VALUING HVI QUALITY DIFFERENCES IN U.S. COTTON

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Abstract

Hedonic price analysis as it applies to analyzing and understanding how cotton prices are affected by quality attributes is discussed. Two hedonic studies on cotton are described and results presented as a means of illustrating applications and results for cotton pricing. Relevance of this approach to analyzing price structures and some objectives for future research are also discussed.

Introduction

Interest in research on the quality dimensions of prices in cotton was increased by the industry's adoption of High Volume Instrument (HVI) grading. Few question that HVI grading has fostered the use of cotton by textile manufacturers by providing more objective and accurate measurements on an expanded array of quality attributes on cotton. While achieving that result, however, the pricing or valuation of cotton on the basis of the expanded number of attributes was made more complex. Thus, price *discovery* was complicated and the need for more sophisticated and reliable price analysis accompanied these changes.

The objective of this presentation is to present an overview of some of the price analysis we have been doing on price-quality relationships and speculate on where this avenue of analysis may lead. The sequence of the presentation is as follows: The analytical approach is summarized, then a synopsis of two studies is provided. Some observations and future objectives are offered to close the presentation.

The Hedonic Analytical Approach

The hedonic theory of price determination views the price of a good or commodity as being the composite of the values of its characteristics, with the underlying premise that it is the attributes that have value to users, not the good itself (Lancaster, 1966; Rosen, 1974). This is in contrast to the neoclassical theory that makes the assumption that goods are homogeneous (i.e., there is no variation in characteristics) and that prices are determined solely by the interaction of supply and demand relationships. Successful integration of these divergent theoretical approaches has yet to be achieved, but many recognize that both theoretical approaches have some

relevance for many goods/commodities, and some shortcomings as well. It is my view that we have been more successful in resolving this in the empirical work than in the theoretical work. However interesting some of these issues may be, the purpose here is not to promote a discussion of unresolved theoretical hedonic fine points. Because hedonics is a central component of the price analysis we are doing, basic concepts are reviewed.

The price of a good is seen as a function of the attributes embodied in the good:

$$P = f(X_1, X_2, X_3, ..., Y)$$

where P is price of the good, X_i are attributes, and Y represents other (non-attribute) factors that affect price. The intuitive appeal of this type of formulation for cotton is obvious because of the role of the many dimensions of quality in determining prices of cotton. In this formulation, the Y variable may be thought of as embodying all of the non-attribute, or general market, forces that affect prices. In the empirical applications, various approaches have been applied to capture these effects, including using time dummy variables (Hembree et al., 1986), external price variables (Chen and Ethridge, 1995), and multiple equation models (Ethridge and Neeper, 1987; Bowman and Ethridge, 1992).

Market Valuation Studies

Two studies that involve hedonic analysis of how cotton attributes affect market prices are reviewed below. The studies focus on the first and last pricing points for cotton fiber in the market channel--the producers' spot market prices (point A in Figure 1) and the manufacturers' prices paid (point C).

Producer Prices Received

Research began in 1988 to develop an analytical system to support daily price reporting for the emerging HVI grading system. Experience gained from prior research (Ethridge and Shaw, 1978; Ethridge and Davis, 1982; Ethridge and Mathews, 1983; Hembree et al., 1986; Ethridge and Neeper, 1987; Bowman and Ethridge, 1992) provided a substantial background for understanding how to approach the task. However, daily tracking of market activity while accounting for all of a myriad of quality combinations had not been done or, as far as we could determine, even been attempted.

Development of the system, which we now call the Daily Price Estimation System (DPES), began with development and testing of a core hedonic model and securing a source of daily market sales observations for the Texas-Oklahoma markets. The initial data source was the Telcot computerized marketing system, which has now been expanded to include two other computerized marketing systems, The Network and Satellite Cotton Exchange. The DPES now accesses about one-third of all of the producer spot market sales in Texas and Oklahoma, with

the unit of observation being individual, mixed-lot sales of cotton (the basis on which cotton trades).

Hedonic model development has gone through several stages and has included the development of procedures to insure correct hedonic model functional form (Brown and Ethridge, 1995). Diagnostic tests are used to insure that no systematic errors develop in the estimates produced. The model constitutes the heart of an automated, computerized system--the DPES (Brown et al., in press).

The current model is configured as follows:

$$P = B_0 e^{B_1 LF^2 + B_2 C1^2 + B_3 DUM1 + B_4 DUM2 + B_5 DUM3}$$
$$e^{B_6 STA + B_7 STA^2 + B_8 STR + B_9 M + B_{10} M^2}$$
$$e^{B_{11} LB + B_{12} HB + B_{13} LO + B_{14} HO + B_{15} R}$$

where:

LF	= leaf grade (1-7),
C1	= first digit of the color grade (1-7),
DUM1	= binary indicator for thesecond digit of the color grade (If the second digit=2, DUM1=1; DUM1=0 otherwise),
DUM2	= binary indicator for thesecond digit of the color grade(If the second digit=3, DUM2=1; DUM2=0 otherwise),
DUM3	= binary indicator for the second digit of the color grade(If the second digit=4, DUM3=1; DUM3=0 otherwise),
STA	= staple length in 32nds of an inch,
STR	= strength of the cotton in grams/tex,
M	= micronaire reading,
LB	= percentage of bales in a lot classed as Level 1 bark,
HB	= percentage of bales in a lot classed as Level 2 bark,
LO	= percentage of bales in a lot classed as Level 1 other extraneous matter,
HO	= percentage of bales in a lot classed as Level 2 other extraneous matter, and
R	= binary indicator for the region (R=0 if the market is West Texas, R=1 for East Texas/Oklahoma).

Daily parameter estimates are obtained with Ordinary Least Squares regression.

Daily results have been generated since late February, 1989, so all of the results are too cumbersome to summarize here. I have chosen to provide a summary of the 1994 crop results, which are a weighted average of the daily results for the 1994/95 producer sales in the East Texas-Oklahoma market. Results in equation form are:

$$P = 16.19 e^{-0.00082 LF^2 - 0.00109 C1^2 - 0.00705 DUM1 - 0.03206 DUM2 - 0.05592 DUM3}$$
$$e^{0.056945 STA - 0.00076 STA^2 + 0.001088 STR + 0.211416 M + -0.0255 M^2}$$
$$e^{-0.00036 LB - 0.01335 HB - 0.02346 LO - 0.07774 HO - 0.07323 R}$$

Converting the equation to a tabular summary is shown in Table 1.

Mill Prices Paid

In 1991 we initiated a study to identify the premiums and discounts paid by U.S. textile manufacturers for cotton fiber attributes. This presents a different type of analytical problem because the data are different; there is no "spot market" for cotton at that pricing point in the U.S.

marketing system. Since there are no reliable secondary data at that pricing point, and primary data are more desirable anyway, an effort was made to gather primary data. Buying departments of major textile manufacturers were contacted, objectives of the research were explained, and assurances of confidentiality of firm information were provided. Eight firms--6 buying departments and 2 marketing associations--began providing contract data on purchases and sales (2 more manufacturing firms are now providing data, with several others considering cooperating with the research). The contract data form the basis of price formation at that pricing point, and are the most appropriate data for a study of price formation at that point, but the data pose some problems because the contracts are not completely standardized.

After resolving data issues, alternative model formulations were evaluated (Chen, 1995). The time-series component of the data required that some means of controlling for effects of general market forces be incorporated in the model. Two external price series were tested for this purpose--the N.Y. futures price on the date of the contract and the Daily Spot Cotton Quotation for the base quality on the date of the contract. The resulting hedonic models for three production regions (West, Southwest, and South--Midsouth and Southeast combined) for the period covering the 1992 crop through the 1995 crop contracted to February, 1995 (Chen and Ethridge, 1996) were:

West :
$$P = .0228 (DG1)^{0.124} (DG2)^{0.121} (L)^{1.095} (S)^{0.065} e^{0.576(M)}$$
$$e^{-0.072(M^2)} (GP)^{0.541} e^{0.023(cls) + 0.023(mch) - 0.009(exp)}$$
$$e^{0.083(lm) + 0.028(Y93) + 0.027(Y94) - 0.073(y95)}$$

Southwest :
$$P = .4219 (DG1)^{0.174} (DG2)^{0.240} (L)^{0.181} e^{0.388(M)}$$
$$e^{-0.054(M^2)} (GP)^{0.719} e^{0.058(cls) - 0.13(Y93)}$$
$$e^{-0.010(Y94) - 0.086(y95)}$$

South :
$$P = .4101 DG1^{0.159} (DG2)^{0.190} (L)^{0.232} e^{0.363(M)}$$
$$e^{-0.043(M^2)} (GP)^{0.678} e^{0.080(cls) - 0.036(mch) - 0.1239(exp)}$$
$$e^{0.028(lm) + 0.018(Y93) - 0.071(y95)}$$

where:

P	= FOB price (¢/lb.) of the cotton specified by or derived from the contracts;
DG1	= 8 - G1, indicating cleanness of fiber, G1 is the first digit of the composite grade;
DG2	= 9 - G2, representing whiteness of fiber, G2 is the second digit of the composite grade;
L	= staple (32nds inch);
S	= minimum strength (grams/tex.);
M	= micronaire reading, an average of high and low micronaire,
Gpr	= general price level of cotton (¢/lb.) at base quality in region r on the date of the transaction as reported in "Daily Spot Cotton Quotations" (U.S. Department of Agriculture);
cls	= indicator variable for type of sale--if cls = 1, the price basis of the sale is to be called relative to the N.Y. futures contract a the discretion of the buyer, if cls = 0, the sale is fixed price;
mch	= indicator variable for type of buyer--if mch = 1, the buyer is a merchant/shipper, 0 otherwise;

exp = indicator variable for type of buyer--if exp = 1, the buyer is a foreign country, 0 otherwise (If both mch and exp = 0, the buyer is a domestic mill);

lm = indicator variable for location--if lm = 1, the cotton is priced at mills (i.e., FOB mill), If lm=0, the cotton is priced at sellers' warehouse (i.e., FOB warehouse);

Y93 = indicator variable for crop year--ifY93 = 1, the cotton is from 1993 crop, 1993 = 0 otherwise;

Y94 = indicator variable for crop year--ifY94 = 1, the cotton is from 1994 crop, Y94 = 0 otherwise, and

Y95 = indicator variable for crop year--ifY95 = 1, the cotton is from 1995 crop, Y95 = 0 otherwise (If y93, Y94, and Y95 = 0, the cotton is from 1992 crop); and

ε = the random error for the model.

These are also summarized in Tables 2, 3, and 4.

What Do We Gain From This Information?

The fundamental value of these estimates is that they give objective information of what markets are doing with respect to market prices and quality premiums and discounts. That is, the "data" obtained from such analyses possess known accuracy and are reproducible. I use the term "data" because the market does not generate observed prices of attributes because markets do not trade in attributes; they trade and generate observed prices only on the composite goods traded. *All* attribute values are estimates.

But this basic information has numerous uses. Where would much of our analytical work in economics be without good price data? For example, the above study on mill premiums and discounts paid provides clear evidence that textile manufacturers differentiate cotton by region of origin for reasons that are not captured in the HVI measurements. Reasons probably include there being some quality attributes that the HVI measurements do not capture and the regions' cottons predominance of use in various types of end products. This presents an issue of the rationale of a national loan schedule.

Another example is that the producer price structure study and the mill price structure study, taken together, allows comparison of price structures at different pricing points, with implications for the efficiency of the market in conveying pricing information (Hudson et al., 1996). Another example is that the new measures of prices permit examination of relationships between cash and futures prices without having to make the assumption that USDA's spot quotations represent producer prices (Hudson et al., in press).

Another point of relevancy of this genre of analysis is that it may eventually be used to improve the accuracy of official quotations.

Future Objectives

Major objectives for future hedonic analysis include:

A. Continue operating and improving the DPES in the Texas-Oklahoma markets, expand dissemination of the information, and develop similar systems for the South and West.

B. Continue analysis on the structure of prices paid by textile manufacturers, expand the data base, and produce the information on a periodic basis (e.g., every 6 months).

C. Develop better theoretical linkages between the hedonic approach and the neoclassical market approach to price determination.

On objective A, the barriers to development of a DPES for other regions (other than the obvious need for financing the work) are primary logistical problems of obtaining a large representative sample of bona fide sales data. Logistics of amassing "on-line" sales data for daily estimates in the absence of computerized information systems are intimidating. However, we know how to develop the systems if the logistical problems of obtaining data can be successfully addressed. Achieving objective B requires continued cooperation of manufacturers and obtaining sufficient funding to continue making the estimates.

Objective C reflects a purely disciplinary interest. It is nevertheless of utmost importance over the long run to achieve the best results from the problem-solving research such as that described in the two studies presented. We have some of that work in progress, but its outcome is yet incomplete and uncertain.

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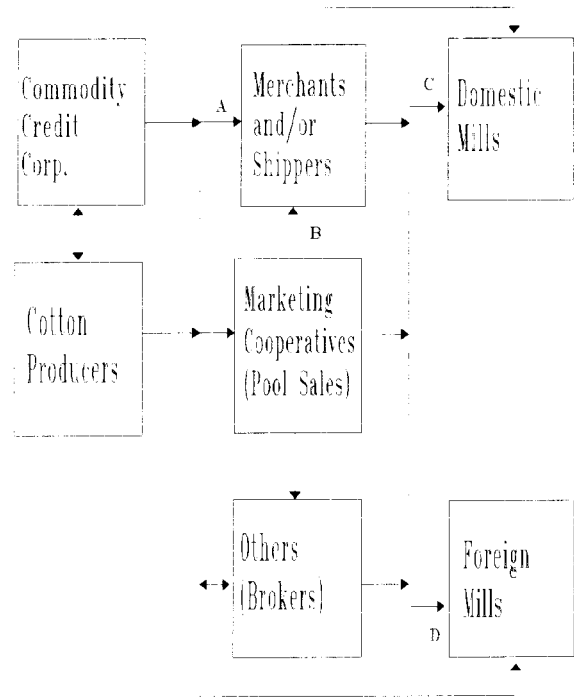
Figure 1. Cotton Marketing Channels   Source: Chen, 1995.

Table 1. 1994/95 Weighted Average Price Estimates from the DPES, East Texas/Oklahoma.

Yearly Weighted Average of the Daily Spot Cotton Price Estimates Dept. of Ag. Economics, Texas Tech Univ.   # Sales: 6,733   Date: 1994 CROP East Texas/ Oklahoma   # Bales: 261,198   Color Grade and Staple Premiums and Discounts in Points/lb.

Color Grade	28	29	30	31	32	33	34	35	36	37	38
11	--	--	--	--	--	--	--	--	--	--	--
21	--	-222	-139	-65	-1	52	95	126	147	--	--
31	--	-260	177	-103	-40	13	55	86	107	--	--
4	--	-313	-230	-157	-94	-42	71.75	72	72	--	--
51	--	-380	-298	-226	-164	-112	-70	-39	-19	--	--
61	--	--	--	--	--	--	--	--	--	--	--
71	--	--	--	--	--	--	--	--	--	--	--
12	--	--	--	--	--	--	--	--	--	--	--
22	--	-271	-188	-115	-52	1	44	75	95	--	--
32	--	-309	-226	-153	-90	-38	4	35	56	--	--
42	--	-361	-279	-207	-144	-92	-50	-19	1	--	--
52	--	-428	-346	-275	-213	-161	-120	-89	-69	--	--
62	--	--	--	--	--	--	--	--	--	--	--
23	--	-442	-361	-289	-227	-176	-135	-104	-84	--	--
33	--	-478	-398	-327	-265	-214	-173	-143	-123	--	--
43	--	-529	-449	-379	-318	-267	-226	-196	-177	--	--
53	--	-594	-515	-445	-385	-335	-294	-264	-245	--	--
63	--	--	--	--	--	--	--	--	--	--	--
34	--	--	--	--	--	--	--	--	--	--	--
44	--	--	--	--	--	--	--	--	--	--	--
54	--	--	--	--	--	--	--	--	--	--	--

Micronaire Diff. Points/lb.		Leaf Grade Diff. Points/lb.		Bark Disc. Points/lb.		Strength Diff. Points/lb.	
Mike Range		Leaf Disc./ Grade Prem.		Bark Code	Grams/ Disc.	Disc./ Tex.	Prem.
24&below	--	1	--	Level 1	-95	18&below	--
25-26	--	2	72	Level 2	-537	19	-35
27-29	-323	3	42			20	-27
30-32	-197	4	-0	Other		21	-19
33-34	-114	5	-53	Discounts		22	-12
35-49	-0	6	-118	Points/lb.		24&25	-0
50-52	-164	7	--			26	12
53&Above	--			Other Code	Disc.	27	20
				Level 1	-166.	28	27
				Level 2	-506.	29	35
						30	43
						31&above	51

Staple	Composite Grades												
	11	21	30	31	40	41	50	51	60	61	70	71	12
28	-911	-1001	-1017	-1103	-1137	-1221	-1281	-1362	-1460	-1539	-1702	-1777	-1011
29	-697	-790	-807	-896	-932	-1019	-1081	-1166	-1268	-1349	-1519	-1597	-801
30	-482	-579	-597	-689	-726	-817	-881	-969	-1074	-1159	-1335	-1416	-590
31	-266	-367	-385	-481	-520	-613	-680	-771	-881	-968	-1151	-1234	-379
32	-50	-154	-173	-273	-313	-410	-479	-573	-686	-777	-966	-1053	-167
33	167	59	39	-63	-105	-205	-277	-374	-491	-585	-781	-870	46
34	384	273	252	146	104	63.75	-74	-175	-296	-393	-595	-687	260
35	602	487	466	357	313	206	129	25	-99	-200	-408	-504	474
36	821	702	680	568	522	412	333	226	97	-6	-221	-320	688
37	1040	918	895	779	732	619	537	427	294	188	-34	-135	903
38	1260	1134	1111	991	943	826	742	629	492	382	154	50	1119

Staple	Composite Grades												
	22	32	42	52	62	23	33	43	53	63	34	44	54
28	-1100	-1200	-1316	-1455	-1628	-1215	-1313	-1426	-1562	-1731	-1447	-1558	-1690
29	-893	-997	-1118	-1262	-1442	-1012	-1114	-1232	-1373	-1549	-1254	-1369	-1506
30	-686	-794	-919	-1069	-1255	-810	-915	-1038	-1184	-1367	-1060	-1180	-1322
31	-478	-590	-720	-875	-1068	-606	-716	-843	-994	-1184	-866	-990	-1137
32	-269	-385	-519	-680	-880	-402	-515	-647	-804	-1000	-671	-799	-952
33	-60	-180	-319	-485	-692	-197	-315	-451	-613	-816	-476	-608	-766
34	150	26	-117	-289	-503	8	-113	-254	-421	-631	-280	-416	-580
35	361	233	84	-93	-314	214	89	-56	-229	-446	-83	-224	-393
36	572	440	287	104	-124	421	291	142	-37	-260	114	-31	-205
37	783	647	490	302	67	628	494	340	156	-73	312	162	-17
38	995	855	693	500	258	835	698	539	350	113	510	356	171

Mike Differences--Points/lb.			Strength Differences--Points/lb.		
Mike Ranges	Discount		Strength Discount	Strength	Premium
26 & Below	-807		18 & Below	-127	26	25
27-29	-596		19	-105	27	41
30-32	-412		20	-84	28	56
33-34	-163		21	-64	29	71
35-49	-0		22	-45	30	85
50-52	-528		23	-26	31 & Above	99
53 & Above	-729		24 & 25	-0		

Note: type of sale--average of fixed and call prices; type of buyer--domestic mills; location--mill; and crop year--average of 1992-1995 crops.

Staple	Composite Grades												
	11	21	30	31	40	41	50	51	60	61	70	71	12
28	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-
31	424	269	304	95	97	-104	-147	-340	-447	-632	-846	-1018	180
32	463	307	342	132	134	-69	-111	-306	-413	-599	-815	-987	217
33	500	344	379	168	170	-34	-77	-273	-381	-567	-784	-958	254
34	537	380	415	203	205	62.89	-43	-240	-349	-536	-754	-929	289
35	573	415	450	237	239	33	-10	-208	-317	-506	-725	-901	324
36	608	450	485	271	273	66	22	-177	-287	-476	-696	-873	358
37	-	-	-	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	-	-	-	-

Staple	Composite Grades												
	22	32	42	52	62	23	33	43	53	63	34	44	54
28	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-
31	31	-137	-329	-557	-837	-240	-400	-585	-802	-1071	-708	-882	-1089
32	67	-101	-295	-524	-806	-205	-366	-552	-771	-1041	-676	-851	-1059
33	103	-67	-261	-491	-775	-171	-333	-520	-740	-1011	-644	-821	-1030
34	138	-33	-229	-460	-745	-138	-301	-488	-710	-983	-614	-791	-1001
35	171	0	-197	-429	-716	-105	-269	-458	-680	-955	-584	-762	-973
36	205	32	-166	-399	-687	-74	-239	-428	-652	-928	-554	-734	-946
37	-	-	-	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	-	-	-	-

Mike Differences--Points/lb.			Strength Differences--Points/lb.		
Mike Ranges	Discount		Strength Discount	Strength	Premium
26 & Below	-200	-279	18 & Below	-	26	-
27-29	-82	-171	19	-	27	-
30-32	11	-86	20	-	28	-
33-34	110	0	21	-	29	-
35-49	0	-124	22	-	30	-
50-52	-619	-732	23	-	31 & Above	-
53 & Above	-813	-921	24 & 25	-		

Note: type of sale--average of fixed and call rices; type of buyer--domestic mills; location--mill; and crop year--average of 1992-1995 crops.

Table 4. Estimated Cotton Prices (¢/lb.) and Fiber Premiums and Discounts (points/lb.), Southern Region.

Staple	Composite Grades												
	11	21	30	31	40	41	50	51	60	61	70	71	12
28	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-
31	354	211	216	49	25	-137	-201	-357	-480	-630	-853	-993	157
32	404	260	265	97	73	-90	-154	-312	-436	-587	-812	-953	206
33	453	308	314	144	120	-45	-109	-268	-393	-545	-772	-914	254
34	501	355	361	190	166	64.42	-65	-225	-351	-504	-732	-875	301
35	548	401	406	235	210	44	-22	-183	-310	-464	-694	-838	346
36	594	446	451	279	254	86	20	-142	-270	-424	-656	-801	391
37	-	-	-	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	-	-	-	-

Staple	Composite Grades												
	22	32	42	52	62	23	33	43	53	63	34	44	54
28	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-
31	18	-138	-319	-533	-798	-202	-353	-528	-734	-990	-606	-773	-971
32	66	-92	-274	-489	-756	-156	-308	-484	-692	-950	-563	-731	-931
33	113	-46	-229	-446	-715	-110	-264	-441	-651	-910	-521	-690	-891
34	159	-2	-186	-405	-675	-66	-221	-399	-610	-872	-480	-650	-853
35	203	42	-144	-364	-636	-23	-179	-358	-571	-834	-439	-611	-815
36	247	84	-103	-324	-598	19	-138	-319	-533	-797	-400	-573	-778
37	-	-	-	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	-	-	-	-

Mike Differences--Points/lb.   Strength Differences--Points/lb.

Mike Ranges	Discount	Strength Discount		Strength	Premium
26 & Below	-677	18 & Below	-	26	-
27-29	-525	19	-	27	-
30-32	-390	20	-	28	-
33-34	-199	21	-	29	-
35-49	-0	22	-	30	-
50-52	-220	23	-	31 & Above	-
53 & Above	-327	24 & 25	-		

Note: type of sale--average of fixed and call prices; type of buyer--domestic mills; location--mill; and crop year--average of 1992-1995 crops.