Prices of Cannabis in California from Licensed and Unlicensed Retailers

Robin S. Goldstein, Raffaele Saposhnik, and Daniel A. Sumner

Little public information or analysis is available about licensed or unlicensed cannabis prices. Here, we report on about 232,000 online cannabis prices from about 2,600 cannabis retailers across California, classified by location, package and product type, storefront or delivery-only, and licensed versus unlicensed status. We find that dried cannabis flower prices listed by licensed retailers average 11% higher than prices listed by unlicensed cannabis retailers. Prices are 25% higher at licensed compared to unlicensed storefronts and 7% higher at licensed compared to unlicensed delivery services. In this article, we further explore dried flower price comparisons by package size, delivery-only vs. storefront retailers, and region.

Estimates indicate that dried cannabis flower makes up about two-thirds of the California cannabis market by volume.

Cannabis from illegal channels has long been widely available and used. In California, cannabis for California residents with doctors' recommendations has been sold legally in dispensaries for more than two decades. Cannabis purchase and use has been legal for all adult users in California since the passage of California's Proposition 64 on November 8, 2016. However, California has had its thoroughly regulated cannabis market and taxed cannabis market only since 2018, when the Medical and Adult-Use Cannabis Regulation and Safety Act (MAUCRSA) went into effect. Some rules, such as testing for heavy metals, were not enforced until as late as January 2019. Here, we report on patterns of listed prices of cannabis from licensed and unlicensed retailers across California in July 2019, 18 months after the taxed and regulated market first opened, and one year after state regulations were first fully implemented.

What is Licensed Cannabis?

In all U.S. states with legal "recreational" or "adult-use" cannabis regimes, cannabis producers, distributors, and retailers must obtain state licenses in order to sell legally. Licensing and "seed-to-sale" tracking systems help states collect taxes, monitor the flow of cannabis through the legal system, and enforce safety, testing, and labeling regulations. Unlicensed retailers face neither the costs of complying with taxes and regulations themselves nor the costs of buying supply from compliant producers. So unlicensed cannabis sellers tend to sell at lower prices than licensed sellers. In this article, for simplicity, we will use the term "licensed cannabis" to refer to products sold through the supply chain from licensed growers through licensed retailers. It is useful to note that it is not unlawful for consumers to buy from unlicensed sellers or possess unlicensed products.

To the ordinary California consumer, in most cases, there is no obvious difference between licensed and unlicensed cannabis, nor between licensed and unlicensed retailers. Some consumers in California may recognize and be willing to pay more for licensed cannabis, but our consumer research and interviews with industry experts and market participants suggest that many, perhaps most, consumers are not able to differentiate between licensed and most unlicensed retailers or their products. That seems to be especially true for unlicensed sellers that use the Weedmaps services from which we have collected data.

Figure 1. Average California Retail Price per Gram of Cannabis Flower by Package Size: Delivery-only vs. Storefront
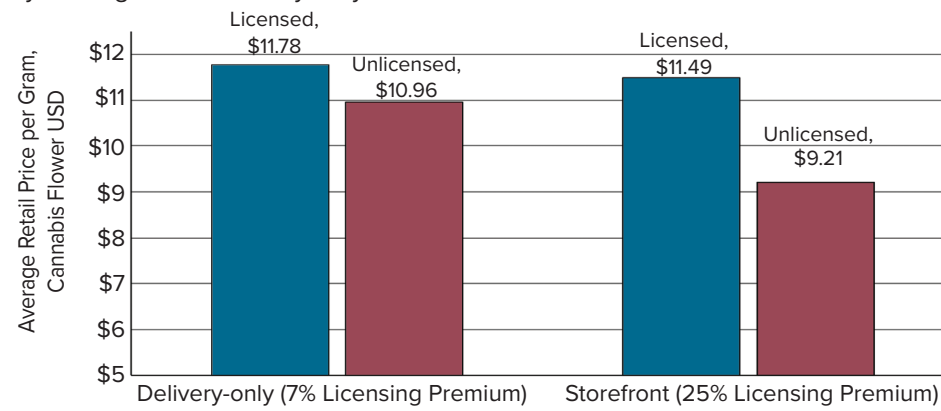
Measuring Licensed and Unlicensed Prices

The UC Ag Issues Center has been collecting cannabis retail price data since 2016. Our data come from Weedmaps, a popular cannabis e-commerce platform where retailers list prices by product attributes and package sizes, and report a wide variety of retailer information, including store location or service area for delivery-only retailers.

For this article, we report retailers' license status directly from license number information that retailers post on Weedmaps. The license number of a retailer is found at the bottom of a list of details on the third tab of a retailer's landing page. We designate as unlicensed those retailers whose listings leave the license number field blank. There is no reason why a retailer would not want to list a license number

if it had one, unless the retailer were engaged in cannabis business activity outside the scope of its license. Typically, customers would not notice the distinction between licensed and unlicensed retailers, unless they were specifically looking for this information.

Weedmaps has been operating for more than a decade, initially for retailers offering "medicinal" cannabis, which was the only legal market in California at the time. Several academic studies have indicated that the majority of cannabis retailers list on Weedmaps. However, some unlicensed retailers may be hesitant to advertise publicly. We cannot rule out the possibility that Weedmaps prices are not representative of overall California prices, especially small informal "street" retailers. Nonetheless, to our knowledge, Weedmaps has the most comprehensive data

on California retail cannabis prices available. We argue that these Weedmaps data provide a useful window on the market, and that they are the most reliable data set currently available for comparing licensed and unlicensed prices while holding many other factors constant.

Cannabis Flower Products

We analyze the retail prices of dried cannabis flower, the most common cannabis product, which is sold in stores or delivered to customers in plastic or glass packages in sizes ranging from one gram (about two typical "joints") to one ounce (28.35 grams). Industry and government analysts estimate that dried cannabis flower makes up about two-thirds of the California cannabis market by volume. The remaining third of the market, which we do not consider in this paper, includes a wide variety of products manufactured from extracted cannabis oil and specialty flower products such as extra-high-potency "moonrocks" or extra-low-potency "trim."

What is a Retailer?

Some California cannabis retailers have storefronts, but most retailers (72% in our data) are delivery-only. Storefront and delivery-only retailers are separate state license categories and separate listing categories on Weedmaps. We treat each storefront location with a Weedmaps listing as a separate retailer. However, some delivery-only retailers post multiple listings on Weedmaps that have identical product menus, prices, and phone numbers, but with different locations within their delivery radius and different numbers of customer reviews. In our retailer counts and price average calculations, we omit duplicate listings that have zero customer reviews (whether storefronts or delivery-only services) because this indicates either it is not a separate retailer or it is no longer operating.

Figure 2. Average California Retail Price per Gram of Cannabis Flower by Package Size
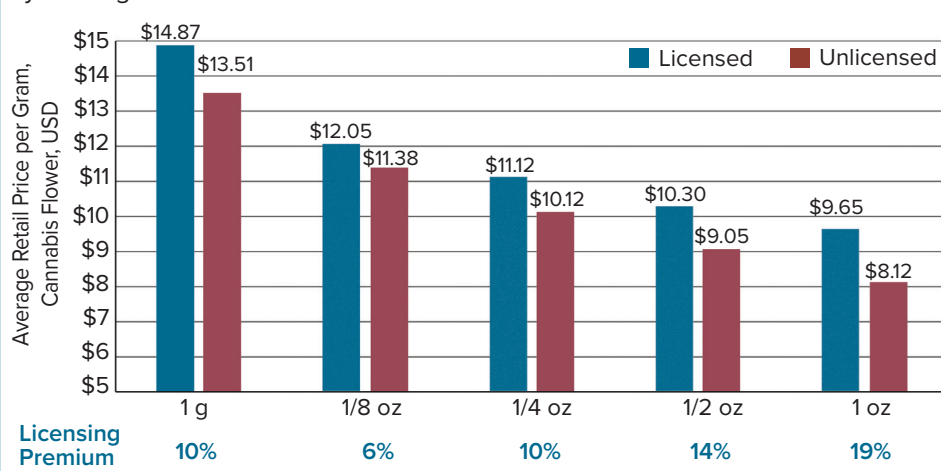
Figure 3. Regions of California for Calculations of Numbers of Retailers and Average Prices

Price Data

Our data set consists of retail prices per gram of cannabis flower for the eight most common package sizes: 1 g, 2 g, 1/8 oz, 4 g, 5 g, 1/4 oz, 1/2 oz, and 1 oz. In computing averages, we used each cannabis flower package as an observation. We did not weight each price observation by the volume of cannabis in the package because we understand from interviews that larger packages comprise a smaller volume of transactions. We excluded uncommon flower packages other than the eight sizes listed above. These uncommon packages made up less than 1% of the potential prices listed.

We took two important steps to remove spurious listings and other sources of noise from the data set. First, as noted above, we excluded (both from retailer counts and price averages) retailers that had zero reviews. This excluded about 10% of potential retailers. Second, for delivery-only retailers that had duplicate listings with identical menus, price lists, and phone numbers, we counted their listings only once. This reduced the data set from about 4,855 to 2,589 active and distinct retailers. The prices reported here are based on 231,538 flower prices, of which 63,192 prices (27%) are from licensed retailers and 168,336 prices (73%) are from unlicensed retailers.

Licensed-Unlicensed Price Differences Overall and by Type of Retailer

Overall, licensed cannabis flower averages $11.64 per gram, 11% more than unlicensed flower, which averages $10.50 per gram. But this 11% difference, which we call a "licensing premium," conceals more complex relationships beneath the surface. Some retailers operate storefronts, while far more operate delivery-only services. Figure 1 compares average flower prices at delivery-only retailers and storefront retailers. The average licensing premium is about 3.5 times higher at storefronts (25%) than at delivery services (7%). In the unlicensed market, delivery-only prices are 19% higher than storefronts, but in the licensed market, delivery-only prices are only 3% higher.

Licensed-Unlicensed Price Differences by Package Size

Figure 2 shows licensed and unlicensed cannabis flower prices by package size. As for most other packaged consumer products, there are price discounts for buying cannabis flower in larger retail packages. Single-gram packages of licensed cannabis are 54% more expensive per gram than one-ounce packages, and single-gram packages of unlicensed cannabis are 66% more expensive per gram than one-ounce packages.

Price premiums for licensed retailers are lower for small packages such as single-gram (10%) and 1/8-ounce (6%), and higher for larger packages such as 1/2-ounce (14%) and one-ounce (19%).

Licensed-Unlicensed Price Differences by Region

For our regional price averages, we chose the simple partitioning shown in Figure 3. We acknowledge that any such division of California into six regions is arbitrary by nature, and we attempt to err on the side of simplicity. In further econometric work, we use much more specific location identifiers.

Locations of Licensed and Unlicensed Retailers

Figure 4 shows the numbers and percentages of licensed vs. unlicensed retailers by region. We order the regions along the X-axis from north (left) to south (right). We define a retailer's location by the zip code of the storefront, or area of the primary listing for delivery-only retailers.

In regions with fewer total retailers, more of the retailers are licensed retailers. In the populous, retailer-dense areas of Los Angeles County and our Southern California region, only about a quarter of retailers are licensed,

Figure 4. Numbers and Percentages of Licensed and Unlicensed Retailers by California Region
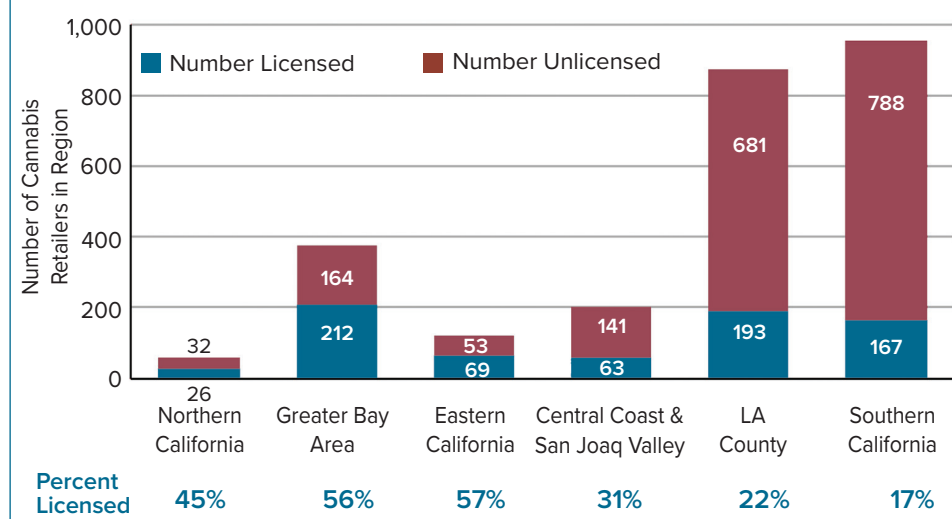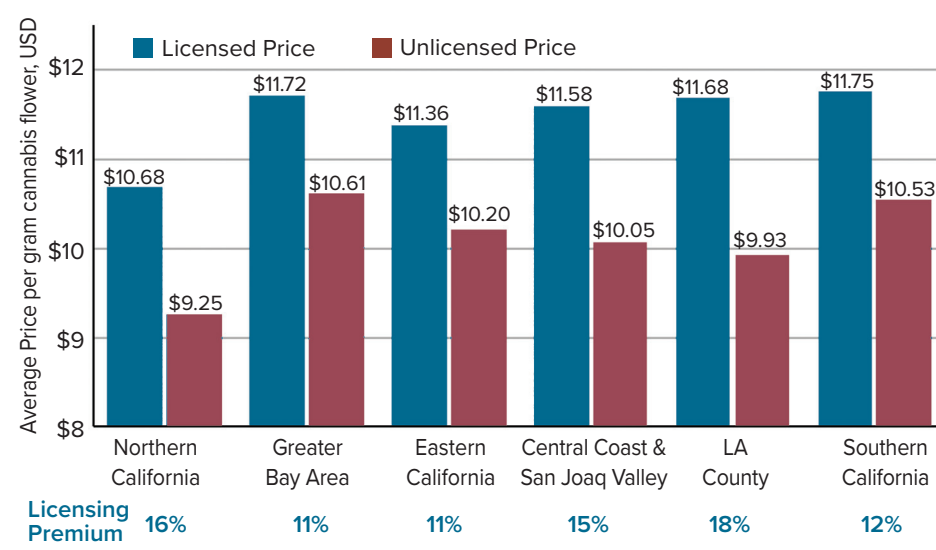
	Northern California	Greater Bay Area	Eastern California	Central Coast & San Joaq Valley	LA County	Southern California
Number Unlicensed	32	164	53	141	681	788
Number Licensed	26	212	69	63	193	167
Percent Licensed	**45%**	**56%**	**57%**	**31%**	**22%**	**17%**

Figure 5. Average Licensed and Unlicensed Prices and Percent Licensing Premiums by California Region

	Northern California	Greater Bay Area	Eastern California	Central Coast & San Joaq Valley	LA County	Southern California
Licensing Premium	16%	11%	11%	15%	18%	12%

whereas in our Greater Bay Area region, almost three-fifths are licensed. The Bay Area has more licensed retailers than Los Angeles or Southern California, but only about one-fifth as many unlicensed retailers. We note that this is correlated with the prevalence of delivery-only retailers, which comprise 78% of licensed retailers and 89% of unlicensed retailers in these data.

Licensed and Unlicensed Prices by Region

Figure 5 shows price differences by region. Again, we list regions in order from north to south. In general, more densely populated regions appear to have more expensive cannabis, with unlicensed prices appearing to be even more sensitive to the same regional variations than licensed prices are. Our Northern California region (not including the Bay Area), home to the so-called "Emerald Triangle" of Humboldt, Mendocino, and Trinity counties, a sparsely populated area where much of the state's cannabis is produced, has the lowest retail prices.

Interpretation and Limitations

Although studies have reported that the majority of licensed cannabis retailers in the U.S. post listings on Weedmaps, unlicensed retailers are likely less well represented, as many of them may choose not to advertise their services publicly. The numbers we report for unlicensed retailers may not be representative of all unlicensed retailers in California. We have data on listed prices for each product for each retailer, but we have no access to data on quantities. We compute the averages for each retailer, and averages of these retailer average prices, by counting each listed item once. These concerns with the price data affect both licensed and unlicensed retailers alike. Some licensed retailers are large, others small, and size differences also apply to unlicensed retailers. We think that the reported comparisons between licensed and unlicensed retail prices are useful even given the limitations of the Weedmaps data set. We note, however, that if we were able to include "street" dealers in the definition of "unlicensed retailers," then we would expect the estimated average prices of unlicensed retailers to be lower.

Conclusions

Our large data set offers a unique window into licensed and unlicensed cannabis flower retail prices in California. Aside from giving the first systematic glimpse into licensing premiums in a U.S. state, our data appear to illuminate two interesting phenomena that warrant further exploration: first,

substantial price premiums exist for delivery-only service retailing versus storefront retailing in the unlicensed market but not the licensed market; and second, larger licensing premiums are present for large package sizes (e.g. one ounce) than for small package sizes (e.g. 1/8-ounce). Our results may be useful for economists and policymakers who face the challenging task of assessing substitution between licensed and unlicensed cannabis.

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Authors' Bios

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For additional information, the authors recommend:

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President Trump and Migration after Three Years

Philip Martin

Candidate Trump made reducing unauthorized migration a central theme of his campaign for the presidency. President Trump issued executive orders that instructed the Department of Homeland Security to build a wall on the Mexico-U.S. border, increase deportations, and reduce refugee admissions; we examined the implementation of these orders in *ARE Update* in March-April 2019. In three years, President Trump has implemented policies to reduce unauthorized migration and asylum-seeking. Agricultural guest worker programs have not changed significantly, but rising labor costs are pushing farmers to invest in mechanization and housing for guest workers.

Walls, Deportations, and Refugees

After three years, the scorecards on the wall, deportations, and refugees are incomplete. Fences and barriers on the Mexico-U.S. border are being repaired, replaced, and expanded. Still, only a third of the 2,000-mile border has major pedestrian and vehicle barriers after three years, 100 miles more than when President Trump took office. After Congress refused to appropriate the funds requested for the wall for FY19, the U.S. had its longest partial government shutdown in modern history, closing nine of the 15 federal agencies for 35 days in December 2018–January 2019.

President Trump promised to build an additional 450 miles of border wall before the November 2020 election, which would mean barriers on over half of the Mexico-U.S. border. He declared a national emergency in February 2019, and moved over $6 billion from the military and other sources to build and repair fences and barriers on the Mexico-U.S. border. New barriers involve two parallel fences thirty feet high with six-inch square bollards, tubes with a rebar core and filled with concrete for the first 10 feet.

There were an estimated 10.5 million unauthorized migrants in the U.S. in 2017, down 14% from a peak of 12.2 million in 2007 (Figure 1). The 5.5 million non-Mexican unauthorized migrants outnumbered the 4.9 million unauthorized Mexicans in 2017, the first time that non-Mexicans outnumbered Mexicans among the stock of unauthorized foreigners (Figure 2, page 6). For the past four years, Figure 3 on page 6 shows that more non-Mexicans than Mexicans were apprehended just inside the U.S. border with Mexico.
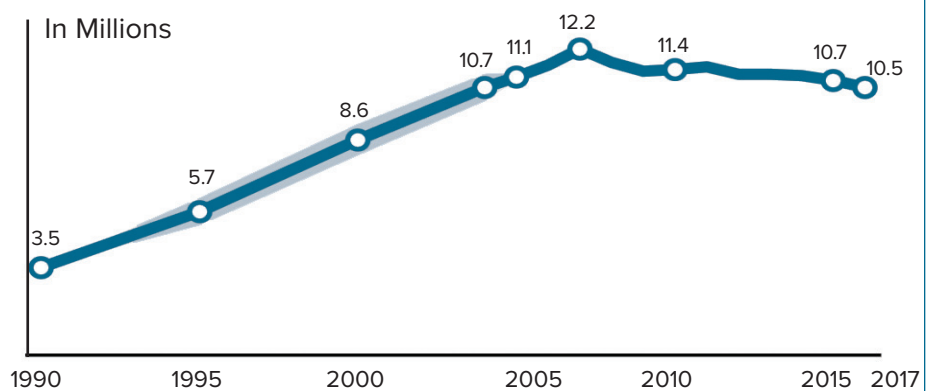
Candidate and President Trump promised to deport "millions" of unauthorized migrants, especially the 2 to 3 million convicted of U.S. crimes. Some 256,000 migrants were deported in FY18, down from a peak 435,000 in FY13 but up from less than 50,000 a year in the 1990s. Figure 4 on page 7 shows that almost three-fourths of foreigners arrested by Immigration and Customs Enforcement (ICE) agents were convicted of U.S. crimes, most often driving under the influence or possessing dangerous drugs.

Deportations rose under the 2007–13 Secure Communities program, which enlisted many of the 3,141 state, county, and local police agencies to provide DHS's Immigration and Customs Enforcement agency with the fingerprints of all persons arrested for and convicted of U.S. crimes. Secure Communities enabled ICE to identify suspected unauthorized migrants and to request that state and local prisons and jails hold them until ICE agents take them into custody.
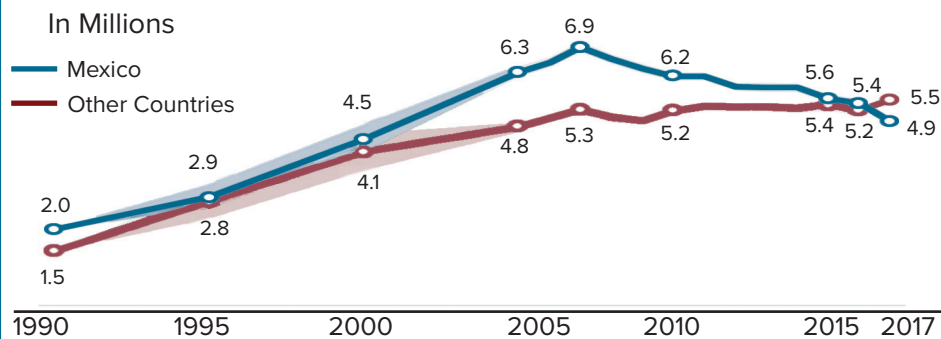
President Obama ended Secure Communities in 2013 and prioritized the removal of recent unauthorized entrants and migrants convicted of U.S. crimes. President Trump revived Secure Communities and made all unauthorized foreigners priorities for removal. Some states and cities reacted by declaring themselves to be sanctuaries for unauthorized migrants, refusing to share information with or to detain migrants for ICE. The result has been a series of suits and counter suits between sanctuary cities and states and the federal government over whether to penalize sanctuary jurisdictions if they do not cooperate with ICE.

Figure 1. Unauthorized Migrants, 1990–2017

In Millions

3.5 · 5.7 · 8.6 · 10.7 · 11.1 · 12.2 · 11.4 · 10.7 · 10.5

1990   1995   2000   2005   2010   2015   2017

Note: Shading shows range of estimated 90% confidence interval.
Source: Passel, J. and D'V. Cohn. 2019 Pew Research Center, 2018.

Figure 2. Stock of Mexican and Non-Mexican Unauthorized Residents, 1990–2017

In Millions

— Mexico
— Other Countries

Mexico: 2.0, 2.9, 4.5, 6.3, 6.9, 6.2, 5.6, 5.4, 4.9
Other Countries: 1.5, 2.8, 4.1, 4.8, 5.3, 5.2, 5.4, 5.2, 5.5

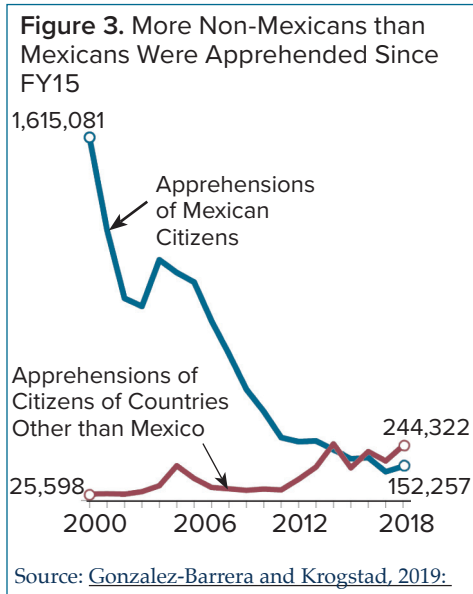1990 1995 2000 2005 2010 2015 2017

Source: Gonzalez-Barrera and Krogstad, 2019; www.pewresearch.org/fact-tank/2019/06/28/what-we-know-about-illegal-immigration-from-mexico/

Each president proposes a quota of refugees who can be resettled in the U.S., and the federal government provides grants to NGOs to help these newcomers to find jobs and become self-sufficient. President Trump reduced the number of refugees admitted from over 80,000 a year to a planned 18,000 in FY20, the lowest quota since the Refugee Act of 1980 was enacted and required states and cities to confirm their willingness to resettle refugees. The U.S. Supreme Court in June 2018 ruled that President Trump has the authority to ban arrivals from six countries: Iran, Libya, North Korea, Somalia, Syria, and Yemen.

ICE and Guest Workers

ICE enforces laws that seek to bar the employment of unauthorized workers.

Figure 3. More Non-Mexicans than Mexicans Were Apprehended Since FY15

1,615,081

Apprehensions of Mexican Citizens

Apprehensions of Citizens of Countries Other than Mexico

244,322

25,598

152,257

2000 2006 2012 2018

Source: Gonzalez-Barrera and Krogstad, 2019:

ICE agents arrested 680 unauthorized workers in August 2019 in seven poultry processing plants near Canton, Mississippi, the largest workplace raids in a decade.

ICE opened 6,812 new workplace cases in FY19, up from 1,701 during FY16. Most cases begin with an audit of the I-9 forms completed by newly hired workers and their employers to verify the worker's legal status. If worker-submitted identification documents do not match the data in government databases, employers must inform suspect workers and ask them to correct their records or face termination. Workers who cannot prove that they are authorized to work often quit and move to another employer. This circulation of unauthorized workers is criticized both by migrant advocates, who note that migrants must often start over at the bottom with a new employer, and by restrictionists, who want unauthorized workers removed from the United States.

U.S. spending on border and interior immigration enforcement topped $24 billion in FY18. There are 79,000 federal employees involved in immigration enforcement, compared to 10,000 in labor law enforcement.

President Trump, in April 2017, issued a Buy American and Hire American executive order that instructed federal

agencies to study existing guest worker programs and to implement changes "to protect the interests of U.S. workers … including through the prevention of fraud or abuse." The U.S. has three major guest worker programs: the H-1B program that admits 85,000 migrants a year with a college degree to fill private-sector U.S. jobs requiring such degrees; an unlimited number of H-2A visas for foreign workers to fill seasonal farm jobs; and, 66,000 H-2B visas a year to fill seasonal nonfarm jobs. Other migrants with F-1 student, J-1 cultural exchange, and L-1 intra-corporate transfer visas may also work in the United States.

The H-2A program has expanded significantly. Some 258,000 farm jobs were certified to be filled with H-2A workers in FY19, up from less than 50,000 in FY05 (Figure 5 on page 8). The top five H-2A states, Florida, Georgia, Washington, California, and North Carolina, accounted for over half of the H-2A jobs. Growth in H-2A jobs may slow if labor-saving mechanization is adopted or imports increase, and may increase if the federal government makes it easier for farmers to employ H-2A workers.

Speaking to the American Farm Bureau Federation in January 2019, President Trump said that farmers "need people to help you with the farms… It's going to be easier for them [guest workers] to get in than what they have to go through now. I know a lot about the farming world." In July 2019, the U.S. Department of Labor proposed several changes to the H-2A program, including modifying procedures to calculate the Adverse Effect Wage Rate (AEWR), the minimum wage that farmers must pay to H-2A workers and U.S. workers employed with them.

DOL's proposed changes to the H-2A program have drawn mixed responses from farm employers. Most praise the proposed simplified recruitment

Figure 4. Share of Foreigners Arrested by ICE Who Have Been Convicted of U.S. Crimes
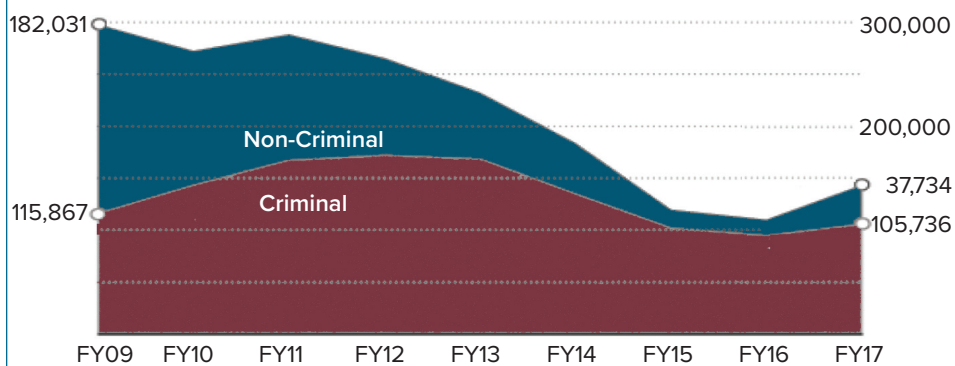
procedures that involve posting job vacancies online rather than running print ads. However, some fear that the new approach of establishing an AEWR for each job title, so that the equipment operator AEWR will be different than the harvest worker AEWR, will complicate compliance without reducing labor costs, especially if H-2A workers fill multiple roles. The proposed changes still require that farm employers provide free housing to guest workers, and do not open year-round jobs on dairies to H-2A guest workers.

Congress may revise the H-2A program. The House in December 2019 approved HR 5038, the Farm Workforce Modernization Act (FWMA). It would legalize currently unauthorized farm workers, streamline the H-2A program as proposed by DOL, and require farm employers to use the internet-based E-Verify to check newly hired workers, so that employers know instantly if a worker is authorized. Almost all House Democrats supported the FWMA, while three-fourths of Republicans opposed it.

The FWMA would allow unauthorized farm workers who did at least 180 days of farm work in the previous 24 months to apply for Certified Agricultural Worker (CAW) status, which would give the CAW worker and his/her dependents renewable 5.5 year work permits that allow employment

in any industry. However, CAW workers could receive immigrant visas only if they continued to do farm work and paid a $1,000 fine. After implementation of the CAW legalization program, farm employers must use E-Verify to check the status of new hires, making agriculture the first industry to be required to use what is now a voluntary program.

The FWMA would modify the H-2A program and grant 3-year rather than the current maximum 10-month visas. This means that H-2A workers who complete a contract with one farmer, but have time remaining on their 3-year visas, could remain in the U.S. up to 45 days to find a new employer who is certified to hire H-2A workers. The FWMA would freeze the 2020 AEWR, which averages $14 an hour, and allow it to increase by a maximum of 3.25% a year through 2030.

Beginning in July 2018, the Social Security Administration revived the issuance of no-match letters that inform employers that the information they provided when reporting worker earnings and income tax deductions does not match government records (none were issued between 2012 and 2018). No-match letters do not prove that a worker is unauthorized, since the mismatch could be due to data entry mistakes or marriage and name changes, but the letters do put employers on notice that particular

workers may be unauthorized. Employers notify the workers named in no-match letters and ask them to correct their government records, prompting many to quit.

Farmers: Where to Invest

Farmers face significant uncertainty about the cost and availability of farm labor. State minimum wages are rising, more states are requiring overtime pay after eight hours a day and 40 hours a week, and the absence of unauthorized newcomer workers is putting upward pressure on labor costs. The issue for farmers is where to invest: machines to replace workers, housing for migrant guest workers, or production abroad.

Agriculture's usual response to rising labor costs is labor-saving mechanization. The slowdown in unauthorized Mexico-U.S. migration has spurred interest in labor-saving machines, including mechanical pruners and weeders. However, mechanizing harvests presents difficult technical challenges that often require coordination throughout the supply chain, from nurseries that develop dwarf trees to farmers planting orchards designed for machines to consumers accepting machine-harvested produce. Commodities that are expanding or replanting new varieties, such as changes in apple varieties, are mechanizing faster than commodities whose acreage is shrinking, such as apricots and peaches.

Farmers must provide free and approved housing for H-2A guest workers. Most labor-intensive agriculture is in metro counties with high housing costs. The 40th percentile fair market rent for a two-bedroom apartment in Monterey County in 2020 is over $1,800 a month, so that a worker earning $15 an hour for 160 hours would spend three-fourths of $2,400 in earnings on rent. Some farmers are building barracks for H-2A workers at a cost of $20,000 to $30,000 per bed.

Figure 5. H-2A Jobs Certified and Visas Issued, FY2005–2018

Source: U.S. Departments of Labor and State

Still, many note that if mechanization or trade reduces the demand for hand labor, an investment in housing could be a stranded asset with limited value.

The third option is to produce labor-intensive commodities abroad and export them to the United States. Half of U.S. fresh fruit, and a third of U.S. fresh vegetables, are imported, and Mexico supplies about half of U.S. fresh fruit imports and three-fourths of U.S. fresh vegetable imports. Many U.S. farmers have operations or partners in Mexico and other countries to produce fresh fruits and vegetables year-round for U.S. consumers. Rising U.S. labor costs are encouraging more investment abroad.

Migration and Uncertainty

President Trump's first three years of migration policy making have had several major impacts. First, the threat of government shutdowns at home, and tariffs and the suspension of foreign aid abroad, resulted in more miles of barrier on the Mexico-U.S. border and a sharp reduction in the number of Central American asylum seekers.

Second, many migration policy changes were blocked by judges who issued injunctions that prevented their immediate implementation. Appeals reversed or revised many of these injunctions, allowing policies to go into effect that range from transferring funds to build the wall to requiring asylum seekers to wait in Mexico for hearings before U.S. immigration judges.

Third, refugee admissions are at historic lows, and entries from particular countries are blocked. Closer scrutiny of student and other visa applications from particular countries have discouraged some foreigners from seeking to visit the United States.

Many migration patterns have not changed. Legal immigration continues at 1.1 million a year, including two-thirds who are sponsored by family members already in the United States. Enforcement of the "public charge" rule, a longstanding law that allows the denial of visas to foreigners likely to become dependent on federal welfare programs or are unable to provide proof of U.S. health insurance, may make it more difficult for some immigrants to obtain visas.

Border apprehensions of 851,000 in FY19, over 2,300 a day, obscure the fact that much has changed on the Mexico-U.S. border. The 20,000 Border Patrol agents are the most ever, and there are more barriers and cameras than ever before to detect and deter unauthorized entries. Instead of solo Mexican men seeking to elude the Border Patrol in order to work seasonally in U.S. agriculture, most unauthorized border crossers are

Central American families who seek out Border Patrol agents to apply for asylum.

Farmers who hire workers are unsure where to invest. California farm labor costs are likely to keep rising due to state minimum wage and other laws and the absence of new unauthorized arrivals. Many farmers hoped that President Trump would facilitate a low-cost transition from unauthorized to guest workers. Since that has not happened, farmers are weighing the merits of investing in mechanization, housing for guest workers, and production abroad. Many are doing all three until the optimal choice becomes apparent.

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For more articles by Phil Martin on immigration, see https://giannini. ucop.edu/publications/are-update/ search/?q=martin.

Impact of the U.S.-China Trade War on California Agriculture

Colin A. Carter and Sandro Steinbach

The U.S. Administration's attempt to force economic policy reform in China by starting a trade war has failed to meet its goals. China retaliated with import tariffs that target U.S. agriculture. We review the impact of China's retaliatory tariffs on a collection of California agricultural products, including fruits, nuts, and wine. For almonds and pistachios, the tariffs did not reduce the volume of U.S. exports to China. However, the trade war diminished California exports of walnuts, wine, oranges, and table grapes.

In 2018, the U.S. started a trade war by introducing import "safeguard" tariffs and quotas on washing machines and solar panels, followed up by tariffs on steel and aluminum apparently imposed for national security reasons. Then the U.S. levied additional tariffs on hundreds of Chinese products. One of President Trump's stated goals was to use import trade barriers as leverage to force China to change its policies regarding intellectual property rights and government subsidies. In response, China imposed retaliatory import tariffs, specifically targeting U.S. agricultural exports. These retaliatory tariffs have reduced U.S. agricultural exports to China by close to $14.4 billion per year, eliminating China as the number one export market for U.S. agriculture. In this article, we focus on a relatively small share of this total agricultural trade and study seven agricultural commodities exported primarily from California to China (see Table 1 for the list of products).

In a 2018 *ARE Update* article, Carter analyzed the initial round of China's retaliatory tariffs and concluded that for wine, walnuts and table grapes, there would be little export price impact but a loss of market share for California exporters in the Chinese market. For almonds and pistachios, Carter concluded that the volume of U.S. exports would not be unduly impacted. We show below that the export volume impacts on these commodities turned out as anticipated by Carter. With the retaliatory tariffs in place, Chinese consumers ended up paying higher prices for almonds and pistachios; nevertheless, imports of these tree nuts from the U.S. remained steady because of the U.S. position as the dominant global supplier.

In the case of almonds and pistachios, the U.S. has 86% and 71% of world exports, respectively. The U.S. share of walnut exports is lower (54%), and China is actually a net exporter of walnuts. As a result, U.S. walnut exports to China declined somewhat due to the trade war.

Overall, the trade war has done little to change Chinese policies but the tariffs have harmed U.S. consumers and reduced economic growth in the United States. A recent study found that due to higher prices, U.S. consumers have lost $51 billion on purchased products such as textiles, apparel, furniture, leather goods, and other manufactured products.

U.S. consumers of the seven agricultural commodities analyzed in this article may have benefitted from lower prices (due to diminished exports) if wholesale/retailers passed on the savings. So far, the U.S. government has spent $28 billion to compensate farmers harmed by the trade war, further reducing economic efficiency. In some cases, farmers have come out ahead in the short-run after receiving government subsidies, but in the long-run the trade war could damage the reputation of U.S. agriculture as China pivots towards other export suppliers.

Table 1 shows the escalation of China's retaliatory tariffs in 2018

Table 1. China Import Tariffs in Response to U.S. Tariffs

HS Product Code	Commodity	Former Tariffs (%)	2018 Tariffs (%)	2019 Tariffs (%)
80211	Almonds, In Shell	10	25	60
80212	Almonds, Shelled	10	25	60
80231	Walnuts, In Shell	25	40	75
80232	Walnuts, Shelled	20	35	70
80251	Pistachios, In Shell	5	20	55
80252	Pistachios, Shelled	5	20	55
80510	Oranges, Fresh	11	26	61
80610	Grapes, Fresh	13	28	63
220410	Sparkling Wine	14	29	54
220421	Wine	14	29	54

Source: USDA FAS GAIN Report Number: CH2019-0194, 1/05/20

Figure 1. Average Chinese Imports from the U.S. Before and After the Tariff Increases
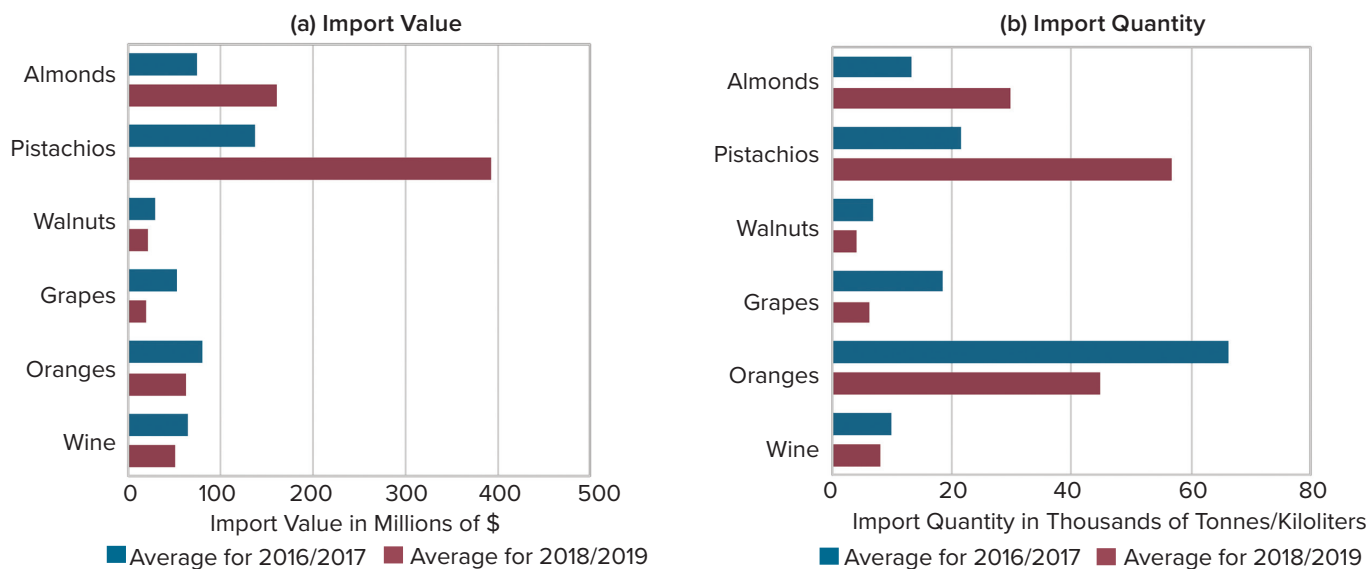
Source: Chinese customs statistics (Trade Data Monitor, 2020)

and 2019. California farmers are the primary U.S. supplier of the seven targeted products listed in Table 1. Before the trade war, China's import tariffs on the commodities listed in Table 1 ranged from 5% on pistachios to 25% on walnuts. China's initial World Trade Organization tariffs on walnuts were relatively high (20 to 25%) to protect its large domestic industry. The annual production of walnuts in China is close to 1 million metric tons, compared to less than 600,000 metric tons in the United States. China is self-sufficient in walnuts but remains reliant on world markets for pistachio and almond supplies. For instance, China is the world's largest pistachio importer. It is the third-largest importer of almonds and the third-largest importer of fresh oranges.

In the first wave of retaliation, China raised its tariffs to the 20% to 40% range. Then, in the second wave, some of China's retaliatory tariffs more than doubled from 2018 to 2019. At present, U.S. walnut exports face the highest tariff (75%), while the tariff on pistachios is 55%, up from 5% before the trade war (see Table 1).

We use international trade data from 2016 and 2017 as a benchmark against

which we evaluate the market impact of the Chinese retaliatory tariffs. 2016/2017 is the "before" the retaliatory tariffs period and 2018/2019 is the "after" period. In Figure 1a, we report the before and after value of imports into China from the United States and Figure 1b reports import quantities.

Incidence of China's Retaliatory Import Tariffs

There are three potential effects associated with the retaliatory tariffs. First, is *trade destruction*, causing U.S. exporters to lose sales to China. Second, is *trade diversion,* which results from China importing the products in question from other exporting countries. The third is *trade deflection,* which means the U.S. shifts lost sales to China to other importing nations. Below, we briefly discuss each of these potential impacts.

The annual value of Chinese imports of the seven targeted products (in Table 1) from the United States increased from $439 to $706 million from 2016/2017 to 2018/2019, according to Chinese customs statistics. Figure 1 compares import value and quantity of the targeted products. The annual average value

of Chinese almond imports from the United States increased from $75 to $160 million and pistachios from $137 to $394 million in 2018/2019 over 2016/2017.

In contrast, the annual value of China's imports from the United States declined by 20% and 29% for wine and walnuts, respectively. Therefore, we believe there was some *trade destruction* for the targeted products, but this was countered by the substantial growth in China's pistachio imports from the United States.

Although the U.S. remains a major supplier of these seven products to China, it has lost significant market shares to foreign competitors partially due to the trade war. Table 2 summarizes changes in U.S. market shares in China and shows the maximum potential trade losses due to the tariffs as the percent difference between columns C and D. As shown in columns A and B in Table 2, all products experienced a significant drop in market share, with the U.S. market share for almonds dropping by more than 55%, from 97.4% to 44%. Therefore, lost trading opportunities amplified the *trade destruction*.

Table 2. Average U.S. Market Share in China for 2016/17 and 2018/19 and Potential Trade Losses

Commodity	Column A Average U.S. Market Share for 2016/2017 (%)	Column B Average U.S. Market Share for 2018/2019 (%)	Column C 2019 Imports from the U.S. ($ mil)	Column D 2019 Imports from the U.S. Assuming Average 2016/2017 Market Share ($ mil)	Percent Change Column (C - D) / C
Almonds	97.4	44.0	197.1	511.9	-159.7
Pistachios	90.8	67.8	483.4	734.5	-52.0
Walnuts	87.8	66.2	14.3	24.1	-68.9
Grapes	8.7	3.1	6.0	56.2	-829.8
Oranges	25.9	14.7	38.2	103.3	-170.8
Sparkling Wine	0.4	0.3	0.1	0.4	-472.1
Wine	2.7	2.2	32.9	59.1	-79.4

Source: Chinese customs statistics (Trade Data Monitor, 2020)

Assuming average 2016/17 market shares for 2019, Chinese imports from the U.S. could have been double their current 2019 level ($1,489 million instead of $772 million). Although there is sufficient supply in the market, in a "but for" world, the U.S. may have chosen not to meet all of the increased import demand in China.

There is some degree of *trade diversion* going on. Sales losses for walnuts, almonds, and table grapes largely drive this diversion. The data indicate that Australia (almonds, grapes, oranges, walnuts), Peru (grapes), Chile (walnuts, grapes), Egypt (oranges), and Iran (pistachios) gained from the Chinese tariffs against the United States. For instance, California was the most important exporter of walnuts to China but with the tariffs, China has shifted to Chile and Australia for imported walnuts—that is what we call *trade diversion*.

There is only limited evidence of *trade deflection* at the aggregate level. The U.S. expanded sales of the seven products to China (value up by 15.4% comparing 2018/2019 to 2016/2017), despite an overall weaker trend of total U.S. exports of these products (value up 5.8% in 2018/2019 versus 2016/2017). This trend in overall exports is mostly driven by additional exports of almonds and pistachios, while other products show

a significant decline from 2016/2017 to 2018/2019. Only grapes recorded an increase in export quantities to other countries in the same period (plus 5.5%).

The magnitude of export changes is smaller for the world market compared to the Chinese market, while the signs of these effects are mostly the same. Therefore, U.S. exports of targeted products (see Table 1) to non-retaliatory countries could have been lower without the trade war, which indicates a limited degree of *trade deflection*. Notably, annual U.S. exports of the seven products to Hong Kong dropped from $1,233 mil to $1,026 mil from 2016/2017 to 2018/2019. This drop implies that China adjusted its trade patterns substantially by channeling fewer imports through Hong Kong and directly importing these products from the United States.

Conclusion

Sufficient time has passed that we can assess the broad impacts of the U.S.-China trade war on California agricultural exports. There is no evidence that this blunt policy approach has had any success and instead it has only served to harm consumers in both countries and financially injured some U.S. farmers. Although producers of almonds and

pistachios substantially increased their exports to China, they also lost market shares in that growing market. This implies that U.S. exporters had to forego trade gains as a result of the trade war. In addition, there could be long-lasting consequences for California associated with China looking elsewhere for export suppliers, and using this opportunity to diversify its supply chains.

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