Organic Produce Association: 3-Year Transition Rule Economic Analysis

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Executive Summary

- **Project Objectives:** The primary objective of this analysis is to estimate the effect of allowing existing conventional produce growers to test out of the existing three-year-transition-to-organic rule on consumer and producer welfare.

- **Study Design:** The proposed research will use econometric methods to disentangle the effect of allowing produce growers to test out of organic soil-content requirements and sell into the organic product market, given the state of demand for conventional and organic produce, the existing production capacity in the conventional produce industry in general, and the cost of converting from conventional to organic production.

- **Data:** In our analysis, we estimate the necessary econometric and economic simulation models using demand data for conventional and organic produce from industry sources, estimates of the relative production costs of conventional and organic produce from the academic literature, and the cost of conversion from industry members.

- **Methods of Analysis:** Our analysis consists of two stages. In the first stage, we estimate the percentage of growers who would be likely to convert from organic to conventional using data on the relative profitability of producing and selling conventional and organic produce, and the cost of converting from conventional to organic. In the second stage, we use the estimated conversion rates in the first stage to estimate the likely impact on consumer and producer surplus (well-understood measures of economic benefit to buyers and sellers, respectively) from eliminating the three-year conversion rule. We use econometric methods to estimate the expected impact on market prices and volumes, and use economic simulation methods to estimate conversion rates, and the expected increment to consumer and producer surplus. We focus on three important commodity groups for our analysis: Fresh apples, berries, and tomatoes.

- **Key Measures:** Our analysis produces several measures of interest: The expected conversion rate for growers in each of our case-study commodity industries, the expected impact on market prices and shipment (demand) volumes, and the impact on consumer surplus and producer surplus. In each case, we conduct sensitivity analysis to examine the robustness of our numerical findings to alternative modeling assumptions.

- **Findings:** We find that our "most likely" estimated conversion rates lie between 20% and 30%, depending on the case-study commodity. Specifically, we expect 29.8% of conventional apple growers to convert to organic, 24.3% of berry growers, and 25.7% of tomato growers under our base-assumption scenarios. We find that retail prices for organic produce will fall for all three commodities, but shipments will rise. Organic growers, both incumbent and converting growers, will lose revenue due to lower market prices, but benefit from larger total shipments. The net benefit to growers therefore depends on the data and the relative magnitude of each effect. Consumers, however, benefit from both lower organic prices and greater shipments. Under our base assumptions, and average conversion rates, we expect an increase in grower surplus (profit) of $22.6 million per year for apples, $55.6 million per year for berries, and $32.7 million per year for tomatoes. We expect most of the gains to accrue to consumers, however, as consumer surplus will rise by $83.6 million for organic apples, $205.9 million for berries,[1] and $121.3 million for tomatoes.

- **Broader Implications:** Our findings have a number of implications for the broader macro and agricultural economies. First, increasing domestic production of organic fruits and vegetables will reduce our reliance on foreign sources of food. Second, reducing the price of organic produce will largely benefit lower-income consumers - a demographic that currently under-indexes in consumption of fresh fruits and vegetables. Third, the COVID-19 pandemic exposed the U.S. agricultural system as less resilient than we expected. Allowing additional flexibility to move not only between distribution channels, but among production systems and types of commodities is one way to improve the resilience of our food supply. Fourth, food price inflation emerged in 2022 as an issue of national priority. Reducing the price of organic produce, which comprises a growing share of the overall food supply, will provide a measure of protection against resurgent fresh fruit and vegetable prices. Finally, increasing the consumption of organic fresh fruits and vegetables serves a broader and longstanding policy goal of improving the diets of American consumers, as we continue to consume less than our recommended daily amounts of fruits and vegetables.

- **Conclusion:** We conclude that removing the three-year transition rule will accelerate the conversion to organic production for our three case-study commodities, with substantial economic benefit to both consumers and producers of organic produce. The benefit to consumers, however, is roughly 4 times the benefit to producers as consumers will see lower prices due to increased production that is currently allocated to conventional-produce production.

[1] As we explain in more detail below, the conversion rates are based on data for strawberry production so we assume the conversion rates will be the same for all berry growers.

Introduction

Between 2010 and 2021, the total value of organic-food production in the U.S. rose from $26.9 billion to $52.0 billion (in constant 2021 dollars), or almost doubling in 11 years (USDA-ERS 2024). In 2021, organic produce represented some 40% of all organic food (or $19.2 billion) so organic fruits and vegetables are both an economically important part of the U.S. food supply, and are growing rapidly. Consumers perceive significant health and taste benefits associated with organic food, along with superior environmental and sustainability attributes of organic produce (Hughner, et al. 2007) so the growth in demand for organic fruits and vegetables is perhaps not surprising. However, despite rapid growth in organic production, organic produce still sells for a significant price premium over conventional produce. While some of this premium may indeed be due to higher production costs, the fact that growers cannot move easily between organic and conventional production presents a barrier to entry into the organic industry that may sustain price premiums over what they would be in a purely competitive industry.

Indeed, the Organic Food Production Act (1990) and the subsequent rulemaking that constitute the National Organic Program (NOP) mandate a three-year transition to organic. In practical terms, growers who are currently producing fresh fruits and vegetables using conventional methods (generally using chemical fertilizers, pesticides, and herbicides) have to adhere to National Organic Standards (NOS) of production for a three-year period before their products can be sold and marketed as certified-organic (USDA-AMS 2024). During this three-year period, growers incur organic costs of production and generate organic yields, but can only sell their output for conventional prices. Therefore, the three-year transition period represents a burden to transitioning that many growers find prohibitive. In many cases, such as with controlled-environment (CE) production, growers can physically transition to organic in one production cycle, so the three-year transition rule represents an unrealistic burden, and cost, to transitioning to organic. For fresh produce, it is possible to scientifically soil test in order to establish whether or not organic growing conditions exist, regardless of the length of time the grower has followed organic production standards.

It may be the case that preventing growers from transitioning more quickly, and avoiding the implied cost of the three-year transition, holds organic production, and prices, from moving to where a competitive market suggests they should be. Any barrier that prevents a competitive market from reaching equilibrium holds the potential to reduce consumer and producer (grower) welfare below what it could be in a socially-optimal outcome.

In this analysis, we seek to examine the impacts on consumers and producers of removing the three-year transition rule, and allowing growers who are able to scientifically test-out of organic soil standards to transition immediately to organic certification.

Objectives

The primary objective of this research is to estimate the economic benefit to producers and consumers of organic produce from allowing conventional-produce growers to test into certified organic status without waiting the usual 3 years as specified by the NOP. In order to achieve this primary objective, we also achieve other objectives that feed into our overall objective, including:

- Provide a theoretical framework that explains why allowing a more rapid transition to fully organic production can provide economic benefits to both producers and consumers of organic produce.
- Create a data base of demand for organic produce, and cost-of-production estimates that underlie supply decisions,
- Estimate demand models that quantify the price-sensitivity of demand for organic produce, and the extent to which it substitutes with conventional produce,
- Estimate a model of the organic produce supply chain, with the objective of determining the "pass-through rate" or linkage between changes in retail prices and farm-gate equivalents,
- Use data on conventional and organic cost of production, and simulation models of the decision to convert from conventional to organic production in order to estimate the percentage of conventional acreage that may convert to organic production if the three-year transition rule is relaxed,
- Specify, calibrate, and solve equilibrium models of the organic produce market that allow us to predict the impact of accelerated transition into organics on market prices, shipments, and producer and consumer surplus.

Theoretical Expectations

We begin by framing our expectations for the potential benefits to producers and consumers in a basic model of economic equilibrium, and welfare. In economics, the "demand curve" that describes consumers' purchasing decisions represents a combination of prices and quantities that show the volume of a particular good that consumers are willing to purchase at each price. Assuming consumers have a fixed amount of income to spend, as prices fall consumers purchase more. This is called a "movement down the demand curve" and captures the Law of Demand, which is about as close to a "law" as the study of economics gets. Importantly, the height of the demand curve at each quantity (in Figures B1 and B2 in the Appendix) represents the "willingness to pay" for that quantity of goods by all consumers, or the value they place on each amount of production. On the producer side, a "supply curve" represents the combination of prices and quantities that producers (growers) are willing to supply at each price. Because costs rise with production, higher prices bring forth more supply - a "movement up the supply curve" akin to the movement down the demand curve in the consumer case.

Market equilibrium occurs when all of the available supply is demanded by consumers, and the "law of one price" ensures that an equilibrium price exists that clears the market.

We can calculate the total amount of "surplus" available to each side of the market by comparing the positions of the supply and demand curves relative to the equilibrium price. Consumers who purchase in a competitive market earn a surplus because their willingness to pay for every unit of production up to the equilibrium is always above the market price. In essence, everything they purchase is "worth more" to them than they are required to pay. In terms of Figure B2 in the appendix, the amount of consumer surplus is the total area below the demand curve and above the market price, or the triangle bounded by the points "FAB."

A similar logic holds on the producer side. If the supply curve represents the unit cost of producing each unit between 0 and the market equilibrium, then producers earn a "surplus" (or profit) equal to the difference between the market price and the height of the supply curve. In terms of Figure B1 in the appendix, this is the area of the triangle "ABC." Total surplus, or "welfare" in economic terms is the sum of consumer surplus and producer surplus.

Any change in market conditions that causes either the supply or demand curve to change will cause either consumer surplus, producer surplus, or both, to change as well. In the current case, we assume that removing the three-year transition rule will have the effect of shifting the supply of organic produce outward. Assuming Figures B1 and B2 represent the market for organics only, a shift from conventional to organic production means a "shift" in the supply curve as producers are willing to bring more organic production to the market at each price.

What does this shift do to producer and consumer surplus? When the supply curve shifts to the right, the new market equilibrium implies lower prices and larger volume, or greater shipments of organic produce. Lower prices and larger shipments mean that the net effect on producers is complicated, as they lose profit due to lower prices, but gain from larger shipments. In terms of Figure B1, the net effect is given by the difference in the sizes of the triangles "ABC" and "DEC." Because the sizes of these triangles depend on the relative slopes of the two curves, and the extent of the shift, the net effect is indeterminate, and depends on the data at hand, as we show below.

The consumer case is more straightforward, as consumers benefit from both lower prices and higher volumes. In Figure B2 in the appendix, the initial consumer surplus rises from the size of the triangle "FAB" to the area of "FGH." For any shape of the supply and demand curves within reason, the net effect for consumers will be positive. The only question is how positive?

In the data analysis described below, we aim to calculate the sizes of these triangles, and how they change due to a hypothetical removal of the three-year transition rule.

Research Methods and Models

For each product market, the key variables in the theoretical framework are the slopes of the supply and demand curves, and a measures of "how far" the supply curve is likely to shift due to relaxing the three-year transition rule. We conduct our analysis in two stages in order to measure each of these variables.

Stage 1: Estimating Conversion Rates

In the first stage, we measure the shift in supply by estimating the percentage of growers (or rather the percentage of acreage) that would likely convert from organic to conventional using data on the relative profitability of producing and selling conventional and organic produce, and the cost of converting from conventional to organic. Using data on "representative farm" costs of production from industry and academic sources that we describe in more detail below, we know at least on average how profitable each method of production is likely to be. However, there is considerable variability in reality that will drive the probability that a particular grower chooses to convert conventional to organic production. Based on conversations with university extension faculty, we understand that the state-of-the-art in producing each type of produce is relatively well understood, so the primary source of variability is the relative yield of conventional and organic production. Yield tends to reflect the underlying production capacity of land, which is the primary variable from farm to farm. Given differences in relative organic productive capacity, some growers will find it profitable to switch immediately, while others will not be able to justify a switch because their ability to produce organic output is constrained by the quality of their land.

We assume the decision to switch to organic is a long-term investment decision, so a grower will convert acreage from conventional to organic only if the net present value (NPV) of doing so is greater than zero.[2] The cost to transitioning, or the cost of

[2]The net present value of an investment decision is the difference between the present value of all future cash inflows,

the investment, is assumed to be the present value of producing fresh fruits and vegetables at organic costs of production for three years, at organic yields, but earning only conventional produce prices. The cash inflows to the investment start at the end of the fourth year (the first production begins only after the three-year transition is completed) and are assumed to run for a ten-year investment horizon. We discount all cash inflows at a relatively high cost of capital (15%, reflecting a substantial risk premium on average internal capital costs) so any inflows beyond year 10 are insignificant in present value terms. We then discount the present value of the years 4 - 14 cash inflows back to year 3, and then as a lump sum back to year 0 to compare to the present value of costs. The NPV is then the difference between these two present values.

If the NPV of converting is greater than zero, a producer is assumed to convert immediately. Conceptually, our approach estimates the percentage of acres that are currently constrained from converting from conventional to organic. That is, they would convert immediately if they were not prevented from doing so by the three-year transition rule.

We generate a statistical distribution of NPV values by assuming organic yields are randomly distributed over growers, and hence the land available to convert to organic production. In general, agricultural yields are assumed to be log-normal, which means that there is a greater probability of a low yield than a high yield, so we follow this convention here. By assuming organic yields are log-normally distributed, we use Monte Carlo simulation to generate NPV values that are log-normally distributed so only a certain percentage of acreage falls above the NPV = 0 conversion threshold. We interpret this percentage as our estimate of the share that is likely to convert to organic in our Results section below. We then use this conversion percentage to inform our welfare analysis in Stage 2.

Stage 2: Estimating Producer and Consumer Benefits

In the second stage, we use the estimated conversion rates in the first stage to estimate the likely impact on consumer and producer surplus (well-understood measures of economic benefit to buyers and sellers, respectively) from eliminating the three-year conversion rule. We use econometric methods to estimate the expected impact on market prices and volumes, and use economic simulation methods to estimate the expected increment to consumer and producer surplus. We focus on three important commodity groups for our analysis: Fresh apples, berries, and tomatoes.

Our second-stage analysis consists of three parts: (1) an econometric model of demand, (2) econometric analysis of pass-through rates from retail prices to farm prices, and (3) an economic equilibrium-simulation model of the welfare effects on producers and on consumers. In this section, we describe each of these modeling efforts in more detail.

Part 1: Econometric Analysis of Demand

In the econometric model of demand, we aim to estimate the "elasticity" of demand for organic produce, which is a measure of the slope of the demand curve in figure A2 in the appendix. Elasticity estimates measures the percentage change in demand for a 1% change in each explanatory variable – prices, demographic factors, and trend variables that may otherwise explain changes in demand over time. In this stage, we focus on the price elasticity of demand, while holding the other factors constant econometrically, which describes how consumers respond to a change in the supply of each produce item. Price elasticities are key inputs to our equilibrium model that allows us to predict how prices are likely to change with an expansion of supply.

Our econometric demand model is a simple log-log (or Cobb-Douglas) specification that explains variation in the total retail volume of each commodity, on a weekly basis, using variation in retail prices, changes in the population, per-capita income, a time-trend and lagged value of retail volume. By including lagged retail volume as an explanatory variable, our demand model is dynamic in the sense that it captures both short-term and long-term changes in response to any of the other explanatory variables in the model. Including changes in the population captures the fact that if per-capita demand is constant, then the retail demand for any product will change simply because there are more people available to purchase. Including income is also important as organic products tend to be "normal" or even "luxury" goods - meaning that consumers will generally buy more of them if their incomes increase (Hughner, et al. 2007). Finally, we include retail prices as they are expected to be the primary drivers of demand

up to a specified time horizon, and the present value of the investment required to earn the cash inflows. Present value is the discounted value of money earned in the future, discounted at an assumed cost of capital, plus a reasonable risk premium.

so, holding all of these other factors constant econometrically, our estimates of the price elasticity of demand should be relatively accurate, or "unbiased" in econometric terms.

Part 2: Retail-Farm Price Linkage

Higher demand does not necessarily translate dollar-for-dollar into grower prices. In fact, changes in supply occur at the market level, while growers are more interested in incremental revenue to their businesses. Therefore, we use an econometric model to estimate the extent to which changes in retail supply are passed through to changes in grower prices for each of our case-study commodities. We use econometric estimation to find these "retail-farm pass-through rates" because there are many factors that vary over time and can otherwise explain observed variation in farm-level prices. Econometric modeling holds these factors constant in order to isolate the relationship between variation in retail prices and variation in farm prices. Intuitively, these pass-through models estimate the share of each retail dollar that goes through to the farmer in terms of higher farm-gate prices.

Our specific econometric pass-through models are relatively simple as we estimate regression models that include the grower price for each commodity as dependent variables, and retail prices and time trends as explanatory variables. Including time trends is important because the retail-farm price relationship varies seasonally and depends on the cost of moving fresh produce from the farm to the retail sector.

Part 3: Producer and Consumer Benefit

The primary output of the study will be an estimate of the impact of changing organic produce supply on grower profit (producer surplus) and consumer benefit as measured by consumer surplus, estimated under different conversion percentage scenarios. The mathematical details of how incremental producer and consumer surplus are calculated are relatively complicated, so we leave the mathematical details to the appendix below, but the intuition is straightforward.

On the producer side, incremental profit is the difference between higher revenue generated from the combination of higher volume, lower costs of production, or both created by a positive shift in supply and the sum of production and distribution costs. We estimate the change in producer surplus due to the shift in supply estimated in Stage 1 above by calculating the change in equilibrium prices implied by the elasticity of demand, the change in equilibrium quantity due to the change in prices, and then the difference in the producer surplus "triangles" from our theoretical model. Because our demand model is dynamic in the sense that it measures changes in demand that occur in both the short and long runs, we estimate the long run change in producer surplus and the short run change and report both in our Results section below.

On the consumer side, consumer surplus is estimated as the difference between the amount consumers are willing to pay for a certain amount of organic produce and the new, likely lower, price induced by the change in supply. Our general approach is the same as in the producer case described above, only now we calculate the size of the change in the consumer surplus "triangle" due to the change in equilibrium prices and quantities. As we explain above, consumers benefit from both lower prices and greater retail volumes so we expect the change in consumer surplus to be substantially larger than the change in producer surplus. Again as in the producer case, we estimate both long run and short run changes in consumer surplus as we assume consumers take time to fully adjust to any change in supply in re-establishing purchasing patterns.

Data Sources and Assumptions

Our econometric and simulation models use data that are appropriate to each part of the analysis, but face limits on what is available. In this section, we describe the specific data sources used in each part, and the assumptions made in using them for the purposes at hand.

In order to estimate the retail demand model, we use retail scanner data from Category Partners, LLC for each commodity, aggregated out to the level of the retail category.[3] We use data on a weekly level for the 2023 calendar year (i.e, January 1, 2023 - December 31, 2023) for the entire U.S. retail market. Our retail data are "scanner data," which means that they are captured in the first instance from consumer purchases at retail stores that are scanned before bagging. The Category Partners data reflects retail sales from the majority of retail stores in the U.S., but not all, so all of our demand results are to

[3] Note that although Category Partners made the data for this analysis available to us, they are not responsible for any of the conclusions derived herein and were not involved in the analysis, so all conclusions remain the responsibility of the authors.

be interpreted as conservative estimates of the total weekly retail demand for each commodity.

We also aggregate over many different varieties and sub-varieties in estimating our demand models at the category level. We recognize that there is considerable heterogeneity in retail products sold in each case, both over varieties and packages, but we assume that the average retail price each week accurately reflects week-to-week variation in prices that consumers pay at the retail level. Aggregating the data this way also assumes that retail movement across different grocery stores and regions are highly correlated on a week-to-week basis. Without more specific data to the contrary, we recognize that aggregating out to the national market is a potential weakness of our study, but because our objective is to link changes in retail demand to changes in national grower prices, aggregating to a market measure at some point is necessary.

We also include variables that capture changes income and population. We use per-capita income data at the national level from the Federal Reserve Board of St. Louis statistical data service (FRED). Our national population estimates are from the U.S. Bureau of Census, American Community Survey.

We estimate the retail-farm price pass-through models using our retail price data above and farm-price data from the USDA Agricultural Marketing Service, Market News Service (AMS-MNS). The AMS-MNS data are also at the weekly level and are aggregated over all varieties and packages for each commodity. Because we assume every item produced is ultimately sold, or at least that the loss between the wholesale and retail levels is the same, aggregating wholesale prices this way should not bias our pass-through estimates.

For the Stage 1 analysis, we use cost-of-production estimates for each organic and conventional produce item. Production data for individual firms is proprietary, so we use published studies conducted at U.S. land-grant universities, supplemented with information from the published agronomic literature. For apples, we use cost-of-production estimates from the Washington State University Extension Services for conventional and organic apple production (WSU 2022). For both organic and conventional production, our cost estimates were generated for Gala apples, on a typical apple farm in the state of Washington. Extension services do not conduct cost-of-production studies every year, however, so we use the most recent versions of each study - 2019 for conventional and 2022 for organic. We use current (2024) Gala apple prices from the AMS-MNS database referred to above. The WSU Extension cost-of-production estimates, however, assume equal yields for organic and conventional apples. We questioned this assumption, so referred to the academic literature in agronomy for updated yield estimates for each type of data. Slattery, et al. (2011) suggest that organic apples produce some 10% less than conventional apples on equivalent land, so we use this estimate as our mean yield for organic apples.

For berries, we use data from similar cost-and-return studies conducted by extension faculty at the University of California at Davis (Bolda, et al. 2024a,b). However, because the berry category is a broad aggregate of strawberries, raspberries, blueberries, and others, and production methods differ greatly between each, we focus only on strawberry production costs. Further, we could not find suitable cost-and-return studies for any of the other berry commodities, so our focus on strawberries is both practical and necessary. Fortunately, the U.C. Davis data captures production costs for both organic and conventional strawberries, in comparable geographies (the Central Coast of California) and for the 2024 production year. In order to make our analysis as comparable as possible across categories, we use 2023 prices for organic and conventional strawberries from the AMS-MNS price database.

Our tomato cost-of-production data are from cooperative extension services at the University of Florida (Wade, et al. 2020). Similar to the berry case, there are many different variety of tomatoes. Although the University of Florida study is non-specific, we assume the data refers to a generic variety (likely "mature green" tomatoes) grown on a representative Florida tomato farm. This study, however, only reflects data from conventional production and not organic. Therefore, we rely on an influential "meta-analysis" that compares organic and conventional yields across several different types of crops, in common production situations, to conclude that organic tomatoes in Florida yield some 30% below conventional yields (Seufert, et al. 2012).[4] As in the other two commodity-cases, we use tomato prices for the

[4] A "meta-analysis" is an empirical study that essentially averages the results from dozens of other studies in the published literature. They are generally used to reconcile differences among academic studies in order to come up with a single "take-home" estimate of an effect that has been widely studied. In our case, the Seufert, et al. (2012) study finds an average 20% effect, but refers to a wide dispersion among the published findings, and argues that organic yields are likely to be lower in settings with severe pest and disease pressures, which describes the Florida production case.

2023 calendar year from the AMS-MNS price data base.

We summarize our cost-of-production data in table 1 below. Note that in each case the "Std. Dev." data field refers to the standard deviation of the assumed log-normal yield distribution that drives our probability-of-converting estimates.

In the Results section that follows, we present our consumer and producer benefit estimates over a wide range of assumed conversion percentages, simply due to the uncertainty involved in estimating conversion rates. We intend for these results to show the sensitivity of the potential benefits to the number of growers that convert, and the possible range of outcomes.

Results

In this section, we show our key results in tabular and graphical form, and explain their significance relative to our objectives. We begin by presenting our findings for the Stage 1 analysis (rates of conversion to organic) and follow with the Stage 2 (producer and consumer benefits) analysis.

Stage 1: Conversion Rates

We estimate the expected rate of conversion from conventional to organic production for each of our three case-study commodities, under our base assumptions and a range of alternative assumptions regarding relative yields and production costs for each commodity. We present our "most likely" results here, in graphical form.

In the case of apple production, we find that organic yield is substantially lower than conventional yield, but prices for organic apples are correspondingly higher (table 1). The data in table 1 show that the cost per acre for organic apples is only slightly higher than for conventional apples, but the yield difference means that the per-pound difference in production costs are substantial.

Again assuming the the most important conversion-cost is the fact that conventional producers will incur organic production costs for three years, but sell at conventional prices, we find that the NPV of conversion is greater than zero for some 29.8% of conventional acreage. Figure 1 shows this finding in graphical form. Figure 1 is the statistical distribution of NPV values over all growers, assuming that heterogeneity in organic yield represents the most significant difference among them. The percentage of growers we expect to convert to organic production is given by the area under this curve to the right of the NPV=0 point, or roughly 1/3 of growing-acreage are expected to convert to organic if the three-year transition constraint is removed.

Second, we estimate the percentage of berry growers who are likely to convert using cost of producing conventional and organic strawberries. Again, assuming all berry growers are represented by data for strawberry growers is a strong assumption, but in the absence of more specific data on the cost of producing other berry items, our estimates are likely to be broadly true. We show our mean conversion rate in figure 2 below. This figure represents the results of our NPV simulation in which organic yields are again substantially lower than conventional yields, as in the apple case, but per-acre production costs for organic strawberries are slightly lower than conventional costs on a per acre basis. Given the differences in yield, however, the cost-per-tray for organic strawberries drives much of the price premium shown in table 1. Under our base assumptions, we find a conversion rate for strawberry growers, or more accurately strawberry acreage, of 24.3%, which we interpret as meaning that almost one quarter of strawberry acres are currently constrained by the three-year transition rule.

Our third set of results in Stage 1 show the expected conventional-to-organic conversion rates for fresh tomato growers. We recognize that there are many different types of tomato grown in the U.S., and many different production regions, so recall that our assumptions apply specifically to field tomatoes grown in the State of Florida, under non-controlled environment conditions. As in the strawberry case, production costs per acre are lower for organic production relative to conventional, but yields are dramatically lower according to academic sources (Seufert, et al. 2012). Nonetheless, we find that some 25.7% of growers are expected to find conversion to organic production profitable in order to take advantage of the substantial price premium shown in our base data in table 1.

Stage 2: Producer and Consumer Benefits

We use the estimated conversion rates above to condition our "most likely" case for how much production is likely to convert to organic production in each of the apple, berry, and tomato markets. Because of the uncertainty involved in estimating the conversion rates in the previous section, and the heterogeneity among varieties of each product and production conditions across the U.S., we present the expected

Table 1: *Comparative Returns, by Crop and Type*

	Apples		Berries		Tomatoes	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Yield	51,200	46,080	9,000	6,000	30,000	21,000
Price	$0.66	$0.76	$11.00	$15.00	$0.87	$1.22
Variable Costs	$32,372	$36,180	$105,806	$93,326	$20,944	$18,850
Fixed Costs	$9,771	$9,208	$5,946	$6,330	$3,171	$3,171
Net Returns	$1,363	$-1,126.94	$-6,806	$11,674	$1,984.5	$-61.05

Note: See text for sources and assumptions. Strawberry prices and yields in trays, others in pounds.

Figure 4. Proportion of Apple Growers Likely to Convert

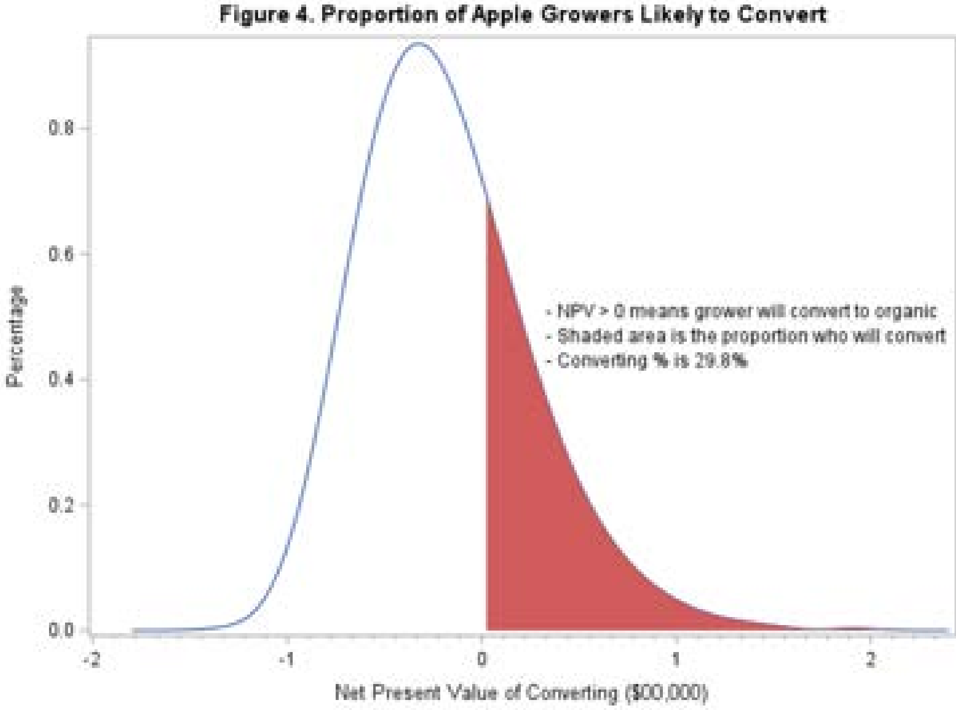


Figure 5. Proportion of Strawberry Growers Likely to Convert

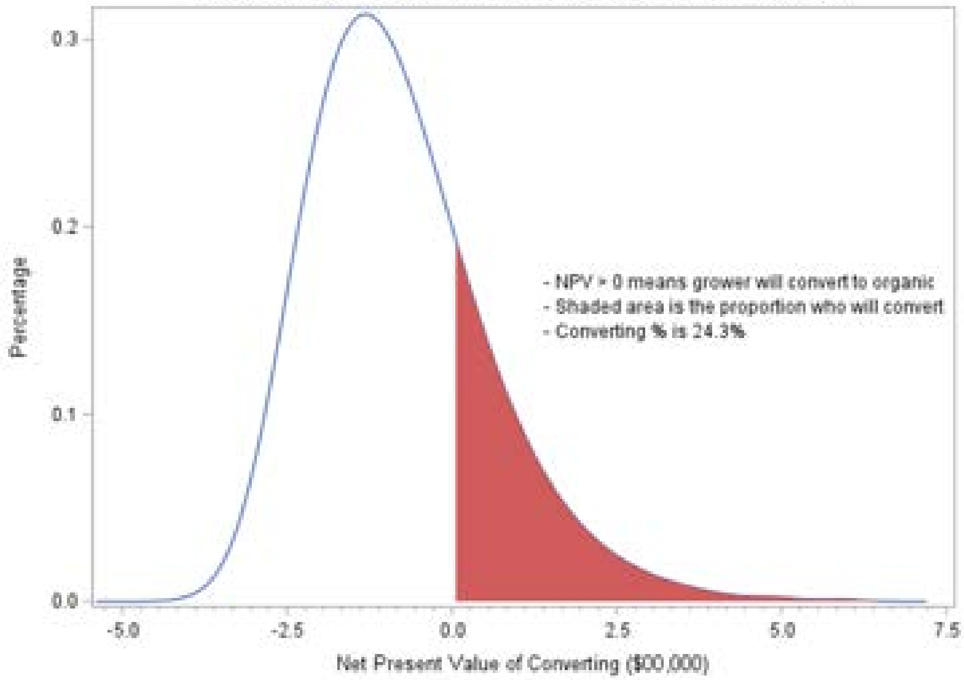
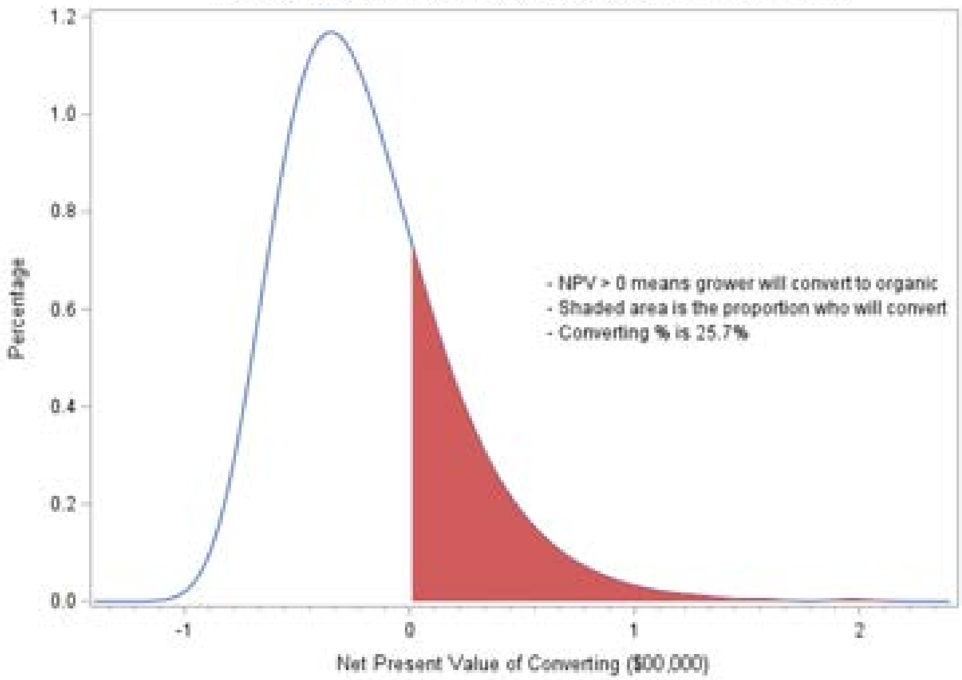


Figure 6. Proportion of Tomato Growers Likely to Convert



changes in producer and consumer surplus under a range of assumed conversion rates, from a low of 5% to 30%. Our estimated conversion rates lie at the top of this range, as we expect that real-world concerns will mean that many growers will remain in conventional production despite the fact that the economic benefits to conversion may be strictly positive under our "ideal" assumptions.

We present our results in this section commodity-by-commodity and explain our findings with respect to producer and consumer benefits in order. We present our results for each part of the econometric analysis, beginning with a summary of our findings with respect to the demand elasticity, the estimated pass-through rates, and finally implications for consumer and producer surplus.

Starting with the apple case, we find an estimated demand elasticity of -1.22 (p-value = 0.015), which implies that the apple category as a whole is elastic in demand, but not strongly elastic.[5] Our econometric price-transmission elasticity, or the rate at which changes in retail prices are passed through to farm prices is 0.90 (p-value = 0.000) which means that if retail prices change by 10%, we can expect farm prices to change by 9%. An estimate of 0.09 means that retail price changes are passed-through to farm price changes almost completely.

We use both of these estimates to simulate changes in producer and consumer surplus. Our simulation results in figure 7 show the changes in producer surplus at the conversion rate shown above, and over the range of conversion rates from 5% to 30%. In figure 7, the expected producer benefits in the long-run (which is more relevant than the short-run for investment decisions) are roughly $433.0 thousand per week, or $22.5 million on an annual basis. Relative to current retail value as a benchmark for comparison, our findings suggest a gain in producer profit of some 3.4% of retail value. As expected, the benefits to consumers are substantially larger as they gain from both lower prices and greater volumes of organic apples. From the most-likely scenario (30% conversion) in figure 7, we expect consumer gains to be roughly $1.6 million per week, or $93.6 million per year. Again measured against retail value, our expected consumer benefits amount to approximately 14.1% of total retail organic-apple value. In short, the expected gains to both producers and consumers of organic apples from relaxing the three-year transition rule are significant.

Next, we consider the case of berries. Recall that we estimate expected conversion rates using cost-of-production data for strawberries, and assume that these conversion rates apply to all types of berries as our retail data describes the entire berry category. In this case, the expected conversion rate is roughly 25%, so we simulate changes in producer surplus and consumer surplus using a 25% conversion scenario.

The estimated demand elasticity for the berry category is very similar to the estimate for apples at -1.31 (p-value = 0.000), which again implies that berries, in general, are elastic in demand. In the broader scope of demand elasticities for consumer products, however, a demand elasticity of -1.31 is still on the less-elastic side which implies that consumers are relatively insensitive to changes in berry prices at the retail level. Our price-transmission elasticity estimate is also very similar to the apple case, as we find that changes in retail prices are passed-through to the farm level with an elasticity of 0.96 (p-value = 0.000) so again changes in retail prices are passed-through to changes in farm prices on a nearly one-to-one basis.

We present the changes in producer and consumer surplus implied by these demand- and pass-through-elasticity estimates in figure 8 below. The data in figure 8 show that the long-term producer benefits of removing the three-year transition rule are $1.1 million, or $55.6 million annually. Again expressed as a ratio to total retail value, the long-run benefits to producer amount to approximately 3.2% of retail value, per year. Consumers stand to benefit considerably more, with nearly $1.6 million weekly ($205.9 million per year) more in consumer surplus, due to both lower prices and larger organic berry shipments. Interpreted as a share of retail value, our findings suggest that consumers benefit by some 12.9% of the existing retail value. In an environment of persistent food-price inflation, lower prices for organics provide one bright spot in an otherwise-bleak food price story.

For the tomato category, the price-elasticity of demand is similar to our estimates for the other two categories (-1.049, p-value = 0.004), but the price-transmission elasticity differs substantially (1.94, p-value = 0.031). Because this price-transmission elasticity is simply not plausible - it implies that retail price changes are passed-through to the farm level on a nearly two-to-one basis, we rely on the theoretical

[5] Items that have an elasticity of demand below -1.0 are referred to as "elastic" in demand, or the percentage change in quantity demanded is larger than the percentage change in price. Items with elasticities between 0 and -1.0 are "inelastic" in demand, or are relatively insensitive to changes in retail price. The p-value refers to statistical significance - a p-value below 0.05 means that the estimate is statistically different from zero in a random draw, 95 times out of 100.

Figure 7. Producer and Consumer Gains, Apples

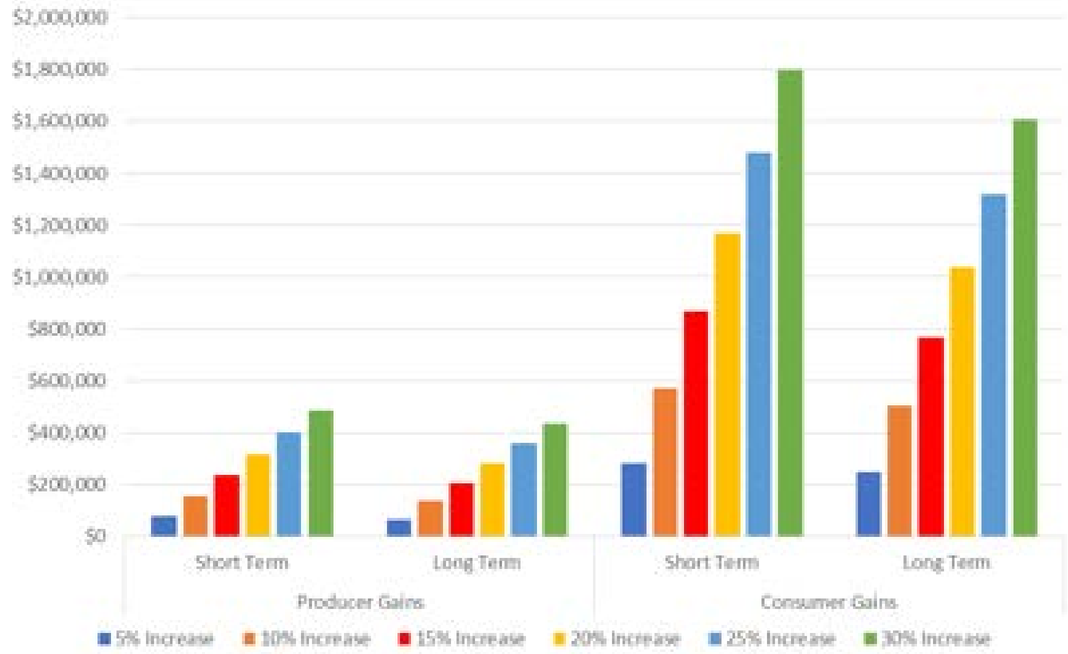
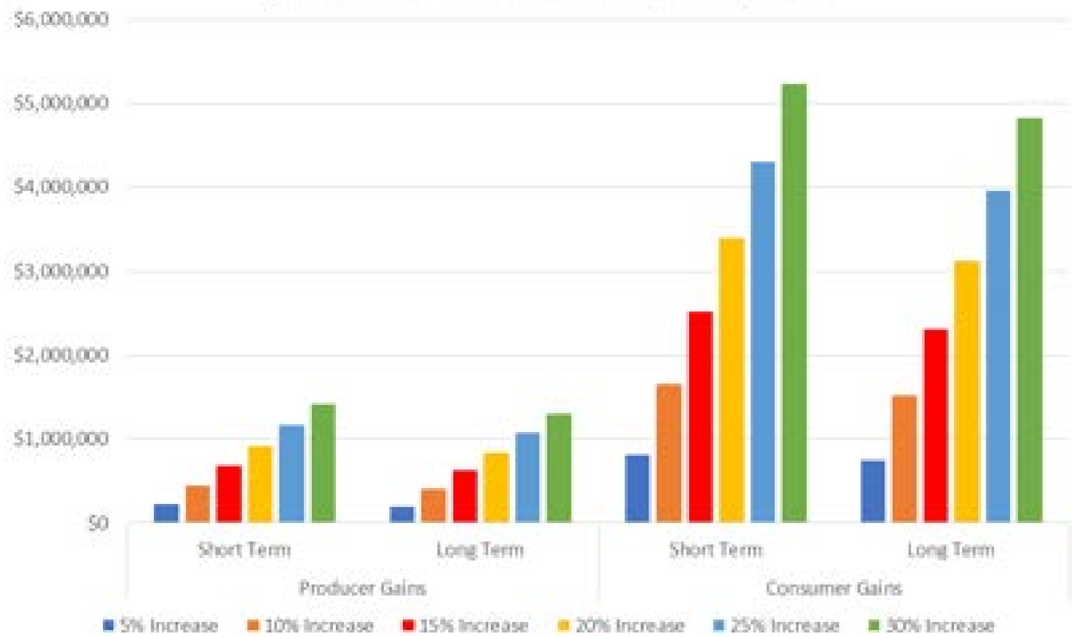


Figure 8. Producer and Consumer Gains, Weekly, Berries



pass-through rate shown in the appendix. That is, if the elasticity of supply for farm inputs and non-farm inputs are similar, then the pass-through elasticity will be roughly 1.0, as in the other two commodity-cases. Our pass-through elasticity estimate may be subject to substantial estimation bias simply due to the heterogeneity in the tomato industry as our retail prices aggregate over all retail tomato items, while our farm prices refer to the generic round tomato captured by the AMS-MNS data. Regardless, our unit pass-through elasticity estimate (i.e., equal to 1.0) will produce a more conservative estimate of the benefits to producers than the estimated value of 1.94.

Using the demand estimate above, and our theoretical pass-through rate of 1.0, figure 9 shows our simulation results for the expected change in consumer and producer surplus for the tomato industry. Recall that the expected conversion rate among tomato growers implies over 25.0% of existing conventional acreage should convert to organics under our assumed cost-of-production parameters. With a 25.0% increase in supply, retail prices for organic tomatoes will fall by some 40%, but volumes will rise by over 35.0% in the long run.[6] Combining lower prices and larger shipments, tomato producers are expected to benefit by roughly $629.0 thousand per week, or $32.7 million per year. Expressed as a percentage of retail value, we expect an increment to producer surplus of nearly 10.2% of retail value. Consumers also benefit, and due to the relative inelastic retail demand for tomatoes (steeper shape to the demand curve in the appendix figures) they tend to benefit by more more, proportionately, relative to consumers of the other commodities. We expect the gain in consumer surplus to be over $2.3 million per week ($121.2 million per year), or nearly 37.6% of retail value. Clearly, the benefits to removing the three-year transition rule are a significant economic benefit to tomato consumers.

To summarize our empirical findings, our estimates suggest that producers stand to gain between 3.0% and 10.0% of the current retail value of organic fruits and vegetables if the three-year transition rule is relaxed, and if growers convert according to our profit-maximization assumptions. Consumers stand to benefit much more, however, as we expect an increase in consumer surplus of anywhere between 12.0% and 37.0% of current retail value. Because our sample of commodities is only a very small slice of the commodities than may be produced using organic methods, the overall gains to organic producers and consumers promises to be large, and economically important.

[6]Note that the long-run increase in equilibrium is greater than the initial 25% increase in supply because demand curves slope downward - the initial increase in supply causes a reduction in prices, which leads to greater consumer purchases as they move down their demand curves.

Broader Implications

There are a number of indirect economic benefits that we do not quantify directly, but follow logically from our findings above. First, increasing the capacity of the domestic organic produce industry will help shrink an agricultural trade deficit that is projected to rise to a record $32.0 billion for 2024 (ERS-USDA 2024b). Reducing our reliance on other countries to provide critical food supplies is in our long-term, strategic food security interests.

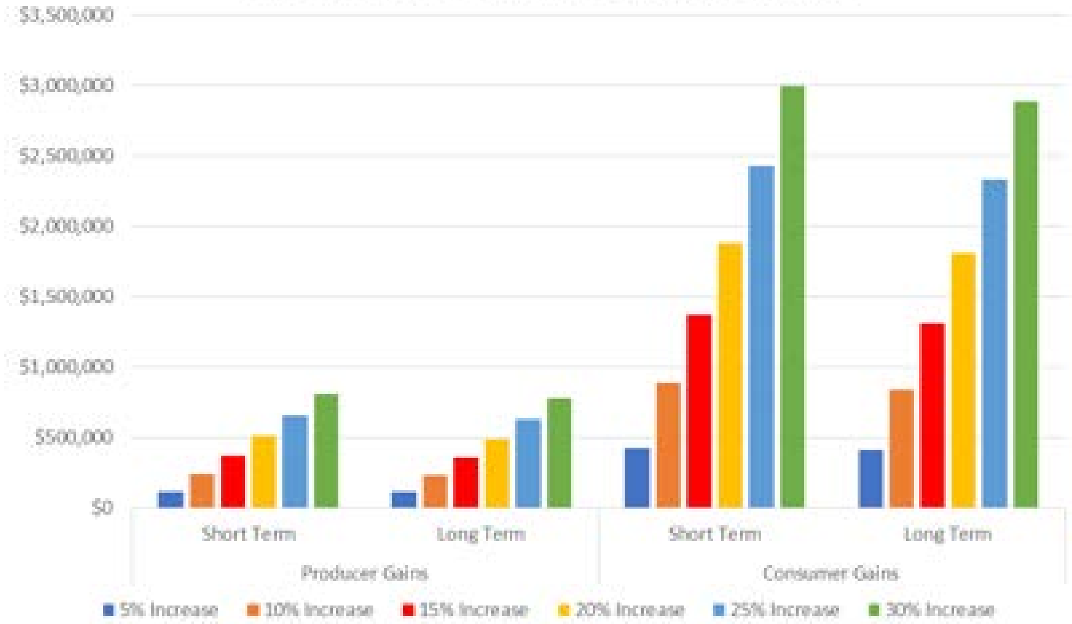
Second, consumers typically cite the high cost of organic produce as a primary barrier to increasing their consumption, which means that organic consumers tend to have higher incomes and an ability to pay that matches their willingness to consume organic produce. Reducing the retail price of organic produce will therefore benefit lower-income consumers who would find a greater range of organic items within their food-shopping budgets.

Third, following well-published examples of supply-chain fragility during the COVID-19 pandemic, supply-chain resilience is now a key policy goal (POTUS 2024). Further, "flexibility" is a central attribute of resilient supply chains (Tang & Tomlin 2008), so providing producers the ability to move between production systems and product types is a low-cost way of achieving resilience and protecting the fresh produce supply chain from future disruptions.

Fourth, following the unprecedented monetary and fiscal stimulus programs during the COVID-19 pandemic, and supply-side problems in many interrelated supply systems, food price inflation roared back in 2022 for the first time in a generation. Reducing organic produce prices provides one way - a very tangible and visible way - to help tackle food price inflation in a critical category of food products.

Finally, Americans typically consume at or below recommended minimums for fresh fruits and vegetables (Krebs-Smith & Kantor 2001). Reducing prices for healthy fresh produce items will lower one of the primary barriers to improving dietary quality, helping consumers shift spending from over-processed foods to more healthy alternatives.

Figure 9. Producer and Consumer Gains, Weekly, Tomatoes



Conclusions

In this report, we examine the economic implications of relaxing the three-year transition rule for organic producers as mandated in the current National Organic Program. Currently, many producers find it not economically viable to convert from conventional to organic production because they cannot cover the cost of producing under organic conditions for three years - with the associated lower yields and higher per-unit costs - with current organic premiums. Further, agronomic practice does not support the three-year rule as some growers can transition their production environment quickly and meet organic soil testing standards by testing out.

We find that there are important economic benefits to relaxing the three-year transition rule, both to producers and consumers. Producers stand to benefit, even though price-premiums for organic products will fall, because they will be able to ship a larger volume of organic produce. As a percentage of retail value, we find that the gains to producers should lie somewhere between 3.0% and 10.0% of the current retail value. Consumers gain from both lower prices and greater volumes, so our measure of consumer benefit - an economic measure of "consumer surplus" - finds an expected gain of anywhere between 12.0% and 37.0% of current retail value.

We caution readers that our modeling exercise is based on many parameters that are currently unknown, such as the percentage of acreage that will convert from conventional to organic, but believe that our approach represents a conservative estimate and is supported throughout by estimates from the academic literature. A more detailed analysis of this issue would perhaps use survey data of growers that specifically asked the question "Would you convert to organic production if the three-year transition rule were relaxed?" Our analysis would also benefit from more current, and comparable, surveys of the relative costs of producing conventional and organic fruits and vegetables, across a larger sample of items.

Appendix A

This appendix describes how we calculate the increment to producer and consumer surplus given the impact parameters, and conversion rates, estimated according to the procedure described above. This model is similar to one used in Richards and Patterson (2000) and was originally developed by Kinnucan et al. (2000). To calculate the change in producer and consumer surplus, the analysis takes into account: (1) the shift in supply due to acreage converting from conventional to organic, (2) the impact on price, (3) the feedback effect of lower prices on the quantity demanded, and (4) the transmission of equilibrium retail prices to the producer level. Although the final solution consists of two simple equations, the model requires separate components for each element (1) to (4). Again in mathematical terms, this model, written in terms of the change in the log of each variable value, appears as:

$$\begin{aligned} d\ln \mathbf{Q_r} &= \mathbf{E_d} d\ln \mathbf{P_r} + \mathbf{G} d\ln \mathbf{Z_r} \\ d\ln \mathbf{X} &= \mathbf{E_s} d\ln \mathbf{W} + \mathbf{H} d\ln \mathbf{Z_s} \\ d\ln \mathbf{W} &= \mathbf{T} d\ln \mathbf{P_r} \\ d\ln \mathbf{Q_r} &= d\ln \mathbf{X}, \end{aligned}$$

where the first equation represents the effect of retail prices and any demand-shift variables on demand, the second is the supply equation that captures both price and supply-shift effects on market output, the third measures the rate of price-transmission from retail to the farm-gate, and the fourth is the market equilibrium identity. Each equation is then substituted into market equilibrium to solve for the resulting price impact of the proposed shift in supply due to eliminating the three-year transition rule:

$$d\ln \mathbf{P_r} = \mathbf{M}^{-1}(\mathbf{G} d\ln \mathbf{Z_r} - \mathbf{H} d\ln \mathbf{Z_s}),$$

Given this change in prices, the addition to producer surplus then becomes:

$$dPS = S^f \mathbf{P_r} \mathbf{Q_r} d\ln \mathbf{W}(1 + 0.5 d\ln \mathbf{X}),$$

and to consumer surplus is:

$$dCS = \mathbf{P_r} \mathbf{Q_r} d\ln \mathbf{P}(1 + 0.5 d\ln \mathbf{Q_r}),$$

which is a well-understood equilibrium displacement approach to solving for market equilibria, and the impact of shocks to either supply or demand.

Each of the variables and parameter values are defined as follows: $\mathbf{W}$ = variables representing FOB (producer or importer) prices for each product, $\mathbf{X}$ = variables representing farm-output of each product, $\mathbf{P_r}$ = variables representing market prices, $\mathbf{Q_r}$ = variables representing retail quantities, S_f = grower's share of the retail dollar for each product type, $\mathbf{Z_r}$ and $\mathbf{Z_s}$ = factors affecting demand and supply, respectively, $\mathbf{E_d}$ and $\mathbf{E_s}$ = matrices of demand and supply elasticities, respectively, $\mathbf{T}$ = price-transmission elasticities (percent of price going to the producer), $\mathbf{G}$ = demand elasticities with respect to exogenous retail factors, $\mathbf{H}$ supply elasticities with respect to the exogenous supply shock (conversion percentages, $\mathbf{M} = \mathbf{E_s}\mathbf{T} - \mathbf{E_d}$ = solution for the change in price variable.

While values for most of these variables are estimated in the relevant demand model, the supply-response elasticities and growers' share of the retail dollar are not. First, reliable estimates of the elasticity of supply are difficult to come by and are not estimable with the data at hand. Therefore, we calculate the effect of each supply shift under a range of supply elasticities from 0.25 to 1.5. Based on previous research for other commodities, however, it is determined that a supply elasticity of 1.0 in the long run is the most likely. This means that a 10 percent increase in the producer price is likely to lead to a long run increase in the supply of each fruit and vegetable product of 10 percent.

We also use two methods to evaluate the relevant price-transmission elasticity, or the rate at which changes in the retail price is transmitted to changes in the farm price. First, we estimate price-transmission elasticities as described in the narrative above, using the AMS-MNS grower data for each commodity, and retail prices from Category Partners.

Second, because econometric estimates of price-transmission elasticities are notoriously subject to estimation error, we also use a validation method from the literature. Specifically, we estimate a price-transmission elasticity using the formula in Gardner (1975) as:

$$\mathbf{T} = \frac{\mathbf{E_b}}{S_f \mathbf{E_b} + (1 - S_f)\mathbf{E_s}},$$

where E_b is the elasticity of supply of non-farm inputs, which is assumed to equal 1.5. Further, ERS-USDA reports the farm share of the retail dollar for all specialty crops and products as 0.255, so we adopt this value as an approximation to the share earned by apple, berry, and tomato producers.

Appendix B

In this appendix, we describe our theoretical framework in graphical form. In figure B1, we show the potential gain to producers as the difference in area between the two triangles bound by the points ABC and DEC, which is clearly indeterminate in size. In figure B2, we show the potential gain in consumer surplus as the area of the shape bound by the points ABGH. In this case, the gain to consumers is clear as the shape has to have a positive area under usual economics assumptions.

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Figure B1. Theoretical Benefits to Producers

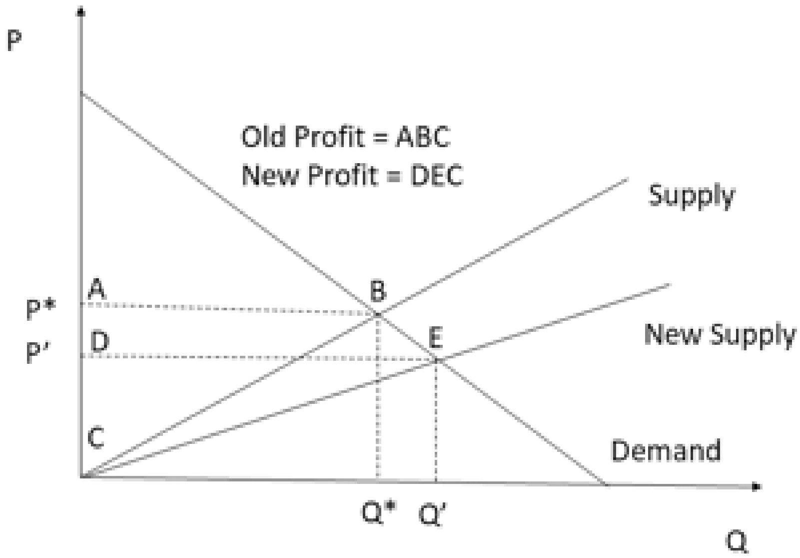
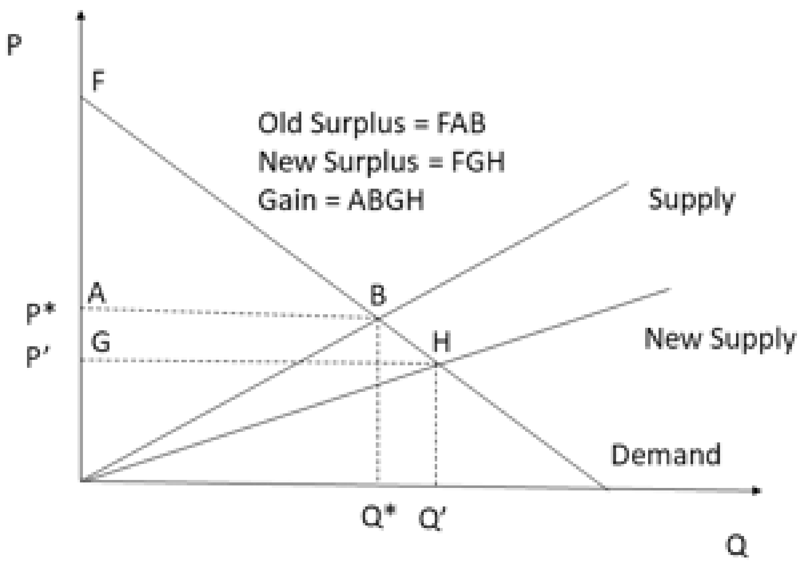


Figure B2. Theoretical Benefits to Consumers



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