



Agricultural and Resource Economics ARE UPDATE

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California Almond Industry Harmed by International Trade Issues

Colin A. Carter and Sandro Steinbach

California almond tree acreage has expanded by roughly three-fold since 2000. As a result, the industry relies more on foreign buyers to purchase the growing supply of almonds. Combined with the acreage growth, recent international trade disputes and supply chain problems have resulted in an over-supply of California almonds, with end-of-year inventories close to an unusually high 30% of the harvest. We investigate the role of trade disputes and supply chain issues on the economics of the California almond industry.

Almonds are the most valuable crop produced in California, and over 70% of the harvest is exported internationally. The annual value of almond exports is over \$4.5 billion, far higher than any other agricultural product shipped out of California. Grower prices for almonds are down over 25% since 2019 and are now below production costs for those farmers who are paying high prices for irrigation water. Warehouses are full, and temporary storage is being relied upon at higher storage costs. The economic problems facing almond growers started with

the 2018 U.S.-China trade war and were exacerbated by the shipping container problems on the West Coast in 2021. Most California almonds are shipped out of Oakland. Recently, trucker protests at the Port of Oakland over California’s Assembly Bill 5 (AB5) law have slowed almond exports further, just as the new harvest is coming in.

In response to the U.S.-initiated trade war, retaliatory import tariffs imposed by foreign buyers cost the California almond industry almost 325 million pounds (or \$875 million) in lost export shipments from April 2018 through April 2022. The impact of the 2021/22

shipping container disruptions was even larger on an annualized basis: between April 2021 and April 2022, almond exports were reduced by an estimated 290 million pounds (or \$870 million).

Table 1 summarizes California’s almond supply and demand from the 2016/17 marketing year—from August through July—to the 2021/22 marketing year. As shown in Table 1, from 2016/17 to 2018/19, growth in almond exports kept up with the expanding domestic supply, and the industry enjoyed relatively high producer prices. These trends were then interrupted in the 2018/19 marketing year

Table 1. California Almonds Supply and Demand (Billion Pounds, Shelled Basis)

	Marketing Year					
	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Marketable Crop	2.09	2.21	2.22	2.50	3.04	2.86
Ending Inventory	0.40	0.36	0.32	0.45	0.61	0.84
Domestic Shipments	0.68	0.73	0.74	0.77	0.81	0.76
Export Shipments	1.42	1.52	1.52	1.60	2.09	1.87
Producer Price (\$/lb)	2.53	2.50	2.45	1.71	1.76	1.80*

Note: *The price for the marketing year 2021/22 is estimated by the authors.

Source: The supply and demand data are from the Almond Board of California. The producer price is from the National Agricultural Statistics Service.

Table 2. Foregone Almond Exports to China, India, and Turkey (Million Pounds)

Marketing Year	China		India		Turkey	
	In-shell	Shelled	In-shell	Shelled	In-shell	Shelled
2017/18	-1.6	-4.4	0	0	0	-0.5
2018/19	-19.9	-31.9	-0.9	-0.2	-5.5	-8.1
2019/20	-48.3	-46.8	-8.1	-2.1	-3.6	-8.8
2020/21	-22.6	-31.6	-11.3	-2.8	-2.8	-10.9
2021/22*	-22.8	-11.0	-8.6	-3.1	-3.0	-6.2
Total	-115.1	-125.8	-29.0	-8.2	-14.8	-34.5

Note: *The 2021/22 marketing year (August to July) includes data through April 2022. The in-shell quantity was converted to pounds using a conversion factor of 0.7.

All data are reported in million pounds kernel equivalent and the total by export destination is provided.

Source: These are the authors' estimates.

after the implementation of retaliatory tariffs by foreign trading partners. The 2021/22 container shipping disruptions at California ports compounded the trade-war effects.

The supply and demand situation has eased somewhat because of the drought, and low crop prices curtailed water use and lowered the 2022 harvest volume by about 6% from the previous year. However, almond inventories continued to build up, reaching 840 million pounds at the end of the 2021/22 marketing year. They are now up over two and one-half times since the beginning of the trade war.

The strong U.S. dollar and rising input costs have provided new headwinds for the almond industry. In addition, a looming economic recession in the European Union (EU) due to high energy prices related to the Russian invasion of Ukraine could result in lower California exports to the European Union. The recent dramatic rise in the price of natural gas and electricity in Europe is an economic shock to that region as large as the effects of the Arab oil embargo on oil prices in 1973. Reuters has reported that, this coming winter, European households will spend an average 10% of their household income on energy bills, twice the amount they spent in 2021. Finding

other importers willing to take on lower-grade almonds used in food processing for traditional European baked goods like marzipan will be difficult for California producers.

The Trade War and Retaliatory Tariffs

In 2018, the U.S. government implemented new import tariffs on steel (25%) and aluminum (10%); the stated reason was for national security. The main targets of these tariffs were China, Canada, Mexico, and the European Union, but other countries were also affected by U.S. tariffs. Several countries responded by imposing retaliatory tariffs on unrelated imports from the United States. These duties restricted U.S. almond exports considerably. China and Turkey levied import tariff increases on in-shell and shelled almonds from the United States of 45% and 10%, respectively. India followed in June 2019, increasing import tariffs (expressed as the ad valorem equivalent) on U.S. almonds to 17% for in-shell and 32% for kernels. This exceeds India's World Trade Organization (WTO)-bound tariff rates.

Table 2 summarizes our estimates of the export losses due to retaliatory tariffs imposed by our international

trading partners for the marketing years 2017/18 to 2021/22. We used a statistical model to estimate the export response to retaliatory tariffs for California almonds, accounting for the reallocation of exports among retaliatory and non-retaliatory markets. The model accounted for unobserved characteristics through high-dimensional fixed effects and used historical trade data from January 2017 to October 2019 to calculate the almond-specific trade responses to the retaliatory tariffs. We then used those estimates to predict the trade effects for marketing years 2017/18 to 2021/22.

We reported trade impacts for China, India, and Turkey because they all imposed retaliatory tariffs against California almonds. The current marketing year includes estimated export losses until April 2022. As a result of the retaliatory tariffs, we estimate that more than 325 million pounds (or \$875 million) in California almond exports were lost. Foregone almond exports to China (-240 million pounds), Turkey (-50 million pounds), and India (-35 million pounds) drove these trade losses. The trade effects were equally large for in-shell and shelled almonds to China but were more pronounced for in-shell almond exports to India. The export losses peaked in the 2019/20 marketing year when the volume of almond exports to retaliatory-tariff countries was almost 120 million pounds below the counterfactual level.

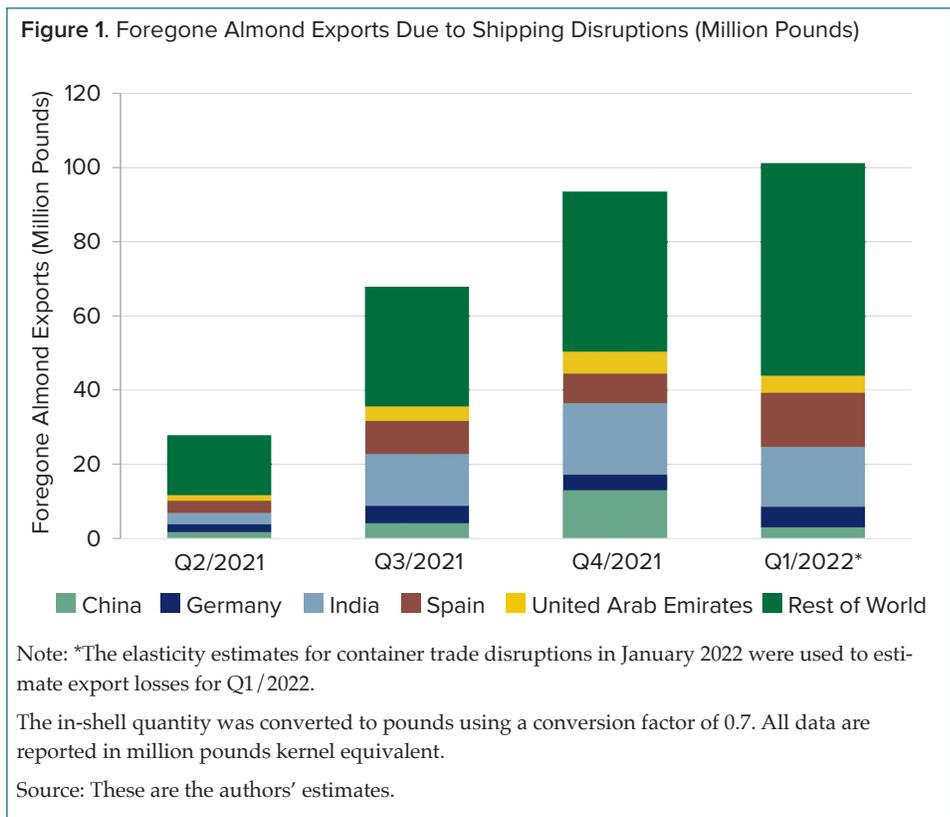
Since the 2019/20 marketing year, the annual export loss was halved due to the Phase One deal with China—which was implemented in March 2020—and Turkey's unilateral reduction of its retaliatory almond tariff from 20% to 10% in May 2019. However, today the almond industry faces significant uncertainty over the potential for the Chinese government to end the current tariff exemption process. The current waiver applies to

retaliatory duties against Section 301 of U.S. trade law, while the retaliatory duties against Section 232 (15%) remain in place. With stalling U.S.-China trade negotiations, a failing Phase One deal, and rising tensions over Taiwan, the Chinese government could halt the tariff exemptions for U.S. almonds.

Recently, China and India have negotiated favorable trade agreements with Australia. As a result, Australian almonds can be imported into China at a 0% tariff. After Australia's new trade agreement (signed on April 2, 2022) with India is ratified, almonds from Australia can be imported to India under a significantly lower tariff than U.S. almonds. However, it remains to be seen whether Australian producers can capitalize on this opportunity, given the considerable time and resources needed to expand production further in the Murray-Darling basin with its extreme water issues.

Shipping Container Backlogs

The 2021/22 shipping container disruptions also cost the California almond industry. Almonds destined for the export market filled warehouses and temporary storage as the industry grappled with the transportation disruptions at California's ports. We conducted an event study—an empirical analysis of how the market responds to a significant event—to measure the trade effects of port congestion on containerized almond exports from California ports. We used historical trade data for California ports to measure how the 2021 port congestion and container shortages impacted almond exports. Our model controlled for unobserved factors with port-product-year and port-product-month fixed effects. We assigned May 2021 as the treatment month and constructed an event window of eight months before and after the pretreatment month of April 2021. The statistical model identified the treatment



effect by comparing containerized almond exports in 2021/22 with those from 2014–2018. The volume of California exports was 19% below the counterfactual level between May 2021 and January 2022. The estimated trade effects were driven by many factors, including limited access to containers for agricultural exports, port congestion, and higher freight rates.

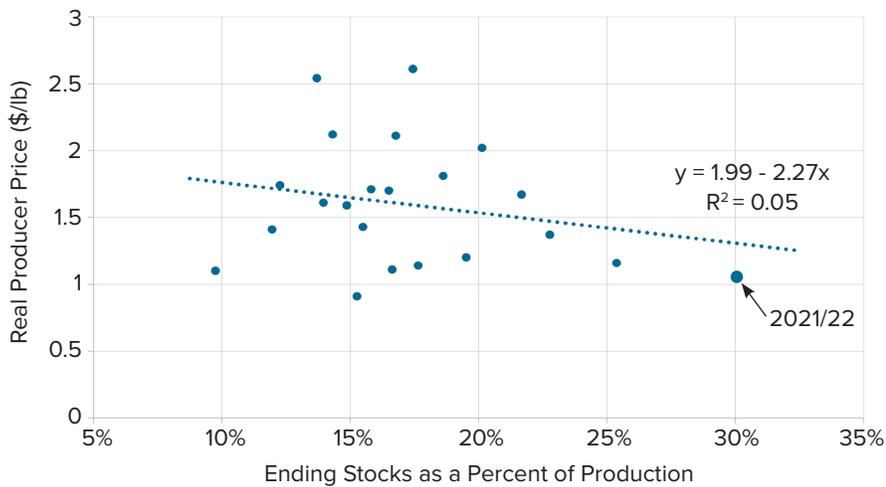
Figure 1 shows the foregone export shipments for major trading destinations, in a hypothetical world without shipping container disruptions. We estimate that shipping container disruptions reduced California almond exports by 290 million pounds (or \$870 million) between quarter 2 of 2021 (Q2/2021) and quarter 1 of 2022 (Q1/2022). However, this varied considerably during the marketing year and depended on the export destination. The most significant losses were recorded during Q4/2021 and Q1/2022, when the volume of almond exports was about 25% below the counterfactual level. These trade losses translate into aggregated

foregone shipments of about 95 million pounds in Q4/2021 and 100 million pounds in Q1/2022. Exports to India were reduced the most (-50 million pounds), followed by Spain (-35 million pounds) and China (-20 million pounds).

Inventories

As in any commodity market, inventories are essential in the almond market to help smooth production from year to year, facilitate supply chain management, avoid costly stockouts, and thereby reduce overall marketing costs. Indeed, inventories are an essential component of the supply of almonds to domestic and world markets because inventories are a form of production control. The marginal value of inventories is the value associated with holding an additional unit of inventory, and it can be viewed as the savings in marketing costs resulting from owning one additional unit of inventory. The marginal value is inversely related to the size of inventories. Now, when inventories are relatively large, the marginal value

Figure 2. Real Producer Price (2000 Dollars) and Ending Stocks for California Almonds



Note: The real price is the producer price adjusted by the national producer price index (PPI) based on 2000 dollars. The PPI is the PPI for all commodities. A linear fit is overlaid.

Source: The PPI comes from the Federal Reserve, the producer price is from the USDA's National Agricultural Statistics Service, and the stock and production data are from the USDA's Foreign Agricultural Service.

of an additional unit of inventory is very small. At the same time, the marginal cost of holding inventories is rising with higher interest rates. This is one reason that market prices are relatively low.

As mentioned above, by the end of marketing year 2021/22, California's almond closing stocks (i.e., inventories) increased to 840 million pounds, up from 320 million pounds in 2018/19. This can largely be attributed to a slowdown in the growth of export shipments. Figure 2 reports two decades of data on end-of-year almond stocks (i.e., inventories) versus grower prices, adjusted for inflation (base = 2000).

There are two important takeaways from this figure. First, the 2021/22 combination of stock levels and price (indicated by the arrow) is somewhat unusual. Stocks as a percent of production are close to 30%, and the price is relatively low compared to the last twenty years, after accounting for inflation. Second, there is an overall negative relationship between stock levels and prices. Figure 2 shows that higher stocks relative to the size of

the harvest depresses grower prices: a 10% increase in inventories as a share of production results in a \$0.30 per pound price decline.

Conclusion

California almond exports have been harmed considerably by foreign tariff retaliation in response to the 2018 U.S.-initiated trade war. These trade losses occurred in major export markets that had experienced significant economic growth due to rising incomes and shifting demand for high-quality tree nuts. The changing trade environment challenges the leading position of California almond producers in foreign markets.

Global shipping container disruptions compounded the adverse effects of retaliatory tariffs, harming California almond exports even more than trade retaliation did. The most significant losses were observed for almond exports to India, Spain, and China.

These international trade losses have put downward pressure on grower prices and at the same time increased almond stocks. Without trade retaliation and container shipping

disruptions, we estimate the ending inventory in 2022 would be about 50% below the current level. This considerable increase in almond inventories since the beginning of the trade war will likely depress almond prices for the next few years.

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Authors' Bios

Colin A. Carter is a Distinguished Professor in the Department of Agricultural and Resource Economics at UC Davis. Sandro Steinbach is an associate professor in the Department of Agribusiness and Applied Economics and the Director of the Center for Agricultural Policy and Trade Studies at North Dakota State University. They can be reached at cacarter@ucdavis.edu and sandro.steinbach@ndsu.edu, respectively.

For additional information, the authors recommend:

Carter, Colin A. and Sandro Steinbach. 2020. "The Impact of Retaliatory Tariffs on Agricultural and Food Trade." *NBER Working Paper w27147*. Available at: <https://bit.ly/3BvM5cT>.

Carter, Colin A., Sandro Steinbach, and Xiting Zhuang. 2021. "'Containergeddon' and California Agriculture." *ARE Update* 25(2): 1-4. Available at: <https://bit.ly/3UarHXf>.

Carter, Colin A., Sandro Steinbach, and Xiting Zhuang. 2022. "Supply Chain Disruptions and Containerized Agricultural Exports from California Ports." *Applied Economic Perspectives and Policy*. Available at: <https://bit.ly/3dv5lzi>.

Agriculture and the Social Cost of Carbon

Maximilian Auffhammer

Putting a number on the economic damage from the emissions of greenhouse gases is a difficult undertaking. Recent advances in statistical methods, exponentially growing computing power, and the ever-increasing availability of detailed data on climate-sensitive sectors of the economy have led to significant new insights, which will affect regulation at the federal and global level.



A new major study on global climate damages shows significant impacts on the agricultural sector.

Photo Credit: Shutterstock

This year produced much new evidence that the observed and anticipated impacts from human-caused climate change are bigger than previously thought. The release of a new report by the United Nations' Intergovernmental Panel on Climate Change made this point quite clearly by synthesizing tens of thousands of scientific papers. If you are still wondering whether it is indeed getting warmer, the answer is an

unambiguous yes! Figure 1 displays the average measured daily temperature for the state of California, and the upward trend is clear.

Economists have contributed significantly along multiple dimensions to our understanding of this shared future and the choices we face. On the one hand, many economists focus on designing more efficient and equitable policies to reduce emissions of global pollutants at the source of this problem. A lot of work has focused on how to design better carbon markets, taxes, and incentives for innovation. Another (much smaller) group of economists has focused on trying to quantify the anticipated impacts of climate change on climate-sensitive sectors.

How Does Climate Affect Agriculture?

Economists have tried to estimate the effect of a changing climate on the agricultural sector for many decades.

Mendelsohn, Nordhaus, and Shaw, writing in the prestigious *American Economic Review* in 1994, used an early “big data” approach to develop a framework that exploits the fact that agricultural land across the United States varies greatly in terms of the climate it experiences.

The intuition underlying this approach is that in a non-changing climate, farmers optimize their production technology and crop choice according to the environment they face. This includes soil quality, slope of the land, agroecological characteristics, and, of course, climate. The authors use standard statistical models to estimate a relationship between climate and the value or profitability of different agricultural lands over a long time period (e.g., 30 years). If land markets function perfectly, the land value should reflect the climate contribution to the value of a given piece of land.

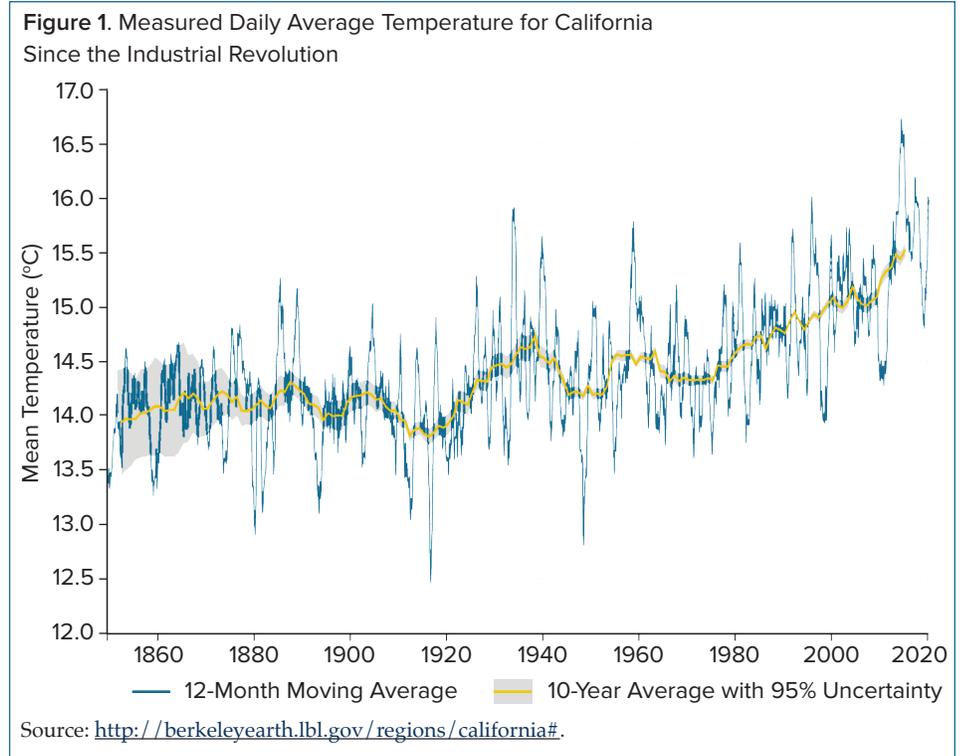
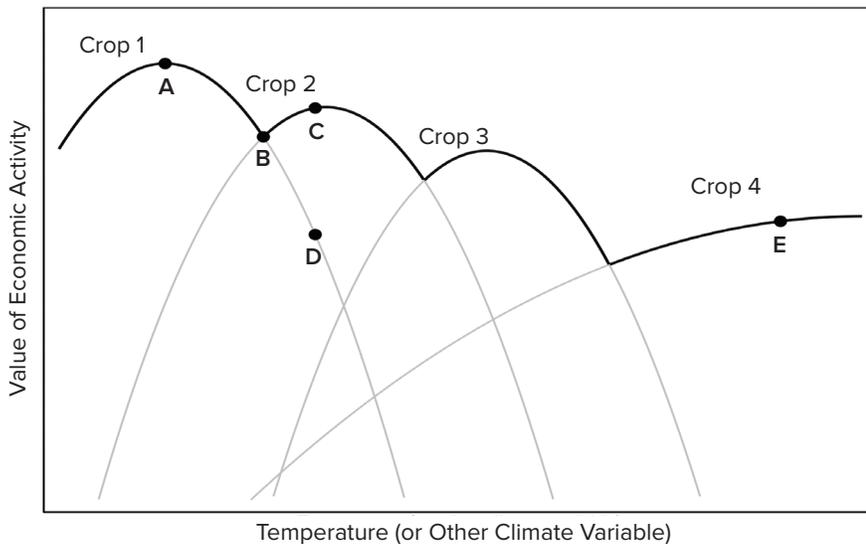


Figure 2. Crop Choice and Profits in the Long and Short Run



Source: Figure inspired by Mendelsohn, Nordhaus, and Shaw (1994).

Figure 2 helps cement the economic intuition behind this approach. Imagine a single farmer, who is currently growing crop 1 and earning profits of A. If faced with a significantly hotter climate, the farmer becomes indifferent between growing crop 1 and crop 2 at point B. If the climate warms further, the farmer is much better off switching to crop 2 at point C rather than continuing to grow crop 1 at point D.

Prior approaches often assumed that farmers would stick with a given crop and not switch, which is, of course, not what happens in the real world. In order to simulate what the agricultural sector looks like in a hotter world, you simply feed the model a hotter world and estimate what the crop distribution looks like across space. This work suggested that climate change could actually be beneficial for U.S. agriculture.

Examining this surprising result, Schlenker, Hanemann, and Fisher identified that an important factor driving agricultural land values—especially in the West—was omitted from the model. They pointed out that (as most Californians know) irrigation

is an important driver of farm profits. When correcting for this, they showed that the estimated national-level agricultural impacts from climate change went from being slightly beneficial to robustly negative.

The subsequent literature has built upon these insights and tried to better model the fact that adapting to climate change is costly, especially in agriculture, where switching crops is expensive. A rich literature exploiting the exploding availability of high-resolution yield and weather data has emerged. A number of papers have used year-to-year variation in agricultural outcomes, temperature, and precipitation to estimate damage functions comparing outcomes of single areas in different weather years and have extracted a relationship between weather and yields or farm profits.

This approach, using statistical modeling, allows one to control for the issue of unobservable confounders—at a cost. The estimated response has often been characterized as a short-run response that does not capture long-run adaptation to a new climate. It is generally true that farmers have more adaptation choices in the long

run than in the short run, and thus estimates which do not take this adaptation into account may overstate impacts.

For example, this may be true for some farmers in the northern hemisphere who can, in the long run, switch crops, change their cropping calendar, or move their operations north. All of these options would moderate the estimated impacts of climate change. However, it is important to point out that there are also examples of adaptation options which are available in the short run and not in the long run (e.g., depletable groundwater resources).

One innovative approach to address the issue facing the literature discussed above is provided by a team of former Berkeley graduate students (Marshall Burke and Kyle Emerick), who use the fact that different areas experience different trends in climate. They exploit this approach statistically to control for confounding factors.

What the literature so far had left out, however, was the fact that many commodities are traded in global markets and that local climate impacts work their way through the global network of markets. Frances Moore of UC Davis, jointly with a number of coauthors, has thought carefully about this issue. She worked with a team that models trade in commodities (GTAP at Purdue University) to incorporate this type of response, while taking the most recent science on how crops respond to climate shocks seriously.

The Social Cost of Carbon

So why does all of this matter? On the one hand, if you are part of the agricultural sector you care about the impacts of climate change on agriculture. But more broadly, it turns out this work is crucial in helping the federal government calculate a very important number that most people have never heard of. The social cost

of carbon (SCC) is the damage one ton of carbon dioxide does over its long lifetime across all sectors and the entire planet.

It turns out this is a difficult number to calculate for multiple reasons. First, most greenhouse gases are long-lived, with the most important one (carbon dioxide) surviving for thousands of years after it exits your car's tailpipe. Second, there are many sectors affected by hotter temperatures, changing rainfall patterns, rising sea levels, and more intense extreme events. Examples are not just agriculture, but energy, migration, health, infrastructure, labor productivity, conflict, water availability, fire, and species loss, to name but a few.

Further, how a hot day affects each of these sectors across the world may differ, depending on the capital you have available locally. For example, if you do not have air conditioning, you will be more vulnerable on a 100-degree day than if you do. Finally, as each ton of pollution emitted today has damages affecting humans and the environment for thousands of years, we need to calculate how, for example, temperatures affect these sectors in a future that is further removed from the present than the onset of the industrial revolution.

You might ask whether this has any practical implications. Turns out, it does! Cost-benefit analyses have been one of economics' biggest contributions to public policy. This type of analysis has been required for a significant share of federal regulations since the 1970s. If federal agencies want to impose a new regulation, often they have to show—as part of a regulatory impact analysis—that the benefits of the regulation (e.g., avoided pollution damages from lower energy consumption due to energy efficiency rules) are greater than the costs (e.g., higher cost of manufacturing said gadgets).

The Evolution of the Social Cost of Carbon

Since basically every human activity causes some greenhouse gas emissions, determining the amount of damage a ton of carbon dioxide does is key. There is a long history of ambiguity around the value of the social cost of carbon, going back to the George W. Bush presidency, when three different federal agencies applied three very different values for the same gas emitted.

During the Obama presidency, an interagency working group produced an official value of \$42 per ton emitted in 2020, using a 3% discount rate. President Biden, in his first month in office, put in place a slightly updated social cost of carbon—which was \$52 per ton—and ordered a significant update, which was supposed to take into account suggested improvements by the National Academies of Science and Engineering.

During the Trump presidency, which halted government work on the value of the social cost of carbon, UC Berkeley's David Anthoff and Resources for the Future's Kevin Rennert, along with a number of current-day and future all-star coauthors, began work that really pushed the envelope on how we calculate this number. They just published a new paper reporting the results in the journal *Nature*. The global press focused on the new central estimate of \$185 per ton of carbon dioxide, which is more than thrice the current value of the social cost of carbon (at a 2% risk-free rate used to discount). While bigger numbers get a lot of attention, this paper presents a massive step forward in our modeling of this all-important number. Let me enumerate what I think is innovative here.

A Giant Step Forward

The new model lives in the light. One of the big advances in social sciences has been a push to publish your data and code so other teams can replicate your findings and possibly modify them to check for robustness. If you would like to run the model, you can! (The new model is openly available at: <https://www.mimiframework.org>).

One of the most important decisions modelers have to make is how much to discount the consumption of future generations. In order to do so, you must choose a number called the discount rate. The higher the rate, the lower the value we place on damages from climate change occurring further in the future.

Massive exercises in surveying experts in the field suggested that the government had been using a rate that was too high. The paper employs a 2% risk-free rate, which is lower than the lowest rate used before, and that is consistent with expert elicitation. The second update is that discounting now takes into account the rate of economic growth, which is key if you care about pricing risk correctly, which most economists do.

The thing we know best about the future is that it is highly uncertain. Social scientists have contributed frameworks that help us make optimal decisions depending on the degree and type of uncertainty we face. The approach adopted here is completely novel in fully characterizing uncertainty from beginning to end.

To recall, these models require many things. The first thing you need is future emissions based on income and population assumptions. In the old days we just put together a handful of scenarios that seemed reasonable and did not really attach probabilities to Earths with different levels of wealth and population. This paper

went far beyond what one could hope for and combined cutting edge statistical approaches on really long-run forecasts with expert elicitation to characterize future states of the economy probabilistically! This sounds straightforward, but it's not, and this alone would have been a major step forward.

However, the authors do not stop there. They fully characterize the uncertainty in the socioeconomic, climate, damage, and discounting components of this novel model. Hence, this new model, called Greenhouse Gas Impact Value Estimator (GIVE), allows us to take into account the change in uncertainty and translates this into a distribution of the social cost of carbon. By taking these different sources of uncertainty into account, we can make better decisions.

One of the biggest criticisms of previous modeling approaches was the fact that the so-called damage functions (discussed earlier), which translate changes in temperature and sea level rise into economic damages, were severely outdated (in some cases based on 30-year-old science). One of the models used in the previous round of social cost of carbon calculations even suggested that higher global temperatures of up to 4 degrees Celsius were beneficial to global agriculture. The same model suggested that one-third of damages came from higher energy consumption. The paper by Rennert, Anthoff, and their team incorporates the work by Frances Moore and coauthors (referenced earlier) to reflect the impact of some agricultural and trade adaptations.

Does this simple switching out of a damage function make a difference? Yes, it does. The paper shows clearly that the agricultural sector across the globe will suffer from climate change. Damages to the sector make up almost a third of the social cost of carbon—which is significant.

Concluding Thoughts

This new paper in *Nature* made significant progress in reflecting the actual observed relationship between climate and crops when calculating one of the most important numbers in federal policymaking—the social cost of carbon. But it's not perfect.

First off, many sectors that are climate sensitive, like biodiversity, conflict, labor productivity, water availability, forestry, and fisheries, are not in the model. Further, the model does not claim to adequately deal with the notion that there are significant, low-probability events that may occur far into the future (e.g., ocean currents stopping, major ice sheets melting).

From a California perspective, many of the crops we grow here are specialty crops. Their climate sensitivity is not understood sufficiently to incorporate them into these models. I would welcome the opportunity to work with partners that have rich datasets on filling that gap.

Finally, anything that has four or more legs, or fins, is not in this model. It would be important to better understand the impact of a changing climate on the cattle, dairy, and aquaculture sectors. There is a lot of work to do. And we better do it fast.

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Author's Bio

Maximilian Auffhammer is the George Pardee Professor of International Sustainable Development in the Department of Agricultural and Resource Economics at UC Berkeley. He can be contacted by email at auffhammer@berkeley.edu.

For additional information, the author recommends:

Carleton, Tamma and Michael Greenstone. 2022. "A Guide to Updating the U.S. Government's Social Cost of Carbon." *Review of Environmental Economics and Policy* 16(2): 196–218. Available at: <https://bit.ly/3T3jP8s>.

Rennert, Kevin, Frank Errickson, Brian C. Prest, Lisa Rennels, Richard G. Newell, William Pizer, Cora Kingdon et al. 2022. "Comprehensive Evidence Implies a Higher Social Cost of CO₂." *Nature*. Available at: <https://go.nature.com/3rBAnZv>.

Auffhammer, Maximilian. 2018. "Quantifying Economic Damages from Climate Change." *Journal of Economic Perspectives* 32(4): 33–52. Available at: <https://bit.ly/3Cqtcsf>.

Moore, Frances C., Uris Baldos, Thomas Hertel, and Delavane Diaz. 2017. "New Science of Climate Change Impacts on Agriculture Imply Higher Social Cost of Carbon," *Nature Communications*, 8. Available at: <https://go.nature.com/3SgFhX2>.

Certified Transitional Labels Hope To Increase Organic Conversion, but Few Know What They Mean

Ashley Spalding

Transitional organic certification programs seek to create a premium market for crops in years two and three of the three-year organic conversion process, but few survey respondents know what certified transitional labels mean. Uninformed consumers view strawberries with the label as lower quality than conventional strawberries. Only after informing respondents of the production practices underlying certified transitional labels do they rate the quality of transitional strawberries above conventional berries.

U.S. consumer demand for organic food products has grown steadily since the National Organic Program (NOP) went into effect in 2002, with sales reaching \$52.3 billion in 2020 and comprising 5% of all food sales. Despite this, fewer than 1% of U.S. cropland is organically farmed, and the U.S. remains a net importer of organic commodities.

This is due in part to the costly and time-intensive three-year transition period, during which farmers must produce using organic methods before being certified as organic. While transitioning, farmers often make significant capital investments, experience lower yields, and usually fail to garner price premiums because output is sold into conventional markets. Farmers must also contend with insufficient technical training and concerns about more costly inputs and increased labor demands. These factors have contributed to a 71% drop in the annual number of farms converting between 2008 and 2019.

Reducing Barriers to Organic Production

A variety of federal programs exist to reverse this trend and assist with organic transition, production, and certification. Under the USDA's Organic Certification Cost Share Program (OCCSP), certified organic farmers receive up to \$750 per year to cover the cost of organic certification. The USDA further provides financial and technical assistance via the Agriculture Management Assistance Program (AMA) in 16 states.

Most recently, the USDA announced a \$300 million investment in a new Organic Transition Initiative. In addition to providing direct financial and technical assistance to farmers and support for organic market development, the initiative will fund up to \$100 million to create an organic transition partnership program. Under this program the USDA's Agricultural Marketing Service will develop partnership networks with local organizations across the United States to connect transitioning and recently transitioned farmers with training, mentorship, and workshops on production practices, certification, regulations, organic supply chains, and marketing to help them overcome challenges inherent to the transition process.

In contrast to these public support programs, some entities have implemented a market-based approach to support farmers during the transition period by creating a new product category to generate higher returns for farmers and ease the financial strain of transitioning. Quality Assurance International (QAI), California Certified Organic Farmers (CCOF), Organic Certifiers (OC), and Ecocert—all accredited certifying agencies (ACAs)—have

implemented transitional organic (TO) certification guidelines and introduced Certified Transitional labels in recent years for farms in years two and three of the organic conversion process. Kashi, a U.S.-based producer of cereals and other plant-based foods sold in the United States and Canada, partnered with QAI in 2016 to become the first company to market a product as Certified Transitional at the retail level. Since then, Washington State has created its own certified transitional program and commensurate label (Figure 1) that similarly covers farmers who have completed one year of the transition process.

Consumer Perceptions of Certified Transitional Products

For transitional certification programs to work as intended, however, some consumers must view transitional food products as being of higher quality than their conventional counterparts and thus, be willing to pay a premium for them relative to the price of conventional goods. These premiums then help cover the additional cost incurred

Figure 1. Certified Transitional Labels



Table 1. Distribution of Responses to “I Feel Confident That I Know the Exact Definition of This Label” (Percent)

	All Respondents		Farming/Ag Background		No Farming/Ag Background	
	USDA Organic	Certified Transitional	USDA Organic	Certified Transitional	USDA Organic	Certified Transitional
Strongly Agree	27.2	2.0	34.2	4.7	26.4	1.7
Agree	32.5	4.9	30.3	6.8	23.8	4.6
Somewhat Agree	22.3	7.9	15.8	7.3	23.1	8.0
Neither Agree Nor Disagree	9.4	17.1	9.4	15.8	9.4	17.3
Somewhat Disagree	3.8	8.3	3.0	9.8	3.9	8.1
Disagree	2.4	16.1	2.6	13.7	2.4	16.3
Strongly Disagree	2.3	43.7	4.7	41.9	2.0	43.9
Sample Size (N)	2,351	2,351	234	234	2,117	2,117

Source: Based on author’s survey and calculations.

during years two and three of the three-year transition period, thereby facilitating further organic conversion.

I designed a survey in collaboration with a prominent berry seller using its existing consumer panel to determine if, and under what circumstances, consumers view transitional strawberries as a good with intermediate quality between certified organic and conventional berries. Specifically, the survey asked respondents to assign values, on a scale of 1 to 10, to the perceived quality of differently labeled but otherwise identical packages of strawberries, both prior to and after being informed of the production practices indicated by the label. One package is conventionally grown and unlabeled, and the others are USDA Organic and Certified Transitional. The company invited 8,982 individuals to participate in the survey and received 2,006 complete and 416 partial responses. Because demographic questions were not included, and the survey was sent as an anonymous link, I cannot determine whether it was a representative sample for the general population. Based on past studies, the panel had a slightly higher representation of retirement-age households and female participants.

Initially, consumers viewed strawberries labeled as Certified Transitional as

lower quality than both conventionally grown and USDA Organic strawberries. On average, respondents assigned quality ratings of 5.77, 7.83, and 4.9 to unlabeled (conventional), USDA Organic, and Certified Transitional berries, respectively. As seen in Table 1, this can be attributed to the fact that consumers, even those with a farming background, do not know the definition underlying Certified Transitional labels (hereafter referred to as TO labels).

While the vast majority of all respondents were confident they knew the definition of the USDA Organic label, only 14.8% of all respondents and 19% of those with a farming or agricultural background knew the meaning behind TO labels. Respondents who indicated at least some familiarity with the TO label definition, on average, assigned a quality rating of 6.59 to TO strawberries compared to a rating of 4.61 for those unfamiliar with the label. An unpaired t-test indicates the difference in means of the two groups is statistically significant at the 1% level.

Information Improves Quality Perception

Simple information about the TO label’s definition can remedy this problem and increase the perceived

quality of TO strawberries, such that it lies between conventional and organic strawberries. After all of the survey respondents were provided with the label definitions for the certified claims, referred to here as the initial information treatment, their mean quality ratings for TO strawberries (6.75) increased above conventionally grown strawberries (5.7), whose quality rating remained steady. The increase in the mean rating for TO berries after the initial information treatment is statistically significant at the 1% level. Notably, there is also a smaller, but statistically significant, increase in the mean valuation of USDA Organic strawberries (8.08), indicating that even relatively well-known certifications may benefit from more informed consumers.

Table 2 presents the mean quality ratings for TO strawberries before and after the initial information treatment, disaggregated by respondents’ prior familiarity with the TO label. All respondent segments increased their quality ratings on average, though the increase for those most familiar with the label is not statistically significant. The percentage increase in mean valuation is negatively correlated with respondents’ initial familiarity with the label, with those least familiar with the production practices indicated by the TO label increasing their quality rating by over 65%, on average. The large shift in how these consumers perceive strawberries with a TO label after being presented with the definition is consistent with results showing uninformed consumers are driving poor quality ratings and is indicative of how information can solve quality perception issues for transitional goods.

To determine if valuation could improve if label definitions were combined with additional information such as where, how, and by whom strawberries are grown, the respondents were randomly assigned to one of three hypothetical information

treatments that allowed them to obtain more information. The three subgroups were asked to rate each product's quality if, after being presented with the label definitions, they were able to 1) speak to each farmer growing these strawberries, 2) see an additional display at the point of purchase with the aforementioned information, or 3) see the name of the grower and a website or QR code that allowed them to access the additional information, respectively.

The mean valuations of the first two subgroups (i.e., speak to a farmer and in-store display) had statistically significant increases of 2.3% and 2.9%, respectively, relative to their post-definition ratings alone. The mean valuation of the third subgroup experienced no statistically significant change, indicating consumers are more responsive to information that is presented to them directly, rather than information they have to take additional steps—such as scanning a code with their phones—to access.

Implications

At present, many consumers are unfamiliar with Certified Transitional labels and the production practices they represent. As a result, some producers growing or using transitional crops may opt for other more established and well-known certifications (e.g., Non GMO Project or Certified Pesticide Residue Free) to market their products and obtain price premiums during the transition period. These certifications, however, are limited and imperfect substitutes for transitional certification, as their standards either do not fully overlap or do not cover the full range of crops produced by converting farms. Since these labels may be of use to some, but not all, transitioning operations, the existence and promotion of a single label that encompasses all transitioning crops may be the best way to distinguish this product category and generate additional revenue. Moreover, proponents

Table 2. Mean Quality Ratings of Certified Transitional Strawberries on a Scale of 1 to 10 by Response to “I Feel Confident that I Know the Exact Definition of This Label”

	Pre Definition	Post Definition	Percent Change
Strongly Agree	6.809	7.239	6.32
Agree	6.787	7.412	9.12
Somewhat Agree	6.471	7.271	12.36
Neither Agree Nor Disagree	5.308	6.642	25.13
Somewhat Disagree	5.376	6.753	25.61
Disagree	5.238	6.851	30.79
Strongly Disagree	3.956	6.542	65.37

Source: Based on author's survey and calculations.

argue that certifying transitioning operations may improve their access to USDA support services like farm loan products during the transition and may facilitate better supply chain management.

To accrue these benefits, those marketing their products as transitional must overcome consumers' lack of familiarity with the certification and commensurate labels. Survey results indicate that producers marketing products with labels tied to certified and well-defined standards benefit from providing consumers with precise information about the production practices indicated by the labels. This is especially true for labels lacking broad awareness, such as certified transitional.

Transitional producers can further improve valuation by providing opportunities for consumers to speak directly with farmers (e.g., at farmers markets) or by providing additional information on displays at the point of sale. These improvements, however, are relatively small compared to the improved valuation derived from simply providing the label's definition. This indicates that transitional producers with limited resources can eschew these more complex and potentially expensive forms of information provisions in favor of simple information (e.g., including the definition on the back of the product's package) and still benefit greatly.

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Author's Bio

Ashley Spalding received her Ph.D. from the Department of Agricultural and Resource Economics at UC Davis. She is currently an agricultural research economist in the USDA Economic Research Service. She can be reached at: Ashley.spalding@usda.gov.

The findings and conclusions in this article are the author's and do not represent any official USDA or U.S. government determination or policy.

For additional information, the author recommends:

U.S. Department of Agriculture. 2022. “USDA to Invest up to \$300 Million in New Organic Transition Initiative.” Available at: <https://bit.ly/3M9xtVy>.

U.S. Department of Agriculture, Agricultural Marketing Service. 2020. “Agricultural Marketing Service Strategic Plan FY 2020–2024.” Washington DC.



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Giannini Foundation of Agricultural Economics, University of California

Department of Agricultural and Resource Economics
UC Davis
One Shields Avenue
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Co-Editors

Ellen Bruno
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Ria DeBiase
Giannini Foundation of Agricultural Economics
Department of Agricultural and Resource Economics
University of California
One Shields Avenue
Davis, CA 95616
E-mail: rwdebiase@ucdavis.edu
Phone: 530-752-3508

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