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THE ROLE OF USDA GRADE STANDARDS IN QUALITY DETERMINATION

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As concern over health risks of pesticide residues and environmental damage from pesticide use increases, consumers and various advocacy groups are attempting to draw a link between the appearance of fresh fruits and vegetables and use of pesticides. Concern over this relationship is nearly two decades old and has been the focus of intense debate in the past three years. The target of the debate is U.S. Department of Agriculture (USDA) grade standards which, some allege, cause "excessive" pesticide use, that is, pesticide use beyond that which is socially desirable.

Specifically, the grade standards under fire have been deemed "cosmetic standards," meaning they are solely appearance standards and not indicators of taste or nutrition. However, the term "cosmetic" is not used in USDA grade standards and some confusion exists over exactly which standards are the "cosmetic" ones. Even when certain standards are singled out and pronounced "cosmetic," defenders of these standards attempt to show that they are proxies for taste or other "non-cosmetic" attributes or that produce grown through good management practices to control quantity will automatically meet the quality standards set.

In actuality, survey results indicate that many consumers do prefer appearance quality to reduced pesticide use (van Ravenswaay and Hoehn 1991a, b; Weaver, et al., 1991). If this is true, and assuming that pesticide-use regulations are set properly and adhered to by growers, pesticides are not "overused." Many studies have been conducted to show that USDA grade standards do increase pesticide use (see Conklin and Mischen 1993 for a complete review of these studies). These studies have focused on individual crops and consumers' attitudes regarding pesticide use. While consumers are concerned about the health and environmental risks of pesticide use, and some consumers will indeed pay to have produce grown without pesticides, the studies on "cosmetic" standards are less convincing. These studies focus on specific produce items and tend to use biased questions such as, "How important are 'cosmetic' standards in producing your crop?" (Rosenfeld 1991; Sorensen 1991). They have

been conducted primarily by advocacy groups and have not been subject to peer review. Furthermore, the question, "Do USDA grade standards cause excessive pesticide use?" is difficult, if not impossible, to answer based on its inherent subjective nature.

The statement that USDA grades and standards cause excessive pesticide use is based on the assumption that USDA grade standards determine produce quality. The purpose of this paper is to test that assumption. Three research questions are posed to accomplish this task of determining the role(s) of USDA grade standards in the produce marketing channel. They are: 1) Who sets the standards used to determine produce quality? 2) On what are these standards based? 3) Would grower and marketer costs be affected if USDA grade standards were reduced or eliminated?

Briefly, grades in general have two functions: 1) to separate produce into distinct categories by quality attributes to create a more homogeneous product, and 2) to facilitate long distance trade by referring to a common set of characteristics. Standards, on the other hand, denote the lower limit of a grade. USDA grade standards are voluntary unless specified within a marketing order which applies to a certain item grown within a particular geographic region. The effect of USDA grade standards at the consumer level is a reduction in the time it takes for each consumer to sort through a bin of produce for items of desired quality in exchange for a reduction in the range of produce quality. In practice, however, this reduction results in only the top grade appearing in retail markets, with an occasional offering of two sizes. Consumers, therefore, make little use of USDA grade standards in produce.

Market participants may also use alternative arrangements for providing information on produce quality and their roles as determinants of quality. These alternatives are the use of brands, certification, and a change in market structure. Branding and grade standards both serve to provide information on produce quality. While grade standards seek to convince consumers that everything within that grade is the same, branding is a form of product differentiation. Growers and marketers using branding are attempting to convince consumers that produce within their brand is consistently of higher quality than unbranded produce.

Vertical integration is another way in which information on produce quality can be passed through the market channel. When growers, packers and shippers are all part of one corporation, information about produce quality flows more quickly and may be more accurate than if produce is changing hands between three different organizational entities. The use of these various alternative arrangements is a signal that grade standards as conduits of information may not be acting efficiently. Also, their role as determinants of produce quality may be more important than USDA grade standards if the latter is not performing efficiently.

Theoretical Model

Three models were developed to explain the role of USDA grade standards in the market. The three models respond to the questions: 1) Who sets quality standards? 2) Do you rely on USDA grade standards as a means of quality determination? 3) Would your costs increase if USDA grade standards were reduced or eliminated? If the participant responded that his/her firm sets the standards, the variable YFIRM was coded "1." Otherwise it was coded "0." The variable USDA was coded "1" if the participant responded that USDA grade standards are used in quality determination. Finally, a "yes" response to the third question regarding costs was coded as a "1" for the variable USDAG. Independent variables used to explain the responses were:

- Position in the marketing channel (POS)
- Level of vertical integration (LEVEL).
- Sales volume (VOL).
- Number of buyers (SELLTO).
- Whether or not the individual labeled the produce (LABEL).

Both VOL and SELLTO, the only two continuous variables, were categorized and renamed INDEX and INDEX2, respectively. It is expected that as the number of buyers (INDEX2) increases, there will be an increase in the probability that the firm will say that it sets the standards for the produce it sells due to the dependence relationship outlined by Pen (1959). If the buyers are many, costs are also expected to increase if USDA grade standards are reduced or eliminated because the firm will rely on the grade standards for communication and enforcement. Likewise, as a firm becomes more vertically integrated (LEVEL) one would expect that the firm would be more likely to set the standards, that the standards would be independent standards used alone or in combination with USDA grade standards, and that their costs would not be affected if the USDA grade standards were reduced or eliminated because the produce would not be changing owners frequently.

Total sales volume (INDEX), as a proxy for horizontal integration, is also an indicator of market power. As a result, one would expect large firms, and also firms that brand and label their produce, to set their own standards, which will be independent standards used alone or in combination with those set by USDA. One would also expect these firms not to be affected by a reduction or an elimination of USDA grade standards. Results from the analysis will also suggest which position (POS) in the marketing channel has the most market power. Coding for all of the variables can be found in Table 1.

Empirical Evidence

Structured interviews were conducted with eighteen retailers, forty-four marketers and twenty-eight growers from around the

Table 1. Coding for Variables

Variable	Descriptor	0	1	2	3	4	5	6
YFIRM	Does Your Firm Set the Standards?	No	Yes	n/a	n/a	n/a	n/a	n/a
POS	Position in the Marketing Channel	Grower	Marketer	n/a	n/a	n/a	n/a	n/a
LEVEL	Level of Vertical Integration	n/a	Number of Levels of the Marketing Channel Within a Single Firm					
INDEX	Sales Volume Per Year	n/a	<=$1mil.	$1-20mil.	$20-50mil.	$50-100mil.	$100-200mil.	>=$200mil.
INDEX2	Number of Buyers	n/a	1-10	11-50	51-100	101-200	200-500	>=500
LABEL	Do You Label Your Produce?	No	Yes	n/a	n/a	n/a	n/a	n/a
BRAND	Do You Brand Your Produce?	No	Yes	n/a	n/a	n/a	n/a	n/a
USDA	Do You Use USDA Grade Standards?	Yes	Exceed	n/a	n/a	n/a	n/a	n/a

United States during the fall of 1992 and winter of 1993. Participation was confidential and voluntary. Grower and marketer participants were selected randomly from *The Packer Merchandising and Availability Guide* and through fruit and vegetable grower organizations. Interviews were conducted in Florida, California, Arizona and at the 1992 Produce Marketing Association convention in Denver, Colorado. California, Florida and Arizona were chosen for the grower and marketer interviews because their fresh market vegetable acreage is responsible for 47 percent, 11 percent and 6 percent of total U.S. vegetable acreage, respectively (U.S. Department of Agriculture, 1992). California and Florida are the top two fruit producing states representing 47 percent and 17 percent of total U.S. orchard acreage, respectively (U.S. Department of Agriculture, 1987). The retailers represent seven of the eight retail chains conducting business in the metropolitan Phoenix area. The individual responses were aggregated into seven observations in order to have complete information on each retail chain.

In an effort to determine how grade standards are currently being used and how their roles may be changing, participants were asked who sets quality standards for the fresh produce they sell and on what these standards are based. The answers varied based on position in the marketing channel (Table 2): 64 percent of the growers responded that their firm sets standards either alone or in cooperation with other participants; 57 percent of the marketers responded in the same manner; and 100 percent of the retailers responded that they were solely responsible for setting quality standards. Only 22 percent of the growers and 10 percent of the marketers responded that marketing orders or minimum state standards played a role in the quality of produce they sold. Forty-five percent of the marketers and 25 percent of the growers responded that the buyer is involved in setting quality standards.

When study participants were asked on what they base their standards, responses once again varied by market position (Table 3): 48 percent of the marketers and 39 percent of the growers responded that they relied on USDA grade standards; 20 percent of the marketers and 21 percent of the growers said they set the standards in-

Table 2. Who Sets Quality Standards?

Response	Growers*	Marketers*	Retailers
Your Firm	67%	57%	100%
Buyer	26%	45%	0%
Min.State Standard	4%	5%	0%
Marketing Order	19%	5%	0%
Other	4%	18%	0%

*Totals exceed 100% because respondents were permitted to respond "yes" to more than one choice.

dependently; and 100 percent of the retailers, 30 percent of the marketers and 36 percent of the growers said they use a combination of USDA and their own standards. Many added that in bad-quality years produce quality tended toward the lower bound of U.S. #1, but that in average-to-good-quality years, produce was expected to exceed that top grade level.

Regression Models

Due to the binary nature of the dependent variables, YFIRM, USDA and USDAG, logistic response functions were used to obtain answers to the three research questions stated earlier (Hosmer and Lemeshow, 1989). Although the same general principles of linear regression are used for logistic regression, some differences in interpretation of the model and the assumption exist. Most significantly, the distribution of the conditional mean, E(Yx), is S-shaped. The S-shape resembles a plot of a cumulative distribution of a random variable.

Retailer data was omitted due to perfect multicollinearity in survey responses. Backward stepwise regression was used to eliminate insignificant variables. The only variable that can be used to explain a particular firm's response to, "Who sets the standards for the produce that you sell?" is the INDEX variable. (Final regression equations can be found in Table 4). The odds ratio—the change in probability of getting a positive response with a one-unit change in the independent variable—for INDEX is 1.655.

Table 3. On What Are These Standards Based?

Response	Growers*	Marketers*	Retailers
USDA Standards	39%	48%	0%
State Standards	4%	7%	0%
Independent	21%	20%	0%
Ind./USDA or State	36%	30%	100%
Other	11%	0%	0%

*Totals exceed 100% because respondents were permitted to respond "yes" to more than one choice.

Table 4. Final Regression Models

Model 1

$E\{YFIRM\} = 1 / [1 + \exp(0.91717 - 0.50397\ INDEX)]$

Model 2

$E\{USDA\} = 1 / [1 + \exp(2.3373 + 0.98567\ POS - 0.58553\ LEVEL - 0.34605\ INDEX - 1.1550\ YFIRM - 1.1862\ LABEL)]$

Model 3

$E\{USDAG\} = 1 / [1 + \exp(-1.7081\ POS + 0.77560\ LEVEL)]$

The following were used as independent variables for Model 2 in determining the factors that influence whether or not a particular firm uses standards that exceed those set by USDA: the same independent variables, the dependent variable (YFIRM) from the previous regression, and a new independent variable that indicates whether or not the organization brands its produce (BRAND). The INDEX2 and BRAND variables were dropped from the full seven-variable model. The six-variable model predicts well (73 percent correct in-sample predictions). The interpretation of the odds ratios reveals that the more vertically integrated a firm is, the more likely it is to respond that it uses grade standards that exceed those set by USDA. Likewise, as a firm increases in size or uses its own labels, it is more likely to use standards that exceed the USDA grade standards. Furthermore, marketers are less likely to use grade standards that exceed those set by USDA.

The main purpose of grade standards as written today is to facilitate long distance trade and handling of produce. Standards facilitate trade by reducing costs that would otherwise be incurred acquiring information about, and enforcing, produce quality. Although they do not correspond exactly to retailers' desired levels of quality characteristics, some participants indicated they do help reduce transactions costs. When participants were asked whether or not the elimination of the USDA grade standards would affect their costs of quality measurement and enforcement, 50 percent of the retailers, 58 percent of the marketers and 22 percent of the growers indicated their costs would increase.

Again, logistic regression analysis was used to determine which factors can be used to predict if an individual believes that his/her costs would increase with a reduction or elimination of the USDA grade standards. The same dependent variables from the previous regression as well as the USDA variable were used to select the final two-variable model which includes position in the marketing channel (POS) and level of vertical integration (LEVEL). As expected, as LEVEL increases the likelihood of a positive response to USDAG decreases since produce does not change hands as often with a highly vertically-integrated firm in the marketing channel. There is also a significant difference in how growers and marketers respond to the question. Marketers believe they are more likely to be affected by a reduction or elimination of USDA grade standards. This is understandable since the role of the marketer is to arrange exchanges between buyers and sellers of produce for which accurate information regarding produce quality is of utmost importance.

Conclusions and Implications

In considering the evidence, it appears that USDA grade standards are not a direct cause of excessive pesticide use for three reasons.

First, and most importantly, USDA grade standards are a voluntary set of grade standards. Although 100 percent of the retailers, 78 percent of the marketers and 75 percent of the growers who responded to this survey in some manner use USDA grade standards to set the standards that are in use, retailer standards, fueled by consumer quality preferences, are those that govern produce quality. Sixty-four percent of the growers responded that their firm sets the standards in cooperation with other participants or alone; 57 percent of the marketers responded in the same manner; and 100 percent of the retailers responded that they are solely responsible for setting quality standards. These results indicate that growers and marketers, along with their retail buyers, choose to use USDA grade standards.

Second, USDA grade standards were established to facilitate long distance trade and handling and to differentiate the products at the consumer level. The regulations do not state that a purpose of USDA grade standards is to determine the quality of produce reaching the consumer. USDA grade standards serve to pass costly information regarding produce quality from one member of the marketing channel to another and to act as an enforcement mechanism for produce quality over geographic distances. Survey results indicate that a significant number of retailers (50 percent) and marketers (58 percent) believe that their costs would increase if USDA grade standards were reduced or eliminated.

Third, survey participants responded that USDA grade standards represent the minimum quality levels that retailers are willing to accept and are only a factor when the quality of the particular produce item is seasonally poor. Their responses are corroborated by an increase in branding as an alternative source of information about product quality. USDA grade standards may not be set efficiently. However, the error may actually be that they are set too low. Therefore a reduction or an elimination of the USDA grade standards will not serve to reduce "cosmetic" quality and consequently pesticide use, but rather increase information costs and therefore prices to consumers.

Results of the logistic regression models can be used to predict the future role of grades and standards in the produce marketing channel. If the current trends of vertical and horizontal integration and labeling continue, results of the models indicate that USDA grade standards will likely be of declining importance in the future. The larger and more vertically-integrated firms are using their own independent standards alone or in combination with those established by USDA. Furthermore, the more vertically-integrated firms do not rely so heavily on USDA grade standards as a means of reducing information and enforcement costs since many transactions occur within the firm rather than between firms.

If USDA grade standards were reduced or eliminated, marketers would see the greatest increase in costs, as would the less vertically-integrated firms. Marketers and smaller, less vertically-integrated firms still rely on USDA grade standards for information and enforcement. Consequently, changing USDA grade standards would hurt those firms that national agricultural policy typically seeks to protect.

In conclusion, if USDA grade standards do not determine produce quality, they cannot affect the amount of pesticides applied to fruits and vegetables. There are, however, other factors influencing the marketing of organic vegetables and fruits. National standards for organic produce (now being developed) may reduce information costs and increase ease of marketing organic produce. Furthermore, there are no standards for marketing pesticide-reduced or other low input fruits and vegetables. Finally, numerous regulations governing the marketing of organic produce increase marketing costs dramatically in order to ensure the organic characteristic.

While this study answers some questions regarding the impact of USDA grade standards on pesticide use, many questions remain about the efficiency of the marketing channel to handle organic or pesticide-reduced fruits and vegetables.

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