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JUICE APPLE MARKETS AND PRICE ANALYSIS

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Introduction

The market for juice apples is one of major importance to apple growers both in Michigan and the United States. The juice market has provided an outlet for an average of 23% of the U.S. crop during recent years. This market is even more important to Michigan growers with an average of 35% of Michigan's crop being sold for juice during recent years.

The U.S. market for apple juice has experienced large growth during the last 20 years. Apple juice sales grew from an equivalent usage of about 18 million bushels in the late 1960's to over 90 million bushels during 1983-1984 -- which is more than a five-fold growth during this period (Figure 1). Growth of the apple juice market has been particularly noteworthy since 1976, when the U.S. market grew by 57 million bushels during the 8-year period 1977-1984.

The outstanding growth of the apple juice market in the United States has been related to changing consumer preference trends. Increasing numbers of consumers express preferences for drinks which are natural, low calorie, healthful and without added sugar. Apple juice seems to be well suited to these preferences. Growth in demand for apple juice has also been accentuated by marketing apple juice in new forms, new containers and in new markets. Apple juice is now retailed in a wide variety of container sizes and types, with an especially noteworthy new container being the individual serving size aseptic pack. These different sizes and containers have helped increase the exposure and appeal of apple juice to various consumers. Apple juice has also become fairly common in many food service markets such as restaurants, cafeterias,

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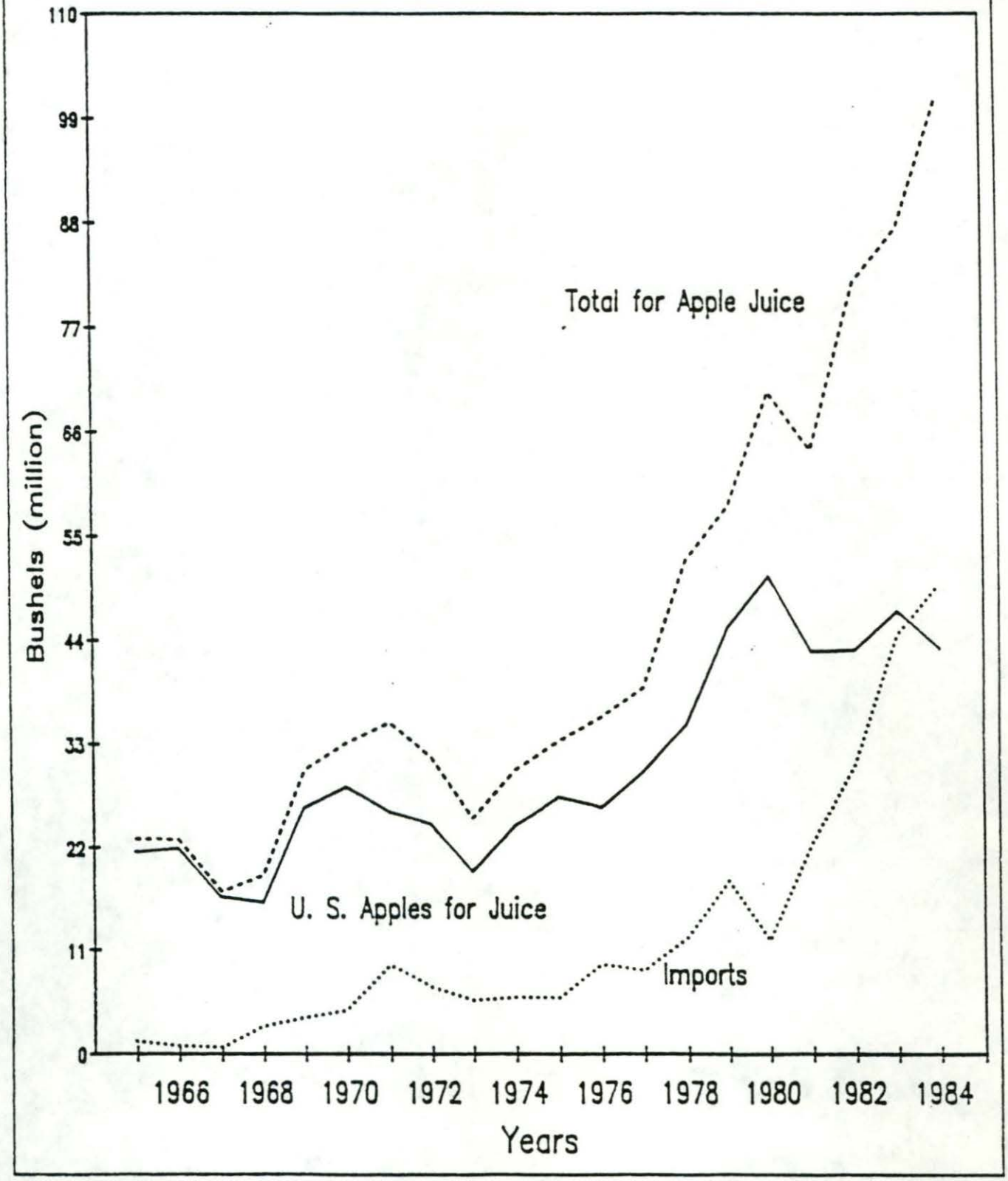
Figure 1. U. S. Apple Juice Market Trends



Sources: U. S. Apples for Juice, Non-Citrus Fruits and Nuts, USDA.
Imports, Foreign Agricultural Service, USDA.

airlines, etc. Retail consumer packs of frozen concentrated apple juice have become quite common during the last 10 years, whereas before that time, this pack was often not available in many parts of the United States. Apple juice has also been marketed to a growing degree in recent years in juice combinations with a variety of other fruit juices. Increased demand for apple juice has also been strengthened by the advertising dollars of several large national brand companies which have entered the apple juice business. Increased shelf space in grocery stores, along with expanded merchandising attention by grocery retailers has also contributed to the overall growth trends for apple juice. The expanded shelf space and retail offerings are of course related in part to the increased types of packages, brands, forms of apple juice and offerings of juice in several different sections of the grocery department including frozen and dairy.

During the early portion of the demand growth period for apple juice in the United States, much of the increase in demand was supplied by apples grown in the U.S. As a result of this, the percent of the nation's crop being sold for apple juice increased. During the mid 1960's about 12% of the national apple crop was sold for juice, whereas by 1979-1980 this had risen to 23% of the crop. More recently since 1979-1980, all of the increase in U.S. apple juice consumption has been filled by imports of apple juice concentrate (Figure 1). Thus the percent of the U.S. crop being sold for juice has remained at about 22-23% since 1979. In recent years the quantity of U.S. apples sold for juice has declined somewhat, with an average of about 43 million bushels during the most recent four years (1981-1984) which is down somewhat from a peak of 57 million bushels during 1979-1980.

Imports

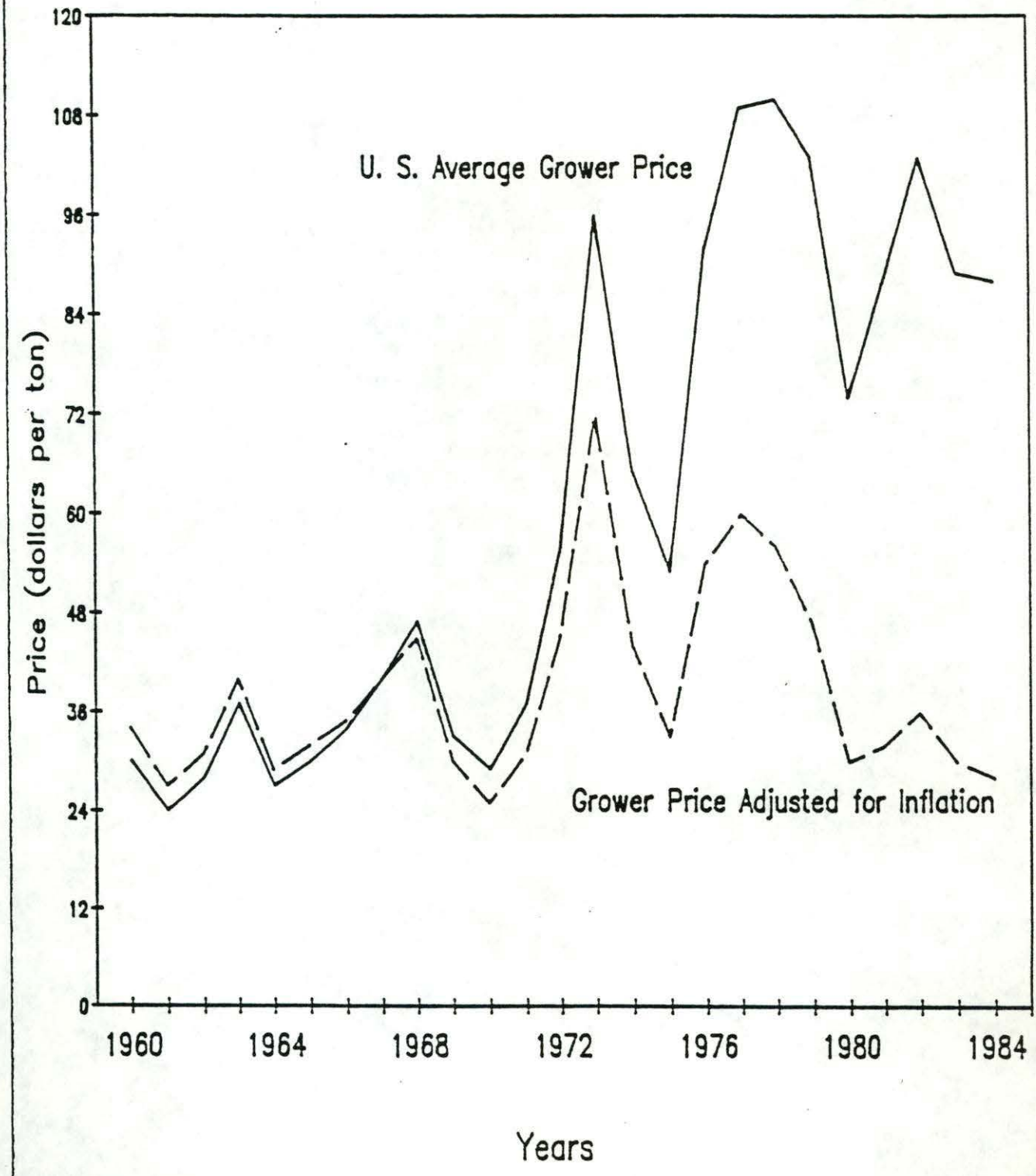
Imports of apple juice concentrate have expanded dramatically in recent years (Figure 1). The growth of imports has been especially large since 1978. Until the late 1960's, imports of apple juice concentrate were insignificant, with imports in 1966 and 1967 amounting to the equivalent of less than 1 million bushels per year. In a dramatic contrast by 1984 imports had grown to a level comparable to 50 million bushels. Imports

during the late 1960's and the early to mid 1970's rose gradually from 1 million bushels to about 12 million bushels equivalent by 1978. Since 1978 imports have risen rapidly to 50 million bushel in just seven years. Imports in recent years now constitute over 50% of the total supplies of apple juice marketed in the United States.

To a degree imports have facilitated the overall growth in the U.S. apple juice market. This can be particularly significant during certain years of a short U.S. apple crop and perhaps in periods of strong demand for U.S. apples for other reasons. On the other hand, imports of apple juice concentrate compete very strongly with juice apples grown in the United States. Imported concentrate is readily substituted for domestically produced apple juice for many markets and uses. The very large import quantities have tended to have a downward impact on the price of U.S. produced juice apples. This is particularly noteworthy since 1979 as grower prices for juice apples have declined (Figure 2) while overall demand for apple juice in the U.S. has increased dramatically. The downward price pressure impact on the U.S. apple industry may be particularly significant in the future because U.S. apple production is expanding. Apple production has been trending upward in recent years and is expected to increase substantially in the near future. This projection is related to large new plantings of apple orchards in some parts of the country and to rising average yields per acre due to improved techniques and production technology.

The strong U.S. dollar in recent years has been one major factor contributing to the surge of imports of apple juice concentrate into the United States. Some exporting countries have also encouraged expansion of their apple industry in a variety of ways in order to expand exports to the growing U.S. market. Certain foreign countries provide export subsidies for apple juice concentrate including exports to the United States. These and other reasons have contributed to the dramatic growth of imported apple concentrate in recent years and its major impact on the U.S. apple industry.

Figure 2. Grower Prices For Juice Apples



Source: Non-Citrus Fruits and Nuts, USDA, (various issues)

The Market for Juice Apples

Market prices for juice apples at the grower level are heavily influenced by prices for apple juice. Hence major supply or demand factors which effect prices of apple juice, such as supplies of imports, are reflected by processors in their demand for juice apples from growers. Various demand factors, such as the rising consumer preference for U.S. apple juice, are reflected initially at retail. These demand factors are then reflected back through the marketing systems by various wholesale buyers to processors of apple juice. The impact of these market factors on the apple juice market is then in turn reflected to growers through the demand by processors for juice apples. Hence the prices for juice apples to growers include the impact of a number of factors at different market levels between processor and consumer.

Grower prices for juice apples in Michigan and certain other producing regions, are also influenced by grower bargaining. The grower bargaining association attempts to analyze all supply and demand factors and to influence to some degree the price-discovery process for juice apple prices.

Juice apples in Michigan and other regions of the United States are grown mainly in combination with apples grown for other major uses such as fresh market. The non-juice major markets also include processing into applesauce and frozen apple slices (which together are commonly called "peeler" markets). Some juice apples are undersized fruit which are sorted out from apples sold for peeler processing. Another major source of supply for juice apples is sort-outs from fresh packing lines. These sort-outs may include undersized apples, as well as fruit with major defects, or off-color apples of varieties that are not desired for peeler markets. A third major source of supply for juice apples is drop apples which have fallen on the ground during harvest.

Occasionally an apple grower who has a block with an unusually high percentage of small apples or with defects such as from hail, may market the entire production of that block for juice. Usually apples from this source are, however, a minor percentage of the

overall juice apples supplies. In a few instances growers have tried growing certain orchard blocks strictly for the apple juice market. Until imports became so large during recent years, there were an increasing number of growers who were interested in shifting certain blocks to the production of strictly juice apples. Although this practice seemed to be on the threshold of becoming more common, since imports have grown so large and hence put downward pressure on prices, grower interest in raising entire blocks for juice has waned.

The amount of juice apples sorted out from fresh packing lines or from peeler processing fruit depends partly upon the size and quality of apples. In a year in which growing conditions result in an unusually high percentage of small apples or hail damage, there will tend to be a higher percentage of these apples sorted out for juice. The opposite happens in years of unusually high quality fruit.

The relative prices in the different markets are also important. The impact of the relative prices may be especially important in years in which apples have a normal size range. If the juice market demand and prices are especially high, a greater percentage of borderline size and quality apples will be sorted out of fresh markets to be sold into juice. When juice markets are especially strong, growers will also be inclined to sell entire blocks of apples with a substantial percentage of small, hail or other blemished apples for juice. By contrast, if juice prices are relatively low compared to fresh or peeler markets, a higher percentage of the marginal size and quality apples will be left in the fresh pack and/or sold for peeler processing.

Grower prices received for juice apples tend to be lower than average prices for peeler processing apples or for fresh market apples. This is partly because juice markets can utilize fruit with a wide range of characteristics, including apples which are too small for the other major markets or which have been heavily damaged by hail. Juice markets can also utilize drop apples which are not satisfactory for fresh market or peeler processing.

During the later 1970's when the demand for U.S. grown juice apples was growing very rapidly, especially before imports increased to such large proportions, prices for juice apples increased relative to the prices of peeler processing apples. During a few years, the differential between prices for juice apples and peeler processing apples narrowed. During 1973-1976 the Michigan prices for peeler apples averaged $61 per ton higher than prices for juice apples, whereas during 1978-1981 prices for peeler apples, averaged only $30 per ton higher than juice apples. The differential between these two prices then widened again somewhat during 1982-1984. When the price of juice apples is especially high in comparison to prices for peeler or fresh market apples, growers will tend to sell more of their marginal quality and size apples for juice. Thus, the price of juice apples has some impact, particularly under certain circumstances, on the price for fresh apples and peeler market apples.

When the price of juice apples is especially low, growers may decide that the returns are insufficient to warrant picking up drop apples from the ground. Thus especially in low price years, substantial quantities of potential juice apple supplies may be left in the orchard to rot. In years of especially low juice prices, there may also be some apple blocks that are left completely unpicked on the trees, although this occurs substantially less frequently than leaving drops in the orchard because of low prices for juice apples.

Price Analysis

An analysis was made of prices received by growers for juice apples. This included an evaluation of certain supply factors such as the U.S. apple crop size and quantity of imports of apple juice concentrate into the United States. The analysis also included several demand factors; such as disposable consumer income adjusted for inflation and the price of an important competing product--frozen orange juice. The analysis indicates

that grower prices for juice apples are significantly associated with: (1) the size of the U.S. apple crop, (2) imports of apple juice concentrate, (3) prices of frozen orange juice, and (4) U.S. consumer disposable income.

The size of the U.S. apple crop is determined at the grower level while imports of apple juice concentrates enter the U.S. market channel at the processor or reconstituted manufacturer level in the marketing system. Factors which affect consumer demands, such as consumer income, tastes, preferences, and prices of competing products, manifest themselves at the retail level through their influence on consumer purchase decisions.

The size of the U.S. apple crop in any particular year, is influenced to a large extent by weather conditions which impact the apple orchards. Although the amount of bearing apple acreage will also impact the size of crop, this acreage is determined by growers' planting decisions several years previously (along with any tree removal decisions made by growers in recent years). While overall apple crop size is determined primarily by weather, the amount of apples sold for juice will also be influenced by overall quality of the apple crop and by relative prices and returns from different market uses such as juice, fresh, applesauce, and frozen apples.

In earlier periods apple juice and orange juice were apparently regarded by most consumers as two substantially different products without a high degree of substitutability between these two juices. Thus, historically, there was a relatively lower impact of orange juice prices on the price of apple juice and juice apples. In recent years the relationship between orange juice and apple juice seems to have increased. Apparently there are a growing number of consumers who substitute apple juice for orange juice. The increased relationship among orange juice and apple juice has been encouraged by a rapid growth in the popularity of apple juice during the last 10 years. The competitive position of apple juice has also increased in part because of the relatively recent introduction of frozen concentrated apple juice in grocery store

markets, whereas frozen concentrated orange juice has been marketed in large volume for several decades. Apple juice in a number of food service markets including juice dispensers and vending machines has also increased substantially in recent years as an additional alternative to orange juice. Much of this food service apple juice is made from reconstituted apple concentrate.

In addition to the above reasons the impact of the price of orange juice on apple juice prices has been accentuated by supply-reducing freezes in Florida during several recent years. These freezes have reduced substantially the supply of U.S. juice oranges. Imports of foreign orange juice concentrate have, however, increased substantially which has limited somewhat the impact of the Florida freezes on the apple juice market.

Growth in disposable consumer income can be expected to have a positive effect on the price of the apple juice and hence juice apples. The effect of inflation in the economy may dampen the impact of rising consumer income to some extent since inflation reduces the amount of real purchasing power of the consumers' dollar income. Since consumer disposable income tends to trend upward over a period of years, to some extent it may also reflect the increasing preference trend of many consumers for apple juice.

Results of the Price Analysis

The relationship of the price-determining factors to grower prices for juice apples can be summarized in the following equation (see Appendix for data used and model statistics):

$$PJ = -417.603 - 1.2935\ A - 2.0946\ I + 2.4176\ PO + .2015\ DI$$

Adjusted $R^2 = .87$ SER = 8.11

In which:

PJ = Price of juice apples received by U.S. growers, season average price, in dollars per ton.

A = Apple crop size in the United States, utilized production, in millions of bushels.

I = Imports of apple juice concentrate expressed in millions of equivalent bushels.

PO = Price of frozen orange juice at retail, 6 oz. can, cents per can.

DI = Disposable income, U.S., per capita, deflated by the Consumer Price Index, in dollars per person.

The equation is estimated using data for the period 1971 to 1984.

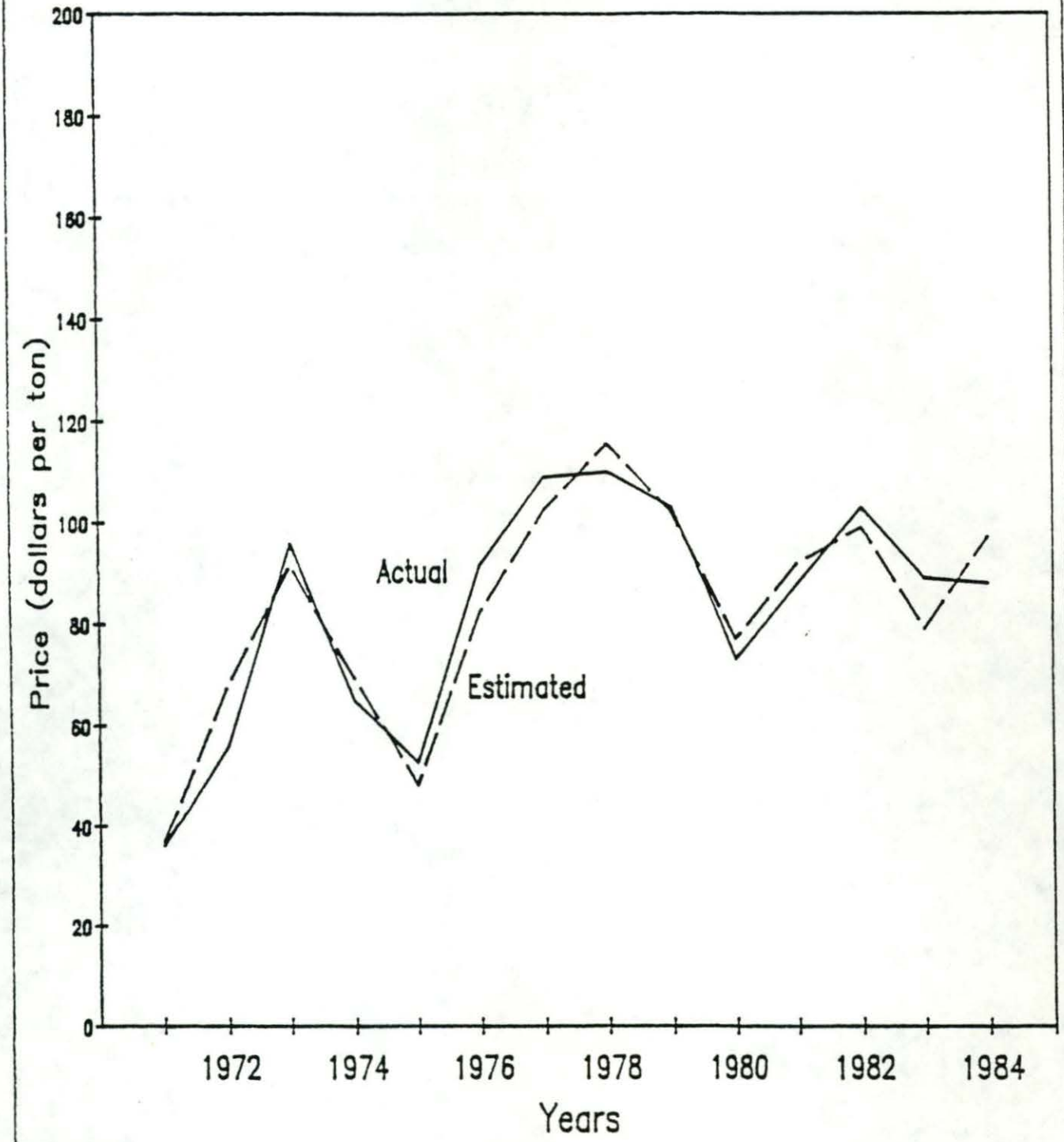
A summary interpretation of the equation is:

1. An increase in U.S. apple production of one million bushels can be expected to be associated with a decrease of $1.29 per ton in the average grower price for juice apples.
2. An increase in imports of apple juice concentrate equal to one million bushel equivalent can be expected to be associated with a decrease of $2.09 per ton in the average grower price for juice apples.
3. An increase in the retail price of frozen orange juice of one cent per 6 oz. can is expected to be associated with an increase of $2.42 per ton in the average grower price for juice apples.
4. An increase in U.S. real disposable income of $1 per person can be expected to be associated with an increase of $ .20 per ton in the average grower price for juice apples.

The results show that the four price-determining factors of apple crop size, imports, orange juice price and disposable income explain 87% (as indicated by the adjusted R^2 value) of the annual variation in grower prices for juice apples. When the price equation is used to estimate prices for juice apples, the prices estimated with the equation are very similar to actual prices (Figure 3). Estimated prices, in all years except one, are within $10.00 per ton of actual prices. These small differences indicate a high degree of accuracy of the equation in estimating grower prices for juice apples.

Figure 3. Prices for Juice Apples

Actual and Estimated



Source for actual prices: Non-Citrus Fruits and Nuts, USDA (various issues).

In addition to the four price-determining variables included in the price equation, an alternative equation was analyzed using trend as an additional variable. This was done in an attempt to reflect more precisely trend factors such as the increasing consumer preference for apple juice. When a trend factor was added along with disposable income, however, the trend variable was statistically insignificant. Therefore trend was omitted as a separate variable. In the price equation with disposable income and no separate trend factor, the disposable income variable probably, in part, reflects the impact of increasing consumer preference for apple juice, especially since both of these factors have trended upward during the period of the analysis.

In the model discussed in the report, the quantity of imports is based on calendar year data. An alternative for this factor of import data based upon a July 1-June 30 year was also analyzed. The resulting equation model was, in this case, definitely inferior to the model with import data on a calendar year.

An alternative model was tested in which the quantity of U.S. apples sold for juice was substituted for total U.S. apple crop size as an independent price-determining variable. When the quantity of U.S. apples sold for juice is used the relationship to price for juice apples (the coefficient) for a million bushels of U.S. juice apples (1.53) was very similar to the coefficient for an equivalent of one million bushels of imports (1.59). This tends to confirm the logical hypothesis that there is a similar impact on juice apple prices of an equivalent quantity supplied whether from U.S. produced apples or from imports.

The overall aspects of the model in which U.S. juice apple quantity was used for U.S. supplies were inferior to the model in which total U.S. crop was used. The explanatory power of the model regarding juice apple price was reduced when juice apple quantity was used. The adjusted R^2 value decreased from .87 to .69. The standard error of regression increased from 8.1 to 12.7. In addition the coefficient for juice apple

sales was not statistically significant at the 5% level whereas that for total U.S. apples was highly significant.

Another problem with using the juice apples quantity is that the quantity sold for juice is substantially simultaneously determined with price for juice apples, whereas the total U.S. apple crop is more independently determined by previous grower acreage decisions and the impact of weather. Apple industry practice also gives heavy significance to the total size of the crop, because USDA and industry estimates of the crop have been made and receive considerable attention in early fall when major juice apple price decisions are made. By contrast the amount sold for juice is not known until after the marketing year and less industry attention is given to this factor during the crucial fall pricing period.

For the above reasons the model which uses the total U.S. crop size seems to clearly be a superior model. It is therefore the one used and discussed in this report.

Summary

The U.S. apple juice market has experienced a large growth in demand during the last 10 years. This expanding apple juice market is increasingly important to U.S. apple growers. Imports of apple juice concentrate have expanded greatly since 1979, and now comprise over 50% of the total supplies for apple juice. Imported apple juice concentrate in a direct substitute for U.S. grown apples.

An analysis was made of prices received by growers for juice apples. The results show that prices for juice apples are closely correlated with (1) apple crop size in the U.S., (2) the quantity of imported apple juice concentrate, (3) prices of frozen orange juice, and (4) consumer disposable income. These factors explain 87% of the variation in prices for juice apples. The results can be used to predict prices for juice apples as the above factors change.

The expanding U.S. apple juice market is potentially especially important to U.S. apple growers because their productive capacity is increasing while demand for some

traditional major markets such as for applesauce and slices are either stagnate or declining. U.S. apple production is expected to experience a dramatic increasing trend during the next few years. While a portion of this increase in supply can be expected to be sold into fresh market, which has a gradually increasing demand, the expected increases in supply are likely to be considerable larger than the increases in fresh market demand. Thus the growing U.S. market for apple juice will be needed by U.S. growers in order to market their expanding production from orchards that are already planted.

An ironic and troublesome feature for U.S. growers is that while the U.S. apple juice market is growing greatly, demand for U.S. juice apples is stagnate or declining somewhat due to the huge influx of imported apple concentrate. Imports have become a major problem for U.S. apple growers, and have had a major impact on prices received by growers for juice apples. Without changes in U.S. trade policy and/or dramatic weakening of the U.S. dollar, imports are expected to continue to have major effects on U.S. apple growers.

Appendix

Table 1. Data for Price-Determining Factors

Year	Grower Price for Juice Apples, U.S., Season Average (PJ)	Apple Crop, Size, U.S., Utilized Production (A)	Imports of Apple Juice, Concentrate, Bu. Equivalents (I)	Retail Price Frozen Orange Juice 6 Oz. Can (PO)	U.S. Real Disposable Income Per Capita (DI)	Consumer Price Index U.S., All Items Annual Average	U.S. Population
	$/T.	Million bu.	Million bu.	¢	$	1967 = 100	Millions
1971	36.1	144.8	9.5	24.9	2,984	121.3	207.7
1972	55.9	139.8	7.1	25.0	3,081	125.3	209.9
1973	95.9	148.2	5.7	24.6	3,242	133.1	211.9
1974	64.0	154.4	6.0	25.8	3,159	147.7	213.9
1975	52.6	168.3	5.9	25.4	3,148	161.2	216.0
1976	91.6	152.1	9.6	28.7	3,212	170.5	218.1
1977	109.0	157.8	8.9	33.3	3,286	181.5	220.3
1978	110.0	180.5	12.4	45.4	3,388	195.4	222.6
1979	103.0	192.0	18.5	52.0	3,378	217.5	225.1
1980	73.7	209.8	12.1	56.0	3,254	246.8	227.7
1981	87.9	183.5	22.7	57.0	3,257	272.4	229.9
1982	103.0	192.8	30.9	73.0	3,246	289.1	232.1
1983	89.0	197.5	44.6	71.0	3,343	298.4	234.3
1984	88.0	196.9	50.1	70.0	3,499	311.1	236.7

Sources:

Price of Juice Apples and Apple Crop Size: Non-Citrus Fruits and Nuts, Statistical Reporting Service, U.S. Department of Agriculture (various issues).

Imports: Foreign Agricultural Service, U.S. Department of Agriculture, as reported in 1985 Crop Statistics and Market Analysis by Thomas Butler and Marie Bernthal, American Agriculture Marketing Association, Lansing, MI.

Orange Juice Price: "Estimated Retail Food Prices by City," U.S. Department of Labor Statistics 1970-1979. "Consumer Prices: Energy & Food," U.S. Department of Labor, Bureau of Labor Statistics, 1980-1985.

Disposable Income, Consumer Price Index, Population: Economic Report of the President, U.S. Government Printing Office, 1985.

Single Equation Model for Grower Prices Received for U.S. Juice Apples

Years 1971 - 1984
14 Observations
LS // Dependent Variable is PJ

	COEFFICIENT	STANDARD ERROR	T-STATISTIC
Constant	-417.60289	72.330362	-5.7735490
A	-1.2934907	0.2732783	-4.7332359
I	-2.0946201	0.3959070	-5.2906867
PO	2.4175555	0.4792116	5.0448597
DI	0.2015257	0.0253688	7.9438440

R-squared	0.913100	Mean of dependent var	82.89286
Adjusted R-squared	0.874478	S.D. of dependent var	22.88118
S.E. of regression	8.106585	Sum of squared resid	591.4504
Durbin-Watson stat	2.139590	F-statistic	23.64193
Log likelihood	-46.06978		

PJ = Price of juice apples received by U.S. growers, season average price (dollars per ton).

A = Apple crop size in the United States, utilized production, in millions of bushel

I = Imports of apple juice concentrate in millions of equivalent bushels.

PO = Price of frozen orange juice at retail, 6 oz. can, cents per can.

DI = Disposable income, U.S., per capita, deflated by the Consumer Price Index, in dollars per person.

Residual Plot	obs	RESIDUAL	ACTUAL	FITTED
| : *| : |	1971	-0.80106	36.1000	36.9011
| * : | : |	1972	-12.0630	55.9000	67.9630
| : | * : |	1973	4.45695	95.9000	91.4431
| : * | : |	1974	-4.51681	64.8000	69.3168
| : | * : |	1975	4.36617	52.6000	48.2338
| : | : * |	1976	9.29267	91.6000	82.3073
| : | * : |	1977	6.46069	109.000	102.539
| : * | : |	1978	-5.63218	110.000	115.632
| : |* : |	1979	1.05025	103.000	101.950
| : * | : |	1980	-3.27687	73.7000	76.9769
| : * | : |	1981	-4.00850	87.9000	91.9085
| : | * : |	1982	3.93749	103.000	99.0625
| : | : * |	1983	9.91867	89.0000	79.0813
| *: | : |	1984	-9.18446	88.0000	97.1845