not essential for the main results of the paper.

$q_0$ may alternatively be interpreted as the level of $q$ below which buyers can recognize the quality of the product at the time of purchase with certainty.

For example, the buyer utility may be summarized by $\beta u(q) - p$, where $u$ is continuous and increasing in $q$ and $\beta > 0$ is a parameter reflecting the buyer taste for quality.

If somehow customers of a particular seller convincingly commit themselves to pay a high price for a high quality and ignore other sellers that may offer the same quality at a lower price, they may be able to persuade that seller to deliver qualities higher than $q^M$. In fact, customers with a large enough demand may manage to commit themselves to pay a high price through binding contracts or vertical integration. However, in most markets with a large number of buyers each one of whom buys a small amount, these options require considerable cooperation, contract enforcement, and monitoring, which are likely to be too costly to be practical.

For a formal critique of the infant-industry argument from an adverse selection point of view see Grossman and Horn (1988).
References


Kilby, P., forthcoming, "Breaking the Entrepreneurial Bottleneck in the Late-Developing Countries: Is There a Useful Role for Government?" Journal of Development Planning.


Figure 1

Figure 2
Figure 3

Figure 4