Market Price Analysis for Washington Organic Apples and Pears in 2003-2006

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Organic tree fruit production has attracted a significant interest over the last decade. Total US sale of organic food was about $13.8 billion for 2005, and is growing at near 20% annually (OTA, 2006). Fresh fruits and vegetables are the largest category of organic food sales (Dimitri and Greene, 2002). The state of Washington is the leading state in organic apple production, accounting for about 38% of total US organic apple acres. Certified Washington State organic apple acreage increased from well below 500 total acres in the late 1980s to 7,642 acres in 2006 with an additional 4,100 acres in the transition process. Pear is another major fruit grown in Washington, occupying about one third of national acreage. Certified organic pear acreage is 1,251 acres with 276 acres in transition (Granatstein, Kirby and Feise, 2007).

Due to the reasons we have discussed in the last report (Wang and Ge, 2006), the organic apple and pear certified acreages dropped since their peaks in 2002 and with a slight increase in 2006 for apples (Granatstein and Kirby, 2006).

In this updated project, we estimate an inverse demand function to reveal the price response to quantities for organic apples and pears separately from 2003 to 2006. This demand function includes multiple grade fruits so that the cross grade effect can be evaluated. Specific objectives of this paper include, (1) estimating the percentage of low grades fruits marketed in recent years; (2) investigate the general price respond to quantities supplied to market; (3) studying the relationship between crop size of the lower grade fruits and the price response of higher grade fruits; and (4) analyzing the price boosting effect from a reduction in lower grade supplies.

Data

The data source we use in here is the same with that of last report but the range of the data is extended from November 10, 2003 to August 28, 2006 for apples and from August 23, 2004 to August 28, 2006 for pears.

Over the three year period, the largest apple variety is Gala, accounting for 29.80%, followed by Red Delicious, 20.17%, Fuji, 19.65%, Golden Delicious, 17.68%, and Granny Smith, 12.70%, of the total quantity. The dominating pear variety is D'Anjou, accounting for 74.34%, followed by Bartlett, 17.94%, and Bosc, 7.72%, of the total quantity. There are 31,130 weekly entries for apples, each of which represents the total pack-out transactions of one size-grade

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apples in a particular package type, for a particular variety, and from a particular storage during a week. The sample size for pears is much smaller, only 4,453 weekly entries.

The various apple sizes of different pack types are converted into three categories according to table 1. The criteria used to measure different grades for apple remains the same but since only two grades are reported in the pear transactions, WAF and US#1, we do not consider either to be low grade because US#1 dominates the sales indicating it is the most popular grade.

Table 1. Apple and Pear Size Conversion

Apple							Pear						Grouping
Tray pack			Euro Pack		Bag Diameter Inch		Tray pack			Euro Pack	Bag Diameter Inch		
Standard	2 Layer	1 Layer	2 Layer	3 Layer			Standard	Half box	1 Layer	2 Layer			
42LB	21LB	12LB	27LB	40LB	3LB	5LB	44LB	22LB	12LB	27LB	3LB	5LB	
36	36	36	25	40									Large
48	48	48	35	52									Large
56	56	56	40	60			50		12,14				Large
64	64	64	45	68			60	30	16				Large
72	72	72	50	75			70	35	18	42			Large
80	80	80	55	83			80	40	22	48			Large
88	88	88	60	90	3	3	90	45		54			Medium
100	100	100	70	105			100	50	27	60			Medium
113	113	113	78	117			110	55		66			Medium
125	125	125	84	126	2.75	2.75	120	60		72			Medium
138	138	138	90	135			135	65,70		81	2.5	2.5	Small
150	150	150	100	150	2.5	2.5	150	75			2.375	2.375	Small
163	163	163	108	162			165				2.25	2.25	Small
175	175	175	122	183			180				2.125	2.125	Small
198	198	198	134	201	2.25	2.25							Small
216	216	216	140	210									Small

We analyze three different pack types for apples and among them, the most popular Tray Pack (TP) accounted for 57.89% of the total, Bag (BG) with 27.17%, the new and increasing Euro Pack (EU) of 14.94%, respectively. Pack types excluded are Cell Pack, Heavy Pack and Triwall bin because their quantities are very limited. Most of the apples, 61.56% boxes, are from Controlled Atmosphere (CA) storage and the rest 38.44% from Regular (RG) cold storage. Same pack types are included for the pears with sizes ranging from large (50 to 80), medium (90 to 120), to small (135 to 165).

Because of the different weight of each type of package, we convert all quantity units into a standard 42 pound box (thereafter referred to box) for apples and 44 pound box for pears. There are altogether 3,267,619 boxes of apples reported. Their prices range from $5.04/box to $77.78/box with a weighted average of $23.10/box. (See Table 1 for the conversion details.) We also convert all pear units into the standard box (See Table 1 for the conversion details.) There are altogether 429,004 boxes of pears reported and the prices range from $7.04/box to $62.04/box with a weighted average of $23.93/box. It appears that apples and pears are sold at about same price level but price variation is larger for apples.

The data features obvious seasonal pattern. In general, regularly stored fruits leave the market for several months between May and August. The Gala apples and Bartlett pears show an early harvest in late August and an early end of RG fruits in April. As for CA stored fruits, normally they entered the market no early than November. The exceptions are Gala apples which have several observations during harvest months, and Red Delicious apples and Bartlett pears which have a lot of observations between July and August. Bosc pears from CA storage are only sold between May and October.

Analysis

The low grade apples are marketed as fresh for each of the varieties (Upper panel of Table 2). For the five varieties over the three years, about 2.30% of apples are in grade US Extra Fancy or lower. Fuji has the highest percentage, 4.47%, in the lower grades, followed by Granny Smith, 3.80%, and the other three varieties each has less than 3% in the lower category. Because the prices of these grades are lower, the sale revenues they bring to the industry only account for 1.56% of the total. They range from 3.12% for Fuji down to 0.58% for Red Delicious.

Table 2. Quantities and Sales for apple (2003-2006) and pear (2004-2006)

		Percent Weight				Percent by Sale	
	Quantity	Over all varieties	Low Grade*	Small Size	Sale	Low Grade*	Small Size
	(million pound)	(%)	(%)	(%)	(million $)	(%)	(%)
Apple							
Fuji	27.49	19.65	4.47	14.57	16.56	3.12	10.55
Gala	41.69	29.80	1.20	34.29	23.55	0.95	27.65
Golden Delicious	24.73	17.68	2.55	22.04	13.58	1.68	17.30
Granny Smith	17.77	12.70	3.80	30.92	9.81	2.51	24.18
Red Delicious	28.21	20.17	0.89	34.42	13.31	0.58	31.54
Apple Total	139.89	100.00	2.30	27.88	76.81	1.56	20.86
Pear							
D'Anjou	22.34	74.34	83.26	15.26	11.98	85.55	10.62
Bartlett	5.39	17.94	83.94	6.94	2.99	88.97	4.42
Bosc	2.32	7.72	94.04	6.19	1.28	95.35	3.38
Pear Total	30.05	100.00	84.21	13.07	16.25	86.99	8.91

Note, the "Low Grade" denotes US#1 for pears, which is the dominating pear grade.

As for different sizes of fruits, we found the small ones account for a significant portion of the total crop for apples (upper panel of Table 2) but under 10% for pears.

The inverse demand function approaches will be taken to conduct regression analysis using price as dependent variables and quantities and other impacting factors as independent variables (Cornes, 1992). These factors include year variable, size, pack type and storage type, all of which are assumed to affect the price of fruits to some extent. Hedonic price functions are incorporated in this case to measure a wide variety of commodity characteristics such as size and grade, based on Lancaster's (1966) theory that consumers take commodity characteristics as the fundamental sources of utility[1]. The fruit prices are highly seasonal and variables accounting for seasonality need to be included (Wang and Ge, 2006). The quality of the fruits in regular storage facilities may decrease over time after harvest resulting in a decreasing in prices. Large supply of fresh fruits in the fall, habitual consumption of apples in the fall and winter, and more competition from other available summer fruits such as melons may all have a seasonal effect on apple and pear prices. Hence we include additional five bi-monthly seasonal dummy variables as themselves as well as in combination with the dummy variable for storage, so that the seasonality effect is allowed to be different for apples from the regular storage versus from CA storage.

The analysis results for apples and pears are discussed separately in the following. Notice that the analyses for some certain grades are left out because these particular grades have so few transactions for the particular varieties that statistic analysis is invalid. We also discuss those statistically significant effects only, because the insignificant estimates mean they are not different from zeros and have no effect on the prices.

Apples

The regression results for apples are reported in Tables A1 to A5 in Appendix.

Fuji

For Fuji apples (Table A1), prices in crop year 04/05 show \$0.11 to \$0.61 lower than the year before for all grades. However, the price changes are different across grades in crop year 05/06. The highest quality WAXFP price is \$0.04 above its price in crop year 03/04, WAXF#2 price is still \$0.18 below, and the other grades reach the similar price levels as their 03/04 crop year. This means the price drop in 04/05 has been recovered in the year 05/06.

Medium sized apples have fifteen and nineteen cents price premiums over the small sized apples in WAXF grades and nine cents premium in the WAXFP grade. The large sized fruits have additional five and two cents premiums for WAXFP and WAXF#1 grades but similar to the medium size for the other grades. The Euro Pack apples have a price premium over the regular Tray Pack apples about six cents for WAXFP and four cents for WAXF#1, but 37 cents for WAXF2, while the Bagged apple prices are twelve cents lower than the Tray Pack for WAXFP only.

The prices of each grade react to the quantity of own grade negatively, means there is an opposite relationship between the price and quantity of apples in each grade. One percent increase in own quantity causes 0.025 percent fall for WAXFP and 0.022 percent fall for WAXF#1 as well as 0.19 percent fall for USXF. So there is less than one percent price reaction to one percent quantity change. Worth of mentioning, the quantity of low grades (all grades in the US category) does have a negative effect on WAXFP and WAXF1 prices, the two highest priced fruits. But again, the response is inelastic in that one percent increase in the total boxes of low grades apples only causes 0.029 and 0.025 percent fall in WAXFP and WAXF1 prices, respectively.

We also observed that the prices of apples in regular storage tend to decrease later in the season after harvest. To make it easier to understand, we present the seasonal patterns of prices based on these variables for the top two grades WAXFP and WAXF#1 in Figure 1.

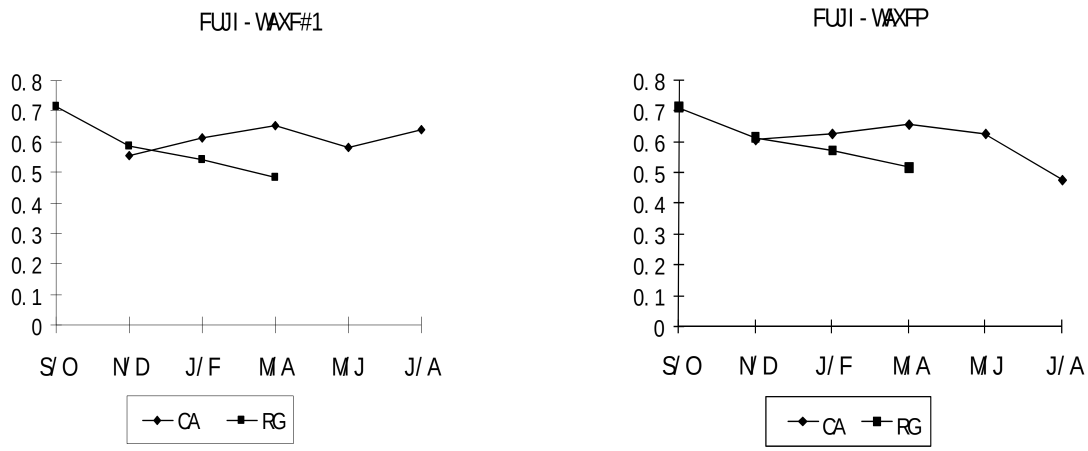

Figure 1. Fitted prices with seasonal effects for Fuji apples of two top grades.

The down sloping curve for RG price indicates the quality of the fruits decreases overtime without being kept in CA storage. This makes their prices to fall below the prices of apples from Controlled Atmosphere after two months of harvest. But the prices for CA storage actually increase over time caused by the fact that all the supply of fruits (organic or non-organic, apples or other fruits) reduces after early fall. For example, the prices for WAXFP increase about two cents every two months after the fall season. The CA curves in Figure 1 show this upward slope from November to April. After April, the Fuji apple prices stagnate or even decrease.

<u>Gala</u>

For Gala apples (Table A2), crop year 04/05 prices show about \$0.11 lower than the year 03/04 for all grades, and WAXF#2 price is \$0.35 lower. The 05/06 crop year has an increase in price back to the 03/04 level. Medium size apples have about 10 cents price premium over the small sized apples, and the large sized fruits have about 16 cents premium.

The Euro Pack apples have a price premium over the regular Tray Pack apples up to 24 cents, while the Bagged apple prices are six cents lower than the Tray Pack for WAXFP. The Bagged apple prices can be same as tray pack for WAXF#1, or higher as for WAXF#2.

On the price response to quantities marketed, there is no clear evidence observed that lower grade quantities would affect higher grade prices. The Gala price is not sensitive to any quantities in general and the cross-year price movement is also smaller than Fuji. Gala has a more stable price.

It is clear that regular stored Gala apple price drops over time after harvest but those from Controlled Atmosphere storage increases as the inventory depletes itself (Figure 2). Gala is an early variety that new fruits start to appear in market in July/August, when the higher price for regular stored fruits can be obtained. As a result, the regular storage apples only last till February, and no inventory is kept in CA room up to July/August. The CA price never falls during the period from September to June.

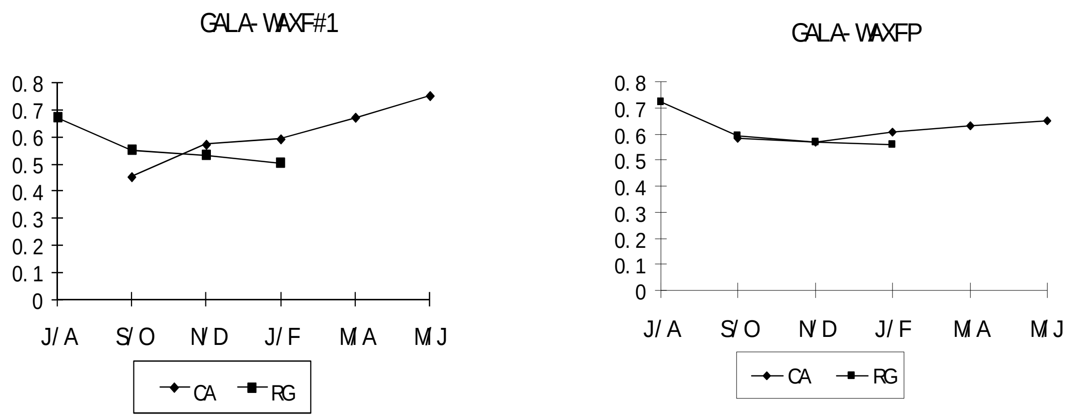

Figure 2. Fitted prices with seasonal effects for Gala apples of two top grades.

Golden Delicious

Golden Delicious prices behave similar to Fuji (Table A3). Crop year 04/05 prices show \$0.14 to \$0.21 drop than the year before, while crop year 05/06 price rises a little but still runs a few cents lower than the 03/04 level. None of the size variables have significant effect on prices, which implies that Golden Delicious apples of all sizes, large or small, are sold at about the same price. The Euro Pack apples have a price premium of \$0.07 to \$0.24 over the regular Tray Pack apples for all grades with shipments, while the Bagged apple price for WAXFP is \$0.22 lower than the Tray Pack and about same as tray pack for other grades.

The quantity of low grades does not have a negative effect on any grade apples. We also observe that the prices of apples in regular storage decrease since harvest for WAXFP and WAXF#1, indicating the quality of the fruits decreases overtime without being kept in CA storage. Comparing to Fuji, the price drop is sharp for almost \$0.30 during March and April for WAXFP. This indicates that the Golden Delicious is harder to store than Fuji. On the other hand, the CA stored apple price increases slightly as inventory is depleting over the season. (Figure3).

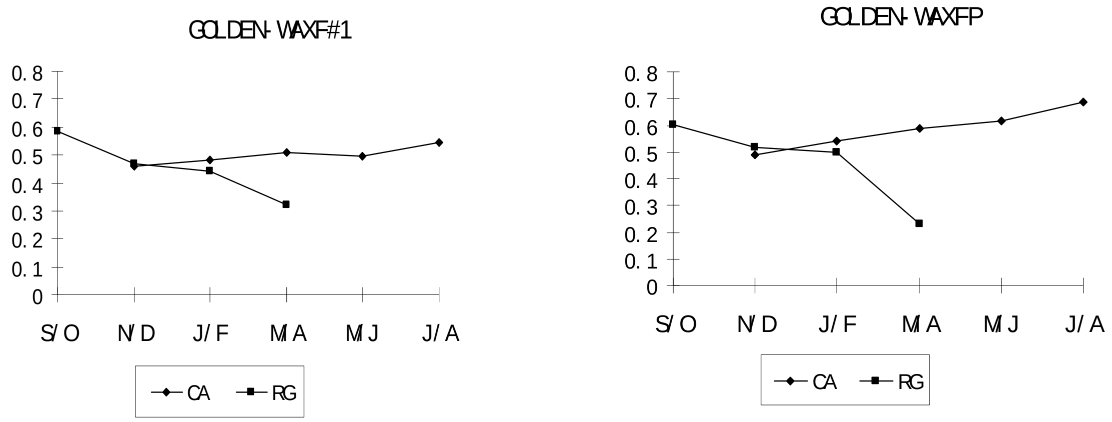

Figure 3. Fitted prices with seasonal effects for Golden Delicious apples of two top grades.

Granny Smith

Similar to the previously discussed varieties, Granny Smith apples (Table A4) also experience a price drop in the crop year 04/05 for \$0.08 and \$0.04 from year before for WAXFP and WAXF#1, the top two grades. However, the crop year 05/06 does not show any increase for WAXF#1, recover about eight cents for WAXFP, but drop for six cents for USXF. The WAXFP price in 05/06 is about same as the year 03/04.

There is no significant price effect for medium size compared to small size, and the large size impact on price is also very small, only adding three cents premium to the WAXFP grade but not to any other grades. The Euro Pack apples have a price premium over the regular Tray Pack apples of eight to seventeen cents for WAXFP, WAXF#1, and WAXF#2, while the Bagged apple price for WAXFP is \$0.16 lower than the Tray Pack only.

Except for the negative effect on own price for each grade, the quantity of low grades does not have a negative effect on higher grade prices.

Similar to all other varieties discussed earlier, Granny Smith also shows a price decrease over the season for fruits in regular storage, and a price increase for fruits in CA storage. From Figure 4 we also observe that Granny Smith is an early ripe variety like Gala, that it has first new crop in the months of July/August.

Red Delicious

Red Delicious is the most traditional variety and has started to lose market share to new varieties. There are very few transactions for WAXF#2, and no regression analysis is reported for this grade. The results in Table A5 show that the 04/05 crop year observes a roughly fifteen cents price drop across all grades than its 03/04, and another three or four cents drop in 05/06 when other varieties have an increase. Medium and large sized apples are sold about eight and eleven cents more expensive in WAXFP and WAXF#1 grades, respectively, than the small sized fruits. Euro Pack is sold ten and 16 cents more than Tray Pack for WAXFP and WAXF#1.

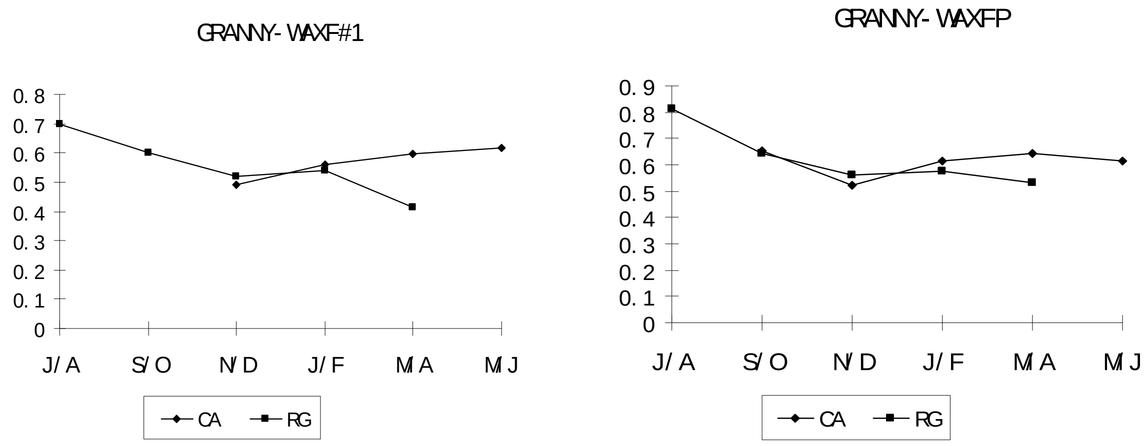

Figure 4. Fitted prices with seasonal effects for Granny Smith apples of two top grades.

Due to the small number of observations of low grade apples for Red Delicious, the quantity of this grade sold to the market does not affect the price of higher grade apples, and only has a negative effect on its own price.

There is a clear time effect on the price of Red Delicious from Regular storage (Figure 5). The price drops about three cents every month since harvest. However, apples from Controlled Atmosphere storage don't have that problem.

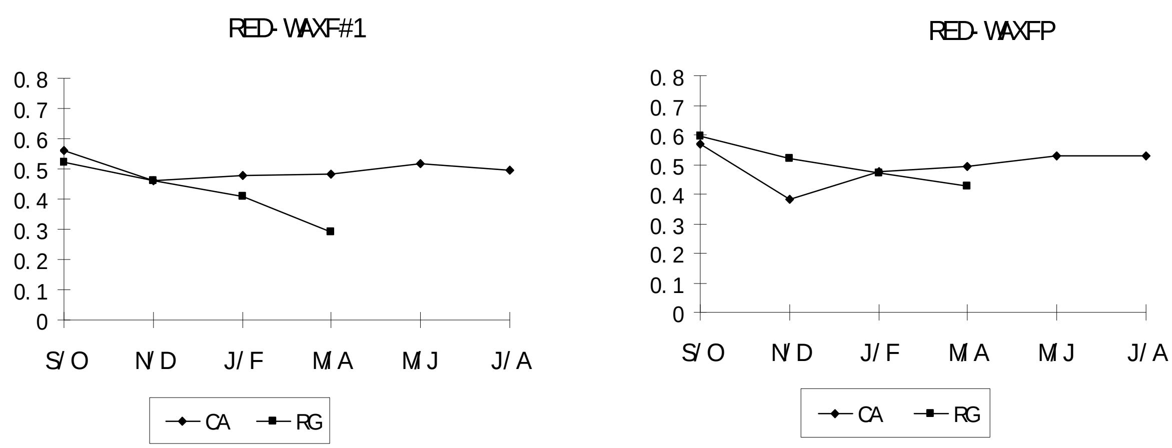

Figure 5. Fitted prices with seasonal effects for Red Delicious apples of two top grades

Impact of marketing low grade apple on the industry profitability

The aforementioned 0.0291 and 0.0245 price elasticities for WAXFP and WAXF#1 grade Fuji apples suggest that if low grade apples in crop year 05/06 reduce by 1% which is 44 boxes for the entire crop year, the prices of WAXFP and WAXF1 will increase by \$0.00021/lb, and $0.000071/lb. This trade-off converts to a reduction in low grade apple sale of $912.19 (assuming not selling as cull but just disposing them), and a sale increase of WAXFP and WAXF1 of $1205.01 and $765.04, respectively. For Fuji apples, market less low grade apples will make the whole industry more profitable.

The impact of the low grade crop volume on the price of other grades is not statistically significant for Gala, Golden Delicious, Granny Smith and Red Delicious. It does not help improve the revenue of the industry by reducing the low grade crop volume.

Pears

All regression results for pears are reported in table A6 in Appendix.

There are only two grades, US#1 and WAF, marketed for the two crop years. Based on the price of 04/05 crop year, prices have improved for crop year 05/06 by about ten cents per pound for D'Anjou, the dominating variety, by seven cents for Bartlett US#1, sixteen cents, Bartlett WAF. Prices remain the same for Bosc, which has limited transactions over the two years. The price of medium size pears is about $0.12 to $0.24 higher than their small size counterpart for all variety and graded except for the WAFs of Bartlett and Bosc. Large size pear prices are about six cents higher than the medium size price.

Different to apples, the pears in Euro Packs are not necessarily more expensive than regular Tray Packs. The WAF D'Anjou price is $0.16 higher for Euro Pack, but US#1 Bosc price is actually $0.08 lower. On the other hand, the Bagged price is $0.14 to $0.36 higher than Tray Pack across all grades except for the WAFs of Bartlett and Bosc. The price response to own quantity is in general negative with the exception for WAF D'Anjou. The elasticities for US#1 D'Anjou, WAF Bartlett, and US#1 Bosc are respectively -0.030, -0.038, and -0.027, indicating they are inelastic.

From the Figures 6 through 8 we can see that pears have shorter storage life than apples. They usually disappear from market by June even those in CA storage. Pears in regular storage have a price drop sharply for Bartlett and Bosc, and a mild price drop for D'Anjou. Bartlett is the early mature variety with new crops in market in July/August.

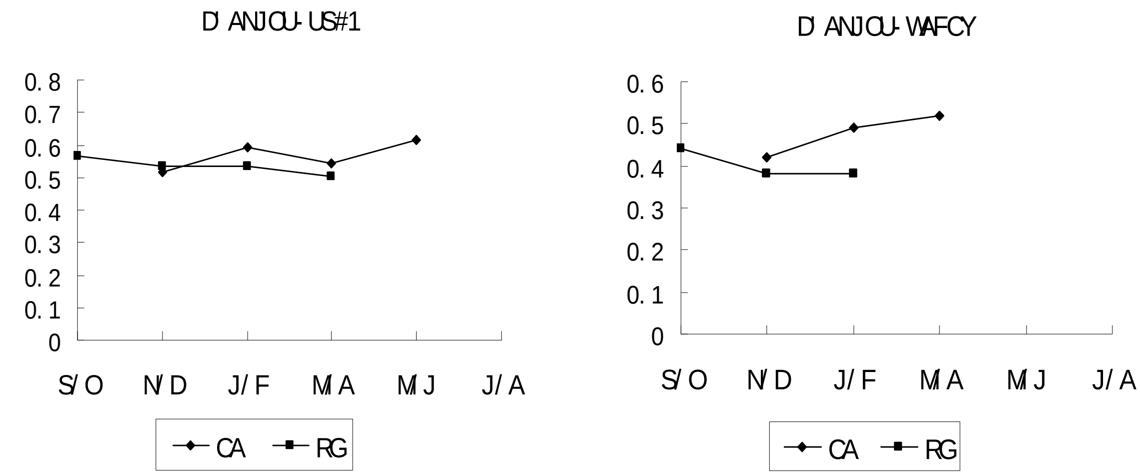

Figure 6. Fitted prices with seasonal effects for D'Anjou pears.

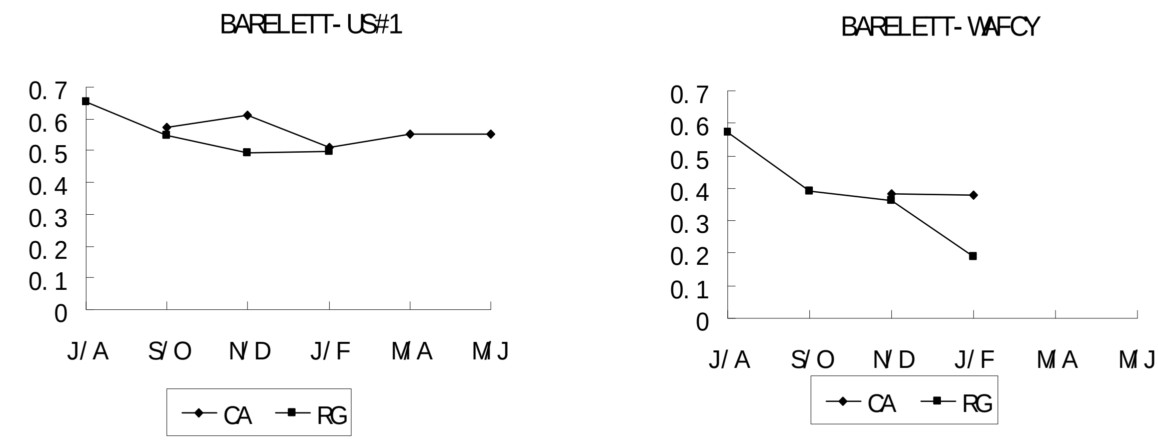

Figure 7. Fitted prices with seasonal effects for Bartlett pears.

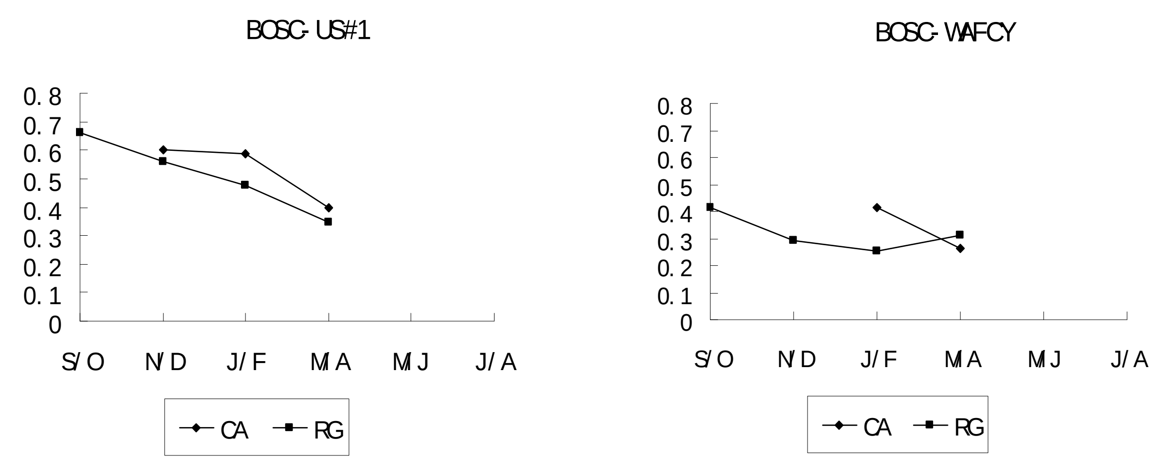

Figure 8. Fitted prices with seasonal effects for Bosc pears.

Summary

In this analysis, we analyze the prices for WA organic apples and pears using the sales data from November 10, 2003 to August 28, 2006, organized by the Wenatchee Valley Traffic Association, the most complete dataset available for WA apples and pears. The apples are from both Wenatchee and Yakima, and the five biggest varieties, Red Delicious, Golden Delicious, Fuji, Gala, and Granny Smith, are analyzed, while the other varieties do not have enough data for the analysis. D'Anjou, Bartlett and Bosc, major pear varieties in WA are also analyzed.

The apple prices range from \$5.04 to \$77.78 with a weighted average of \$23.10 per standard 42 pound box. The pear prices range from \$7.04 to \$62.04 with a weighted average of \$23.93 per standard 44 pound box. It appears that apples and pears are sold at about same price level but price variation is larger for apples.

The crop year 04/05 had a low market price for all apples and pears, and the crop year 05/06 market price recovered from the year before to about the 03/04 level. During this period, the low grade apples (US Extra Fancy or lower) sold to market account for about 2.3% in volume and 1.6% in value. These numbers, compared to the higher values for period without 05/06 which are 3.3% and 2.6%, suggest that a lot less low grade apples were marketed in the crop year 05/06.

The crops sizes have a slightly negative impact on prices only. The crop size of the lower grade apples has a negative impact on the price of higher grade apples for Fuji only. However, based on the market elasticities, only Fuji will benefit from a higher sales value if the lower grade apples are removed from the market, without considering the value of these fruits being sold to processors. The sales gain will be less than \$1,000 over all.

We also find that the Euro Pack for organic pears is not necessarily sold at higher price than traditional Tray Pack, and Bag not necessarily at lower price, as were the cases for apples. Both apple and pear prices are highly seasonal, with those from regular storage having a price drop and those from controlled atmosphere storage having a price rise up to early summer in general. Pears have been marketed for a shorter period than apples, although those from CA storage still enjoy a price increase by May/June for D'Anjou.

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Table A1. Organic Fuji Apple Price Responses to Quantity and Other Attributes

	WAXFP	WAXF#1	WAXF#2	USXF
Constant	0.48***	0.56***	1.04***	0.58***
D04	-0.11***	-0.11***	-0.61***	-0.13***
D05	0.04***	0.01	-0.18***	0.014
DSM	0.094***	0.19***	0.15*	-0.0025
DSL	0.14***	0.21***	0.14*	N/A
DEU	0.056***	0.042***	0.37***	N/A
DBG	-0.12***	-0.0037	-0.014	-0.016
D1	0.0062	0.035	-0.19	N/A
D2	0.13*	-0.085	-0.37***	0.011
D3	0.15**	-0.03	-0.47***	N/A
D4	0.18***	0.011	-0.46***	0.12***
D5	0.15**	-0.06	-0.29**	N/A
DRG	N/A	0.79***	N/A	N/A
D1*DRG	0.23***	-0.75***	-0.29**	0.22***
D2*DRG	0.008	-0.76***	-0.17**	N/A
D3*DRG	-0.054***	-0.86***	-0.12**	-0.062**
D4*DRG	-0.14***	-0.96***	-0.26***	-0.17***
D5*DRG	N/A	-1.01***	-0.014	N/A
Q_{WAXFP}	-0.024***	-0.001	0.022**	-0.011*
$Q_{WAXF\#1}$	-0.0076***	-0.048***	0.0073	-0.01
$Q_{WAXF\#2}$	0.011	0.0097	0.041	0.012
Q_{WAF}	-0.12**	-0.052	-0.44**	-0.39**
$Q_{LowGrade}$	-0.065***	-0.053***	0.0049	-0.11***
Number of observations	535	494	109	139
R^2	0.74	0.63	0.65	0.64

Note, ***, ** and * mean statistically significant at 1%, 5% and 10%, respectively.

Table A2. Organic Gala Apple Price Responses to Quantity and Other Attributes

	WAXFP	WAXF#1	WAXF#2	USXF
Constant	0.47***	0.41***	0.55***	0.45***
D04	-0.12***	-0.11***	-0.35***	-0.11***
D05	0.0006	0.018	0.018	0.015
DSM	0.093***	0.11***	N/A	0.11
DSL	0.16***	0.16***	0.17***	0.12
DEU	0.14***	0.064***	0.24***	N/A
DBG	-0.062***	-0.028	0.21***	0.069
D1	0.062	0.000032	N/A	N/A
D2	0.048	0.12*	-0.0066	-0.10***
D3	0.084	0.14*	N/A	-0.064*
D4	0.11*	0.22***	-0.013	0.0064
D5	0.13*	0.30***	-0.093	0.021
DRG	0.20***	0.22***	0.32***	N/A
D1*DRG	-0.19**	-0.12	-0.23**	-0.091***
D2*DRG	-0.20***	-0.26***	-0.32***	-0.0036
D3*DRG	-0.25***	-0.31***	-0.48***	-0.02
D4*DRG	-0.38***	-0.40***	-0.45***	-0.20**
Q_{WAXFP}	-0.0012	0.0012	-0.0096***	0.0032
$Q_{WAXF\#1}$	-0.0024	-0.032	-0.00024	-0.0031
$Q_{WAXF\#2}$	0.003	0.057***	-0.091*	0.018
$Q_{LowGrade}$	0.0062	-0.024	0.046	-0.097
Number of observations	580	547	81	111
R^2	0.74	0.68	0.80	0.56

Note, ***, ** and * mean statistically significant at 1%, 5% and 10%, respectively.

Table A3. Organic Golden Apple Price Responses to Quantity and Other Attributes

	WAXFP	WAXF#1	WAXF#2	USXF
Constant	0.87***	0.60***	0.71***	0.35***
D04	-0.17***	-0.15***	-0.21***	-0.14***
D05	-0.035***	-0.085***	-0.052**	-0.061
DSM	-0.084	0.072	0.011	0.13
DSL	-0.072	0.075	N/A	0.17
DEU	0.066***	0.10***	0.089***	0.24**
DBG	-0.22***	-0.03	0.0018	0.17
D1	-0.18***	-0.035	-0.34***	-0.21
D2	-0.2***	-0.086**	-0.2**	-0.12*
D3	-0.15***	-0.064*	-0.13**	-0.079
D4	-0.1***	-0.035	0.013	-0.071
D5	-0.072***	-0.05	0.059	0.068
DRG	0.15	0.08*	N/A	N/A
D1*DRG	-0.057	-0.005	0.35***	0.26*
D2*DRG	-0.12	-0.07	0.033	0.042
D3*DRG	-0.19*	-0.12**	-0.0046	0.011
D4*DRG	-0.51***	-0.27***	N/A	N/A
D5*DRG	N/A	-0.16	N/A	N/A
Q_{WAXFP}	-0.014*	-0.0047	0.0092	-0.0068
$Q_{WAXF\#1}$	-0.031***	-0.041**	-0.079***	-0.012
$Q_{WAXF\#2}$	0.037***	0.03***	0.011	0.035
Q_{WAF}	0.051	-0.076	0.32**	-0.1
$Q_{LowGrade}$	-0.026	-0.049	-0.022	-0.01
Number of observations	710	404	189	102
R^2	0.63	0.53	0.64	0.35

Note, ***, ** and * mean statistically significant at 1%, 5% and 10%, respectively.

Table A4. Organic Granny Smith Apple Price Responses to Quantity and Other Attributes

	WAXFP	WAXF#1	WAXF#2	USXF
Constant	0.86***	0.52***	0.51***	0.46***
D04	-0.076***	-0.04***	N/A	-0.15
D05	0.011	-0.04***	N/A	-0.058**
DSM	N/A	0.077	0.13	-0.020
DSL	0.028***	0.093	0.12	N/A
DEU	0.077***	0.13***	0.17***	N/A
DBG	-0.16***	-0.05	-0.026	0.021
D1	-0.16***	N/A	N/A	0.23***
D2	-0.29***	-0.038	N/A	0.051
D3	-0.20***	0.030	N/A	N/A
D4	-0.17***	0.067	0.071**	0.066**
D5	-0.20***	0.088	0.0027	0.11
DRG	N/A	0.17*	N/A	N/A
D1*DRG	-0.012	-0.1*	-0.092*	-0.13**
D2*DRG	0.039	-0.14	-0.072*	-0.018
D3*DRG	-0.039***	-0.19**	-0.035	-0.021
D4*DRG	-0.11***	-0.35***	0.035	-0.15**
D5*DRG	N/A	-0.38***	N/A	-0.059
Q_{WAXFP}	-0.016**	-0.0039	0.0011	-0.0057
$Q_{WAXF\#1}$	-0.004	-0.032**	-0.0065	-0.0039
$Q_{WAXF\#2}$	-0.014	-0.0027	-0.057	0.017
$Q_{LowGrade}$	-0.017	-0.0051	-0.13	-0.13**
Number of observations	500	360	92	126
R^2	0.69	0.62	0.66	0.44

Note, ***, ** and * mean statistically significant at 1%, 5% and 10%, respectively.

Table A5. Organic Red Apple Price Responses to Quantity and Other Attributes

	WAXFP	WAXF#1	USXF
Constant	0.52***	0.44***	0.42***
D04	-0.16***	-0.12***	-0.13***
D05	-0.038***	-0.035***	0.024
DSM	0.078***	0.11***	-0.062
DSL	0.085***	0.11***	-0.014
DEU	0.10***	0.16***	N/A
DBG	0.036	0.097***	0.082
D1	0.041	0.067**	0.047
D2	-0.15***	-0.035	N/A
D3	-0.054***	-0.019	0.14
D4	-0.036**	-0.014	0.053
D5	-0.00069	0.022	0.044
D1*DRG	0.025	-0.039	0.14
D2*DRG	0.14*	0.0015	0.13
D3*DRG	-0.0031	-0.070***	-0.12
D4*DRG	-0.069	-0.19***	N/A
Q_{WAXFP}	-0.000017	-0.0000087	-0.00000068
$Q_{WAXF\#1}$	-0.0000029	0.00000011	-0.000017
$Q_{WAXF\#2}$	0.0011***	0.0011***	0.0012**
$Q_{LowGrade}$	0.000055	-0.000018	-0.00046*
Number of observations	632	492	49
R^2	0.65	0.63	0.55

Note, ***, ** and * mean statistically significant at 1%, 5% and 10%, respectively.

Table A6. Organic Pear Price Responses to Quantity and Other Attributes from 2004-2006

	D'Anjou		Bartlett		Bosc	
	WAF	US#1	WAF	US#1	WAF	US#1
Constant	0.55***	0.496***	0.36***	0.36***	0.42***	0.48***
D05	0.11***	0.095***	0.16***	0.066***	-0.0068	0.0016
DSM	0.17***	0.19***	-0.028	0.24***	N/A	0.12***
DSL	0.23***	0.25***	N/A	0.30***	0.021	0.21***
DEU	0.16***	-0.017	-0.0036	0.033	-0.042	-0.077**
DBG	0.36***	0.14***	N/A	0.18***	N/A	0.34***
D1	N/A	N/A	-0.012	-0.036	N/A	0.11
D2	-0.40***	-0.2***	N/A	N/A	N/A	0.014
D3	-0.33***	-0.12**	-0.0048	-0.1***	0.0024	N/A
D4	-0.30***	-0.17***	N/A	-0.055**	-0.15	-0.19***
D5	N/A	-0.10*	N/A	-0.057	N/A	N/A
DRG	N/A	0.13**	0.19***	0.044	N/A	N/A
D1*DRG	-0.38***	-0.28***	-0.17*	-0.068	N/A	-0.039
D2*DRG	-0.039	-0.11*	-0.21***	-0.16***	-0.12***	-0.041
D3*DRG	-0.11***	-0.19***	-0.38***	-0.054	-0.16	-0.11***
D4*DRG	-0.056*	-0.17**	N/A	N/A	0.047	-0.05
Q_{WAFCY}	0.029*	0.021***	-0.071*	0.0090	-0.18	0.0049
$Q_{US\#1}$	0.0017	-0.026***	-0.0083	-0.011	-0.0019	-0.055**
Number of Obs.	302	656	96	193	59	177
R^2	0.73	0.80	0.60	0.64	0.36	0.72

Note, ***, ** and * mean statistically significant at 1%, 5% and 10%, respectively.

Endnotes:

[1] The demand model takes the form:

$$P_1 = a_{10} + a_{11}D04 + a_{12}D05 + a_{13}DSM + a_{14}DSL + a_{15}DEU + a_{16}DBG + a_{17}DRG + \sum_{i=1}^{5} b_{1i}D_i + \sum_{j=1}^{5} c_{1j}D_j * DRG + \sum_{k=1}^{n} d_{1k}Q_k + \varepsilon_1$$

$$\vdots$$

$$P_n = a_{n0} + a_{n1}D04 + a_{n2}D05 + a_{n3}DSM + a_{n4}DSL + a_{n5}DEU + a_{n6}DBG + a_{n7}DRG + \sum_{i=1}^{5} b_{ni}D_i + \sum_{j=1}^{5} c_{nj}D_j * DRG + \sum_{k=1}^{n} d_{nk}Q_k + \varepsilon_n$$

where P_k and Q_k denote the price and quantity sold for grade *k*; *k* is from 1 to *n* representing grades from the highest down to the lowest. All the quantity data in the regression are in thousands of standardized 42/44 pound boxes for apples/pears, and all price data are in dollar per pound. *D*04 is the year dummy variable for 04/05 crop year and *D*05 is for 05/06 crop year, leaving crop year 03/04 as the default. For pear data, we only have 2 year observations and thus only *D*05 is included leaving 04/05 crop year as the default. *DSM* and *DSL* are size dummy variables for medium and large sizes respectively, leaving the small size as default. *DEU* and *DBG* are package dummy variables for Euro Pack and Bag, leaving regular Tray Pack as the default. *DRG* is the dummy variable for fruits from regular cold storage, leaving fruits from CA storage as the default. D_1, D_2, D_3, D_4, and D_5 are bimonthly dummies for September/October, November/December, January/February, March/April, and May/June, respectively, leaving July/August as default.