

# The Problem of Over-Shooting Supplies of a Tree Crop

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California producers comprise a large share of the market for many perennial specialty crops, so supply changes in California have a large effect on market prices. We look at the impacts of ever-increasing California supplies of walnuts and almonds and discuss possible grower risk-management strategies and industry strategies to expand demand to match higher supplies.



Since 2001 average walnut yields have increased dramatically—up from 1.5 tons to 2.25 tons per acre in 2010. Prices fell more than yields increased in some years, thus creating lower total sales revenues per acre for California growers.

**T**ree crops have been a large and important part of California's agricultural production sector for decades, yet those crop markets still suffer from a unique problem brought on when the production of a perennial crop is highly concentrated. In brief, the problem is that total industry supplies of a tree crop (or any other perennial crop with a long timespan between planting and reaching full production) will often have significant effects on total industry revenues received by growers, such that growers

are punished for increases in industry output. In a mature market total industry supplies can “over-shoot” the quantities demanded, causing a large price decline that leads to a decline in total industry revenues for the crop year.

This article uses the almond and walnut industries in California as examples to illustrate this over-shooting problem. Recent data from each market are used to illustrate the problem. Then, the simple economics underlying the problem are explained. Finally, some implications of the problem are outlined.

## The Downside of California's Dominance in Tree Crop Markets

A key factor in the over-shooting problem is that almond and walnut growers in California each produce over 99% of the total crop in the United States; they effectively comprise the market in this country because only small “hobby” farms exist in the 25–30 other states reporting some almond or walnut output. This creates some unique economic challenges and opportunities for growers in California. Strategies must be developed at the industry-level to handle ever-increasing supplies without depressing grower prices, and at the grower level to manage the income risk inherent in these settings.

Production decisions are made at the farm level but when aggregated, they have dramatic effects on the financial results of the entire industry due to California's dominant role in the domestic market, as well as its prominent role in the global export market. In particular, industry yields and total output are directly linked to market prices, as shown below.

The fact that over 99% of both almond and walnut production in the United States is concentrated in

California means that most orchards are in a similar climate zone and, thus, subject to the same production situation.

That causes supply fluctuations in the same direction for nearly all producers and, hence, the entire industry. Next, those supply fluctuations directly lead to price swings because, effectively, California's supplies are the domestic market's *total* supplies. As a result, nearly all producers in California have similar annual financial returns per acre in mature orchards, compared to growers of other tree crops.

## Historical Evidence of Over-Shooting

The domestic markets for almonds and walnuts are volatile due to the influence of new acreage coming into production, thus causing significant changes in total supplies. The two California industries have a history of “over-shooting” the quantity demanded over time, thus depressing prices and incomes for some years.

This situation happened to almond growers in the 1990s, despite the market being much larger and more established compared to the markets for walnuts and other nut crops. It also happened to walnuts in the 2000s.

In essence, over-shooting results from individual decisions within a perennial crop industry that has relatively good market prospects. Growers are attracted to the profit potential for such a crop, and they plant new acreage. Unfortunately, it does not take much increase in acreage to expand supplies of the commodity beyond the level needed to satisfy the fairly stable domestic demand.

This problem is complicated by the fact that an almond tree normally takes six or more years to produce a full crop of nuts, and produces for 30-plus

Table 1. California Almond Production and Market Data, 2002–2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Bearing Acreage (acres)	545,000	550,000	550,000	590,000	610,000	640,000	680,000	718,000	740,000
Yield per Acre (pounds)	2,000	1,890	1,840	1,550	1,840	2,170	2,400	1,956	2,230
Production (million pounds)	1,090	1,040	1,010	915	1,120	1,390	1,630	1,410	1,650
Grower Price (\$/pound)	1.11	1.57	2.21	2.81	2.06	1.75	1.40	1.60	NA
Value of Production billion \$)	1.20	1.60	2.20	2.53	2.26	2.40	2.35	2.3	NA
Value of Production (\$/ac)	2,203	2,909	4,000	4,281	3,703	3,753	3,451	3,239	NA

Sources: *Noncitrus Fruits and Nuts 2004 Summary*, U.S. Department of Agriculture, National Agricultural Statistics Service (USDA NASS), *Fr Nt 1-3 (05)*, July 2005; *Noncitrus Fruits and Nuts 2007 Preliminary Summary*, USDA, NASS, *Fr Nt 1-3 (08)*, January 2008; and *Noncitrus Fruits and Nuts 2009 Yearbook*, USDA, NASS, May 2010. NA = data not available

years, meaning that farmers have to forecast domestic demand decades in advance before making the decision to plant new acreage. If there is no coordination of planting decisions within the industry, too many growers may “jump in” during some years.

This type of over-shooting adversely affects all growers because prices drop significantly. For almonds, there is clear evidence of over-shooting in the 2005–2009 data in Table 1. Total industry revenues per acre were much lower in 2009 than they were in 2005; prices fell more than output increased over the period.

For walnuts, there is evidence of over-shooting in the 2005–2008 data in Table 2. Total industry revenues per acre were much lower in 2008 than they were in 2005 through 2007; just as for almonds, walnut prices fell more than output increased over the period.

### Revenue Effects of Expanding Output

Total industry revenue is the product of average yields per acre times the number of bearing acres harvested times the average market price. In recent years, both yields and total acreage of almonds and walnuts have increased. As a result, it should not be surprising that there have been significant swings in prices for both almonds and walnuts.

#### Almonds

Almond yields per acre have increased in most years recently (second row of

Table 1). For example, between 2005 and the peak year of 2008, there was a 55% increase in average yield. Despite a slight decline during the next two years, the average yield in 2010 was the second-highest on record. The scale of the growth in yield, combined with steadily increasing acreage, pushed total production (shown in the third row of Table 1) to record levels in 2008, and then again in 2010.

This creates a challenge to the industry because of its implications for almond prices and for the industry’s profitability in serving market segments that are expanding much more slowly over time. For example, most domestic market segments have relatively smooth levels of (inelastic) demand across time, so buyers for those market segments want a relatively stable flow of a commodity. The supply expansion continues to outpace growth in domestic markets for almonds. As a result, yearly crop surpluses go into export markets, most of which have lower average prices, thus lowering growers’ average revenues per pound.

Changes in almond supplies have the potential to significantly influence prices for U.S. growers. Historically, California’s increasingly large crops have significantly depressed average prices for producers. Note the decreasing prices for 2005–08 shown in the fourth row of Table 1. The average price in 2008 of \$1.40 per pound was only about half of the average price of \$2.81 per pound received by growers

in 2005. As a result, the total value of utilized production, (which is the quantity used, not stored) shown in the fifth row of Table 1, is lower in 2008 (\$2.35 billion) than it was in 2005 (\$2.53 billion), despite the record yields produced during 2008.

The risks to individual growers can be seen more easily when looking at gross revenues per acre. As shown in the bottom row of Table 1, revenue per acre (expressed as dollar “value of production per acre”) was significantly higher in 2005 (\$4,281) than it was in 2008 (\$3,451). In other words, prices fell more than yields increased, thus creating *lower* total sales revenues per acre for California growers. The problem is apparent again in the revenue per acre results for 2009.

This downward trend in revenues is a major challenge to the industry because individual producers must manage their personal financial risks associated with the underlying market price swings. Simply stated, declines in sales revenues mean declines in profitability that can threaten the economic sustainability of many producers.

#### Walnuts

Walnut yields per acre had been fairly stable for decades until 2001, when average yields exceeded 1.5 short tons for the first time. Since that year, average yields have increased dramatically, up to 2.25 tons per acre in 2010 (second row of Table 2). That means there was a 50% increase in average yield over the nine-year period of 2001 to 2010. The

Table 2. California Walnut Production and Market Data, 2002–2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Bearing Acreage (acres)	210,000	213,000	214,000	215,000	216,000	218,000	223,000	227,000	227,000
Yield per Acre (short tons)	1.34	1.53	1.52	1.65	1.60	1.50	1.96	1.93	2.25
Production (short tons)	282,000	326,000	325,000	355,000	346,000	328,000	436,000	437,000	510,000
Grower Price (\$/ton)	1,170	1,160	1,390	1,570	1,630	2,290	1,280	1,690	NA
Value of Production (million \$)	329.94	378.16	451.75	557.35	563.98	751.12	558.08	738.53	NA
Value of Production (\$/ac)	1,571	1,775	2,111	2,592	2,611	3,445	2,503	2,503	NA

Sources: 2010 California Walnut Objective Measurement Report, USDA, NASS, September 3, 2010; California Walnut Acreage Report, USDA, NASS, May 26, 2006. NA = data not available

average yield in 2010 was the highest on record. The scale of the growth in yield, combined with steadily increasing acreage, pushed total production (shown in the third row of Table 2) to a record level of 510,000 tons in 2010.

Changes in walnut supplies have significantly influenced prices for U.S. growers. Note the increasing prices for 2005-07, shown in the fourth row of Table 2. The average price in 2007 of \$2,290 per ton was about 46% above the average price of \$1,570 per ton received by growers in 2005. As a result, the total value of utilized production, shown in the fifth row of Table 2, is higher in 2007 (\$751 million) than it was in 2005 (\$557 million), despite the lower yields produced during 2007. Conversely,

yields per acre and total production increased significantly in 2008, causing the average price to drop about 46% to \$1,280 per ton. As shown in the bottom row of Table 2, revenue per acre was significantly lower in 2005 (\$2,592) than in 2007 (\$3,445).

In 2008 the drastic price decline caused average revenues per acre to fall to \$2,503—lower than they had been in 2005, despite a 23% expansion of production in 2008 compared to 2005. Again, prices fell more than yields increased in some years, thus creating lower total sales revenues per acre for California growers in those years.

### The Economics of Over-Shooting

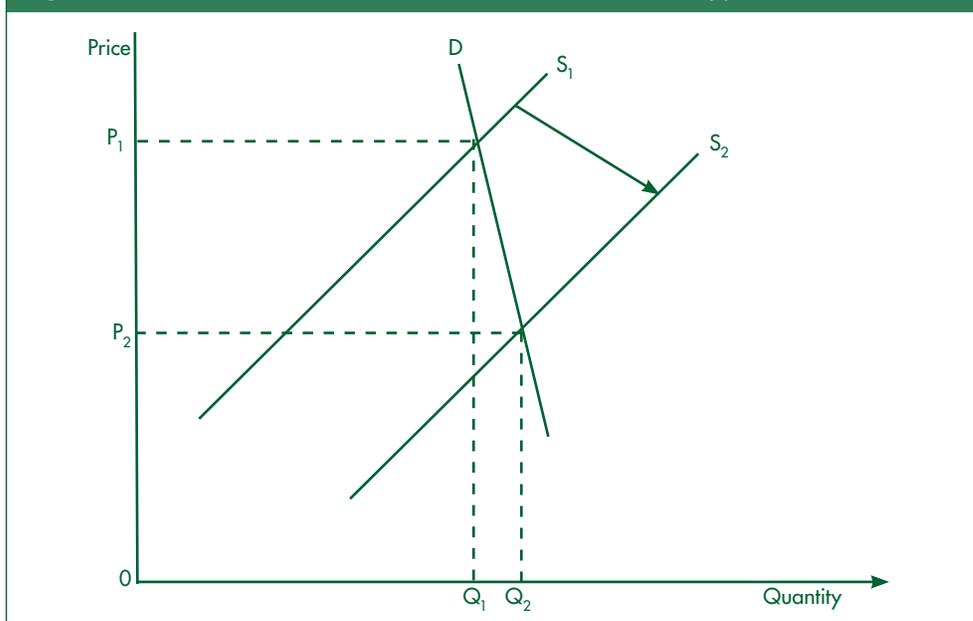
Over-shooting can occur in any commodity market, but it is more prevalent

and problematic in mature markets for perennial crops. A “mature” market is one in which demand (i.e., consumption) per capita is fairly stable because consumption uses and patterns are fairly specific and stable, so increases in total demand are mostly due to an increasing population. In economic terms, this means the “demand curve” is inelastic in the short-term. Figure 1 illustrates how such a stable market reacts to changes in supplies available.

In the hypothetical market illustrated in Figure 1, the dramatic revenue effects of a supply increase can be seen. The original quantity demanded is  $Q_1$  and the average market price is  $P_1$ . The total revenue is the area inside the rectangle created by the dashed lines from  $Q_1$  and  $P_1$  to the demand curve. After the supply curve expands from one year to the next (from  $S_1$  to  $S_2$ ), the new quantity demanded from the industry is  $Q_2$  and the new market price is  $P_2$ . The industry’s total revenue is the area in the new rectangle created by the dashed lines from  $Q_2$  and  $P_2$  to the demand curve. The percentage of change in quantity is much smaller than the percentage change in price, thus the resulting revenue totals have decreased from the first year to the second. The growers have expanded their output and been “rewarded” with a decrease in their sales revenues!

In the real markets for both almonds and walnuts, demand has expanded over time partly in response to marketing efforts by the industries. For

Figure 1. Inelastic Demand Means Revenue Declines When Supplies Over-Shoot



both crops, most of the growth in demand has come from expanding into new markets—especially overseas. In recent years, about 60–70% of California’s almonds and 50–60% of walnuts have been exported. However, domestic markets have grown also—although more so for almonds.

Domestic per capita consumption of almonds was fairly stable during the 1980s and 1990s, averaging about 0.6 pounds per year, before rapidly rising to about 1.2 pounds in 2008. In comparison, consumption per capita of pistachios was 0.2 pounds in 2008, and for walnuts it was 0.5 pounds. Domestic per capita consumption of walnuts is the second-highest for any nut and has not expanded in decades. In general, walnut per capita consumption has averaged about 0.4 to 0.5 pounds per year since before 1980.

Changing demand requires long-term investment, usually taking years as marketers find new markets, inform potential consumers, and capture sales opportunities. Thus, the demand curve in Figure 1 is gradually moving to the right, slowly helping to alleviate the effects of over-shooting.

### Implications of Over-Shooting

Only an industry-wide approach can influence the total supply of a crop. Individual growers have negligible effects on total supplies, thus they cannot solve the over-shooting problem; they can only develop risk management plans for dealing with the revenue effects of the phenomenon.

The geographically concentrated nature of many California tree crop industries would facilitate industry-wide efforts aimed at “supply control.” The ultimate goal of such strategies is to gain control over total industry supplies of a commodity so that price levels can be controlled to some extent. One example of a supply-control program used in California is a “tree-pull” effort,

in which an industry tries to reduce its total acreage and, thus, total output.

The almond and walnut industries each have supply-control programs in their arsenals as part of the federal marketing orders that authorize various forms of collective action in the industries. The Almond Board has occasionally utilized supply control in the form of required reserves held by handlers. However, a reserve program has not been implemented since the 1990s, and there is apparently no appetite among growers or handlers in either the almond or walnut industries to use supply-control programs.

This makes demand expansion the main industry tool to combat declining prices due to ever-expanding supplies. The data shown in the two tables indicate that the almond and walnut industries, in general, have each done a good job of expanding markets so as to keep revenues increasing in most years. The potential of these industries to produce ever-larger crops through expanding acreage and yields means, moreover, that the almond and walnut industries must continue to invest in efforts to expand markets for their crops.

However, the instances of over-shooting supplies noted in this article point out that tree crops are a volatile investment. In any perennial crop industry, individual growers are subject to the revenue risks caused by overshooting and, therefore, should have a management plan in place. The choices facing an individual farmer are whether or not to produce the crop and, if so, how to manage the revenue risk over time. The choice depends on the rate of return expected on the investment, as well as the compatibility of the crop with the interests and skills of the farm household.

Part of this assessment will involve risk and the farmer’s tolerance for it. As a person’s level of risk aversion increases, it is increasingly likely that

some degree of “investment” diversification is needed to reduce the household’s exposure to swings in total income over time. This means more-risk-averse people should produce more than just tree crops, adding other commodities to their “crop portfolio” to spread their financial risk across commodity markets.

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#### For additional information, the author recommends:

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