A Note on Price Information in Commodity Markets with Evidence from the Cotton Market

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Abstract

Theory and analysis of price information and its importance have typically assumed that the information is correct. Additionally, most analyses have centered on general price information assuming homogeneous products. This paper examines the implications of incorrect price information on the basis of quality, with evidence from prior research on cotton prices used as an illustration. Results of a conceptual analysis indicate that quality has direct implications on the production and marketing process. Incorrect information on prices of different quality leads to distortions in the market and market inefficiency.

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Introduction

The role of price information in commodity markets is an issue that has received attention in the economics literature for many years. Stigler's 1961 seminal article marked a recognition of the importance of price information in the optimizing behavior of individuals. Rothschild incorporated the role of "learning" about the distribution of prices, and Stiglitz expanded and synthesized the role of imperfect information in economic analysis.

Most of the existing literature, however, centers on the search for, the utilization of, and the optimal amount of information, assuming that the existing information is correct. Some consideration has been given to information on prices of different qualities, but even this work assumes that the information is correct. Lancaster and Rosen both formalized the theoretical analysis of price on the basis of quality, which may have been introduced in empirical form by Waugh.[1] This process, called hedonics, allows the derivation of marginal implicit prices for the attributes and/or quality of a product. Although this approach is a useful analytical technique, it is impractical for individual market participants to use hedonics in deriving price information on the basis of quality.

In general, price information is important because it is needed for efficiency in the functioning of markets. Because prices are rarely known with certainty, economic agents attempt to obtain as much (good) information as is economically feasible. If there is

sufficient correct information (and all agents use it correctly), perfect information is approximated and efficiency is achieved. Two general problems arise, however. First, many commodities have different qualities (e.g., cotton, fruits and vegetables, livestock, etc.), thus complicating the process of discerning and using price information. Second, if the information (particularly on different qualities) is inaccurate, resource misallocation can occur.

The implications of incorrect general (aggregate or average) price information are more readily understood (e.g., see Bressler and King; Leavitt, Hawkins, and Veeman; Tomek). However, the implications of incorrect price information on the basis of quality are not. The objective of this paper is to explore those implications, using evidence from prior research on cotton prices as an illustration.

Price Information in Cotton

Cotton is a commodity that contains a diverse and complex set of quality attributes. USDA designates over 800,000 combinations of quality attributes, each having a discernable market price. The uniqueness of cotton is that it has a large number of *measured* attributes. All cotton in the United States is classed (graded) using High Volume Instrument (HVI) grading (U.S. Dept. of Ag., 1993). This objective grading system provides quality information on the color, leaf content, fiber length, micronaire (a measure of fineness and maturity), and fiber strength on each bale of cotton in the U.S.

The textile processing of cotton is sensitive to the combination of quality attributes

being used. That is, processors of cotton (textile mills) must have knowledge about the quality of cotton being used in order to regulate textile machinery operations and quality of the products. Different qualities of cotton can be substituted for one another to some degree, depending on the difference in price between those qualities. From the producer perspective, different varieties and cultural practices produce different qualities. Decisions on which varieties to plant or cultural practices to use are largely driven by yield potential and price differences between qualities. Given the complexity of the potential qualities available in the market, price information on the quality differentials (called premiums and discounts) is therefore relevant. These differentials, however, are not directly observable in the market because individual qualities are not traded. That is, cotton is a composite commodity so that cotton fiber strength, for example, is not traded individually from the cotton itself. The only observable price is the price for a pound of cotton, not the price of the strength embodied within it. Thus, it is not feasible for individuals to derive the quality differentials themselves.

There are two sources of price differential information generally available to market participants. One is the Daily Spot Cotton Quotations (DSCQ), which is published daily by the Agricultural Marketing Service, USDA. The DSCQ contains a base price for a base quality, and the quality differentials from that price for each of seven designated marketing regions (U.S. Dept. of Ag., Daily Issues). The DSCQ is the official government estimate of price differentials. The other source of price differential information is the Commodity Credit Corporation's (CCC) loan schedule. However, the

CCC loan schedule is based on an average of the DSCQ quality differentials for the first seven months of the marketing year, averaged with the previous year's loan schedule (U.S. Dept. of Ag., 1994). Therefore, the CCC loan schedule differentials resemble the DSCQ differentials.

These differentials are used in many ways in market activity. For example, the DSCQ are used in the settlement of prices on cotton delivered against futures contracts, as well as for general information about differences in prices of different qualities of cotton. The CCC loan schedule differentials are often used in forward contracts between producers and merchants. Thus, these sources of price differential information have proliferated the market so as to be *assumed* by many participants to be an accurate reflection of market price differences. If the information on the quality differentials is correct, market participants can make effective decisions on the trade-offs between qualities. If not, market participants are likely making incorrect decisions, leading to resource misallocation and market inefficiencies.

Analytical Framework

The following analytical model contains two parts--the cotton sector and the textile sector. To simplify, all markets (input and output) are assumed, as per Rosen, to be perfectly competitive except that cotton is not homogeneous.

Consider the price of cotton (P_c) to be determined as:

$$P_c = f\,(Q_c\ ,\ TR\ ,\ C\ ,\ L\ ,\ M\ ,\ S)\ , \tag{1}$$

where Q_c is the quantity of cotton, TR is the trash content of cotton, C is the color of the cotton, L is the length of the cotton fibers, M is the micronaire of cotton, and S is the strength of cotton fibers. Thus, both quantity and quality impact the price.

The quantity of cotton produced is some function of an aggregate production input, I, which may affect both the quantity and quality of the product.

$$Q_c = g\,(I)\ . \tag{2}$$

Taking Equations 1 and 2, a profit function for the producer of cotton is defined as:

$$\pi = P_c Q_c - rI - F\ , \tag{3}$$

where r is the price of the aggregate input and F is the fixed cost. Taking the partial derivative of π with respect ot the aggregate input results in:

$$\frac{\partial \pi}{\partial I} = P_c\frac{\partial Q_c}{\partial I} + Q_c\frac{\partial P_c}{\partial I} + Q_c\frac{\partial P_c}{\partial TR}\cdot\frac{\partial TR}{\partial I} + Q_c\frac{\partial P_c}{\partial C}\cdot\frac{\partial C}{\partial I} + Q_c\frac{\partial P_c}{\partial L}\cdot\frac{\partial L}{\partial I} + Q_c\frac{\partial P_c}{\partial M}\cdot\frac{\partial M}{\partial I} + Q_c\frac{\partial P_c}{\partial S}\cdot\frac{\partial S}{\partial I} = r\ . \tag{4}$$

Equation 4 reduces to:

$$VMP_I\,(1 + \eta_d^{-1}) + Q_c\left[\frac{\partial P_c}{\partial TR}\cdot\frac{\partial TR}{\partial I} + \frac{\partial P_c}{\partial C}\cdot\frac{\partial C}{\partial I}\right] \left[+ \frac{\partial P_c}{\partial L}\cdot\frac{\partial L}{\partial I} + \frac{\partial P_c}{\partial M}\cdot\frac{\partial M}{\partial I} + \frac{\partial P_c}{\partial S}\cdot\frac{\partial S}{\partial I}\right] = r\,, \tag{5}$$

where VMP_I is the value of the marginal product of input I, η_d^{-1} is the price flexibility of demand for the input. In the case of perfect competition with a homogeneous output, $\eta_d^{-1} = 0$, and the partial derivatives of price with respect to the different quality attributes equals zero so that $r = VMP_I$. Thus, the impact of quality (TR, C, L, M, and/or S) is to alter the optimal usage of the input I.[2]

This has an important implication for the role of price information because the marginal impact of quality on price (premium or discount) is not observable in the market. Thus, the producer is reliant on price information to make input decisions.

Consider the situation depicted in Figure 1. Without a quality impact on price, the producer would observe a VMP of VMP_1. If, however, a total premium of size "A" was available in the market and the producer had the information to realize it, the resulting VMP would be VMP_2. This would increase the optimal aggregate input usage from I_1^* to I_2^*. Suppose, however, that the information available to the producer through the DSCQ or the CCC loan schedule only showed a premium of size "B" to be available in the market. The result is a lower perceived VMP of the input (VMP_3) and a lower use of the input (this scenario works in reverse in the situation where a discount is present in the market). The implication of this situation being that incorrect price differential

information leads to non-optimal input usage, and thus, non-optimal output levels.

Information on price differentials is important to the textile industry as well. Textile mills likely have some idea of the *use-value* of cotton for their end products. However, they are dependent on existing price information for estimate of *market-value*. Textile mills purchase cotton with specific sets of quality attributes (or ranges of quality attributes) in order to produce specific end products. Mills can alter the combinations of the qualities in order to produce that product based on the availability and prices of different qualities of cotton. This trade-off between different qualities on the basis of price is reliant on information about the differentials in price on the basis of quality. If the information they possess or use is reliable, they can effectively make these trade-offs to maximize profit. However, if the information is incorrect, as above, mills will make incorrect input purchase decisions, and thus, not minimize the costs of production. If they do not minimize costs, the consumers of textiles do not get the product at the lowest possible price.

This relationship can be further explained by using Rosen's framework. In Figure 2, the producer of cotton has an indifference curve in production ("offer curve"), and the textile mill manufacturer has an indifference curve in consumption ("bid curve") of a specific quality attribute of cotton (strength in the figure). Using Rosen's assumptions, including perfect information of both parties, these two curves are tangent at some point that lies on the hedonic price function for strength, yielding an optimal price and quantity of strength in the market. If the *perceived* hedonic function (premiums and discounts) for

strength is different because of incorrect price differential information from the DSCQ or CCC (the dashed line in Figure 2), the result is a movement to a new set of bid and/or offer curves, and a disequilibrium in the market for strength.

Rosen's single attribute case can be extended to a two attribute case to highlight the implications of incorrect information on quality trade-offs. Figure 3 shows the situation where the producer and the mill are producing and using fiber strength and length. Along the actual market price ratio line (the contract curve), the mill and producer come together (indifference curves are tangent) where there is an optimal trade-off of S^* and L^*. If information were perfect, this would be the market result as per Rosen. However, if the price information on quality differentials provided by the DSCQ or CCC loan schedule showed a different price ratio than the market (e.g., the dashed contract curve in Figure 3), producers would offer more strength and less length than optimal. In contrast, mills would attempt to purchase less strength and more length than the market would provide. Neither party would understand why the solution is non-optimal because they *assumed* that the price information provided to them was correct.

The result of the incorrect price information on quality, then, is a market disequilibrium for quality. This is not to say general disequilibrium, because the market will find a price of *cotton* to clear the supply. However, the result is suboptimal because the qualities produced/sold are not optimal. Thus, the exchange process is inefficient and the market is inefficient.

Evidence from the Cotton Market

The marginal implicit prices of cotton have been examined on a national and regional level at the consumer (mill) pricing point (Chen, Ethridge, and Fletcher), and on a regional market level on a daily basis at the producer pricing point (Brown et al.). These studies used a hedonic price framework to derive the marginal implicit prices and attribute premiums and discounts for the individual quality attributes of cotton based on large samples of primary market transactions data. The Daily Price Estimation System (DPES) has examined these marginal implicit prices in the Southwest Region (Texas and Oklahoma) on a daily basis since 1988 (Brown et al.), and constitutes a reliable, analytically rigorous, repeatable (Brown and Ethridge) set of measures of cotton market price premiums and discounts available at the producer level. The existence of this daily set of estimates allows an examination of the accuracy of the official price information provided by the government.

Hudson, Ethridge, and Brown examined the accuracy of the daily price information provided to producers in the Soutwest Region by the DSCQ by using the results of the DPES from two standpoints--the magnitude of the premiums and discounts and the movement of those premiums and discounts through time. They found that the DSCQ premiums and discounts did not accurately represent the producer market in terms of the level of premiums and discounts or the movement of the market permiums and discounts through time. Cotton producers were, therefore, receiving inaccurate information on the level of premiums and discounts and thier day-to-day movement.

The CCC loan schedule is adjusted by using the DSCQ (Carr and Ethridge), so that errors in the DSCQ lead to errors in the CCC loan schedule. Carr and Ethridge simulated a CCC loan schedule for Texas and Oklahoma using market (DPES) premiums and discounts rather than the DSCQ. After five years, the CCC loan schedule would have looked substantially different (especially at the lower end of the quality spectrum). Thus, the errors in the premiums and discounts of the DSCQ are affecting both of the primary sources of price information to producers.

Chen, Ethridge, and Fletcher found similar results when examining prices paid by textile mills. More specifically, they found that the prices paid by mills for several attributes were not as different from that producers in the Southwest received, as the DSCQ suggest, suggesting that signals from textile mills were being passed through the market. However, because neither the DSCQ nor the CCC loan schedule reflected the market premiums or discounts, these signals were not being observed by cotton producers.

One direct implication of this incorrect information in the market has been observed by Misra et al.. This study examined the optimal decision by producers on the number of gin lint cleanings using the price differential information provided by the market (DPES), the DSCQ, and the CCC loan schedule. They found that one gin lint cleaning was optimal under market premiums and discounts (DPES), regardless of cotton variety or harvest date. In contrast, two or more lint cleanings was found to be optimal in more than half of the cases examined when price differentials from the DSCQ and the CCC loan schedule were used. If producers use the DSCQ or the CCC loan schedule to make this

decision (as they appear to do), the net result is lower producer net returns. Additionally, textile mills receive cotton that is excessively cleaned relative to what the market is specifying through the market premiums and discounts.

Conclusions

Evidence available in the cotton market indicates that the price differential information for quality differences that is being provided to the market is incorrect, at least in the Texas-Oklahoma markets (the only markets for which there is objective evidence). If market participants are, as expected, *assuming* that the government information is correct, then neither farmers nor textile manufacturers are making optimal input and output decisions. A secondary implication is that producers are not likely making optimal marketing decisions. That is, the price information available to them is incorrect so that when it is time to market the output, their understanding of what that output is worth in the marketplace is not reliable. This may lead to reduced revenue for the output, compounding the problem of non-optimal input usage.

From the textile perspective, the incorrect price differential information leads to incorrect decisions on the combination of inputs (qualities of cotton) to utilize in their production process. This implies that they are not utilizing that set of inputs that will maximize profit (or minimize cost) for a given quality of the output (textiles). If that is the case, it also implies that consumers of textiles are not getting the product they desire for the minimum cost.

This raises the question of whether the cotton market is inefficient. No direct evidence can be offered to answer that question at this point. However, it seems clear from the available evidence that it is certainly possible. This issue needs further study to definitively answer that question.

This paper highlights the importance of quality to the exchange process through the price of a commodity. That is, in those commodities where quality is important, the quality of the product has an impact on the price, optimal input usage, optimal output, and ultimately, the optimal level of exchange. Thus, the quality impact on price is a necessary consideration when examining markets.

The role of quality also highlights the importace of price information on the basis of quality. If product/inputs were truly homogeneous or prices were known with certainty, this would not be a consideration. Because prices are often not known with certainty, price information becomes important. The role of general price information has been recognized for some time. However, it is clear that information on the price differentials on the basis of quality has an important role in the exchange process, especially for those products where quality is important.

Endnotes

1. There appears to be some earlier empirical works that may have employed the same technique (e.g., Taylor), but Waugh is the most widely recognized for the early use of hedonics in its empirical form.

2. An example of an input that has a direct impact on quality is ginning. Producers make decisions about how many lint cleanings to put their cotton through based on information on price differentials (Misra et al.). Other inputs such as amount and timing of chemicals and water are other examples.

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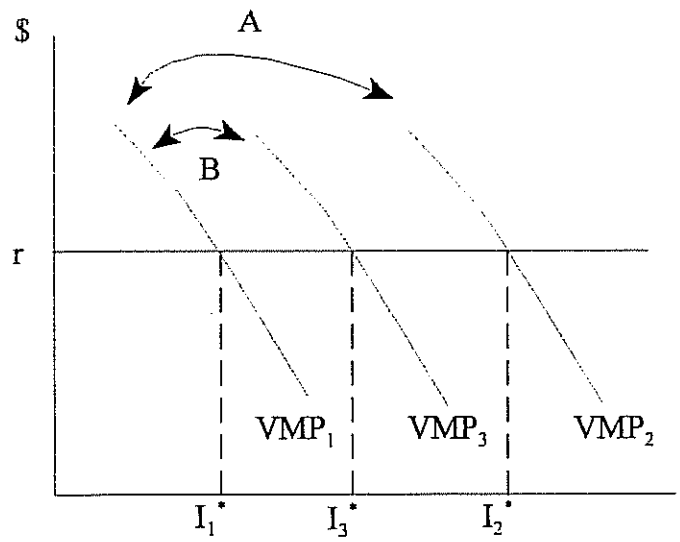

Figure 1. Effects of Incorrect Price Information on Input Usage Decisions.

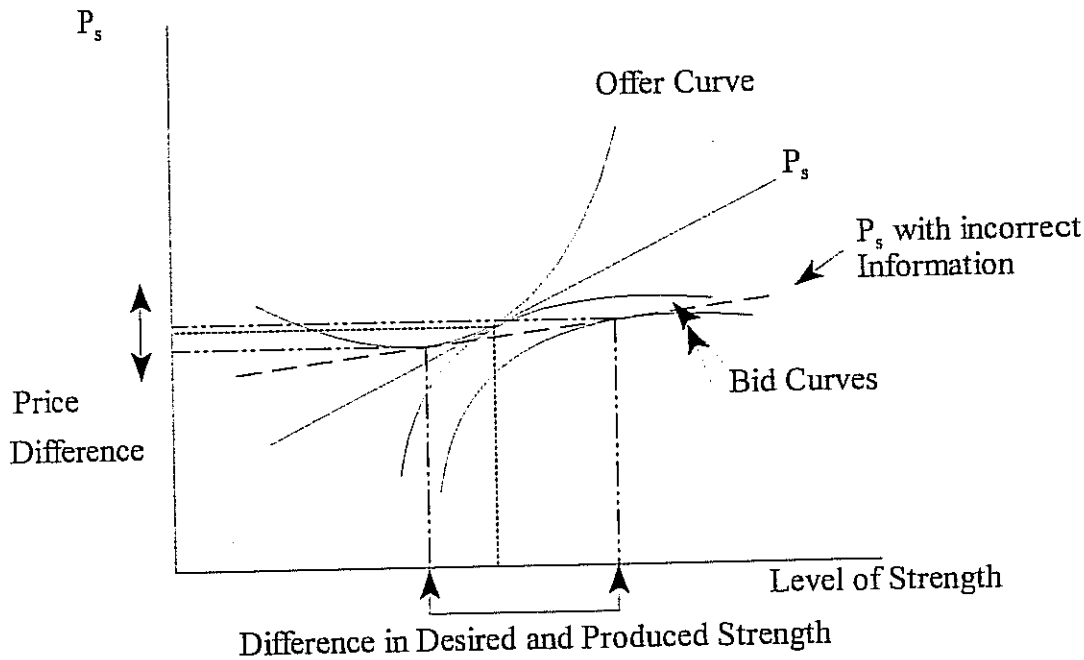

Figure 2. Bid and Offer Curves for Strength and the Implications of Incorrect Price Information.

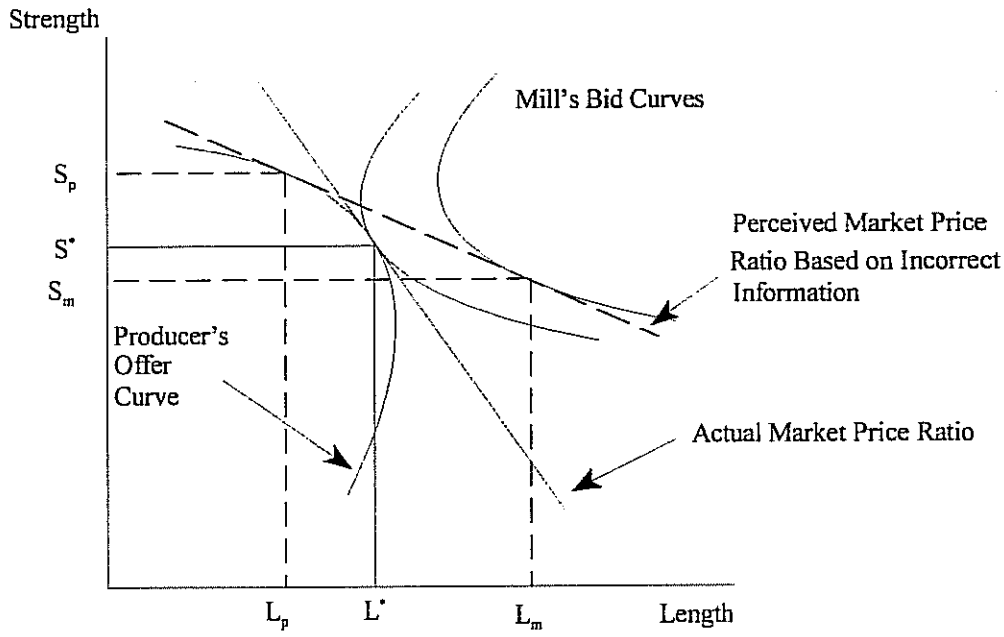

Figure 3. Effects of Incorrect Price Differential Information on the Market Exchange Process.