

Contributions of the California Almond Industry to the California Economy

Report for the *Almond Board of California*



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**William A. Matthews, Sophia Baratashvili and
Daniel A. Sumner***

*William A. Matthews is a project scientist at the University of California, Agricultural Issues Center (AIC). Sophia Baratashvili was an undergraduate student research assistant at AIC, Daniel A. Sumner is the director of AIC and is the Frank H. Buck, Jr., Distinguished Professor in the Department of Agricultural and Resource Economics, UC Davis

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Contributions of the California Almond Industry to the California Economy

Executive Summary

The California almond industry is large, dynamic, and closely linked to other parts of agriculture and the California economy. The California almond industry remains the single largest producer of almonds and processed almond products in the United States and the world, accounting for close to 80 percent of all global almond production. Almost all of the almonds produced in California are also processed within the state to some degree. Much of California processed almond product quantity and value is shipped out of California and is used in other parts of the U.S. and the world.

The economic contributions of the almond industry begin with inputs into almond production on almond farms. California almond farms purchase inputs, for example crop protection products, fertilizer, and crop services including horticultural consultation and treatments, from other industries. Almond huller-shellers, almond handlers, and almond product manufacturers purchase inputs such as electricity, trucking and hauling services, packaging equipment and materials to name a few, as well as services like banking and accounting from other industries in the economy. These input purchases create indirect economic activity that occurs in California solely due to the demand from production on almond farms and processing by hullers-shellers, handlers and product manufacturers.

In addition to these indirect impacts, income earned by workers, farmers, managers, and others in the almond industry generates consumption of goods and services throughout the economy. For example, almond farmers may have children that attend local schools that therefore have additional teachers. Similarly, an almond processing plant employee shops for clothing or other goods which adds to local retail sales and employment. These purchases, in

turn, induce even more jobs and more income for those outside the almond industry. These induced effects spread the impact of the almond industry throughout the economy into all industries and to workers in every occupation.

California almond farming depends on a viable local almond processing industry because in-hull almonds are costly to move long distances. Likewise, although the California almond processing industry ships whole kernels, almond paste and other products across the country and around the world, its viability requires almond production on nearby farms. Therefore, to consider economic impacts, we consider the two segments of the California almond industry—almond processing and almond farming— together. Neither could remain economically viable without the other.

We quantify these myriad impacts using detailed almond-specific data for the 2017/18 crop year and Economic Impact Analysis for Planning (IMPLAN), a database and model of economic linkages. IMPLAN was also used in a similar study to measure the almond industry’s economic contributions from the 2013/14 crop year. This “input-output” modeling approach quantitatively traces the direct employment, incomes, and value-added in almond farming and processing throughout the economy to measure the size of the overall impact. Using these well-established methods, we document linkages from the almond production and processing industries to the rest of the California economy and measure how almond farming and processing contribute to income and jobs throughout the economy.

During the 2017/18 crop year, which is the period from August 2017 through July 2018 during which almonds are harvested and marketed, California almond farm sales were about \$5.4 billion, and sales of processed almond products (wholesale) totaled about \$7.4 billion (Table ES.1). Although California farms harvested over 300 million more almonds in 2017/18

compared to 2013/14, an increase of over 16 percent, average farm price for almonds in 2013/14 were close to 60 percent higher per pound compared to the 2017/18 crop year. The difference in prices for the two periods is reflective in industry sales revenues for producers and processors and permeates all measures of economic impact. The higher prices in the 2013/14 period generated more income for industry stakeholders, which was then spent in the economy generating higher indirect and induced effects when compared to the 2017/18 crop year. For example, the sum of the state value of output attributable to almond production and processing through direct, indirect and induced effects in 2017/18 was about \$19.6 billion compared to \$21.8 billion in 2013/14. Value of output adds the output value of almonds at the farm gate, processed almond products and other products involved in the production, and marketing of almond products through the marketing chain. In that sense, the value of some almonds may be counted more than once as it moves through the marketing chain.

Table ES.1 also compares California's economic value added attributable to the California almond industry for the two time periods. This total is listed in the processing column to reflect the full value added of the industry, including the almond farm sector through processing. Value added is the contribution of almond production and processing to the state economy calculated to remove any double counting of the same output in more than one sector and of intermediate inputs, such as crop protection and fertilizer products to almond farms or almonds from the farm to almond processing. The calculation attributes to each sector the amount of economic value that specific sector adds to the intermediate inputs it purchases. This is the amount that the almond industry added to the California gross state product during the 2013/14 and 2017/18 crop years. Almond farming and processing in 2017/18 generated \$9.2 billion in value added compared to \$11.2 billion in 2013/14. Again, the higher prices received

for almonds and almond products in 2013/14 generated a higher measure of value added when compared to the 2017/18 crop year.

The direct number of jobs supported in the almond industry were greater in the 2017/18 crop year compared to the 2013/14 crop year. This is plausible considering the increase in volume of almonds produced and processed. The majority of new jobs supported are found in the post-harvest hulling-shelling, handling and product manufacturing with some job increase on farms.

Table ES.1: Comparison of Contributions to the California Economy from the California Almond Industry During the 2013/14 and 2017/18 Crop Years

	Almond Farm		Almond Farm and Processing*	
	2013/14	2017/18	2013/14	2017/18
California Almond Production and Value				
Volume of Marketable Almonds Produced in Crop Year (million pounds)	1,900	2,215		
Average Farm Price of Almonds (\$ per pound)	\$3.85	\$2.45		
California Almond Industry Sales				
Direct (\$ billion)	\$7.3	\$5.4	\$10.5	\$7.3
Indirect and Induced (\$ billion)	\$6.4	\$7.3	\$11.3*	\$12.3*
Full Effect (\$ billion)	\$13.7	\$12.7	\$21.8*	\$19.6*
Contributions to Value Added (Gross State Product)				
Direct (\$ billions)	\$3.8	\$2.8	\$0.7	\$1.7
Indirect and Induced (\$ billion)	\$3.8	\$4.4	\$10.5	\$7.5*
Full Effect (\$ billions)	\$7.6	\$7.2	\$11.2	\$9.2*
Contributions to Employment				
Direct (1,000 jobs)	20.9	20.2	4.7	10.0
Indirect and Induced (1,000 jobs)	47.2	47.8	99.1*	99.9*
Full Effect (1,000 jobs)	68.1	68.0	103.7*	109.9*

Source: IMPLAN data and calculations supplemented with additional projections and model results.

Note: * Includes the full contribution of almond production and processing including indirect and induced impacts. Full effects of almond processing sales, value-added and jobs include the value of almond production at the farm as an input

Introduction

Almonds are the second largest crop produced in California after grapes. California produces all of the U.S.-supplied almonds and 80 percent of the global supply on an annual basis. California manufactures a full range of processed almond products and the economic scope of the California almond industry extends far beyond the farm gate. California almonds are used for a wide variety of food ingredients and consumer goods, including roasted almonds, almond butter, almond milk, and almond flour to name a few.

After briefly describing recent economic patterns and trends of the California almond industry, this report turns to explain the linkages between the California almond industry and the rest of the state's economy. We then show the massive economic contributions that the California almond industry makes to the California economy from output value, to labor income, and contribution to value added, which feeds into the gross state product (the standard measure of the size of the California economy). We summarize these contributions by highlighting the 110,000 California jobs that are created by the California almond industry. We show that the almond industry is especially vital to the economy of California's Central Valley, where practically all of the California almond supply is produced and processed.

Section 1. Trends and the Current Situation of the California Almond Industry: Background to the Analysis of the Economy-Wide Contributions

1.1 Economic Background and Context of California Almond Production and Processing

California has been the leading producer of almonds in the world for the past 40 years. Production of almonds in California during the 2017/18 crop year accounted for 80 percent of global production. The crop for almonds is the period from August 1 through July 31. California's combination of Mediterranean climate and proper soils makes California the ideal location in the world to grow high quality almonds efficiently.

In 1980, California almond farms produced 322 million pounds of almonds; in 2018, almond production in California was 2.28 billion pounds, a seven-fold increase in production over the past 40 years (Figure 1.2). This increase in almond production is a result of a steady increase in planted and bearing acres and improvements in orchard management practices, which increased yields per acre. As Figure 1.1 shows, from 2000 to 2018 almond orchard acreage more than doubled from just over 510,000 acres to more than 1 million acres. Yields per acre also increased during this same period going from an average of just under 1,400 pounds per acre to about 2,000 pounds per acre.

California's comparative advantage in meeting growing global demand over the decades through increased acreage and productivity, has led to almonds dominating California agriculture (Figure 1.3). In the past decade, almonds have surpassed both alfalfa hay and grapes as the single leading commodity crop by acres planted. Almonds surpassed alfalfa hay acreage in 2013 and grapes in 2014. California crop acreage dedicated to almond orchards has continued to grow and in the 2017/18 crop year accounted for 1.1 million acres or around 14 percent of California's 7.86 million acres of harvested commercial crop acreage.

California's significant expansion of almond production over the past twenty years has been driven by large increases in export demand as well as domestic demand for almonds in the US (Figure 1.4). In the early 2000s, domestic consumption of almonds increased slightly until around 2003/04 when the domestic market experienced a two-year decline. From the low consumption point of this period in 2005/06, when U.S. demand totaled less than 200 million pounds, total consumption in the U.S. has increased more than three-fold to just under 750 million pounds. This rate of growth in almond consumption far outpaces the 30-percent U.S. population growth experienced during the same period. Not only have there been higher numbers of U.S. residents consuming California almonds, but also, most residents have been increasing their personal consumption on average. Figure 1.5 shows the increase in per capita consumption of almonds among U.S. residents over the past dozen years. In 2005/06 U.S. residents, on average, consumed slightly more than half a pound of almonds per year. By 2017/18 per capita consumption had increased to more than $2^{1/4}$ pounds per year, an increase of over 260 percent.

The dramatic growth in domestic consumption of California almonds has been overshadowed by an even greater increase in demand from export markets. During the thirteen-year period from 1998/99 to 2011/12 almond exports went from just over 410 million pounds to over 1.5 billion pounds, a ten-year increase of slightly more than 230 percent. California's dominant position as the global leader in almond production makes foreign exports an important source of revenue for California's almond industry. During the 2017/18 crop year exports accounted for close to 70 percent of utilized California almond production (Figure 1.4).

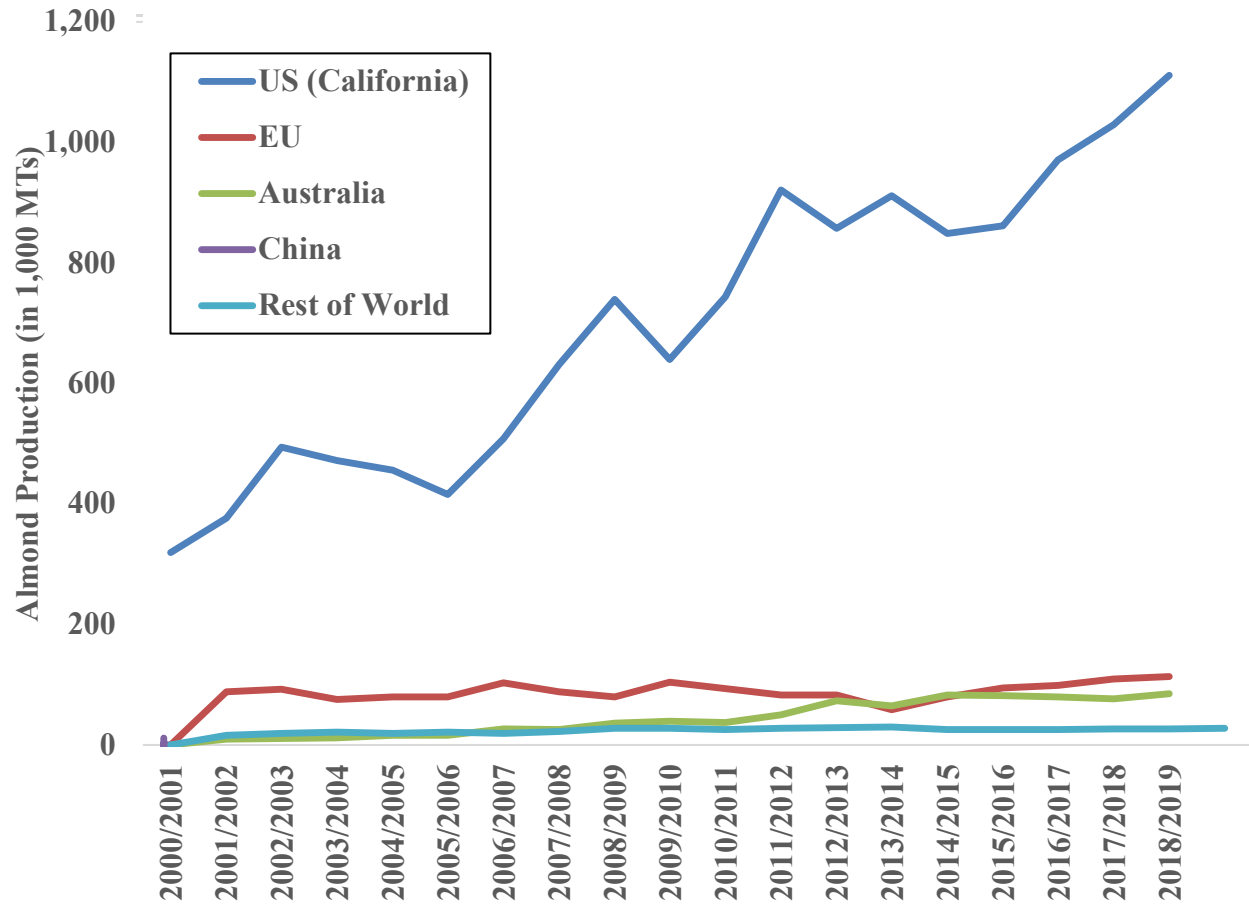
Foreign demand for California almonds has become more widespread in the past decade. Although the greatest demand for California almonds outside the U.S. in 2017/2018 remained

the European Union (EU), the share of export volume shipped to the EU declined from 47 percent to 36 percent of total almond exports from 2008 to 2018 (Table 1.1). At the same time exports to India and China/Hong Kong increased and exports to other destinations that receive less than 5 percent of total exports expanded.

The expanding demand for California almonds and almond products from U.S. consumers and foreign markets has resulted in a stimulus for California's farm economy and the U.S. and California economy as a whole. Moderate growth in almond production along with steady to increasing prices led to slight increases in the overall value of California's almond production from 1980 to 2000. Starting in the early 2000s, the importance of almonds to California agriculture began to shift dramatically. Figure 1.6 tells the story of the California almond industry's rise to become the top crop produced in the state, which can be broken down into four distinct segments. During the first segment, from 2000 to 2005, the real value of California almond production tripled while the farm price for almonds more than doubled. From 2005 to 2010, this rapid expansion contracted with almond prices falling by 40 percent and farm value of almonds declining about 16 percent. Much of the decline during this time period may be linked to the global economic crisis, which occurred at the end of 2008 and the beginning of 2009. Farm prices and the value of almond production began a resurgence in 2011 which rivaled the growth experienced during the early part of the century. From 2011 to 2014, farm prices for almonds doubled and the value of almond production in California increased 236 percent with much of this increase linked to increased acreage of almond orchards and improved yields. The 2013/14 crop year marked the peak for almond prices and values over the past decade. Starting in 2015, prices and values began to decline once again. A main factor in the most recent decline is weather related as California experienced a 5-year drought resulting in lower yields.

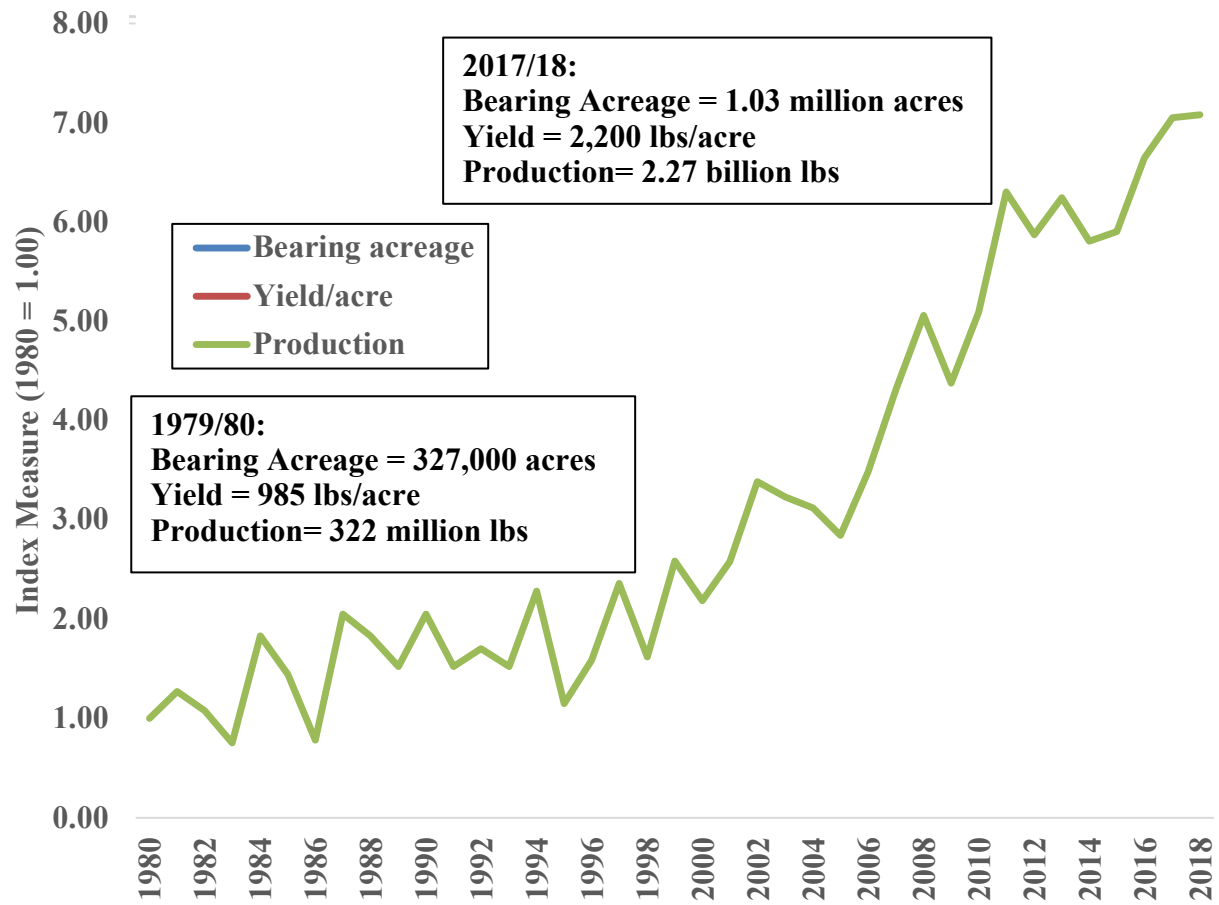
The impressive growth over the past two decades has transformed the California almond industry into a major contributor to the California economy and specifically to the economy of California's Central Valley where practically all almonds are grown and processed. The remainder of this report will use economic tools to analyze and measure the magnitude of contribution the California almond industry brings to the California Central Valley and Statewide Economy.

Figure 1.1: US and Global Almond Production by Top Producing Countries



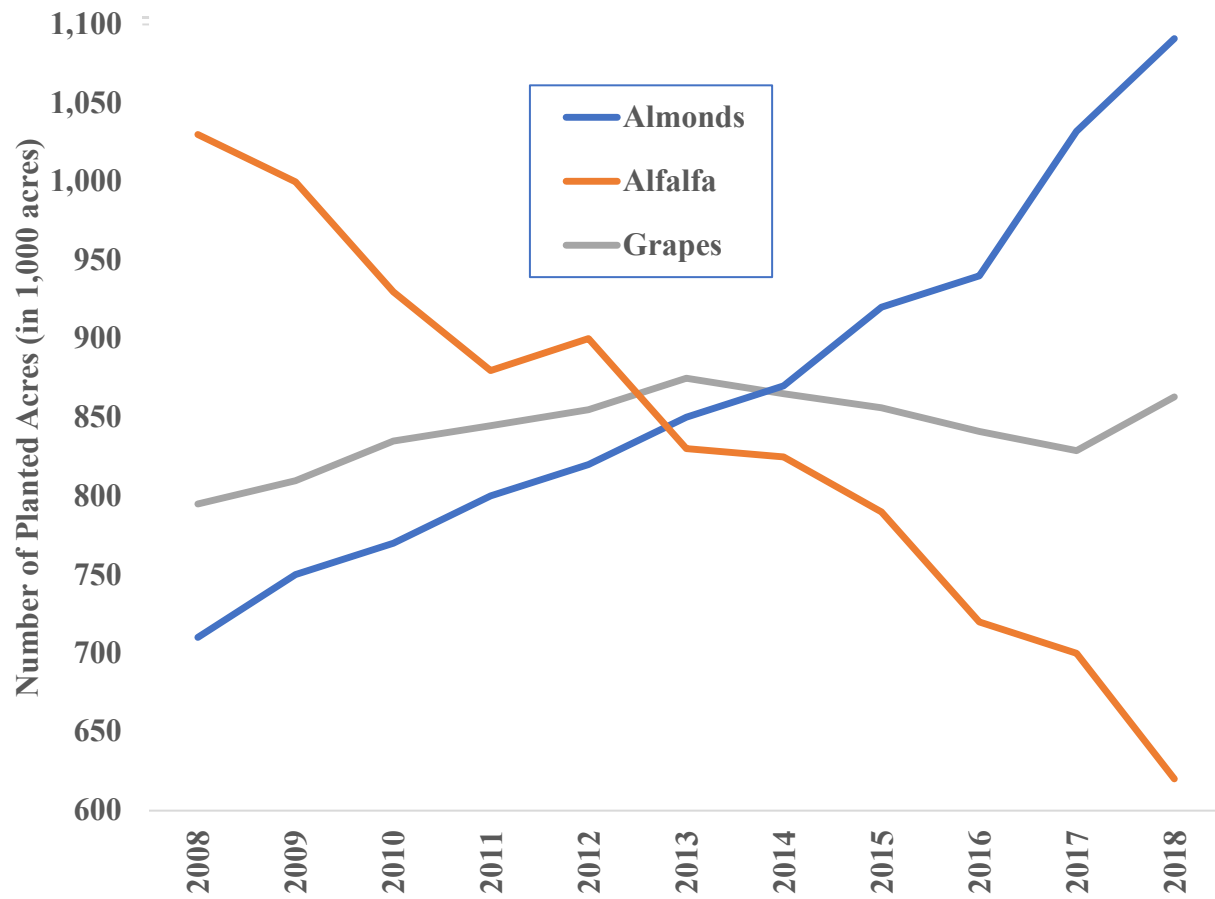
Source: Global almond production data come from USDA Foreign Agricultural Service

Figure 1.2: California Almond Acreage, Yield and Productivity Indexed to 1979/80 Crop Year



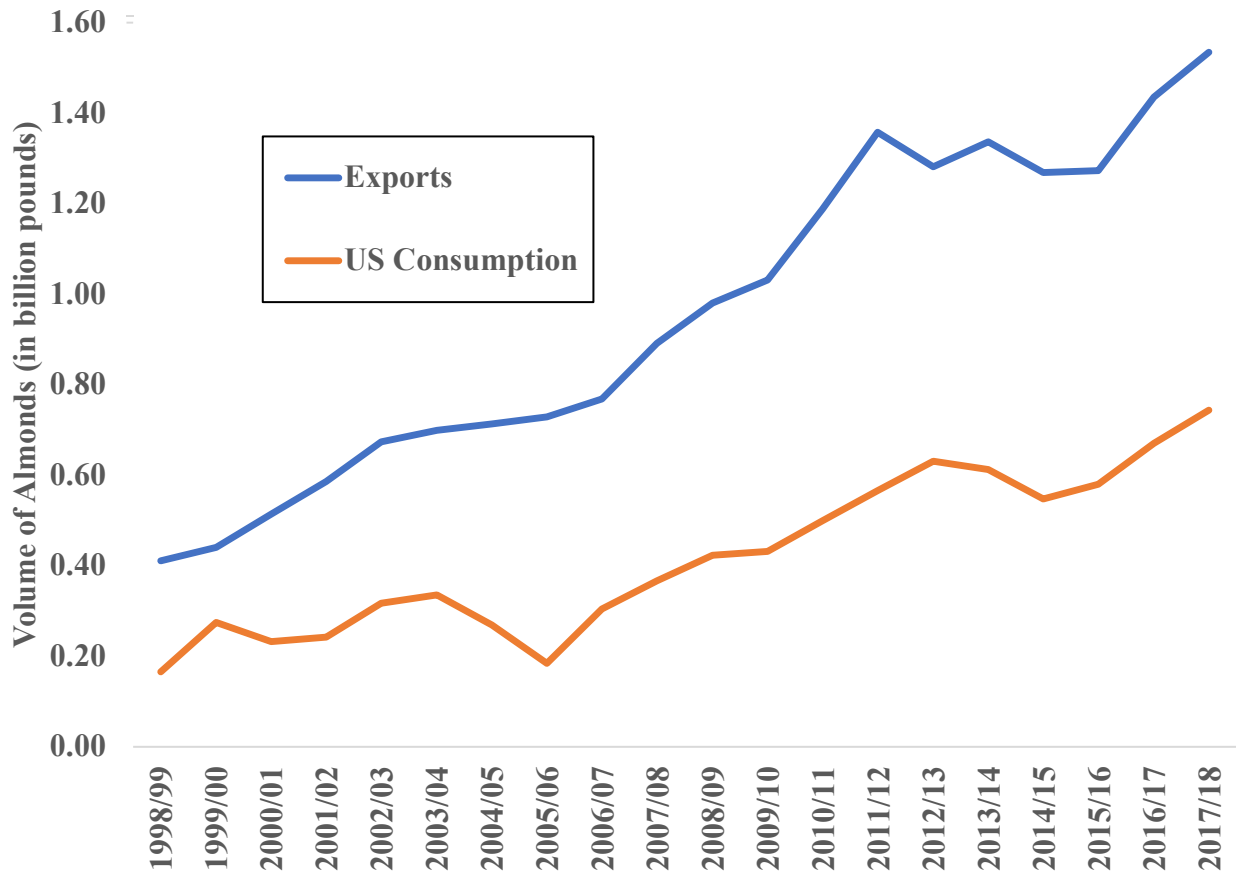
Source: Acreage, yield and production data come from USDA NASS Quickstats.

Figure 1.3 Comparison of Planted Acres by Leading Commercial Commodity Crops in California, 2008-2018



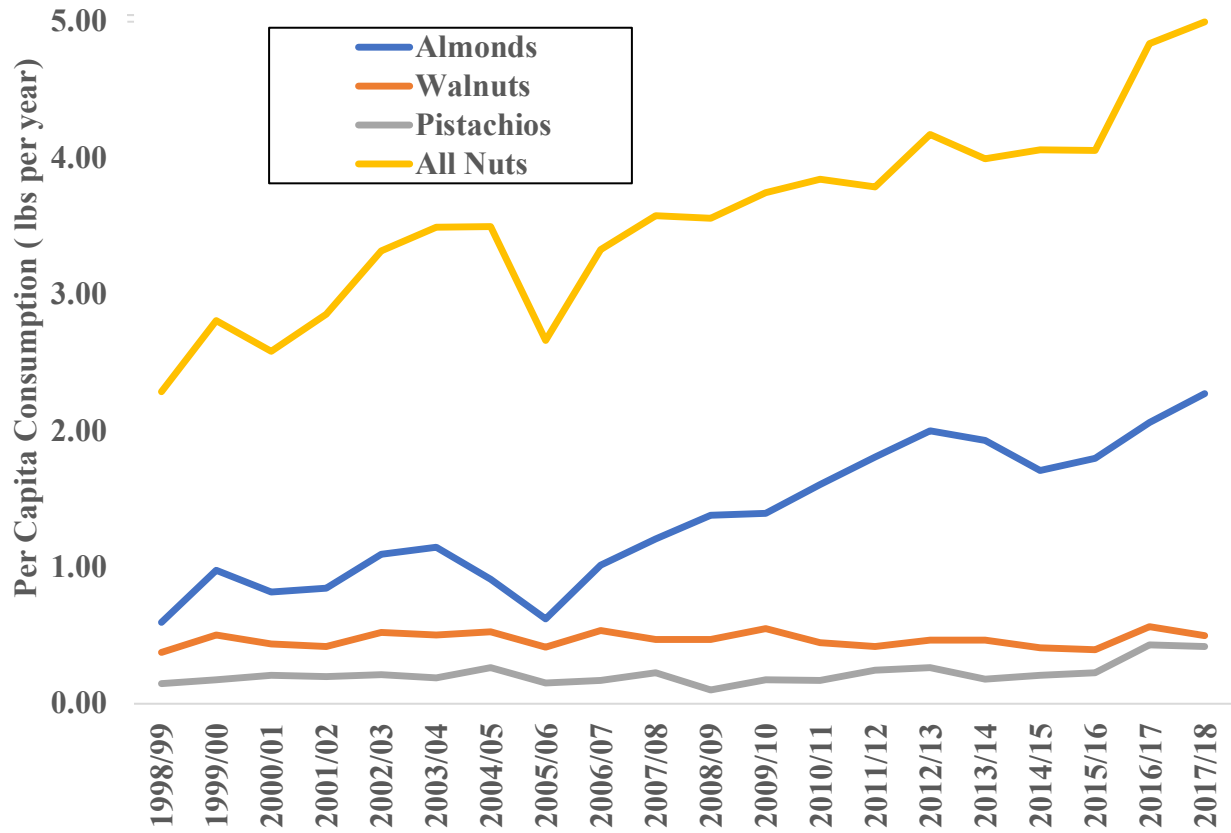
Source: Acreage data comes from USDA NASS Quickstats

Figure 1.4 Comparison of Annual California Almond Utilization between Exports and Domestic Consumption, 1998/99-2017/18



Source: USDA ERS Fruit and Tree Nut Yearbook

Figure 1.5 Annual U.S. Per Capita Consumption of Tree Nuts, 1998/99 to 2017/18



Source: USDA ERS Fruit and Tree Nut Yearbook

Table 1.1 Share of Total Annual California Almond Exports by Destination

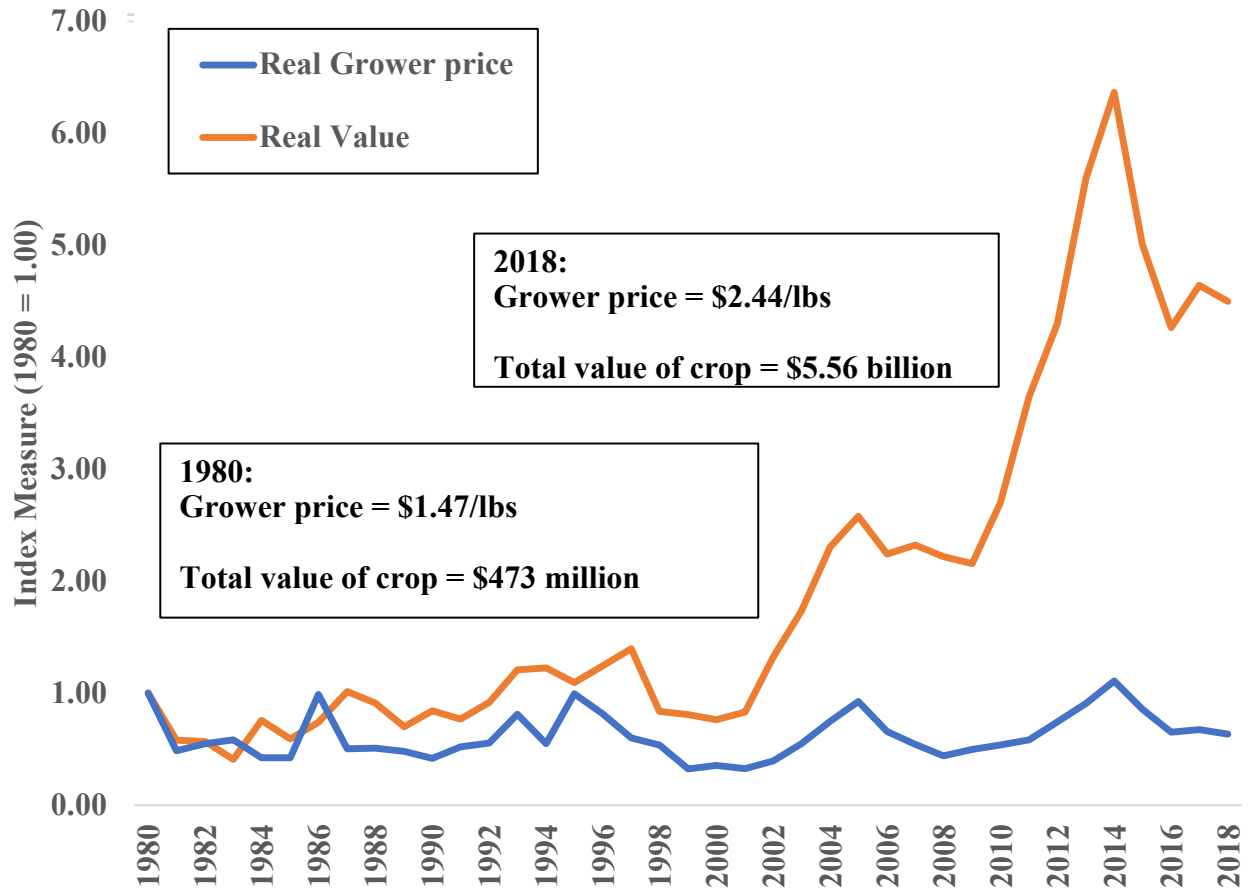
	Percent of Total Exports by Destination*	
	2008	2018
European Union	47	36
India	9	13
China/Hong Kong	8	11
Canada	6	6
Japan	6	6
Other destinations	24	28

Source: US Census Bureau

* Destinations listed receive 5% or more of total California almond exports.

** Figures for 2008 and 2018 are for the calendar year not the crop year.

Figure 1.6 Annual California Almond Farm Price and Total Farm Revenue Adjusted for Inflation and Indexed to 1980



Source: USDA ERS Fruit and Tree Nut Yearbook

Section 2. Methods for Measuring the Economic Contributions of the California Almond Industry

2.1 Modeling and Measuring the Economic Linkages and Contribution

As noted above, this study utilizes well-known input-output (I-O) analysis to measure the economic impacts of the California almond industry. I-O analysis is the most common and straight-forward methodology for measuring the economy-wide impacts of industries. I-O analysis uses data to identify how an industry, in this case the California almond industry, interacts with the other industries and sectors, and models the flow of goods and services between this industry and other elements within the economy. This methodology accounts for the array of economic transactions between each industry and other sectors of the economy, and the magnitude of impact these transactions have on the rest of the economy.

I-O analysis is useful because of its ability to reach beyond the direct economic contributions of an industry and incorporate the ripple effects that occur within an economy. I-O models document the importance of an industry to the economy and account for economy-wide responses to changes in industry output that may be caused by any sort of influence, such as regulatory change or a shift in production technology and methods.

The ripple effects within I-O analysis are computed as multipliers and reflect the magnitude of an impact in the economy from a unit change in output from an industry. In this report, multipliers identify the interdependence between the California almond industry and other parts of the California economy. By employing a series of fixed ratios from the I-O model, it is possible to create a set of multipliers that measure a range of economic impacts from almond industry output to the number of jobs created and state GDP, for example.

2.2 Four types of multipliers

For the California almond industry, our analysis focuses on four multipliers that measure specific economic impacts; (1) value of output (measured by sales revenue), (2) labor income, (3) total value added to state GDP, and (4) employment or the number of jobs supported. Each of these measures have a specific technical definition.

The value of output multiplier measures the total value of direct and indirect requirements from all economic sectors needed to deliver an additional dollar-unit of output of a specific industry to final demand. For example, an increase in value of output by California almond farms is comprised of an increase in on-farm almond production at the farm price and/or an increase in the farm price for the quantity produced. The farm price of almonds is affected by costs of almond inputs and other factors. Likewise, changes in the value of output for almond processing plants is comprised of the prices of processed products multiplied by the quantities of each product manufactured, where the prices of produced products are affected by the costs of inputs including raw almonds. A limitation of the value of output measure for the California almond industry is the potential for double counting the value of almond production by California almond farms. Obviously, the output value of processed almond products includes the value of almonds purchased from California almond farms along with the value of all other inputs used in manufacturing almond products.

The labor income multiplier measures the ratio of what is paid out as compensation to hired labor, contracted labor, and earnings of business proprietors to total value of output. The employment income multiplier represents the share of output value earned by labor and management employed in an industry, whether hired employees or owner-operators.

Value added is that portion of output value not used to purchase inputs from other sectors of the economy. In the case of the almond farms, purchase inputs would include items such as applied nutrients, purchase and maintenance of field equipment, or horticultural services. That means value added is the output value that is contributed by the workers and capital within the almond industry above the value of what is purchased and therefore contributed by other sectors. The almond industry's value added is its economic contribution above the cost of goods and services that were purchased from other sectors and were therefore already measured as the outputs of those sectors. For example, this methodology recognizes that raw almonds purchased from farms is the major input cost item for almond handlers/manufacturers. Therefore, when measuring the value-added contribution of processing we must "net-out" the value of the almonds purchased (and other purchases such as equipment and packaging materials) before assigning the value that was added in the processing stage. Value added is the almond industry's contribution to the size of the California economy, with no double counting of output that is transferred from one link of the supply chain to the next. The value-added multiplier is the ratio of value added to the value of output for an industry.

The employment multiplier measures the number of jobs in an industry per million dollars of output. It includes all jobs and does not distinguish between part-time or seasonal employment within an industry. These jobs include business owners and family members who share in entrepreneurial income as well as full-time and part-time hired workers and contracted workers.

2.3 Direct, Indirect and Induced Effects

Besides using data to establish the four categories of multipliers just described, I-O analysis classifies economy-wide impacts for each of the multipliers as direct, indirect or

induced. Each of these concepts applies to each industry and to each of the four categories of multipliers described above.

Direct impacts are changes in economic measures that occur directly within the industry being examined. For example, when California almond output rises by \$10 million, the direct effect is to add \$10 million to the value of output for the state's economy. When an almond processing plant adds a shift of another 200 workers, the direct employment effect is 200 jobs, that is the direct multipliers are 1.0 for each category.

Indirect impacts are the changes that occur through purchases of input goods and services from supporting industries. For example, if almond farms produce more almonds, farms also likely buy more fertilizer and crop protection products, use more electricity and hire additional hauling services. These impacts cause increases in output, jobs, worker compensation, and value added for the industries that supply these inputs. Then each of these industries all buy more goods and services from yet further sectors and so forth. Our economy-wide data set has quantitative measures of all these relationships, as the effects of purchases ripple through the California economy.

Induced impacts measure changes in the economy caused by changes in consumption expenditures that result from changes in worker compensation in the almond industry and supporting industries. The induced impacts measure how each other industry is affected by added consumption purchases by people earning additional income caused by the direct and indirect effects. For example, almond producers that receive a higher price may pay employees higher wages or offer more work hours. These workers, including the entrepreneur, spend some of their added incomes at local grocery stores, barbershops, car dealers and so on. These local firms have workers of their own who may also earn more and spend their additional income on goods and

services. Workers also pay more taxes and provide more support for government services such as schools. Thus, as with indirect effects, the induced effects from almond economic activity ripple through the whole economy of California and the United States.

Total impacts are the sum of direct, indirect and induced impacts. These apply to all four multipliers: value of output, labor income, value added and employment. Box 2.1 concisely defines each of the multipliers measured and the classification of impacts across the economy.

I-O modeling and analysis is not without limitations. Like all economic modeling, the I-O model used to produce this report represents an abstraction of the real world and depends upon assumptions that may be imperfect. Furthermore, the accuracy of results and analysis hinges on the reliability of the raw data used to model economic activity. The I-O modeling system used for this report is IMPLAN (Impact M for Planning), originally developed by the USDA Forest Service. Using multiple data sources, the IMPLAN group develops a comprehensive model of the U.S economy and the economies of each U.S. state. Although the IMPLAN group provides a valuable tool for conducting economic impact assessment and provides good insight on the U.S. national economy, the representation of specific industries in smaller, more localized geographic areas within the IMPLAN database is challenging. To increase the accuracy of modeling specific industries in specific locations, IMPLAN allows users to modify the model to better represent the industry and geographic region under study. In this analysis we adjust the IMPLAN model relative to the California almond industry using data supplied by almond industry stakeholders as a means to better represent the industry's economic activity.

BOX 2.1

Using Input-Output Models to Measure Economy-wide Impacts and Contributions

Input-output models link the magnitude of changes in an industry or segment of the economy to the associated changes in all the other industries and segments throughout the economy. Moreover, income generated by this economic expansion will be spent on other services from groceries to new cars to schoolteachers. Input-output models and the associated data on economic linkages in the economy provide the tools and information to quantify these impacts as “multiplier effects” without leaving out impacts or double counting. Impacts are generally classified as direct, indirect and induced effects.

Direct Effects: Direct effects are impacts directly within the affected industry. For example, hiring 10 workers to prune an almond orchard has a direct employment effect of 10 jobs.

Indirect Effects: Indirect effects are the changes in industries outside the directly affected industry through purchases from supporting industries of input goods and services. For example, an increase in almond trees may entail purchase of additional horticultural tools and buying more almond transport services, and these input suppliers have purchases of their own that ripple further.

Induced Effects: Induced effects are economic ripples that result from added consumption generated by the added income spent by those with income from the direct and indirect effects. For example, almond processor employees spend their incomes at local grocery stores, auto dealerships and barbershops and these local firms have workers whose expenditures ripple further, creating additional economic activity.

The sum of direct, indirect, and induced impacts comprises the full impact or contribution of an industry on the California economy. We report the contributions using four economic measures.

Value of Output: The value of direct output or service contribution of an industry or segment. For example, the direct value of almond farm output is simply the market value of almonds produced and for almond processors it is the total market value for the almond products they sell.

Labor Income: The compensation received by hired employees, contract workers and entrepreneurs (owner-operators) who work in an industry.

Value Added: Value added is the measure of salaries and wages, proprietor income and profit minus business taxes. It is that proportion of value of output contributed by labor and capital within the sector. An industry’s value added is the economic contribution of a sector above the cost of goods and services purchased from other sectors. Value added is the industry’s contribution to the size of the California economy.

Employment: Employment is defined as the number of jobs including part-time or seasonal employment. This includes self-employment and unpaid family workers.

2.4 Building the I-O Model for the California Almond Industry

Flow Chart 2.1 serves as a basis for our model of the California almond industry. In this study we define the California almond industry to include on-farm almond production by California farmers, the initial processing of almonds post-harvest by hullers and shellers, further cleaning, sorting and marketing of almonds by handlers and production and marketing of manufactured almond products by manufacturers for commercial use and for final retail sales.

Going from left to right in the flow chart, California almond farms rely on transactions with input suppliers from various sectors ranging from the farm chemical and horticultural industry to the local accounting and banking industry. The resulting harvest of almonds from California almond farms is transported to hullers and shellers for initial processing. As with almond farms, this level of processing requires additional inputs from supporting industries to run and maintain the huller and sheller equipment. The hulling-shelling process also produces the revenue-generating by-products (hulls and shells) used by the livestock industry as feed ingredients and bedding material among other things. Once through the hulling and shelling process, almonds are then transported to handlers and manufacturers to be further processed and sold either as simple whole kernels or highly processed products such as almond milk and all products in between. These almond products are then sold either in California, across the United States, or exported to foreign markets, mostly to Asia and the European Union. This analysis does not go beyond the handler or manufacturing plant loading dock to include the retail sales of almond products. Our criteria for considering the boundaries of the California almond industry is the determination of whether the value of output by a sector within the supply chain would remain stable if California almond production were greatly reduced. Thus, for example, we assert that most retail activity involving almond products, whether in the grocery store industry or food

service industry would continue, even if those products were not from California farms. In a scenario in which almond production and processing shifted from California to elsewhere, California retailers would still sell almond products produced out of state just as coffee and bananas sold in California are from farms outside California and California almonds are sold in states that produce no almonds. In contrast, as noted above, California on-farm almond production is crucial for the almond transports, almond processing sectors and almond product shipments and export handling within California.

For this analysis we use multipliers from the IMPLAN model and database for California for the calendar year 2018. We then use California almond industry data for the 2017/18 crop year to calculate the value of output, worker income, value added, and employment impacts for 2018. The data used was supplied by almond industry stakeholders who voluntarily responded to questionnaires about their business. The data provided by questionnaire respondents were used to estimate almond industry direct impact totals for each of the four almond industry sectors.

The IMPLAN data set is segmented into 536 industry sectors. No specific sectors are available for almond farming, hulling and shelling, almond handling or almond manufacturing. To complete this analysis each of the four almond industry sectors was matched with an existing IMPLAN sector based on similarity in economic activity. The sectors selected were then modified to more closely match almond-industry economic activity using the questionnaire data provided by industry stakeholders. IMPLAN sectors are based on the U.S. Bureau of Economic Analysis' latest Benchmark Input-Output Study.

Using multipliers calculated for these modified sectors in the IMPLAN database, we estimate the value of economic contributions for the California almond industry using the best available California almond industry data for 2018. We use information provided by the Almond

Board of California Position Reports along with per unit values of almond products to determine the aggregate levels of farm, huller-sheller, handler, and product manufacturer output during the 2017/18 almond crop year. The multipliers and contribution estimates are provided in Section 3.

Figure 2.1: Flow of almonds and other inputs through the production and marketing chain

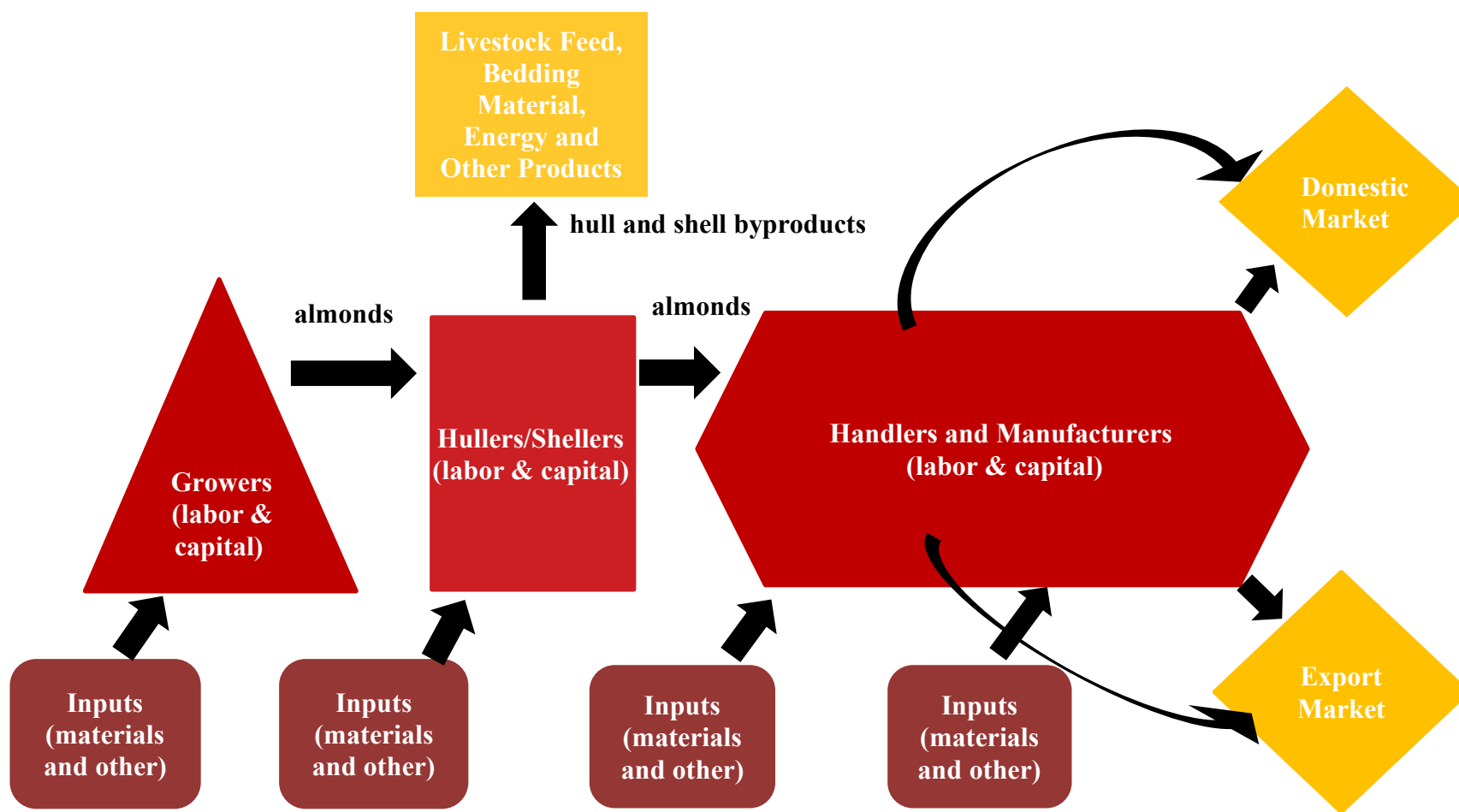


Table 2.1 Industry Sectors within IMPLAN used to Analyze the California Almond Industry

IMPLAN Sector	Almond Products Produced within Sector
Tree Nut Farming	On-Farm Almond Production
Support Activities for Agriculture	Almond Hulling and Shelling
	Almond Handling (Bulk sorting, cleaning and packaging of kernel)
Roasted Nuts and Nut Butter Manufacturing	Almond Product Manufacture (Highly processed almond products)

Source: IMPLAN

Section 3. Economic Contributions of California Almond Production and Processing to the California Economy

This section traces how California almond production and processing affect the value of output, labor income, value added, and employment within the California economy through direct, indirect and induced effects outlined in Section 2. California almonds are the second most valuable agricultural crop in the state behind grapes and the third most valuable commodity overall when including dairy production. As such, the direct and economy-wide impacts from California's almond industry are substantial.

We update the IMPLAN data using estimates of the direct value of output of California almond farms, hullers and shellers, handlers and manufacturers during the 2017/18 crop year, to conduct analysis of economic contributions of the California almond industry to the California economy. As noted in Section 2, we supplement the IMPLAN dataset using information provided via survey responses from California almond industry stakeholders. Also, we do not include the retail sales of almonds and almond products as part of the California almond production and processing industry.

Furthermore, we calculate the contribution of almond production and processing to the economy of California's Central Valley, which we define to include the counties of Butte, Colusa, Fresno, Glenn, Madera, Merced, Sacramento, Kern, Kings, San Joaquin, Solano, Stanislaus, Sutter, Tehama, Tuolumne, Yolo, Yuba and Tulare. Almond farms in this region account for virtually all almond production in California. The same is true for output from almond huller-shellers, almond handlers and almond product manufacturers.

This analysis uses three existing industry sectors contained within the IMPLAN model (Table 2.1). These sectors include tree nut farming used to model California almond farms, support activities for agriculture used to model both California almond huller-shellers and California almond handlers and roasted nut and nut butter manufacturing used to model California almond product manufacturers. Each of the IMPLAN sectors used for this study was modified using data provided by California almond industry stakeholders. The modifications were made to align the economic activity within the IMPLAN sector to more closely resemble each almond industry segment being modeled.

3.1 Contribution of Almond Farming and Processing to the California Economy

Table 3.1 shows the impact multipliers and value of contribution from almond farms to the California economy for the 2017/18 crop year. The rows of the table are values for direct, indirect, induced and total impacts for value of output, labor income, value added and employment.

Focusing on the multipliers, the basis for analysis lies in the direct value of output from each of the four sectors that make up the California almond industry. For example, reading from the top left of Table 3.1 every \$1.00 of almond output by California almond farms results in an additional \$1.341 of output in the state's economy through indirect and induced effects, so the total effect multiplier is 2.341. During the 2017/18 crop year, on-farm almond production in California generated about \$5.4 billion in direct output, which drove the California economy to produce about \$7.28 billion in additional output through indirect (about \$3.66 billion) and induced (about \$3.62 billion) effects for a total of a little over \$12.7 billion in output.

Out of the \$5.4 billion in direct output revenue earned by California almond farms about \$2.42 billion, or \$0.45 of every dollar of on-farm output, was paid to workers and proprietors on the farms as labor income. Almond farm production accounted for about \$2.7 billion in additional labor income within the state through indirect (\$1.5 billion) and induced (\$1.2 billion) effects for a total of almost \$5.2 billion added to the California economy as labor income.

Labor income makes up the majority of California almond farms' total value added, which is the contribution to the state's GDP. For every dollar of output earned on almond farms about \$0.52 is added to the California GDP. Almond production on California farms during the 2017/18 crop year generated direct value added of about \$2.4 billion. Contributions from indirect (\$2.15 billion) and induced (\$2.25 billion) effects of almond production amounted to \$4.4 billion for a total contribution of about \$5.1 billion to the California GDP.

Almond production on California farms directly supports about 3.7 jobs for every \$1 million of output produced. During the 2017/18 crop year, California almond farms supported 20,206 direct on-farm jobs. Almond production in the state also generates jobs in other parts of the economy through indirect and induced effects. During the 2017/18 crop year, approximately 28,000 jobs were supported indirectly by California's on-farm almond production and another 19,820 jobs were supported through induced effects. In total, for every \$1 million of on-farm almond output about 12.5 jobs are supported in California. This amounted to about 68,000 jobs statewide in the 2017/18 crop year.

All almonds produced on California almond farms gets further processed by huller-shellers, handlers and manufacturing plants within the state into an array of finished products that are sold as consumer products to retail outlets and/or as bulk ingredients used in commercial food manufacturing and restaurants. Hulling and shelling represent the initial processing of the

almonds post-harvest prior to being sold and transferred to almond handlers and manufacturers. Hullers and shellers never take ownership of the almonds and earn their gross revenues through the sale of hulls and shells as almond byproducts and through moderate service fees. The activities of hullers and shellers act as a secondary source of value created by the California almond industry with the sale of almond byproducts to the livestock industry. In contrast, almond handlers and manufacturers earn their gross revenues through the further value-added processing of almond kernels purchased from California almond farms. Therefore, when considering the economic contributions of these two branches of the almond processing sector, it is important to remember that the value of output for handlers and manufacturers includes the value of almonds purchased from California almonds farms. As such, the contributions of California almonds farms are included in the measure of indirect and induced effects of the almond handlers and almond manufacturers. Aggregating the economic contributions of almond huller and shellers with almond handlers and manufacturers provides a measure of the entire almond industry's contributions to California's economy. These measures are presented in Table 3.2.

Every \$1.00 of output from the California almond industry generated an additional \$1.666 in indirect and induced output from the rest of the economy (Table 3.2). During the 2017/18 crop year, sales of processed almonds and almond byproducts by hullers and shellers generated a total direct output value of \$7.34 billion and generated an additional \$12.22 billion in output value in the state's economy through indirect (\$7.35 billion) and induced effects (\$4.87 billion).

The labor income panel in Table 3.2 shows that employees and proprietors of almond processors earned \$501 million or about \$0.68 per \$1.00 of direct output value generated by California's almond processing sectors. California almond processors generated \$5.4 billion in

labor income through indirect (\$3.75 billion, which includes labor income paid out to almond farm proprietors and their workforce) and induced effects (\$1.65 billion). In total, the almond industry in California generated about \$5.9 billion in labor income during the 2017/18 crop year.

The total labor income value makes up over 60 percent of the total value added to the state's GDP by California's almond industry in the 2017/18 crop year. Every \$1.00 of output produced by California almond processors generates about \$0.23 of direct value added and about \$1.257 of total value added to the California economy. In the 2017/18 crop year, the direct value added from the almond industry was \$1.7 billion. An additional \$7.52 billion was added to the California GDP through indirect (\$4.49 billion) and induced (\$3.03 billion) effects of almond production and processing for a total contribution of about \$9.23 billion to California's economy.

Every \$1 million of additional almond industry output supports 1.365 direct jobs within the industry and about 13.62 jobs through indirect (9.97 jobs) and induced (3.65 jobs) effects on the rest of the economy. California almond processors, including hullers and shellers, supported about 10,000 direct jobs and an additional 100,000 jobs through indirect (73,000 jobs, which include jobs on California almond farms) and induced (27,000 jobs) effects. In total, close to 110,000 jobs throughout California were supported by the California almond industry during the 2017/18 crop year.

When examining each of the almond processing sectors individually, it is apparent that the ripple effects stemming from the activities of almond huller-shellers are unique compared to the effects of almond handling and almond product manufacturing. The main source of this difference lies in the reliance on purchased inputs relative to labor. For example, \$1 million of output generated by huller-shellers supports about 6 direct jobs and a little more than 1.5 indirect

jobs (Table 3.3). The higher multiplier related to direct jobs relative to indirect jobs indicates that hullers and shellers purchase few inputs in order to conduct their economic activities. In contrast, almond handlers and product manufacturers have substantially higher indirect job multipliers (10.66 jobs per \$1 million for handlers and 9.89 jobs per \$1 million for manufacturers) relative to direct job multipliers (1.06 jobs per \$1 million for handlers and 1.18 jobs per \$1 million for manufacturers) (Table 3.4 and Table 3.5). This is understandable as their output is dependent on the purchase of raw almonds produced on California almond farms by farm owners and farm workers as well as other inputs necessary to process and package almond products. In addition, the efficiency of automation in processing activities requires fewer direct jobs per unit of output.

The total effect on labor income for the three almond processing sectors is between \$0.70 and \$0.86 with almond product manufacturers having the largest share of output going toward labor income (Table 3.3, Table 3.4 and Table 3.5). The same is true with respect to the contributions of the three sectors to the California GDP. For every \$1.00 of output generated by huller-shellers an additional \$1.38 was added to the California economy during the 2017/18 crop year (Table 3.3). Almond handlers and almond product manufacturers each add about \$1.25 to California's economy from \$1.00 of output generated (Table 3.4 and Table 3.5).

3.2 Contribution of Almond Farming and Processing to California's Central Valley Economy

Using the IMPLAN modeling software and database we also quantified relationships across California's Central Valley. In our analysis we define the Central Valley to include the following 18 California Counties: Butte, Colusa, Fresno, Glenn, Madera, Merced, Sacramento, Kern, Kings, San Joaquin, Solano, Stanislaus, Sutter, Tehama, Tuolumne, Yolo, Yuba and Tulare. These 18 counties account for practically all economic activities conducted within the

California almond industry, including farming and processing. As such, the direct output for each industry sector within the Central Valley is equal to the direct output for the industry statewide.

We begin by examining the contributions at the farm level. Table 3.6 lists the multipliers and various measures of economic contributions that occur during the 2017/18 crop year. First, we examine the impacts and contributions on total output. During the 2017/18 crop year every \$1.00 of output from almond farms in the Central Valley contributed an additional \$0.93 of output in the California Central Valley through indirect (\$0.44 per \$1.00 of output) and induced (\$0.50 per \$1.00 of output) impacts. Central Valley almond farms produced output valued at \$5.42 billion, which generated an additional \$5.087 billion of output in the region.

Central Valley almond farms paid out approximately \$0.45 of every \$1.00 earned as labor income to employees and almond farm proprietors. In addition, almond farm productivity in the Central Valley generated an additional \$0.38 in labor income for every \$1.00 of output through indirect and induced effects. During the 2017/18 crop year almond farms paid out a total of about \$2.42 billion in direct labor income and generated an additional \$2.04 billion in labor income for the region through indirect (\$1.20 billion) and induced (\$840 million) effects. Total labor income from almond farming in the Central Valley accounts for about three quarters of the total contribution of almond farms to the regions GDP. Almond farming contributes significantly to employment in the Central Valley. Combining direct, indirect and induced effects productivity of Central Valley almond farms during the 2017/18 crop year supported about 64,000 jobs in the region.

Aggregating the contributions totals from the almond processing sector in California's Central Valley, which includes activities of almond huller-shellers, almond handlers and almond product manufacturers, provides a measure of the entire industry's impact on the regional

economy of California's Central Valley (Table 3.7). During the 2017/18 crop year the almond industry had a total direct output of \$7.34 billion, with the majority of this output attributed to farm production (Table 3.6). The combination of the three almond processing sectors created an additional \$1.91 billion in output. Total labor income in the Central Valley Region generated from the almond industry was just over \$5 billion, which accounts for about 64 percent of the total value-added contribution of \$7.95 billion to the regions GDP.

Table 3.1: Impact Multipliers and Contributions of California Almond Farms to the California Economy from the 2017/18 Crop Year

<i>Multiplier</i>	<i>Impact Multipliers</i>	<i>Economic Contributions</i>
Value of Output	<i>\$ of output per \$1.00 output</i>	<i>\$ million</i>
Direct Effect	1.000	\$5,424
Indirect Effect	0.675	\$3,660
Induced Effect	0.666	\$3,615
Total Effect	2.341	\$12,699
Labor Income	<i>Labor income per \$1.00 output</i>	
Direct Effect	0.445	\$2,416
Indirect Effect	0.283	\$1,534
Induced Effect	0.225	\$1,219
Total Effect	0.953	\$5,169
Value Added	<i>GDP (\$) per \$1.00 of output</i>	
Direct Effect	0.523	\$2,836
Indirect Effect	0.396	\$2,149
Induced Effect	0.415	\$2,249
Total Effect	1.334	\$7,234
Employment	<i>Jobs per \$ million of output</i>	<i>Number of Jobs</i>
Direct Effect	3.725	20,206
Indirect Effect	5.167	28,024
Induced Effect	3.654	19,820
Total Effect	12.546	68,050

Source: Multipliers were generated in IMPLAN using revenue and costs data supplied by California almond industry stakeholders.

Table 3.2: Impact Multipliers and Contributions of all Almond Production and Processing Activities to the California Economy from the 2017/18 Crop Year

<i>Multiplier</i>	<i>Impact Multipliers</i>	<i>Economic Contributions</i>
Value of Output	<i>\$ of output per \$1.00 output</i>	<i>\$ million</i>
Direct Effect	1.000	\$7,339
Indirect Effect	1.002	\$7,351
Induced Effect	0.664	\$4,873
Total Effect	2.666	\$19,563
Labor Income	<i>Labor income per \$1.00 output</i>	
Direct Effect	0.068	\$501
Indirect Effect	0.511	\$3,750
Induced Effect	0.224	\$1,648
Total Effect	0.804	\$5,899
Value Added	<i>GDP (\$) per \$1.00 of output</i>	
Direct Effect	0.232	\$1,706
Indirect Effect	0.612	\$4,491
Induced Effect	0.413	\$3,032
Total Effect	1.257	\$9,228
Employment	<i>Jobs per \$ million of output</i>	<i>Number of Jobs</i>
Direct Effect	1.365	10,020
Indirect Effect	9.966	73,143
Induced Effect	3.650	26,791
Total Effect	14.982	109,953

Source: Multipliers were generated in IMPLAN using revenue and costs data supplied by California almond industry stakeholders.

Table 3.3: Impact Multipliers and Contributions of California Almond Hullers and Shellers to the California Economy from the 2017/18 Crop Year

<i>Multiplier</i>	<i>Impact Multipliers</i>	<i>Economic Contributions</i>
Value of Output	<i>\$ of output per \$1.00 output</i>	<i>\$ million</i>
Direct Effect	1.000	\$410
Indirect Effect	0.566	\$232
Induced Effect	0.737	\$302
Total Effect	2.302	\$944
Labor Income	<i>Labor income per \$1.00 output</i>	
Direct Effect	0.302	\$124
Indirect Effect	0.149	\$61
Induced Effect	0.249	\$102
Total Effect	0.702	\$288
Value Added	<i>GDP (\$) per \$1.00 of output</i>	
Direct Effect	0.654	\$268
Indirect Effect	0.266	\$109
Induced Effect	0.459	\$188
Total Effect	1.378	\$565
Employment	<i>Jobs per \$ million of output</i>	<i>Number of Jobs</i>
Direct Effect	5.946	2,438
Indirect Effect	1.761	722
Induced Effect	4.059	1,664
Total Effect	11.766	4,824

Source: Multipliers were generated in IMPLAN using revenue and costs data supplied by California almond industry stakeholders.

Table 3.4: Impact Multipliers and Contributions of California Almond Handlers to the California Economy from the 2017/18 Crop Year

<i>Multiplier</i>	<i>Impact Multipliers</i>	<i>Economic Contributions</i>
Value of Output	<i>\$ of output per \$1.00 output</i>	<i>\$ million</i>
Direct Effect	1.000	\$5,027
Indirect Effect	1.038	\$5,216
Induced Effect	0.660	\$3,316
Total Effect	2.697	\$13,559
Labor Income	<i>Labor income per \$1.00 output</i>	
Direct Effect	0.030	\$150
Indirect Effect	0.539	\$2,712
Induced Effect	0.223	\$1,121
Total Effect	0.793	\$3,984
Value Added	<i>GDP (\$) per \$1.00 of output</i>	
Direct Effect	0.201	\$1,011
Indirect Effect	0.643	\$3,231
Induced Effect	0.410	\$2,063
Total Effect	1.254	\$6,304
Employment	<i>Jobs per \$ million of output</i>	<i>Number of Jobs</i>
Direct Effect	1.062	5,340
Indirect Effect	10.663	53,601
Induced Effect	3.627	18,233
Total Effect	15.352	77,174

Source: Multipliers were generated in IMPLAN using revenue and costs data supplied by California almond industry stakeholders.

Table 3.5: Impact Multipliers and Contributions of California Almond Product Manufacturers to the California Economy from the 2017/18 Crop Year

<i>Multiplier</i>	<i>Impact Multipliers</i>	<i>Economic Contributions</i>
Value of Output	<i>\$ of output per \$1.00 output</i>	<i>\$ million</i>
Direct Effect	1.000	\$1,902
Indirect Effect	1.001	\$1,903
Induced Effect	0.660	\$1,255
Total Effect	2.660	\$5,060
Labor Income	<i>Labor income per \$1.00 output</i>	
Direct Effect	0.119	\$226
Indirect Effect	0.514	\$977
Induced Effect	0.223	\$424
Total Effect	0.855	\$1,627
Value Added	<i>GDP (\$) per \$1.00 of output</i>	
Direct Effect	0.225	\$427
Indirect Effect	0.605	\$1,151
Induced Effect	0.411	\$781
Total Effect	1.240	\$2,358
Employment	<i>Jobs per \$ million of output</i>	<i>Number of Jobs</i>
Direct Effect	1.179	2,242
Indirect Effect	9.894	18,819
Induced Effect	3.625	6,894
Total Effect	14.698	27,955

Source: Multipliers were generated in IMPLAN using revenue and costs data supplied by California almond industry stakeholders.

Table 3.6: Impact Multipliers and Contributions of California Almond Farms to the California Central Valley Economy from the 2017/18 Crop Year

<i>Multiplier</i>	<i>Impact Multipliers</i>	<i>Economic Contributions</i>
Value of Output	<i>\$ of output per \$1.00 output</i>	<i>\$ million</i>
Direct Effect	1.000	\$5,424
Indirect Effect	0.437	\$2,370
Induced Effect	0.501	\$2,717
Total Effect	1.938	\$10,511
Labor Income	<i>Labor income per \$1.00 output</i>	
Direct Effect	0.445	\$2,416
Indirect Effect	0.220	\$1,196
Induced Effect	0.156	\$848
Total Effect	0.822	\$4,460
Value Added	<i>GDP (\$) per \$1.00 of output</i>	
Direct Effect	0.523	\$2,836
Indirect Effect	0.283	\$1,533
Induced Effect	0.296	\$1,604
Total Effect	1.101	\$5,972
Employment	<i>Jobs per \$ million of output</i>	<i>Number of Jobs</i>
Direct Effect	3.726	20,206
Indirect Effect	4.936	26,771
Induced Effect	3.133	16,994
Total Effect	11.795	63,972

Source: Multipliers were generated in IMPLAN using revenue and costs data supplied by California almond industry stakeholders.

Table 3.7: Impact Multipliers and Contributions of all Almond Production and Processing Activities to the California Economy from the 2017/18 Crop Year

<i>Multiplier</i>	<i>Impact Multipliers</i>	<i>Economic Contributions</i>
Value of Output	<i>\$ of output per \$1.00 output</i>	<i>\$ million</i>
Direct Effect	1.000	\$7,339
Indirect Effect	1.002	\$6,819
Induced Effect	0.664	\$3,503
Total Effect	2.666	\$17,661
Labor Income	<i>Labor income per \$1.00 output</i>	
Direct Effect	0.068	\$501
Indirect Effect	0.511	\$3,461
Induced Effect	0.224	\$1,094
Total Effect	0.804	\$5,055
Value Added	<i>GDP (\$) per \$1.00 of output</i>	
Direct Effect	0.232	\$1,706
Indirect Effect	0.612	\$4,175
Induced Effect	0.413	\$2,068
Total Effect	1.257	\$7,949
Employment	<i>Jobs per \$ million of output</i>	<i>Number of Jobs</i>
Direct Effect	1.365	10,020
Indirect Effect	9.966	70,486
Induced Effect	3.650	21,947
Total Effect	14.982	102,453

Source: Multipliers were generated in IMPLAN using revenue and costs data supplied by California almond industry stakeholders.

Concluding Remarks

The California almond industry makes vital nutritional, social, and economic contributions across the state of California, the United States, and Globally. Continued growth in demand, both domestically and internationally, for California almonds has enabled the California almond industry to weather recent challenges ranging from drought to international trade disputes. The resilience and growth of the California almond industry has continued to provide huge economic contributions to the state of California and especially to the California Central Valley.

In the California Central Valley, the primary almond producing and processing region in California, the almond industry creates close to \$8 billion in value added for the regional economy from \$17.6 billion in total industry output. Through the direct, indirect and induced effects the almond industry supports about 102,500 jobs in the region.

The California almond industry has major impacts that extend well beyond the Central Valley. Almond production on farms and the manufacturing of processed almond products contributed about \$9.2 billion in economic value added to the California economy during the 2017/18 crop year from \$19.6 billion in industry output. The industry, through its direct, indirect and induced effects supported about 110,000 jobs in the California economy.

In addition to its broad and important effects on economic activity, California almond production contributes to state, national, and global health and well-being by offering healthful, nutritious, and enjoyable products to food consumers everywhere. The California almond industry has developed into the most efficient, competitive and successful producer of almond products in the world. Consumers world-wide enjoy California almond products and ingredients in an expansive variety of products. These consumer benefits are the most important contribution

of the almond industry. The economic health of the almond industry is vital to the economy in California and to consumers locally and globally.