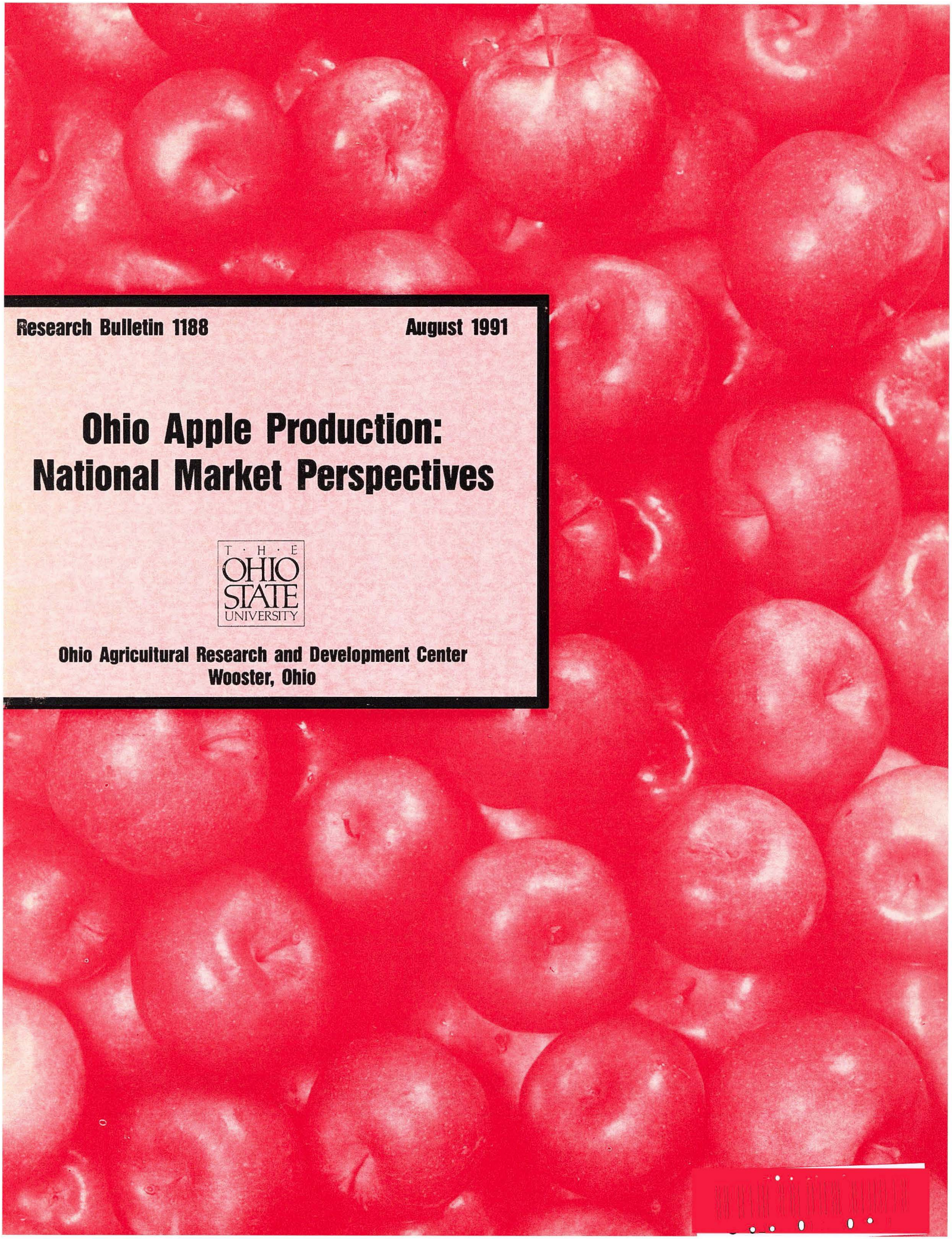

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# Ohio Apple Production: National Market Perspectives

THE OHIO STATE UNIVERSITY

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# OHIO APPLE PRODUCTION: NATIONAL MARKET PERSPECTIVES

Thomas T. Stout, Stanley A. Uchida, and Richard C. Funt[1]

## NATIONAL PRODUCTION AND CONSUMPTION

Apples are an important component of U.S. fruit consumption. Estimated per capita consumption in 1988 (fresh and processed) was approximately 28.0 pounds, ranking apples below oranges and above any other fruit. Per capita fresh consumption, at 19.1 pounds, also ranked second nationally, below bananas at 24.2 pounds, but above oranges at 14.5 pounds (Putnam, 1990). Although fresh imports and exports are rising, the industry (unlike bananas or even oranges) is dominated by domestic production.

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Table 1 provides an illustration, drawing upon the record of fresh apple production at 5-year intervals since the 1973 crop year. Increased per capita consumption, together with increased population, has increased domestic production by more than 50 percent during this period. The U.S. is a net exporter of fresh apples and an importer of juice concentrate (Table 1 and footnote). Total processing uses consume less than half of the annual crop, usually about 41-43 percent. Almost all of the increase in processed apple production has been for juice consumption. Fresh imports shown in Table 1 are apples from the southern hemisphere and recently have included large shipments of Granny Smith apples from New Zealand.

## U.S. PRODUCTION AREAS

Figure 1 identifies principal apple production areas in the United States. Production and yield are very sensitive to weather and are adversely affected particularly by freezes at blossom time. Hence production locations often are adjacent to large bodies of water, which have a moderating effect on local weather extremes. An alternative is production at higher elevations where both altitude and breeze serve to slow spring budding and minimize the occurrence of frost. Finally, yields can be subjected to somewhat greater control in arid locations where atmospheric moisture is low and ground moisture can be controlled by irrigation, as in Washington, Oregon, Idaho and British Columbia (Funt, Lee).

## PRODUCTION BY STATES

Washington and New York have consistently ranked first and second in U.S. apple production for many years (Table 2). But during the 15-year period 1973-1988, Washington increased its share of total U.S. production from under 30 percent to nearly 43 percent, producing by 1988 more than

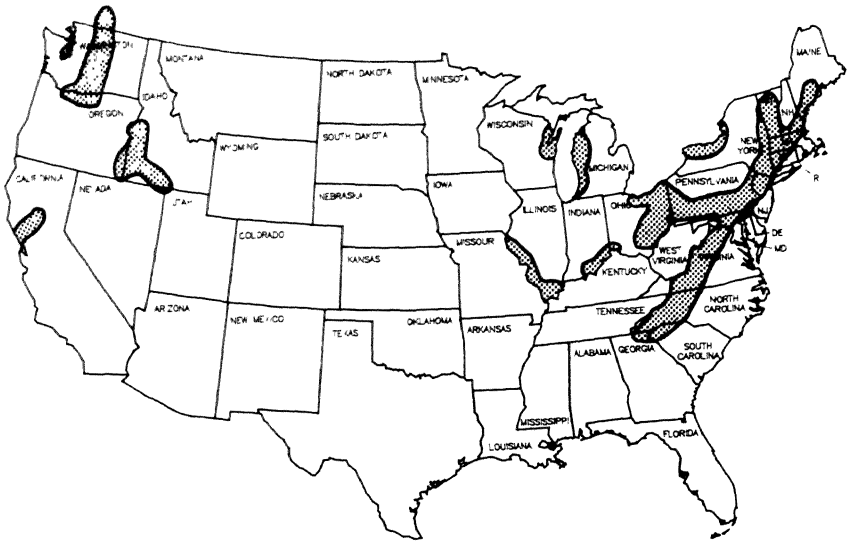
**Table 1: Estimated Utilization of Annual Apple Production, Selected Crop Years, United States, 1973-1990. (Thousands of 42-lb. units)**

| | 1973 | 1978 | 1983 | 1988 | 1989 | 1990 (Estimated) |
|---|---|---|---|---|---|---|
| TOTAL FRESH | 83,700 | 100,500 | 109,995 | 124,769 | 139,999 | 134,320 |
| (Exports) | (4,333) | (7,762) | (11,714) | (13,083) | (17,496) | (16,000) |
| Not Marketed | (321) | (1,267) | (490) | 1,181 | 1,081 | 1,001 |
| TOTAL PROCESSED | 64,514 | 79,362 | 88,871 | 91,455 | 96,307 | 95,700 |
| Canned | 29,869 | 29,133 | 28,590 | 33,312 | 31,395 | 30,300 |
| Juice[1] | 19,526 | 35,590 | 47,226 | 43,443 | 49,183 | 50,000 |
| Dried | 6,064 | 5,262 | 6,745 | 6,786 | 6,724 | 6,400 |
| Frozen | 5,998 | 4,938 | 4,038 | 6,326 | 7,655 | 7,500 |
| Other | 3,057 | 4,438 | 2,271 | 1,588 | 1,350 | 1,500 |
| GRAND TOTAL | 148,217 | 179,862 | 198,867 | 217,405 | 237,276 | 231,021 |
| (Imports)[1] | (2,143) | (3,738) | (5,571) | (6,096) | (5,589) | (6,200) |

[1]The U.S. also imports juice concentrate not shown here. Usually, half or more of U.S. juice consumption is from imported concentrate (52.4 million bushels (equivalent) in 1989).

Source: 1973-1989 Crop Years, Crop Reporting Board, Statistical Reporting Service, USDA, Washington, D.C. Estimates for 1990 by International Apple Institute, Box 1137, McLean, Virginia.

**Figure 1. Apple Production Areas in the United States.**




Source: Westwood, Melvin N., *Temperate-Zone Pomology*, W.H. Freeman and Co., 1978 and Dr. Richard Funt, Professor of Horticulture, The Ohio State University.

four times as many apples as the second-ranking state. For the past decade, Michigan has ranked third. Most of the 12 or 13 top-ranking states have maintained, generally, their same relative rank among producing states, and most of them have actually increased production in the past 15 years. But, given the more rapid rise in Washington output, nearly all other states have experienced a comparative decline in their percentage of national production (Table 2). Although eastern U.S. production is widely scattered among many states, and at widely scattered locations within states (compared to western production patterns), some consolidation of production has occurred. Note that "all other" states in Table 2 account for a steadily declining relative share of total U.S. production.

## PRODUCTION BY CULTIVAR

The (Red) Delicious apple has ranked first in U.S. production for many years,

**Table 2: Total Apple Production, Percentage Distribution of Total Production, and Rank in Production, Selected States, Selected Years, United States, 1973-1988.**

| State | Total U.S. Production | | | | Percent of U.S. Production | | | | Rank in Production | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1973 | 1978 | 1983 | 1988 | 1973 | 1978 | 1983 | 988 | 1973 | 1978 | 1983 | 1988 |
| | (millions of pounds) | | | | (percent) | | | | | | | |
| California | 490 | 500 | 460 | 630 | 7.9 | 6.6 | 5.5 | 6.9 | 4 | 5 | 5 | 4 |
| Idaho | 130 | 132 | 128 | 135 | 2.1 | 1.7 | 1.5 | 1.5 | 10 | 11 | 10 | 10 |
| Massachusetts | 76 | 105 | 97 | 99 | 1.2 | 1.4 | 1.2 | 1.1 | 12 | 12 | 12 | 11 |
| Michigan | 470 | 890 | 750 | 830 | 7.6 | 11.8 | 9.0 | 9.1 | 5 | 3 | 3 | 3 |
| New Jersey | 100 | 90 | 100 | 65 | 1.6 | 1.2 | 1.2 | 0.7 | 11 | 13 | 11 | 13 |
| New York | 720 | 1,080 | 1,100 | 910 | 11.6 | 14.3 | 13.1 | 9.9 | 2 | 2 | 2 | 2 |
| North Carolina | 210 | 322 | 415 | 350 | 3.4 | 4.3 | 5.0 | 3.8 | 8 | 7 | 7 | 7 |
| Ohio | 100 | 135 | 100 | 95 | 1.6 | 1.8 | 1.2 | 1.0 | 11 | 10 | 11 | 12 |
| Oregon | 167 | 142 | 155 | 165 | 2.7 | 1.9 | 1.9 | 1.8 | 9 | 9 | 9 | 9 |
| Pennsylvania | 500 | 400 | 500 | 520 | 8.0 | 5.3 | 6.0 | 5.7 | 3 | 6 | 4 | 5 |
| Virginia | 400 | 515 | 455 | 425 | 6.4 | 6.8 | 5.4 | 4.6 | 6 | 4 | 6 | 6 |
| Washington | 1,860 | 2,148 | 3,055 | 3,900 | 29.8 | 28.4 | 36.4 | 42.7 | 1 | 1 | 1 | 1 |
| West Virginia | 225 | 295 | 220 | 215 | 3.6 | 3.9 | 2.6 | 2.3 | 7 | 8 | 8 | 8 |
| All Other | 777 | 800 | 838 | 819 | 12.5 | 10.6 | 10.0 | 8.9 | — | — | — | — |
| Total U.S. | 6,225 | 7,554 | 8,373 | 9,158 | 100.0 | 100.0 | 100.0 | 100.0 | — | — | — | — |

Source: Noncitrus Fruits and Nuts, annual summaries, Agricultural Statistics Board, NASS, USDA, January, 1975, 1980, 1986, 1989.

followed consistently in second place by Golden Delicious (Table 3). Other well-known cultivars generally have maintained positions relative to each other during the years 1973-1988 (except for the recent rise in popularity of the Granny Smith). But there is no cultivar of standing during this 15-year period that has maintained its importance relative to Delicious; all have slipped in comparative importance, including cultivars like Jonathan and Rome Beauty (Table 3). Hence, both Tables 2 and 3 indicate that, in the past 15 years, there has been a measurable tendency toward (a) increased U.S. production, (b) in fewer locations, (c) among fewer and larger producers, (d) who are specializing in a narrower range of cultivars.[1]

[1]However, A.D. O'Rourke has observed (in 1991 correspondence with the authors) that "most new cultivars planted in the Pacific Coast states are Fuji, Gala or Braeburn."

## UTILIZATION AND MARKET OUTLETS

The percentage of apples consumed fresh versus processed has not changed in recent years, but there has been a change in the distribution of processed uses (Table 4). The biggest change is a substantial increase in juice preparations for both domestic and export markets. Juice preparations often use apples in combination with other fruit bases. The largest comparative decreases in processed products have been in canned apples and 'other' preparations, even though the tonnage of canned apples has actually increased. Vinegar and fresh slices for pie manufacturers are the main 'other' uses. Part of the decline here is the decreased use of apples for vinegar, now made frequently from grain (Funt).

Some growers produce expressly for the processed market, usually under contract to manufacturers, who specify certain cultivars because of their desirable performance characteristics for a particular manufacturing purpose. York Imperial, for example, is a processing apple; Northern Spy is popular for pie slices, and McIntosh and Golden Delicious are preferred sauce apples (Funt). Table 5 summarizes output for fresh consumption by states. The inverse of these figures is, of course, output for processing. Notice that growers in states like California, Michigan, New York, Pennsylvania and West Virginia sell mainly to processing markets, and those in states like Massachusetts, Ohio, Oregon and Washington produce mostly for fresh markets.

Note in Table 5 that other eastern states seem to be shifting production from fresh to processed markets, perhaps in response to the growing national dominance of Washington as a producer of apples for fresh consumption. Massachusetts and Ohio are the only eastern states in Table 5

**Table 3: Percentage Distribution of Commercial Apple Production as a Percent of Red Delicious, and Rank in Production, by Cultivar, United States, Selected Years, 1973-1988.**

| Cultivar | Percent of U.S. Production | | | | Percent of Leading Cultivar | | | | Rank in Production | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1973 | 1978 | 1983 | 1988 | 1973 | 1978 | 1983 | 1988 | 1973 | 1978 | 1983 | 1988 |
| Cortland | 2.0 | 2.1 | 1.8 | 1.2 | 5.7 | 6.1 | 4.4 | 3.0 | 10 | 11 | 8 | 12 |
| Delicious | 34.9 | 34.9 | 41.2 | 40.6 | 100.0 | 100.0 | 100.0 | 100.0 | 1 | 1 | 1 | 1 |
| Golden Delicious | 15.6 | 16.3 | 16.4 | 16.8 | 44.7 | 46.7 | 39.8 | 41.4 | 2 | 2 | 2 | 2 |
| Granny Smith | — | — | 0.9 | 5.5 | — | — | 2.0 | 13.5 | — | — | 14 | 5 |
| Idared | — | — | 1.3 | 1.5 | — | — | 3.2 | 3.7 | — | — | 12 | 11 |
| Jonathan | 6.1 | 5.3 | 4.4 | 3.8 | 17.5 | 15.2 | 10.7 | 9.4 | 5 | 5 | 5 | 6 |
| McIntosh | 7.8 | 10.1 | 8.2 | 7.1 | 22.3 | 28.9 | 19.9 | 17.5 | 4 | 3 | 3 | 3 |
| Northern Spy | 1.3 | 1.4 | 1.2 | 1.1 | 3.7 | 4.0 | 2.9 | 2.7 | 11 | 12 | 13 | 13 |
| R.I. Greening | 1.1 | 2.3 | 1.6 | 1.0 | 3.2 | 6.6 | 3.9 | 2.5 | 12 | 8 | 10 | 14 |
| Rome Beauty | 8.2 | 7.5 | 6.9 | 6.4 | 23.5 | 21.5 | 16.7 | 15.8 | 3 | 4 | 4 | 4 |
| Stayman | 3.8 | 3.0 | 2.7 | 2.2 | 10.9 | 8.8 | 6.6 | 5.4 | 7 | 7 | 7 | 8 |
| Winesap | 2.7 | 2.1 | 1.7 | 1.6 | 7.7 | 6.0 | 4.1 | 3.9 | 9 | 10 | 9 | 10 |
| Yellow Newtown | 2.6 | 2.2 | 1.6 | 1.8 | 7.4 | 6.3 | 3.9 | 4.4 | 8 | 9 | 11 | 9 |
| York Imperial | 5.5 | 4.6 | 4.1 | 3.2 | 15.8 | 13.2 | 9.9 | 7.9 | 6 | 6 | 6 | 7 |
| All Other | 8.4 | 8.2 | 7.2 | 7.3 | 24.1 | 23.5 | 17.5 | 18.0 | — | — | — | — |
| U.S. Total | 100.0 | 100.0 | 100.0 | 100.0 | — | — | — | — | — | — | — | — |
| (million pounds) | 6225 | 7554 | 8373 | 9158 | — | — | — | — | — | — | — | — |

Source: For 1973 and 1978, Noncitrus Fruits and Nuts, annual summaries, Agricultural Statistics Board, NASS, USDA, January 1975 and 1979. For 1983 and 1988, International Apple Institute, Box 1137, McLean, Virginia 22101.

that produce mainly for the fresh market. But, as noted, cultivars in Ohio that contribute a distinctive aspect to fresh market production (and provide some insulation from Washington competitive dominance) are declining in importance relative to production of Red Delicious (Tables 7 and 8).

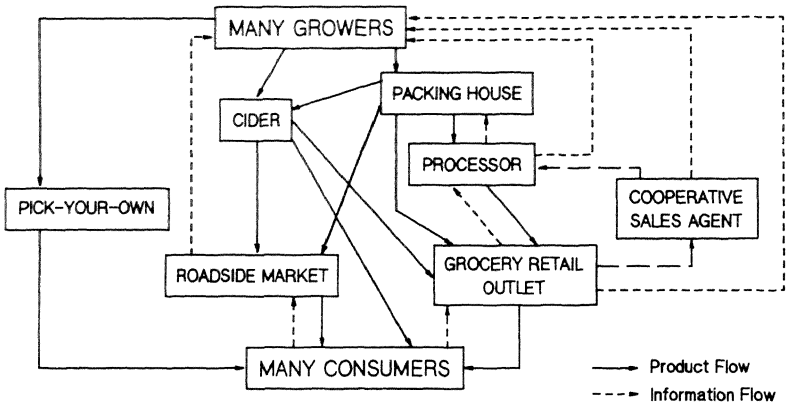
Growers who consider fresh consumption their primary market sell mainly to grocery wholesalers or direct to chain store warehouses, frequently marketing through a cooperative selling agency operated by the growers (Figure 2). In states with high population density (like Ohio), roadside markets also are an important point of sale for fresh consumption.

Producers for the fresh market tend to regard processors as a residual market, used for apples that are wholesome but lack visual appeal because they are small or uneven in color or shape, or have been damaged by weather or insects (Funt, Uchida).

The relative emphasis placed by growers on different market outlets for different purposes was examined in a recent Ohio study (Uchida). Ohio growers sold mainly to the fresh market although other nearby states sold primarily to processors (Table 5). Ohio growers exhibited some divergence of opinion about the merits of various markets, but part of the reason for this divergence appeared to be related to whether they did or did not own apple waxers (which served as a proxy indicator of the market outlet they viewed as primary).

Both groups of growers regarded the *fresh wholesale* (grocery) market as a primary source of income (Table 6). Growers without waxers tended also to regard this market as an outlet to absorb

**Figure 2. Marketing Channels for Apples in the United States.**




Source: Christy, Ralph and Donald Ricks, *The Michigan Apple Marketing System*, Agricultural Economics Staff Paper, No. 81-80, Dept. of Agricultural Economics, Michigan State University, 1981.

**Table 4: Amount and Percentage Distribution of Apple Uses from Domestic Production, United States, Selected Years, 1973-1988.**

| Utilization | 1973 | | 1978 | | 1983 | | 1988 | |
|---|---|---|---|---|---|---|---|---|
| | Million pounds | Percent | Million pounds | Percent | Million pounds | Percent | Million pounds | Percent |
| Fresh Consumption | 3515.4 | 56.5 | 4221.0 | 55.9 | 4619.8 | 55.3 | 5263.3 | 57.8 |
| All Processed Uses: | 2709.6 | 43.5 | 333.2 | 44.1 | 3732.6 | 44.7 | 3844.6 | 42.2 |
| Canned | 1254.5 | 46.3[1] | 1223.6 | 36.7[1] | 1200.8 | 32.2[1] | 1399.1 | 36.4[1] |
| Juice/Cider | 820.1 | 30.3 | 1494.8 | 44.9 | 1983.5 | 53.1 | 1818.1 | 47.3 |
| Frozen | 251.9 | 9.3 | 207.4 | 6.2 | 169.6 | 4.5 | 275.7 | 7.2 |
| Dried | 254.7 | 9.4 | 221.0 | 6.6 | 283.3 | 7.6 | 285.0 | 7.4 |
| Other[2] | 128.7 | 4.7 | 186.4 | 5.6 | 95.4 | 2.6 | 66.7 | 1.7 |
| TOTAL | 6225.0 | 100.0 | 7554.0 | 100.0 | 8352.4 | 100.0 | 9107.9 | 100.0 |

[1]Processing percentages add to 100.0 percent of *processed* utilization.
[2]Includes vinegar, wine, jams, pie slices.

Source: Derived from Noncitrus Fruits and Nuts, annual summaries, Agricultural Statistics Board, NASS, USDA, January 1975, 1980, 1985, and July 1989.

surpluses, rather a low-status role for a market which waxer owners held in a more respectful regard. *Roadside markets* were regarded as a viable option by both sets of growers, although they were given somewhat higher importance by the growers without waxers—the same ones with the tendency to regard groceries as surplus outlets. Both sets of growers saw *pick-your-own* arrangements as low-cost operations with good income generating possibilities, although the non-waxer group saw it as an outlet with a wider range of viable options. *Cider* was regarded as a source of supplementary income with a wide-range of options, including surplus and salvage. Both sets of growers regarded *processing* as a salvage operation or a surplus outlet. This is an attitude entirely different from that held by growers in other states who are contracted to manufacturers.[2]

In all categories treated in Table 6, no-waxer growers exhibited less commitment to their choices than did waxer owners, who tended to be more affirmative about a particular market for a specific purpose. For example, waxer owners saw no other reason even half as important as primary income in explaining their regard for the fresh wholesale market. Non-owners (of waxers) were more open to a wider range of possibilities; their commitment to any particular market was less specific, more casual.

## SEASONAL MARKETING PATTERNS

Marketing patterns for the major apple-producing states were examined by O'Rourke in 1978. Using USDA data, he found that Michigan and New York supplied the market with a relatively stable quantity of fresh apples over an extended marketing period, beginning in September and ending in March. Further, in high production years, these two states tended to expand their marketing activities geographically.

All other states, except Washington, marketed most of their fresh apples in a brief marketing period during September and October. Ohio growers display both of these marketing patterns due probably to the diversity in Ohio of both markets (Table 6), and products (Tables 7 and 8). For Washington, sales are relatively low in these fall months, reach a peak in December, remain strong throughout the winter, and reach their annual high point in March. As supplies of soft fruits (apricots, cherries, peaches, plums) and berries (blueberries, strawberries) become available in spring and summer, Washington inventories and marketings decline about May and have terminated in past summers, although availability now continues until the new crop is released in September (Uchida, O'Rourke).

In examining the competition between apples and other fruits, O'Rourke found that (a) bananas tended to be in fairly constant supply throughout the year, (b) citrus fruits were most plentiful in winter (December through March), and (c) soft fruits were most plentiful from June to September.

Hence, apples appear to experience less competition from other fruits during fall and spring months, and might enjoy periods when revenues could be maximized by (a) a thoughtful marketing strategy, and (b) a judicious timing of sales from storage of (c) a uniformly attractive retail product. These circumstances help to explain three categories of investment commonly found among large apple growers: (1) controlled atmosphere (CA) storage; (2) apple waxer/sizer lines; and (3) participation in cooperative marketing agencies (Uchida).

## PRODUCT QUALITY SPECIFICATIONS

Quality refers to the attributes of a product that satisfy the expectations that users have for it. In foods, considerations like

**Table 5: Percentage of Utilized U.S. Apple Production Marketed Fresh, Selected States, United States, 1973, 1978, 1983, 1988.**

| | Percent of Production Marketed Fresh | | | |
|---|---|---|---|---|
| **State** | **1973** | **1978** | **1983** | **1988** |
| California | 22.0 | 28.0 | 32.9 | 48.4 |
| Idaho | 65.4 | 63.6 | 65.6 | 63.0 |
| Massachusetts | 89.2 | 80.3 | 79.4 | 78.1 |
| Michigan | 34.0 | 42.7 | 36.0 | 27.7 |
| New Jersey | 55.0 | 60.0 | 50.0 | 33.3 |
| New York | 41.7 | 39.4 | 39.5 | 44.5 |
| North Carolina | 64.3 | 46.6 | 41.0 | 37.4 |
| Ohio | 76.0 | 86.2 | 79.0 | 73.7 |
| Oregon | 65.3 | 78.9 | 77.4 | 72.7 |
| Pennsylvania | 37.4 | 39.8 | 35.0 | 26.5 |
| Virginia | 37.0 | 28.3 | 24.4 | 48.0 |
| Washington | 75.5 | 78.2 | 73.8 | 73.1 |
| West Virginia | 41.8 | 34.6 | 26.8 | 30.2 |
| All Other | 75.4 | 77.3 | 72.9 | 72.5 |
| Average U.S. | 56.5 | 55.9 | 55.3 | 57.8 |

Source: Noncitrus Fruits and Nuts, annual summaries and midyear supplements, Agricultural Statistics Board, NASS, USDA, January 1975, 1980, 1986, 1989, and July 1987.

[2]Ohio grower attitudes must, to some extent, be influenced by the presence of over 10 million urban consumers nearby, an advantage unavailable to producers in Washington, for example, or to growers in many eastern states where production is farther from population centers.

freshness, wholesomeness, and suitability for a specific need (recipe, for example) are important. Standards may be developed by, for, or among traders to provide a means of describing product differences in these quality characteristics (see Table 10, for example).

Apples, like most U.S. agricultural products, move through the marketing system on the basis of purchases and sales made by description (relating to quality) rather than by actual product inspection. It is likely that the retail shopper in the grocery store is the first person in the entire marketing process to be examining the apples at the time the purchase decision is being made.

To be able to buy and sell by description in wholesale lots clearly does much to streamline the marketing system, helping it to function smoothly, quickly, and cheaply. Transactions can be made by phone or wire with the briefest messages, as opposed to the expense of requiring buyers to be physically present to inspect each prospective purchase. The system works well when the codified descriptions result in product performance that meets buyer expectations—and when mutually-understood adjustments apply in those unexpected instances when it does not.

So standardized descriptions are important. They work extremely well when all agree on their meaning and their merit. But the system transmits error and expense when there is disagreement or misunderstanding on the meaning or the utility of descriptive applications.

For many decades the USDA has aided marketing efficiency by developing federal grades based on measurable standards for many products, including apples. Tradesmen also develop descriptive terms so that, in many industries, both or either public and private standards may be applied. Typically, there are varied opinions among users about the utility of the method being used. The apple industry is like that. The Ohio study provides an illustration (Table 9).

Among 43 growers, buyer specifications were most important to owners of apple waxers (who focused primarily on wholesale sales to groceries). Growers who did not own waxers, and who placed relatively more emphasis on alternative outlets such as roadside markets, displayed a different set of priorities about quality specifications (Table 9).

But what "buyer specifications" really meant was not entirely clear. When asked what was expected by buyers for the fresh wholesale market, there was a wide divergence of opinion, about the value of waxing apples, for example (Table 10). But there was no category in which there was consensus among all growers that buyers expected any of 10 criteria suggested by the researchers (Table 10). So, while buyer expectations were acknowledged to be important (and growers themselves considered the Table 10 criteria to be important), growers had no precise understanding of what buyer specifications included. Not surprisingly, the Uchida research recommended that buyers should be explicit, and that grading seminars should be co-sponsored by buyers and growers.

**Table 6: Index of Reasons for Using Different Market Outlets for Apples, by Grower Groups, Based on Waxer Ownership, Ohio, 1983[1].**

| Market Used | Primary Income | Supplementary Income | Low-Cost Operation | Surplus | Salvage |
|---|---|---|---|---|---|
| **Fresh Wholesale** | | | | | |
| Own Waxer | 100 | 48 | 21 | 40 | 8 |
| No Waxer | 100 | 51 | 39 | 83 | 21 |
| **Roadside Market** | | | | | |
| Own Waxer | 94 | 100 | 80 | 29 | 23 |
| No Waxer | 100 | 86 | 64 | 60 | 24 |
| **Pick-Your-Own** | | | | | |
| Own Waxer | 59 | 100 | 82 | 18 | 9 |
| No Waxer | 76 | 84 | 100 | 47 | 14 |
| **Cider** | | | | | |
| Own Waxer | 56 | 100 | 28 | 66 | 31 |
| No Waxer | 21 | 100 | 30 | 62 | 52 |
| **Processing** | | | | | |
| Own Waxer | 8 | 21 | 29 | 40 | 100 |
| No Waxer | 13 | 43 | 18 | 63 | 100 |

[1]Forty-three growers each ranked five reasons (1, highest, through 5, lowest) for the use of each type of market shown at the left. Responses were scored by using reciprocals of each rank (5 through 1) so that highest ranks received the highest scores. Respondents were divided into waxer and no-waxer categories (whether growers used waxer/sizer lines in their packing operations served as a proxy for their commitment to the fresh wholesale grocery market). Scores for each category of respondents were then totalled (consider any horizontal row, for example) and the highest score was divided into all the other scores, yielding a set of indices in which the most important reason equals 100. This reveals a *level* of importance attached to secondary or tertiary reasons that rank alone does not identify, and exposes differences in priorities perceived by the two classes (waxer/no-waxer) of growers.

Source: Uchida, S.A., and T.T. Stout, "The Wholesaling of Fresh Ohio Apples," ESO 1506, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio, 1989.

**Table 7: Percentage Distribution of Apple Production, by Cultivar, Top Three Apple-Producing States and Ohio, 1973 and 1981[1].**

| | Washington | | Ohio | | New York | | Michigan | |
|---|---|---|---|---|---|---|---|---|
| Cultivar[2] | 1973 | 1981 | 1973 | 1981 | 1973 | 1981 | 1973 | 1981 |
| | | | | —Percent— | | | | |
| Cortland | — | — | 4.5 | 3.0 | 11.0 | 7.6 | 1.5 | 1.7 |
| Delicious | 64.2 | 65.5 | 14.5 | 19.0 | 12.2 | 11.0 | 15.7 | 18.8 |
| Golden Delicious | 24.6 | 28.0 | 15.0 | 16.0 | 5.6 | 6.3 | 6.8 | 7.7 |
| Jonathan | 2.3 | 0.4 | 17.5 | 15.0 | — | — | 32.3 | 24.2 |
| McIntosh | — | — | 5.5 | 6.0 | 31.9 | 29.9 | 14.4 | 14.1 |
| Northern Spy | — | — | — | — | 2.5 | 2.5 | 12.7 | 10.1 |
| R.I. Greening | — | — | — | — | 8.3 | 10.8 | 1.8 | 1.5 |
| Rome Beauty | 2.4 | 1.4 | 19.0 | 19.0 | 12.5 | 12.1 | 3.6 | 4.8 |
| Stayman | — | — | 8.5 | 11.0 | — | — | 3.6 | 3.3 |
| Winesap | 6.0 | 3.4 | — | — | — | — | — | — |
| All Other | 0.4 | 1.3[3] | 14.4 | 11.0 | 16.0 | 19.8 | 7.6 | 13.8 |
| Total (percent) | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| (million pounds) | 1860.0 | 2700.0 | 100.0 | 100.0 | 720.0 | 800.0 | 470.0 | 640.0 |

[1]Data series discontinued by USDA in 1981.
[2]Two popular cultivars not produced by these states are Yellow Newtown (principally California) and York Imperial (principally Pennsylvania, Virginia and West Virginia).
[3]About half of this was Granny Smith, first reported by USDA in 1981.

Source: Derived from Noncitrus Fruits and Nuts, annual summaries, Agricultural Statistics Board, NASS, USDA, January 1975 and 1983.

**Table 8: Apple Production as a Percent of (Red) Delicious Production, by Cultivar, Top Three Apple-Producing States and Ohio, 1973 and 1981[1].**

| | Washington | | Ohio | | New York | | Michigan | |
|---|---|---|---|---|---|---|---|---|
| Cultivar[2] | 1973 | 1981 | 1973 | 1981 | 1973 | 1981 | 1973 | 1981 |
| | | | | —Percent— | | | | |
| Cortland | — | — | 31.0 | 15.8 | 90.2 | 69.1 | 9.6 | 9.0 |
| Delicious | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Golden Delicious | 38.3 | 42.7 | 103.4 | 84.2 | 45.9 | 57.3 | 43.3 | 41.0 |
| Jonathan | 3.6 | 0.6 | 120.7 | 78.9 | — | — | 205.7 | 128.7 |
| McIntosh | — | — | 37.9 | 31.6 | 261.5 | 271.8 | 91.7 | 75.0 |
| Northern Spy | — | — | — | — | 20.5 | 22.7 | 80.9 | 53.7 |
| R.I. Greening | — | — | — | — | 68.0 | 98.2 | 11.5 | 8.0 |
| Rome Beauty | 3.7 | 2.1 | 131.0 | 100.0 | 102.5 | 110.0 | 22.9 | 25.5 |
| Stayman | — | — | 58.6 | 57.9 | — | — | 22.9 | 17.6 |
| Winesap | 9.3 | 5.2 | — | — | — | — | — | — |
| All Other | 0.6 | 1.9 | 99.3 | 57.9 | 131.1 | 180.0 | 48.4 | 73.4 |
| Total (percent) | — | — | — | — | — | — | — | — |
| (million pounds) | — | — | — | — | — | — | — | — |

[1]Data series discontinued by USDA in 1981.
[2]Two popular cultivars not produced by these states are Yellow Newtown (principally California) and York Imperial (principally Pennsylvania, Virginia and West Virginia).

Source: Derived from Table 7.

**Table 9: Percentage Distribution of Grower Responses About Quality Specification Being Used, Ohio, 1983.**

| Specifications That Are Used | Own Waxer | No Waxer | All Growers |
|---|---|---|---|
| | Percent | | |
| Buyer specifications | 92.3 | 33.3 | 51.5 |
| Federal grades | 7.7 | 20.0 | 16.3 |
| Grower standards | 0.0 | 36.7 | 25.6 |
| No answer | 0.0 | 10.0 | 7.0 |
| TOTAL | 100.0 | 100.0 | 100.0 |

Source: Uchida, S.A., and T.T. Stout, "The Wholesaling of Fresh Ohio Apples," ESO 1506, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio, 1989.

**Table 10: Percentage of Growers Agreeing that Specified Attributes Are Expected by Buyers for Apples Sold to the Fresh Wholesale Market, Ohio, 1985[1].**

| Specifications | Waxer | No Waxer | Survey Population |
|---|---|---|---|
| Grade: | | | |
| U.S. Fancy | 25.0[2] | 20.8 | 22.2 |
| U.S. No. 1 | 0.0 | 37.5 | 25.0 |
| Other | 0.0 | 12.5 | 8.3 |
| Waxing | 84.6 | 8.3 | 35.1 |
| Russeting, less than 10% of surface | 33.3 | 66.7 | 50.3 |
| No bruise | 41.7 | 48.8 | 44.4 |
| No hail damage | 50.0 | 54.2 | 52.8 |
| No indentures | 41.7 | 37.5 | 38.9 |
| No scab | 58.3 | 62.5 | 61.1 |
| No insect damage | 58.3 | 62.5 | 61.1 |
| Condition, 12 p.s.i. | 16.7 | 4.1 | 8.3 |
| Number of respondents (N) | 12 | 24 | 36 |

[1]Data were not collected on apple shape, decay, bitter pit, scald, and punctures or broken skin.
[2]For example, 25 percent of growers (3 out of 12) thought that buyers expected (without necessarily specifying it) apples to meet the U.S. Fancy grade.

Source: Uchida, S.A., and T.T. Stout, "The Wholesaling of Fresh Ohio Apples," ESO 1506, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio, 1989.

## NATIONAL MARKET AREA PRICE RELATIONSHIPS

A market area is customarily defined as a geographic trading territory in which prices are interrelated (Kohls). The size of the trading area is influenced by characteristics of the product, the competitiveness of the market participants, and the absence of shipping constraints. The importance of the geographic scope of these price relationships is, of course, that they define a trading arena in which none of the participants — producers, processors, retailers, consumers — can disregard the actions of their competitors.

Improvements over the years in the technology of transportation and communication have tended strongly to increase the size of geographic market areas and intensify price competition for agricultural products. Grain farmers, for example, have learned a sensitivity to developments in other hemispheres because they affect prices for their own locally-grown contribution to a supply and demand equation that now is global.

A half century ago, most fresh fruits and vegetables displayed local and seasonal availabilities. Prices in semi-isolated and widely separated trading centers influenced each other very little. But today most fresh fruits and vegetables move long distances and enjoy widespread retail availability throughout the year. Prices, once a barometer of local conditions, are now interrelated over geographic areas that are regional at least and often global. U.S. apple producers, once attuned almost exclusively to local markets and local weather, have learned their own sensitivities to broader market forces — for example, the monthly shipment/storage actions of Washington marketers, or the product specifications enforced (with prices) by distant and impersonal produce wholesalers (who are, in turn, impelled by market forces equally impersonal to them).

U.S. apple production occurs in regions that are widely separated (Figure 1), and which annually experience patterns of weather and yield that are locally distinctive.

Yet, apple prices in these scattered areas display relationships to each other that reflect the influence of economic forces encompassing more than local market conditions (Figure 3).

These relationships are illustrated with correlation matrices of retail prices for Red Delicious apples at four major U.S. trading centers (Table 11), and with matrices for FOB prices from five separate producing regions (Table 12). Red Delicious was used because of its prevalence (Table 3) and the availability of data for that cultivar. The basic price data appears in Appendix Tables 1 and 2.

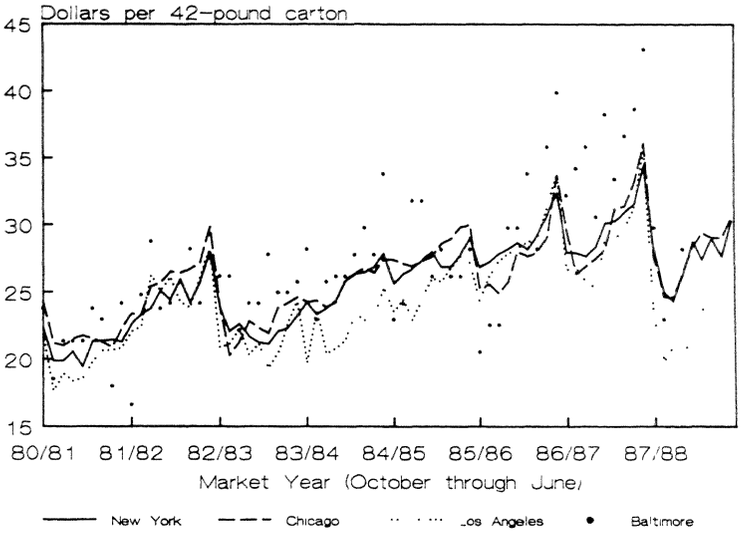
Retail price levels at the four major trading centers corresponded quite closely during the 1980-1987 period (Figure 3 and Table 11). Obviously, these prices are highly correlated; they exhibit similar patterns of variability, tending strongly to move in the same direction in the same amount at the same time.[3] Note that lower correlation coefficients for Baltimore in Table 11 correspond to the more divergent pattern of Baltimore prices shown in Figure 3[4].

These correlations in price *levels* are an indicator of competitive market relationships. But the magnitude of change in the price *levels* is substantial. For example, price levels ranged from $16.65 in October 1981, to $43.14 in June 1987 (see Appendix Table 1). Hence, competitive intensity might have been made to appear stronger than it really was because of the extent ($26.49) of this change in price *levels* during the 7-year period encompassed in these coefficients.

[3]In fact, by squaring the coefficients shown in these correlation matrices, it is possible to estimate the extent to which variation in price at any one point can be explained by price variation at any other point. Consider the Chicago coefficient in the New York City column of Table 11, for example, .927. By squaring this coefficient ($.927^2 = .859$) it is possible to say that 85.9 percent of the variation in Chicago price levels can be explained by variation in New York City price levels.

[4]The divergent price pattern for Baltimore suggests not that there are anomalies in the national market area but in the pricing characteristics of the Baltimore trading center itself.

**Figure 3. Monthly Average Retail Value, Red Delicious Apples, Marketing Years 1980-1988.**




Source: Appendix Table 1.

**Table 11: Retail Price Relationships, Red Delicious Apples: Correlation Between Monthly Average Prices at New York City and at Selected Pricing Points, All Marketing Years 1980/81 to 1986/87[1].**

(correlation coefficients)

| Pricing Point | New York City | Chicago | Los Angeles | Baltimore |
|---|---|---|---|---|
| | | **Retail Price Levels[2]** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .927 | 1.000 | — | — |
| Los Angeles | .921 | .877 | 1.000 | — |
| Baltimore | .799 | .772 | .736 | 1.000 |
| | | **Retail Price Changes[3]** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .563 | 1.000 | — | — |
| Los Angeles | .472 | .447 | 1.000 | — |
| Baltimore | .294 | .232 | .161 | 1.000 |

[1]Baltimore price series discontinued in January 1988.
[2]Correlation between monthly price *levels*, e.g., $24.31 in NYC and $24.55 in Chicago, December 1987 (Appendix Table 1).
[3]Correlation between monthly price *changes* (disregarding price levels) e.g.,+$1.98 in NYC and +$1.90 in Chicago from December 1987 to January 1988 (Appendix Table 1).

Source: Measurements derived from data in Appendix Table 1.

Therefore, Table 11 also records relationships for retail price *changes* (see table footnotes), say 50 to 60 cents from one month to the next at these four locations. By examining only price *changes*, the influence of price *levels* is removed. Indeed, resulting relationships in price changes at these four locations are lower than the relationships shown between *levels* in the top half of the table. The relationships that remain are quite strong in view of (a) the geographic separation of these locations, (b) the presence of widely varying local market circumstances at each one, and (c) the absence of the effect of varying price levels. To be able to say that half or more of the variation in price changes at New York, Chicago, or Los Angeles during this period could be similar to price changes *outside* the scope of any of these trading centers is to acknowledge the existence of strong external forces that affect trading (and pricing) that occur *within* each trading center.

Hence, measurable relationships of both price levels and price changes indicated a competitive market area for Red Delicious apples that appeared to be national in scope, and suggested that individual circumstances anywhere in the area could be affected (at least at retail) by circumstances that developed anywhere else in the area.

Table 12 makes an identical examination of FOB price levels and price changes for Red Delicious apples in five major U.S. producing regions. Notice that FOB price levels and changes are less closely related, reflecting probably the effect of regional production on producer prices, but perhaps also generating an illusion of local isolation and pricing independence that is misleading (given the evidence of Table 11). Notice also that price *levels* indicate one set of relationships between Michigan and the two New York regions, and another between the Washington and Appalachian regions. But price *changes* do not confirm these apparent patterns. Here again, the price *change* matrix probably is the more reliable one since the apparent price *level* relationships coincide with price quotes (see Appendix Table 2) based on two different pricing units (tray packs versus film bags). Price changes in the Yakima Valley appear to have more effect on other regions than price changes in those regions have on each other. But this analysis is based only on Red Delicious, which is not the dominant variety in states like New York or Michigan, where production is focused primarily on processing markets (Table 7). So these price change measurements may underestimate the intensity of competitive relationships in the pricing of other cultivars.

Appendix Tables 3 through 8 explore these same price relationships on a year-by year and on a month-by-month basis. Although relationships among trading centers based on retail price *levels* vary somewhat from year to year, and occasionally even are negative, the overall pattern is notable more for its consistency than for its diversity (Appendix Table 3). But again, this may be more a measure of varying price levels than of competitive intensity. Patterns of retail price *change* show more diversity, changing from year to year, and being more frequently inverse (Appendix Table 4). Still, the effect of competitive influences is apparent, although it is not clear that the influence strengthened or weakened during the 1980-1988 period. Retail price changes appear to be somewhat more closely related at principal trading centers at the beginning and end of crop seasons than during mid-season (Appendix Table 5).

On a crop year basis, FOB price *levels* were rather consistently positive and strong in each of the years examined (Appendix Table 6). FOB price *changes* were more closely related on a year-to-year basis (Appendix Table 7) than they appeared to be for the whole period overall (Table 12).

**Table 12: FOB Shipping Point Relationships, Red Delicious Apples: Correlation Between Monthly Average FOB Prices in the Yakima Valley, Washington, and at Selected U.S. Production Areas, 7-Month Seasons, All Marketing Years, 1983/84—1988/89[1].**

(correlation coefficients)

| Producing Area | Yakima Valley | MD, PA VA,WV | Hudson Valley | Central Western New York | Michigan |
|---|---|---|---|---|---|
| | | | **FOB Price Levels[2]** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .656 | 1.000 | — | — | — |
| Hudson Valley | .134 | .226 | 1.000 | — | — |
| Central/Western NY | .137 | .101 | .885 | 1.000 | — |
| Michigan | .399 | .378 | .759 | .800 | 1.000 |
| | | | **FOB Price Changes[3]** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .581 | 1.000 | — | — | — |
| Hudson Valley | .383 | .402 | 1.000 | — | — |
| Central/Western NY | .565 | .387 | .208 | 1.000 | — |
| Michigan | .124 | .219 | .185 | .357 | 1.000 |

[1]Only the seven months October-April are quoted for all five of these regions.
[2]Correlation between monthly price levels, e.g., $8.06 in the Hudson Valley and $10.00 in Central/Western New York for March, 1989 (Appendix Table 2).
[3]Correlation between monthly price changes (disregarding price levels), e.g. −40 cents in the Hudson Valley and −$1.12 in Central/Western New York for March-April 1989 (Appendix Table 2).

Source: Measurements derived from data in Appendix Table 2.

FOB price change relationships on a month-to-month basis were quite diverse and displayed the strongest positive relationship at the end of the crop year (Appendix Table 8).

## Conclusions and Implications

1. U.S. apple production increased nearly 50 percent during the 1973-1988 period, from 6.2 to 9.1 billion pounds. During those years fresh consumption accounted rather consistently for about 55-58 percent of annual production. This fresh apple industry is a domestic U.S. enterprise, only modestly effected by imports or exports. But the major producer, Washington, (mostly a fresh-market supplier) grew during these years from 30 to 43 percent of total production. Ohio growers also produce primarily for the fresh market, and compete directly with Washington for that market.
2. Consumption of processed apple products increased also, and took the remaining 42-45 percent of domestic production during 1973-1988. Canned products and juice/cider preparations accounted for 75-85 percent of this, but the latter absorbed nearly all of the increase in processed consumption. This increase in U.S. consumption of juice preparations also absorbed some foreign production. Imports and exports (particularly in products like juice concentrate) make foreign competitors more of a factor for concern among U.S. producers of processing apples than of fresh-market apples. Almost all the eastern states (but not Ohio) produce primarily for the processing market.
3. There is evidence that competitive market area price relationships for U.S. apple producers exist on a national basis. Price interrelationships mean that individual industry participants are not safely insulated from the actions of their competitors wherever else they may be in this national arena. External economic forces affect competition within any local area and these are persistent, long-lasting effects. Whether they are favorable or unfavorable to particular individual circumstances may in the long-run have as much impact on local prices and incomes as will anything that is subject to individual managerial control.
4. Modern agricultural marketing in the U.S. is characterized by specialized production at locations favored by nature and technology, by transcontinental shipment patterns to consumers from remote production areas, and by wholesale purchase and sale transactions based on product description rather than inspection. Where descriptive applications are the norm, wholesaling is quick, efficient, and cheap; where they are not, it becomes more cumbersome and costly. There is evidence of confusion and argument about these descriptive applications among both sellers and buyers of Ohio apples for the fresh market. Clearly, this incurs costs for some that are not borne by their competitors who manage their descriptive transactions with clarity and dispatch.
5. The U.S. apple industry is widely aware of the growing impact of Washington production over the years. And the impact carries the same message as does change in the rest of the U.S. fruit and vegetable industry in this second half of the Twentieth Century, which is that local demand can be served at less cost by long-distance transportation than by local production. If this is true, then much of the future well-being of U.S. apple production elsewhere in the market area (including Ohio) would appear to rest on whatever important exceptions to this truth can be exploited effectively—whether they lie in cost effectiveness, market effectiveness, or product effectiveness. These are important managerial implications for apple producers in Ohio or elsewhere in a competitive market area.
6. The managerial role requires a constant surveillance and preparation for improvements in cost control, new markets and new products. *Lowest costs* are associated with productivity (input/output) improvements, including both improved technology and improved information to lower the cost of error. *New markets* include a continuous assessment of income-maximizing alternatives in the fresh market versus the processed market and regard neither as a surplus disposal option. A clear understanding of buyer expectations in either case is required in assessing these alternatives. *New product* decisions include product quality determinations as well as cultivar selection (and quality commitments are easier to amend or alter than is cultivar selection). Buyers often choose between suppliers of a given cultivar on the basis of a package of advantages that are aside from the product itself. For example, supplier commitments concerning packaging, delivery, volume, and adherence to specifications are all, to the buyer, attributes of product quality. Superiority in these matters are important priorities for producer organizations.
7. Product differentiation is an important element in assessing the possibilities for new markets and new products. What can be merchandised effectively because it is different? What can buyers (including consumers) learn to appreciate about *my* cultivar (for example) that they do not associate with other providers as well? To a professional buyer, these differences will boil down to arithmetic which may indeed show that the difference is sufficient to warrant a premium price. To the household consumer, differences may be important and might warrant price premiums for things like assurances about pesticide residues, information about recipes or preparation, or the atmosphere surrounding the purchase experience, for example. What else? Successful product differentiation requires a constant

application of imagination to the search for answers, and the answers change as preferences change.

8. All managerial decisions are being constantly attended, altered, improved—somewhere, by someone—in a market area, and all others in the area, for good or ill, are affected by the consequences, whether they notice them this year or not. Market forces are vastly indifferent to individual circumstances and the pressure for managerial alertness is indeed unrelenting.

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# APPENDIX TABLES

**Appendix Table 1. Monthly Average Retail Value, Red Delicious Apples, Selected U.S. Pricing Points, Marketing Years 1980/81 to 1987/88.**
(Dollars per 42-pound carton)

| Season | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | Season Average |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **New York City** | | | | | |
| 1980/81 | 22.30 | 19.88 | 19.88 | 20.60 | 19.43 | 21.33 | 21.37 | 21.45 | 21.29 | 20.74 |
| 1981/82 | 22.62 | 23.30 | 23.79 | 25.12 | 24.39 | 25.97 | 24.15 | 25.76 | 27.94 | 24.85 |
| 1982/83 | 23.95 | 22.06 | 22.66 | 21.69 | 21.25 | 21.13 | 22.10 | 22.34 | 23.26 | 22.15 |
| 1983/84 | 24.27 | 23.35 | 23.79 | 24.39 | 25.80 | 26.37 | 26.49 | 26.89 | 27.90 | 25.25 |
| 1984/85 | 25.64 | 26.37 | 26.77 | 27.38 | 28.02 | 26.89 | 26.89 | 27.78 | 29.11 | 27.24 |
| 1985/86 | 26.85 | 27.26 | 27.86 | 28.22 | 28.71 | 28.18 | 29.27 | 30.80 | 32.43 | 28.69 |
| 1986/87 | 27.98 | 27.94 | 27.66 | 28.41[1] | 30.15 | 30.32 | 31.01 | 31.65 | 34.47 | 29.75 |
| 1987/88 | 28.18 | 25.04 | 24.31 | 26.29 | 28.75 | 27.42 | 29.03 | 27.66 | 30.32 | 27.42 |
| | | | | | **Chicago** | | | | | |
| 1980/81 | 24.31 | 21.21 | 21.01 | 21.53 | 21.77 | 21.53 | 21.29 | 20.89 | 22.34 | 21.68 |
| 1981/82 | 23.39 | 23.26 | 25.44 | 25.68 | 26.53 | 26.45 | 26.73 | 27.14 | 29.88 | 26.38 |
| 1982/83 | 23.99 | 20.28 | 21.29 | 22.86 | 22.34 | 21.93 | 23.83 | 24.19 | 24.64 | 22.62 |
| 1983/84 | 24.27 | 24.39 | 23.87 | 24.27 | 25.93 | 26.41 | 26.81 | 26.45 | 27.46 | 25.94 |
| 1984/85 | 27.42 | 27.14 | 26.93 | 27.30 | 27.66 | 28.63 | 28.99 | 29.88 | 30.04 | 28.01 |
| 1985/86 | 25.36 | 25.60 | 24.92 | 25.80 | 28.06 | 27.66 | 27.98 | 29.15 | 33.75 | 27.17 |
| 1986/87 | 29.68 | 26.37 | 26.97 | 27.52[1] | 28.22 | 31.25 | 31.45 | 33.34 | 36.13 | 29.97 |
| 1987/88 | 27.66 | 24.68 | 24.55 | 26.45 | 28.47 | 29.47 | 29.07 | 29.07 | 30.64 | 27.67 |
| | | | | | **Los Angeles** | | | | | |
| 1980/81 | 21.85 | 17.66 | 18.95 | 18.39 | 18.59 | 19.80 | 20.64 | 20.68 | 20.85 | 19.62 |
| 1981/82 | 22.06 | 22.42 | 26.25 | 25.08 | 26.13 | 24.27 | 23.83 | 26.13 | 28.18 | 24.92 |
| 1982/83 | 20.89 | 21.13 | 22.26 | 20.32 | 21.17 | 19.35 | 20.48 | 22.66 | 24.31 | 21.28 |
| 1983/84 | 19.72 | 23.63 | 20.40 | 20.81 | 21.41 | 23.43 | 22.90 | 23.14 | 25.36 | 22.27 |
| 1984/85 | 23.55 | 24.47 | 22.90 | 24.55 | 26.05 | 25.80 | 26.81 | 27.66 | 27.18 | 25.35 |
| 1985/86 | 24.31 | 26.25 | 27.30 | 27.86 | 28.34 | 28.75 | 29.03 | 31.37 | 33.83 | 28.55 |
| 1986/87 | 26.69 | 26.81 | 25.72 | 25.35[1] | 28.95[1] | 29.03 | 29.84 | 31.49 | 35.84 | 29.00 |
| 1987/88 | 22.86 | 19.88 | 21.01 | 19.80 | 23.30 | 23.71 | 23.99 | 23.79 | 25.08 | 22.66 |
| | | | | | **Baltimore** | | | | | |
| 1980/81 | 23.79 | 18.55 | 21.37 | 21.37 | 21.37 | 23.79 | 22.98 | 18.02 | 24.19 | 21.93 |
| 1981/82 | 16.65 | 24.80 | 25.80 | 23.79 | 24.19 | 25.80 | 28.22 | 24.19 | 27.82 | 25.54 |
| 1982/83 | 26.21 | 26.21 | 22.18 | 24.19 | 24.19 | 27.82 | 25.00 | 25.00 | 25.80 | 25.16 |
| 1983/84 | 28.22 | 22.98 | 25.80 | 26.21 | 26.21 | 27.82 | 29.84 | 27.82 | 33.87 | 27.49 |
| 1984/85 | 22.98 | 24.19 | 31.85 | 31.85 | 26.21 | 28.22 | 26.21 | 26.21 | 28.22 | 27.57 |
| 1985/86 | 20.56 | 22.58 | 22.58 | 29.84 | 29.84 | 33.87 | 28.22 | 35.88 | 39.92 | 29.76 |
| 1986/87 | 32.26 | 34.27 | 35.88 | 30.64 | 38.30 | 33.47 | 36.69 | 38.71 | 43.14 | 36.38 |
| 1987/88 | 29.84 | 22.98 | 24.60 | 28.22 | ——— DISCONTINUED ——— | | | | | (25.92) |

[1]Estimated by the authors from average prices for other months in the series, including percentage changes from previous and/or subsequent months.

Source: For 1980-1984, Pearrow, Joan, "Fresh Fruit and Vegetables: Prices and Spreads in Selected Markets, 1975-84," SB No. 752, National Economics Division, ERS, USDA, June 1987. For 1984-1988, "Fresh Fruit Prices and Marketing Spreads," ERS Electronic Data Series 88002, ERS, USDA, March 1990.

**Appendix Table 2: Monthly Average FOB Prices, Red Delicious Apples, Selected Production Regions, U.S., 7-Month Seasons[1], 1983-84 to 1988-89.**

| Region Year | Oct. | Nov. | Dec. | Jan.[2] | Feb. | March | April |
|---|---|---|---|---|---|---|---|
| **Yakima Valley—Tray Pack 88-113[3]** | | | | | | | |
| 1983-84 | 10.56 | 10.43 | 10.48 | 10.50 | 12.50 | 12.50 | 12.64 |
| 1984-85 | 14.00 | 12.98 | 11.89 | 12.20 | 14.93 | 15.68 | 16.39 |
| 1985-86 | 14.40 | 12.17 | 12.33 | 13.60 | 15.20 | 14.85 | 15.63 |
| 1986-87 | 13.80 | 11.88 | 11.50 | 9.83 | 14.00 | 14.50 | 15.35 |
| 1987-88 | 7.93 | 7.85 | 7.27 | 7.75 | 10.50 | 11.08 | 11.15 |
| 1988-89 | 13.83 | 12.15 | 12.63 | 12.08 | 13.45 | 12.32 | 11.00 |
| **MD, PA, VA, WV—Tray Pack 88-113[3]** | | | | | | | |
| 1983-84 | 9.58 | 9.11 | 9.17 | 9.00 | 9.92 | 10.42 | 10.33 |
| 1984-85 | 11.19 | 9.35 | 9.24 | 9.20 | 11.07 | 10.18 | 10.09 |
| 1985-86 | 10.38 | 9.51 | 9.88 | 9.58 | 12.19 | 11.21 | 10.50 |
| 1986-87 | 11.18 | 10.73 | 9.90 | 10.00 | 11.75 | 11.25 | 11.25 |
| 1987-88 | 9.69 | 6.87 | 7.06 | *8.00 | 8.00 | 7.75 | 7.50 |
| 1988-89 | 8.63 | 8.12 | 8.00 | 7.45 | 8.56 | 8.13 | 7.38 |
| **Hudson Valley, NY—Film Bags 2 1/4" min.[3]** | | | | | | | |
| 1983-84 | 7.27 | 6.50 | 6.19 | 6.25 | 7.18 | 7.97 | 6.99 |
| 1984-85 | 7.21 | 6.96 | 6.97 | 7.08 | 7.39 | 7.25 | 7.35 |
| 1985-86 | 7.68 | 7.02 | 7.17 | 7.25 | 7.66 | 7.69 | 7.85 |
| 1986-87 | 9.50 | 9.50 | 10.05 | 10.38 | 10.31 | 10.31 | 10.50 |
| 1987-88 | 8.47 | 7.86 | 7.36 | 7.50 | 8.06 | 8.50 | 8.13 |
| 1988-89 | 9.00 | 8.63 | 8.50 | 8.50 | 8.25 | 8.06 | 7.66 |
| **Central/Western NY—Film Bags 2 1/4" min.[3]** | | | | | | | |
| 1983-84 | 7.68 | 7.36 | 7.29 | *7.94 | 7.84 | 7.72 | (7.82)[4] |
| 1984-85 | 7.25 | 7.39 | 6.75 | 7.17 | 7.75 | 7.75 | 7.75 |
| 1985-86 | 7.55 | 7.25 | 6.88 | 6.88 | 8.25 | 8.12 | 8.45 |
| 1986-87 | 10.90 | 10.13 | 9.72 | 9.50 | 11.00 | 11.00 | 11.89 |
| 1987-88 | 8.33 | 8.25 | 8.03 | (8.18)[4] | 8.75 | 9.00 | 9.50 |
| 1988-89 | 10.25 | 9.28 | 9.37 | 9.13 | 8.50 | 10.00 | 8.88 |
| **Michigan—Film Bags 2 1/4" min.[3]** | | | | | | | |
| 1983-84 | 7.50 | 7.27 | 6.75 | *7.50 | 7.33 | 7.06 | 7.11 |
| 1984-85 | 7.36 | 6.99 | 6.87 | *7.35 | 7.42 | 7.50 | 7.47 |
| 1985-86 | 5.96 | 5.87 | 6.18 | 6.25 | 8.00 | 8.35 | 8.77 |
| 1986-87 | 8.63 | 8.60 | 8.35 | *10.50 | 10.69 | 11.25 | 11.85 |
| 1987-88 | 5.30 | 6.25 | 6.30 | *7.02 | 7.25 | 7.05 | 7.75 |
| 1988-89 | 9.18 | 8.23 | 7.68 | 8.01 | 8.25 | 8.08 | 7.76 |

[1]Some production seasons are longer than seven months, but only October-through-April prices are quoted for all five of these regions.

[2]Quoted prices may be fresh or CA storage, sometimes both. January prices used here are those that best fit the 7-month price trend shown for each year and region. Prices have been marked with an (*) if they are CA quotes. All October-December prices are fresh; February-April prices are CA.

[3]Tray packs are 42-lb. bushels. Film bag prices are for twelve 3-lb. bags. These are the only units priced for the entire period in their respective production regions.

[4]Prices in parentheses are estimated.

Source: "Fresh Fruit and Vegetable Prices, (year): Wholesale Chicago and New York City, FOB Leading Shipping Points," Market News Branch, Fruit and Vegetable Division, AMS, USDA.

**Appendix Table 3: Retail Price Levels, Red Delicious Apples: Correlation Between Monthly Average Price Levels at New York City and at Selected Pricing Points by Marketing Years, 1980/81—1986/87.**

(correlation coefficients)

| Pricing Point | New York City | Chicago | Los Angeles | Baltimore |
|---|---|---|---|---|
| | | **1980-1981** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .554 | 1.000 | — | — |
| Los Angeles | .892 | .584 | 1.000 | — |
| Baltimore | .443 | .581 | .506 | 1.000 |
| | | **1981-1982** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .904 | 1.000 | — | — |
| Los Angeles | .764 | .854 | 1.000 | — |
| Baltimore | .563 | .645 | .534 | 1.000 |
| | | **1982-1983** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .473 | 1.000 | — | — |
| Los Angeles | .542 | .388 | 1.000 | — |
| Baltimore | −.038 | .104 | −.305 | 1.000 |
| | | **1983-1984** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .966 | 1.000 | — | — |
| Los Angeles | .653 | .757 | 1.000 | — |
| Baltimore | .818 | .741 | .451 | 1.000 |
| | | **1984-1985** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .635 | 1.000 | — | — |
| Los Angeles | .689 | .903 | 1.000 | — |
| Baltimore | .342 | −.110 | −.174 | 1.000 |
| | | **1985-1986** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .940 | 1.000 | — | — |
| Los Angeles | .974 | .916 | 1.000 | — |
| Baltimore | .877 | .873 | .930 | 1.000 |
| | | **1986-1987** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .924 | 1.000 | — | — |
| Los Angeles | .979 | .924 | 1.000 | — |
| Baltimore | .827 | .686 | .874 | 1.000 |

Source: Measurements derived from data in Appendix Table 1.

**Appendix Table 4: First Differences in Retail Prices, Red Delicious Apples: Correlation Between Monthly Average Retail Price Changes at New York City and at Selected Pricing Points, by Marketing Years, 1980/81—1986/87.**

(correlation coefficients)

| Pricing Point | New York City | Chicago | Los Angeles | Baltimore |
|---|---|---|---|---|
| | | **1980-1981** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .572 | 1.000 | — | — |
| Los Angeles | .748 | .747 | 1.000 | — |
| Baltimore | .464 | .747 | .604 | 1.000 |
| | | **1981-1982** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .234 | 1.000 | — | — |
| Los Angeles | .098 | .732 | 1.000 | — |
| Baltimore | −.139 | .028 | −.010 | 1.000 |
| | | **1982-1983** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .721 | 1.000 | — | — |
| Los Angeles | .507 | .048 | 1.000 | — |
| Baltimore | −.403 | −.245 | −.638 | 1.000 |
| | | **1983-1984** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .592 | 1.000 | — | — |
| Los Angeles | −.301 | .379 | 1.000 | — |
| Baltimore | .636 | .256 | −.366 | 1.000 |
| | | **1984-1985** | | |
| New York City | 1.000 | — | — | — |
| Chicago | −.456 | 1.000 | — | — |
| Los Angeles | .146 | .238 | 1.000 | — |
| Baltimore | −.078 | −.347 | −.855 | 1.000 |
| | | **1985-1986** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .607 | 1.000 | — | — |
| Los Angeles | .643 | .487 | 1.000 | — |
| Baltimore | −.002 | −.205 | .461 | 1.000 |
| | | **1986-1987** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .431 | 1.000 | — | — |
| Los Angeles | .925 | .356 | 1.000 | — |
| Baltimore | .485 | −.161 | .679 | 1.000 |

Source: Measurements derived from data in Appendix Table 1.

**Appendix Table 5: First Differences in Retail Prices, Red Delicious Apples: Correlation Between Monthly Average Retail Price Changes at New York City and at Selected Pricing Points, by Months, Marketing Years 1980-1988.**

(correlation coefficients)

| Pricing Point | New York City | Chicago | Los Angeles | Baltimore |
|---|---|---|---|---|
| | | **November 1980-1988** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .692 | 1.000 | — | — |
| Los Angeles | .641 | .683 | 1.000 | — |
| Baltimore | .813 | .355 | .334 | 1.000 |
| | | **December 1980-1988** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .151 | 1.000 | — | — |
| Los Angeles | .018 | .620 | 1.000 | — |
| Baltimore | −.165 | −.376 | −.451 | 1.000 |
| | | **January 1980-1988** | | |
| New York City | 1.000 | — | — | — |
| Chicago | −.055 | 1.000 | — | — |
| Los Angeles | .069 | −.554 | 1.000 | — |
| Baltimore | −.118 | .526 | −.740 | 1.000 |
| | | **February 1980-1987** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .448 | 1.000 | — | — |
| Los Angeles | .605 | −.152 | 1.000 | — |
| Baltimore | .349 | .093 | −.619 | 1.000 |
| | | **March 1980-1987** | | |
| New York City | 1.000 | — | — | — |
| Chicago | −.215 | 1.000 | — | — |
| Los Angeles | .093 | .151 | 1.000 | — |
| Baltimore | −.065 | −.941 | −.096 | 1.000 |
| | | **April 1980-1987** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .350 | 1.000 | — | — |
| Los Angeles | .756 | .311 | 1.000 | — |
| Baltimore | −.421 | −.301 | −.324 | 1.000 |
| | | **May 1980-1987** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .426 | 1.000 | — | — |
| Los Angeles | .624 | .447 | 1.000 | — |
| Baltimore | .415 | .721 | .454 | 1.000 |
| | | **June 1980-1987** | | |
| New York City | 1.000 | — | — | — |
| Chicago | .445 | 1.000 | — | — |
| Los Angeles | .721 | .569 | 1.000 | — |
| Baltimore | −.185 | .284 | .180 | 1.000 |

Source: Measurements derived from data in Appendix Table 1.

**Appendix Table 6: FOB Price Levels, Red Delicious Apples: Correlation Between Monthly Average FOB Prices in the Yakima Valley, Washington, and at Selected Other U.S. Production Areas, Individual Marketing Years, 1983/84-1988/89.**

(correlation coefficients)

| Producing Area | Yakima Valley | MD, PA VA, WV | Hudson Valley | Central Western New York | Michigan |
|---|---|---|---|---|---|
| | | **1983-1984** | | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .926 | 1.000 | — | — | — |
| Hudson Valley | .691 | .848 | 1.000 | — | — |
| Central/Western NY | .506 | .412 | .355 | 1.000 | — |
| Michigan | -.167 | -.181 | .083 | .593 | 1.000 |
| | | **1984-1985** | | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .596 | 1.000 | — | — | — |
| Hudson Valley | .865 | .770 | 1.000 | — | — |
| Central/Western NY | .895 | .510 | .795 | 1.000 | — |
| Michigan | .770 | .598 | .862 | .769 | 1.000 |
| | | **1985-1986** | | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .732 | 1.000 | — | — | — |
| Hudson Valley | .961 | .696 | 1.000 | — | — |
| Central/Western NY | .875 | .775 | .861 | 1.000 | — |
| Michigan | .824 | .700 | .769 | .894 | 1.000 |
| | | **1986-1987** | | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .856 | 1.000 | — | — | — |
| Hudson Valley | .172 | .069 | 1.000 | — | — |
| Central/Western NY | .969 | .845 | .246 | 1.000 | — |
| Michigan | .493 | .459 | .846 | .595 | 1.000 |
| | | **1987-1988** | | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | -.041 | 1.000 | — | — | — |
| Hudson Valley | .609 | .548 | 1.000 | — | — |
| Central/Western NY | .941 | -.034 | .584 | 1.000 | — |
| Michigan | .722 | -.464 | -.072 | .696 | 1.000 |
| | | **1988-1989** | | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .902 | 1.000 | — | — | — |
| Hudson Valley | .709 | .548 | 1.000 | — | — |
| Central/Western NY | .320 | .327 | .481 | 1.000 | — |
| Michigan | .730 | .705 | .685 | .550 | 1.000 |

Source: Measurements derived from data in Appendix Table 2.

**Appendix Table 7: First Differences in FOB Prices, Red Delicious Apples: Correlation Between Monthly Average FOB Price Changes in the Yakima Valley, Washington, and at Selected Other U.S. Production Areas, Individual Marketing Years, 1983/84-1988-89.**

(correlation coefficients)

| Producing Area | Yakima Valley | MD, PA VA, WV | Hudson Valley | Central Western New York | Michigan |
|---|---|---|---|---|---|
| | | | **1983-1984** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .795 | 1.000 | — | — | — |
| Hudson Valley | .591 | .858 | 1.000 | — | — |
| Central/Western NY | −.134 | −.170 | .021 | 1.000 | — |
| Michigan | −.010 | −.270 | −.032 | .899 | 1.000 |
| | | | **1984-1985** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .789 | 1.000 | — | — | — |
| Hudson Valley | .741 | .967 | 1.000 | — | — |
| Central/Western NY | .693 | .374 | .410 | 1.000 | — |
| Michigan | .428 | .442 | .536 | .434 | 1.000 |
| | | | **1985-1986** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .588 | 1.000 | — | — | — |
| Hudson Valley | .928 | .621 | 1.000 | — | — |
| Central/Western NY | .649 | .812 | .622 | 1.000 | — |
| Michigan | .607 | .905 | .697 | .933 | 1.000 |
| | | | **1986-1987** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .790 | 1.000 | — | — | — |
| Hudson Valley | −.433 | −.508 | 1.000 | — | — |
| Central/Western NY | .920 | .832 | −.389 | 1.000 | — |
| Michigan | −.283 | .115 | .133 | −.016 | 1.000 |
| | | | **1987-1988** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .212 | 1.000 | — | — | — |
| Hudson Valley | .806 | .501 | 1.000 | — | — |
| Central/Western NY | .732 | .283 | .625 | 1.000 | — |
| Michigan | −.195 | −.426 | −.517 | −.037 | 1.000 |
| | | | **1988-1989** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .880 | 1.000 | — | — | — |
| Hudson Valley | .370 | .058 | 1.000 | — | — |
| Central/Western NY | .014 | −.054 | .502 | 1.000 | — |
| Michigan | .501 | .399 | .567 | .182 | 1.000 |

Source: Measurements derived from data in Appendix Table 2.

**Appendix Table 8: First Differences in FOB Prices, Red Delicious Apples: Correlation Between Monthly Average FOB Price Changes in the Yakima Valley, Washington, and at Selected Other U.S. Production Areas, By Months, Marketing Years 1983-1989.**

(correlation coefficients)

| Producing Area | Yakima Valley | MD, PA VA, WV | Hudson Valley | Central Western New York | Michigan |
|---|---|---|---|---|---|
| | | | **November, 1983-1988** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | −.530 | 1.000 | — | — | — |
| Hudson Valley | −.474 | .156 | 1.000 | — | — |
| Central/Western NY | −.508 | −.715 | −.335 | 1.000 | — |
| Michigan | −.470 | −.716 | −.243 | .496 | 1.000 |
| | | | **December, 1983-1988** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .195 | 1.000 | — | — | — |
| Hudson Valley | −.034 | −.676 | 1.000 | — | — |
| Central/Western NY | .803 | .182 | −.479 | 1.000 | — |
| Michigan | −.304 | .435 | .121 | .580 | 1.000 |
| | | | **January, 1984-1989** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .074 | 1.000 | — | — | — |
| Hudson Valley | −.581 | .442 | 1.000 | — | — |
| Central/Western NY | .411 | .138 | −.286 | 1.000 | — |
| Michigan | −.837 | .297 | .902 | −.250 | 1.000 |
| | | | **February, 1984-1989** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | −.041 | 1.000 | — | — | — |
| Hudson Valley | −.154 | −.257 | 1.000 | — | — |
| Central/Western NY | .599 | .528 | −.009 | 1.000 | — |
| Michigan | −.349 | .633 | −.062 | −.514 | 1.000 |
| | | | **March, 1984-1989** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | −.045 | 1.000 | — | — | — |
| Hudson Valley | .221 | .843 | 1.000 | — | — |
| Central/Western NY | −.714 | −.002 | −.422 | 1.000 | — |
| Michigan | .229 | −.624 | −.505 | −.385 | 1.000 |
| | | | **April, 1984-1989** | | |
| Yakima Valley | 1.000 | — | — | — | — |
| MD, PA, VA, WV | .538 | 1.000 | — | — | — |
| Hudson Valley | .528 | −.068 | 1.000 | — | — |
| Central/Western NY | .858 | .611 | .344 | 1.000 | — |
| Michigan | .615 | .321 | .335 | .895 | 1.000 |

Source: Measurements derived from data in Appendix Table 2.