Distributional Effects of Selected Farm and Food Policies

The Effects of Crop Insurance, SNAP, and Ethanol Promotion

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Abstract

This paper investigates the influence of three federal policies often conjectured to have some of the most pronounced effects on food markets: subsidized crop insurance; the Supplemental Nutrition Assistance Program (SNAP); and ethanol promotion. Results indicate that removing subsidized crop insurance would yield economic benefits of $932 million per year. Removing crop insurance would reduce producer and consumer surplus, with taxpayers being the only aggregate beneficiaries, suggesting that the costs are "hidden" in the form of a higher tax burden. Agricultural producers in several western states would benefit from the removal of crop insurance subsidies, whereas producers in the Great Plains states would be the biggest losers. Depending on how SNAP recipients spend their disbursements, the projected benefits of dismantling SNAP range from $12.7 billion to $42.8 billion per year. Reducing ethanol demand is projected to benefit livestock producers and food consumers while harming corn producers.

JEL codes: Q18, Q11

Keywords: crop insurance, farm subsidies, food prices, equilibrium displacement model, food stamps, SNAP, ethanol

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The Agricultural Act of 2014, otherwise known as the Farm Bill, is projected to cost US taxpayers an estimated $95.6 billion per year until 2023 (Congressional Budget Office 2014). As with previous farm bills, the vast majority of spending, 79 percent, is allocated to nutrition programs such as the Supplemental Nutrition Assistance Program (SNAP), more popularly known as food stamps. About 15.4 percent of the total, or $14.6 billion per year, is allocated to spending on farm commodity and crop insurance programs. Debate over the most recent Farm Bill was particularly contentious, and two of the primary points of conflict related to the size of SNAP and the move away from traditional direct payments and commodity programs toward subsidized crop insurance.

Adding to the controversy is the fact that, ironically, one set of government policies that has arguably most affected agricultural markets in recent years is not even contained in the Farm Bill and is administered by the Environmental Protection Agency: biofuels policies. Although direct subsidies to ethanol producers ended in early 2012, the Renewable Fuel Standard (RFS) requires increasing amounts of transportation fuel to come from renewable sources, particularly corn-based ethanol—up to 36 billion gallons each year by 2022. Smith (2012) estimates that the RFS essentially mandated that at least 37 percent of the US corn crop in 2011–2012 be used to produce ethanol, which is then blended with gasoline.

Although much has been written on the merits (and demerits) of "farm subsidies," relatively little empirical work has investigated the effects of individual programs, such as

SNAP, crop insurance, or the RFS, from farm to fork—for instance, on the prices of retail foods and individual farm commodities. Given the differences in the commodities grown in each US state and the differences in the flow of SNAP and crop insurance subsidies to each state, one might expect significant regional heterogeneity in the winners and losers of those farm and food policies. Yet that issue has received relatively scant attention in the academic literature.

The purpose of this research is to explore this knowledge gap. This study uses a national-level partial equilibrium model linking farm production to final consumption and disaggregates effects to different states once the solutions are found. The model is used to address three objectives. First, the study determines the effects of farm subsidy payments (crop insurance subsidies) on farm prices and production decisions. It specifically focuses on the relative effects across different states with different types of agricultural production. Second, the study uses the constructed model to calculate the effects of food assistance programs (i.e., food stamps) on the prices paid for food. The price effects of food stamps are interesting in that the associated demand responses that result from such policies are likely to drive up the price of food, damping the net effect of the transfer on recipients, not to mention the effect on nonrecipients. Third, the study determines the state-, commodity-, and aggregate-level effects of the increasing demand for corn for use in ethanol.

Overview of the Academic Literature

Many authors have studied issues related to farm policy effects, mostly focusing on specific policies and producer effects. Some have used econometric approaches to study the effects of various farm policies. For example, Balagtas et al. (2014) show that certain provisions of the Farm Bill have incentivized farmers to grow fewer fruits and vegetables. Farms lose their eligibility for farm payments if particular fruits and vegetables are planted on base acres; according Balagtas et al. this has led to an estimated 7 million fewer acres in fruit and vegetable production than would otherwise have been the case.

As another example, Kirwan (2009) uses econometric models to calculate the proportion of the value of farm subsidies that accrue to landowners rather than farmers. Despite the usual supposition that landowners capture the lion's share of farm payments, Kirwan estimates that farmer-renters capture about 75 percent of the subsidy, with landowners capturing the rest. Modeling approaches similar to that employed in this paper are used by Alston, Sumner, and Vosti (2008) in the context of international comparisons of farm policies and their potential effect on obesity (the authors find little to no link between farm subsidies and obesity). Alston (2007) analyzes the incidence of farm subsidies (finding that about half the value of subsidies accrues to landowners, about 20 percent to consumers, and about 25 percent to farmers, while about 5 percent is wasted, deadweight loss), and Sumner (2005) examines farm subsidies in the context of World Trade Organization disputes (estimating that prior US subsidies depressed world corn, wheat, and rice prices by about 9.5 percent, 7 percent, and 5 percent, respectively).

In recent years, various nongovernment organizations and academics have paid more attention to the impact of food policies on consumers. Okrent and Alston (2012) and Rickard, Okrent, and Alston (2012) have constructed a model of farm product supply and consumer demand to analyze the impact of various food policies on obesity. Both studies report that farm subsidies are unlikely to have affected obesity rates significantly. Of the various policy scenarios considered, such as the removal of farm subsidies, taxes on fat and sugar, or subsidies for fruits and vegetables, Okrent and Alston (2012) find that only an across-the-board calorie tax would be expected to have a substantive effect on people's body weight. Such a policy, of course, would be regressive, with costs borne disproportionally by the poor.

The present study builds on Okrent and Alston (2012) and Rickard, Okrent, and Alston (2012) in four ways. First, those studies analyze the effects of preexisting policies, such as deficiency payments and countercyclical programs that no longer exist, whereas this study will focus on crop insurance, a program that has grown over time and appears to be the primary form of subsidy going forward (though it is not the only program, as evidenced by the existence of the Agriculture Risk Coverage Program and the Price Loss Coverage Program in the 2014 Farm Bill). Second, those studies do not calculate the welfare effects or costs to consumers and taxpayers of farm subsidies. Third, the studies do not calculate state-level effects. Fourth, neither study considers the effect of food assistance programs or ethanol policies.

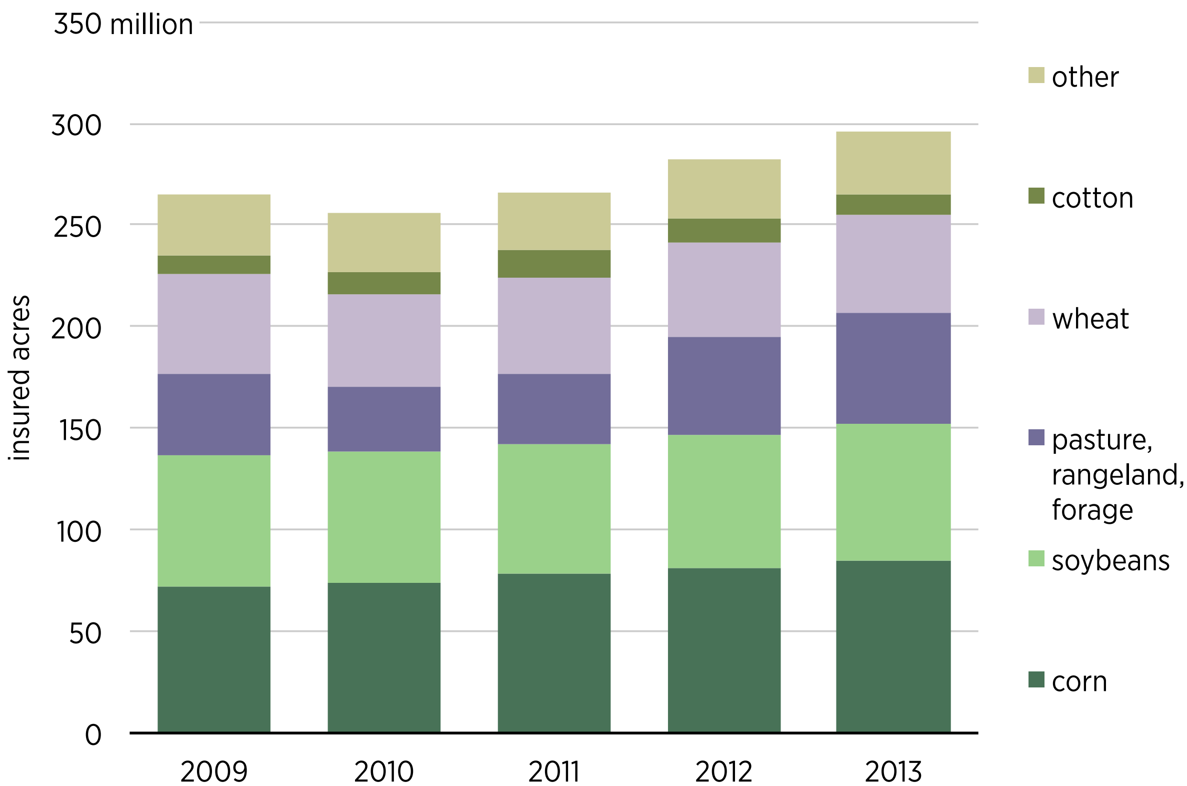
Background on Crop Insurance Programs

Although the federal crop insurance program has existed since the 1930s, it was not widely used until the mid-1990s. The program was originally created after the Great Depression and the formation of the Dust Bowl in an effort to help revitalize the agricultural industry. Initially, the program was available for only a few crops in limited areas, and it operated much like a pilot program until the Federal Crop Insurance Act of 1980 was passed (USDA, RMA, n.d.).

The act established a 30 percent premium subsidy for a policy with a 65 percent coverage level to encourage participation in the crop insurance program. Although participation increased following the passage of the 1980 act, the number of insured acres did not increase substantially until after the passage of the Federal Crop Insurance Reform Act of 1994. The 1994 act required crop insurance coverage for eligibility in other disaster assistance programs (the mandate existed for only one year, in 1994), and insured acreage increased from approximately 100 million in 1994 to 220 million in 1995 (USDA, RMA, n.d.).

In 2013, 295 million acres, or about 83 percent of insurable cropland, were insured under the federal crop insurance program. Federal crop insurance is offered for a large number of crops, but 90 percent of the total acreage enrolled in 2013 was for corn, soybeans, wheat, cotton, and pasture, rangeland, and forage (see figure 1).

Figure 1. Acres of Cropland Insured by Commodity and Year, 2009–2013



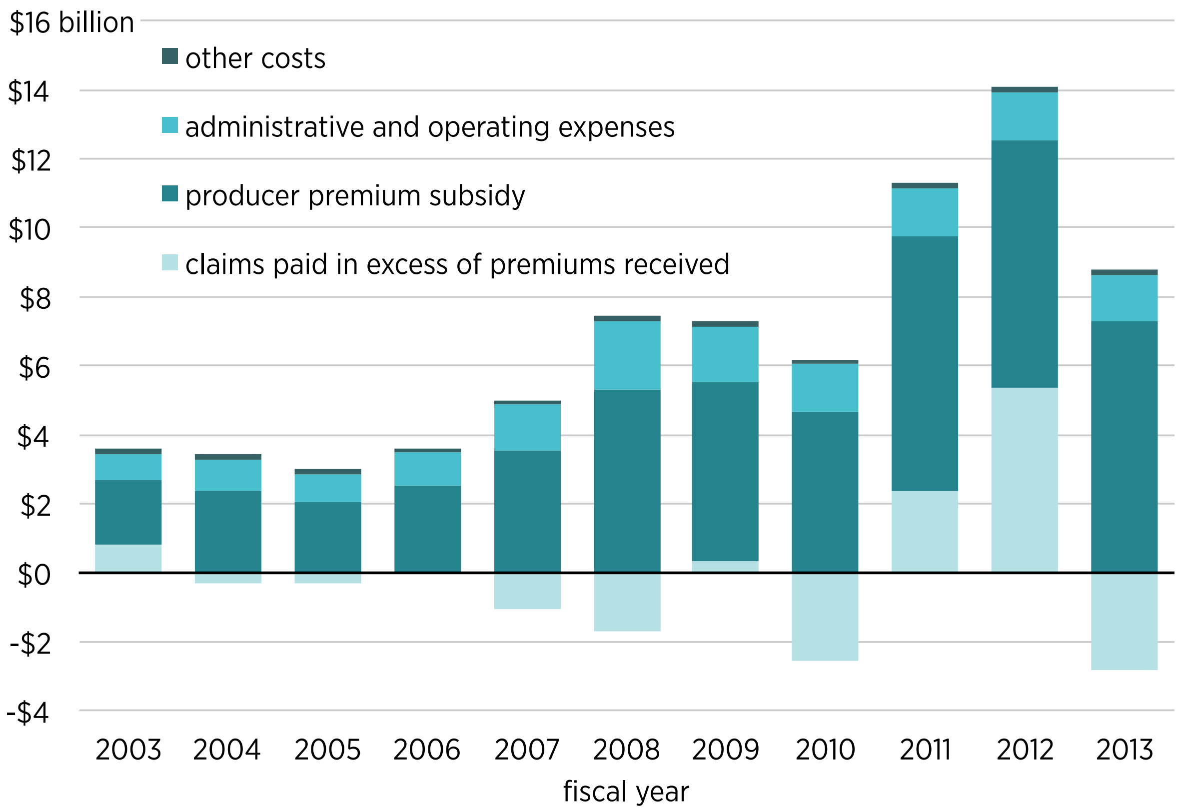
Source: United States Department of Agriculture, Risk Management Agency, Summary of Business website, 2009–2013, http://www.rma.usda.gov/data/sob.html.

The federal crop insurance program is administered by the Federal Crop Insurance Corporation (FCIC), which is managed by the Risk Management Agency of the US Department of Agriculture (USDA). However, policies are sold and serviced through 18 private insurance companies. The FCIC reinsures insurance company losses and reimburses their administrative and operating (A&O) costs to deliver the programs to producers. Unlike other private insurance providers, such as auto or home insurance companies, the federal crop insurance program is a partnership between private insurance providers and the federal government. The individual companies sell and service the policies, but the FCIC establishes guidelines, sets premium rates, pays insurance company A&O expenses, and reinsures insurance company losses (Shields 2013). Smith (2011) estimates that between 2,005 and 2,009 private insurance companies received $1.44 for every dollar transferred to the farmer. In light of criticism over such a high rate of subsidy, the USDA renegotiated the Standard Reinsurance Agreement with private crop insurance companies in 2010 (Shields 2010).

Producers are required to pay only a portion of the crop insurance premium; the federal government pays the remainder. The subsidy amount varies by coverage level and type of coverage, ranging from a 100 percent premium subsidy for catastrophic coverage to only a 38 percent subsidy for 85 percent coverage. A producer who purchases a policy with 65 percent coverage would pay 41 percent of the premium and receive a subsidy for the remaining 59 percent of the premium. In addition to farmers, nonfarming landowners can also benefit from the crop insurance program by insuring a portion of their share lease even if the farm does not.

Since 2006, crop insurance premium subsidies have trended upward. Total government costs increased in 2011 and 2012 because of indemnity payouts that resulted from high crop prices along with a severe drought across much of the United States. Figure 2 shows a breakdown of the government costs of the crop insurance program. Total government costs in 2011, 2012, and 2013 were $11,295 million, $14,071 million, and $5,951 million, respectively.

Figure 2. Government Costs of Federal Crop Insurance by Expense and Fiscal Year, 2003–2013



Source: Risk Management Agency, program costs and outlays.

If commodity prices continue to decline, the costs of the program are likely to fall eventually, depending on whether producers carry yield or revenue insurance. However, new provisions in the 2014 Farm Bill also aim to protect against "shallow losses" by subsidizing a portion of producers' deductibles. The so-called Supplemental Coverage Option does not go into effect until the 2015 crop year; as a result, it is unclear how many producers will enroll. Yet, because Supplemental Coverage Option premiums are subsidized, the program will likely lead to higher government expenditures on crop insurance in the future.

Proponents of crop insurance argue that the agricultural industry faces unique risks, and widespread availability of crop insurance is necessary but would not be possible without the federal crop insurance program. Program proponents argue that private crop insurance markets would fail because of the possibility of large correlated losses and the presence of moral hazard and adverse selection (Glauber 2007). Crop insurance companies are required to offer insurance to all producers, including very risky producers, at a premium rate established in advance by the FCIC (National Crop Insurance Services, n.d.). Other insurance providers, such as those that provide home or auto insurance, have the ability to deny coverage to risky individuals, charge higher premiums, or impose specific underwriting regulations.

Critics of subsidized crop insurance argue that the historically low take-up rates of crop insurance (before subsidization) are a result of preexisting government farm programs and ad hoc disaster payments that help mitigate downside risk, and that in the absence of such programs, insurance demand would likely be higher. Additionally, Smith (2013) casts some doubt on the argument that riskiness in agriculture is an adequate justification for farm subsidies, calculating that the annual failure rate of farms is only 0.5 percent, whereas the annual failure rate for businesses and small nonfarm businesses are 7 percent and 14 percent, respectively. Goodwin and Smith (2013) also point out that despite the potential for large correlated risks in agriculture, such risks can be mitigated with nonagricultural reinsurers, and the potential losses in agriculture are small relative to the value of nonagricultural risks that are annually insured. They also argue that crop insurance subsidies are difficult to justify on typically market failure grounds. To the extent that current crop insurance fails the market test, existing rules on uniform pricing and offering could be changed to help mitigate adverse selection and moral hazard. Critics also argue that much of the federal spending, particularly A&O, flows to insurance companies rather than to agricultural producers and that subsidies to farmers tend to flow to households that earn more than nonfarm households. For example, Wright (2014a, 1) recently wrote:

> Consider a deal where, for about 200,000 farmers, every dollar they can pay to the government in crop insurance premiums will give them an expected return of $1.90. . . . Imagine that it costs the taxpayers at least $1.10 to get farmers paid that expected a 90-cent profit. . . . Imagine that this deal has just been sweetened further with a new set of giveaways in the legislation that is widely called the 2014 Farm Bill, at the end of a half-decade called the “great recession” when farm families’ wealth has soared to over eight times that of the average American family. . . . In an ingenious and successful political marketing campaign, farmers continue to promote public support for this deal as crop “insurance.”

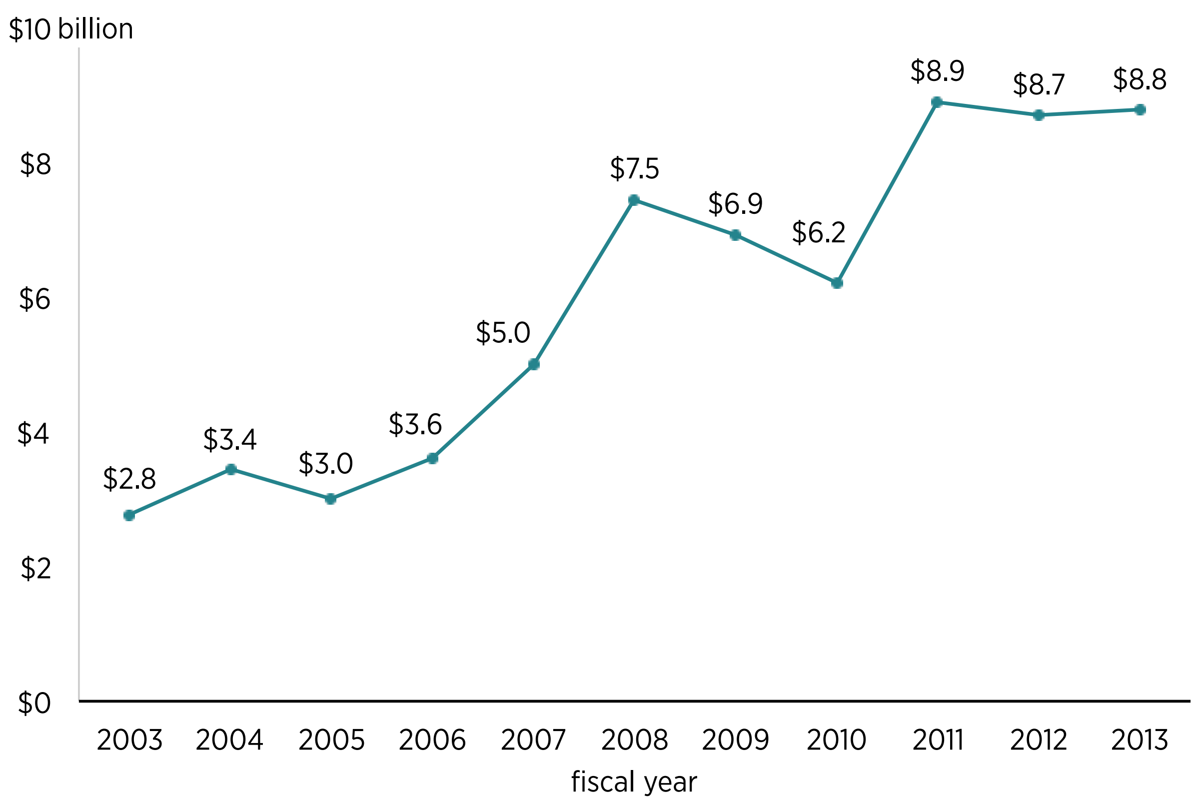
A large academic literature on the crop insurance program focuses on issues related to insurance demand (e.g., Goodwin 1993), pricing (e.g., Skees, Black, and Barnett 1997), and moral hazard and adverse selection (e.g., Coble et al. 1997; Just, Calvin, and Quiggin 1999), among other issues. An earlier review was provided by Knight and Coble (1997), and more recent discussions and reviews can be found in Glauber (2013), Coble and Barnett (2013), Smith and Glauber (2012), and Smith and Goodwin (2013). Despite that volume of literature, to my knowledge there have been no prior attempts to link crop insurance subsidies to food prices, nor is there much research on the distributional impacts (across states and commodities) of crop insurance subsidies.

Over time, the percentage of total premiums subsidized by the government has trended upward but has leveled out since 2001 and has remained fairly constant each year at approximately 60 percent. However, because of increased levels of production and higher commodity prices, government spending on crop insurance subsidies and associated A&O expenses has increased, as shown in figure 3, and has averaged about $8.8 billion per year for the past three years. At the farm level, it has been estimated that, in 2009, the average crop insurance subsidy was about $6,000 per participating farm, ranging from an average of $1,300 for farms with less than $100,000 in sales to $37,000 for farms with more than $1 million in sales (Shields 2013).

As a prelude to the empirical analysis, it is instructive to look at the distribution of producer premium subsidies (and allocated A&O) that go toward different crops and states.

Table 1 shows the crop insurance subsidies attributed to different commodities in 2013, focusing specifically on food-related commodities (i.e., ignoring cotton and tobacco and other nonfood crops). Although the government spent the most subsidized premiums on corn, table 1 reveals that as a share of the value of production, the premiums were higher for wheat and sorghum. For every $1 of wheat produced in 2013, $0.1047 in producer insurance premium subsidies and attributed A&O were spent, much more than, say, for vegetable producers who received only $0.0163 for every $1 produced. Appendix table A1 shows the producer premiums paid by state and commodity. North Dakota received the most in crop insurance premiums in 2013, followed by Texas, South Dakota, Kansas, and Iowa.

Figure 3. Government-Paid Producer Premium Subsidies and Administrative and Operating Costs by Fiscal Year, 2003–2013



Source: Risk Management Agency, program costs and outlays.

Table 1. Crop Insurance Subsidies by State and Commodity, 2013

Commodity	Producer insurance subsidy ($ millions)	Producer insurance subsidy + A&O costs[(a)] ($ millions)	Value of production ($ millions)	Subsidy as a share of value of production[(b)]
Vegetables	192.03	231.56	14,187.83	0.0163
Fruit and tree nuts	292.66	352.92	23,773.43	0.0148
Sugarcane and beets	38.94	46.96	3,012.25	0.0156
Peanuts	27.45	33.10	1,224.71	0.0270
Fish and seafood	0.46	0.55	17,287.00	0.0000
Soybeans	1,535.45	1,851.60	36,250.00	0.0511
Corn	2,859.84	3,448.68	62,392.04	0.0553
Wheat	1,248.79	1,505.91	14,384.27	0.1047
Rice	42.66	51.45	3,158.78	0.0163
Barley	50.75	61.20	1,023.26	0.0598
Oats	6.16	7.43	227.80	0.0326
Sorghum	183.37	221.13	1,423.58	0.1553
Cattle	153.28[(c)]	184.84	39,793.38	0.0046
Pork	0.01	0.01	16,741.42	0.0000
Dairy	7.66	9.24	3,692.34	0.0003
Poultry	0.00	0.00	28,817.67	0.0000
Eggs	0.00	0.00	7,224.55	0.0000

Source: Risk Management Agency.

(a) A&O (administrative and operating) costs and other costs are not reported by commodity; these costs were proportionally allocated on the basis of spending by commodity and state and were about $0.206 for every $1 of producer subsidy in 2013.
(b) The model that follows uses the subsidy shares as exogenous shocks. For livestock products, the relevant shocks are the subsidy calculated as a share of the value of production net the value of feed grains used; these share values are 0.0059 for cattle and 0.0003 for dairy.
(c) Data value includes subsidies for Livestock Gross Margin and Livestock Risk Protection insurance products as well as crop insurance subsidies for alfalfa, forage production, and the pasture, rangeland, and forage programs.

Background on SNAP

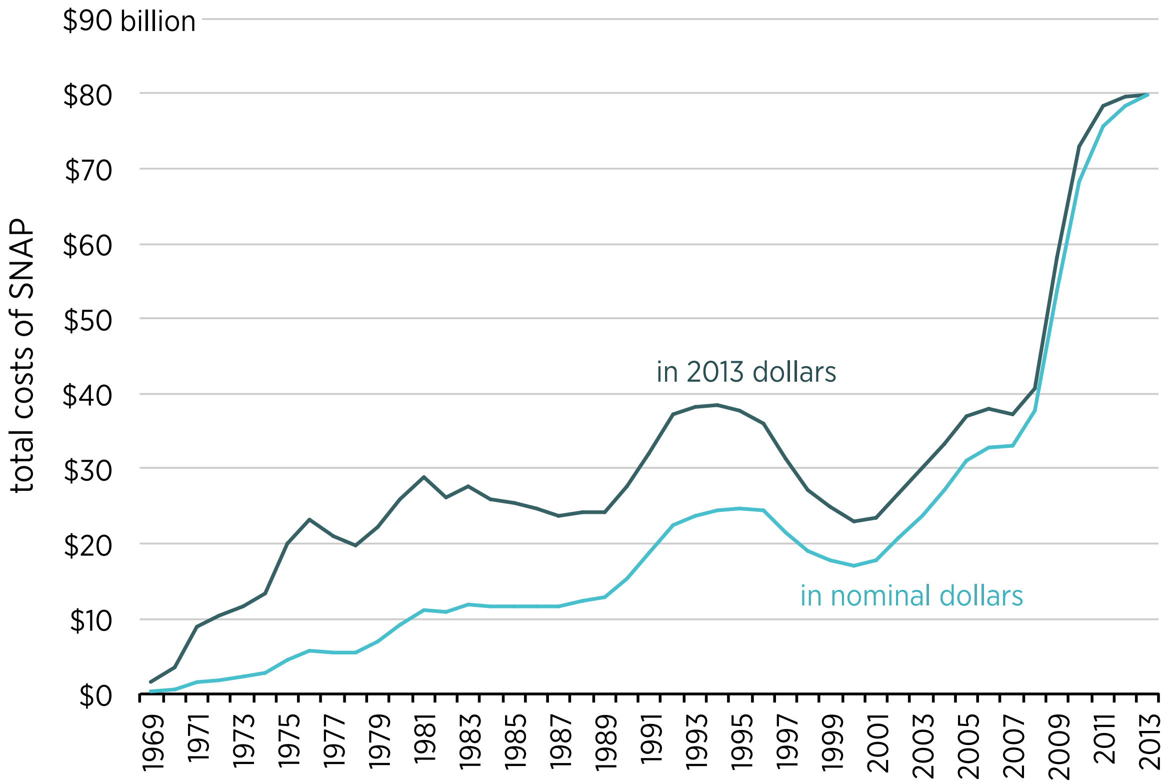
The earliest incarnation of the food stamp program emerged in the late 1930s and early 1940s in reaction to the Great Depression. Although hunger reduction was a goal, another main purpose of the program was an attempt to remove surplus agricultural products from the market to prop up farm prices (USDA, FNS 2014). After disappearing, the program received new life when

President Lyndon B. Johnson signed the Food Stamp Act of 1964. The program has changed in various ways over the years, with one of the more notable recent changes being a move away from physical “stamps” to a system of Electronic Benefit Transfer, where benefits are loaded on a card that can be used at participating retailers.

As previously indicated, the lion’s share of recent Farm Bill spending is allocated to nutrition and food assistance programs, with SNAP representing the largest cost. In 2013, the federal government spent a total of $79.8 billion on SNAP domestically (including spending in Guam and the Virgin Islands). SNAP spending has rapidly increased in recent years because of the recession; spending in 2007, for example, was only $33 billion (USDA, FNS 2007). Not only have the number of participating households increased to more than 47 million (up from about 26 million in 2007), per capita benefits have increased as well. For example, the average monthly payment per person was $72.62 in 2000, rising to $96.18 in 2007, and reaching $133.07 in 2013 (USDA, FNS 2000, 20007, 2013). Figure 4 illustrates the recent rise in SNAP spending. The figure also illustrates a general positive trend in spending on the program that has occurred since 1969, with a brief decline occurring in the late 1990s.

Academic research on SNAP abounds. Early research by Herman Southworth (1945) of the World War II–era War Food Administration argued that food stamps should have the same effect as a pure cash transfer for inframarginal consumers—those who spend more on food than the food stamp benefits provide. Although food stamps or SNAP payments are technically restricted to be spent on only certain types of food, inframarginal consumers can reallocate their budgets in a way that yields the same consumption bundle with or without the restriction. Later research, however, such as that by Senauer and Young (1986), provided empirical evidence that food stamp benefits have a greater effect on food spending than an equivalent amount of cash.

Figure 4. Total Costs of the Supplemental Nutrition Assistance Program by Year in Real and Nominal Terms, 1969–2013



Source: United States Department of Agriculture, Food and Nutrition Service, Supplemental Nutrition Assistance Program website, http://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap.

The question of whether SNAP benefits increase the propensity to buy food or are treated as a simple cash transfer is the subject of many previous papers and ongoing debate. Recent research such as that by Hoynes and Schanzenbach (2009) finds evidence that inframarginal consumers respond similarly to food stamp and non-food-stamp income changes. Breunig and Dasgupta (2005) find that for inframarginal households, the higher tendency to spend extra food stamp dollars on food than extra non-food-stamp dollars appears to arise mainly in multiple-adult households. In a population of SNAP recipients (including extramarginal and multiple-adult households), the effect of a 1 percent increase in SNAP income on food demand is likely to be somewhat greater than the income (or expenditure) elasticity of demand for food, but not substantially so.

Other research has sought to determine the extent to which SNAP payments reduce hunger and food insecurity (e.g., Gundersen, Kreider, and Pepper 2011), influence spending patterns (Wilde, Troy, and Rogers 2009), or cause obesity (e.g., Baum 2011), among other factors. To my knowledge, there is little work looking at the effect of food stamps on food prices, despite the argument that the program is another form of farm support. Oliveira et al. (2005) note the potential for purchases from the related Special Supplemental Nutrition Program for Women, Infants, and Children (WIC, not a part of the Farm Bill), which subsidizes the purchase of infant formula, to increase the prices paid by non-WIC participants. However, work on the larger Supplemental Nutrition Assistance Program on this issue is sparse.

Alston et al. (2009, p. 176) recognized the potential for SNAP spending to affect food prices. In an analysis of the effects of restricting SNAP purchases to only healthy foods, they note, "Changing what may be purchased using food stamps would lead to higher prices for healthy foods and lower prices for unhealthy foods and these price effects would feed back into consumer decisions, with adverse effects on consumption patterns of both participants and non-participants in the [food stamp program]." Barrett (2002) provides an overview of the literature and conceptual issues associated with food assistance programs, and Wilde (2013) provides some recent discussion.

Background on Ethanol Policies

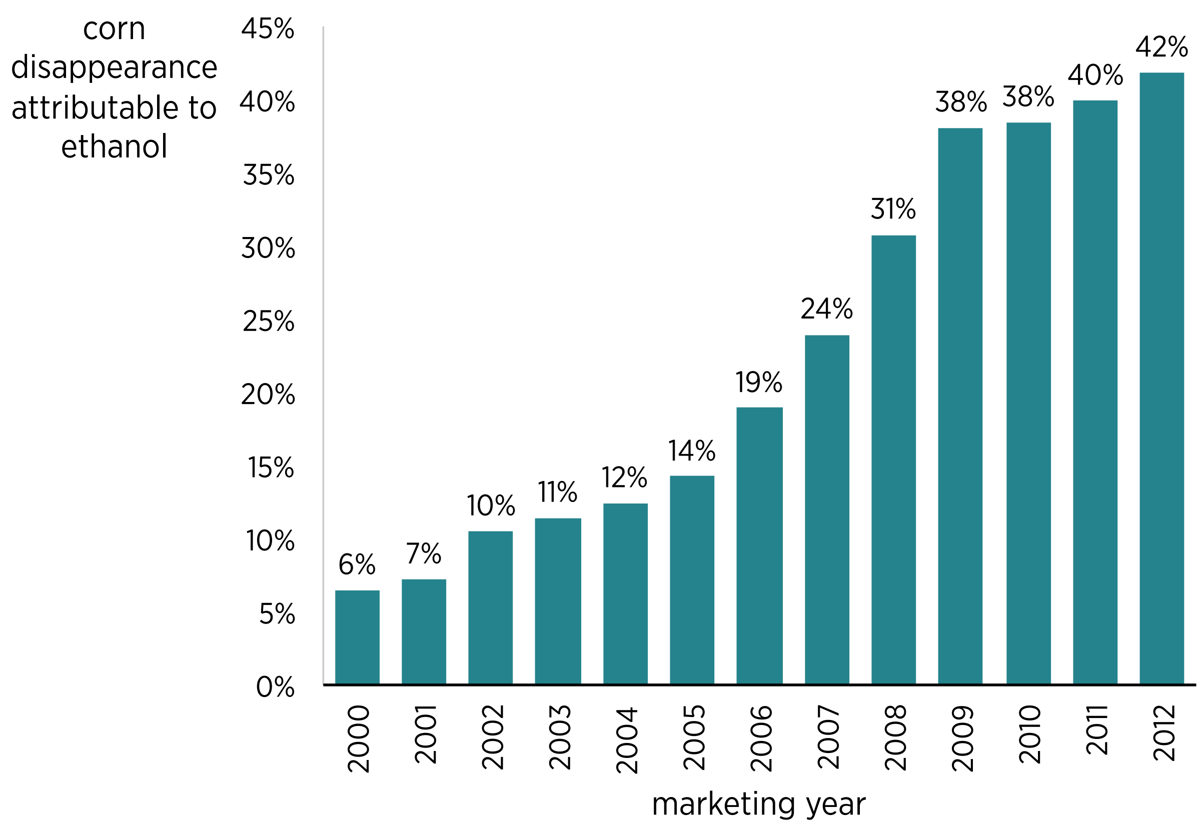
In recent years, policies implemented by the Environmental Protection Agency may have had as much effect on agricultural markets as have policies from the USDA. Various forms of import tariffs and tax credits have existed since the 1980s to promote domestic production of renewable fuels, corn-based ethanol being by far the most prominent example. The Energy Policy Act of 2005 made allowances for a $0.45-per-gallon tax credit for blenders adding ethanol; payments for the credit amounted to $6 billion in 2009 (Congressional Budget Office 2010). The tax credit was repealed as of December 31, 2011.

Another policy included in the 2005 act, and extended by the Energy Independence and Security Act of 2007, is the RFS. The RFS imposes a consumption mandate for renewable fuels. The mandated volume that must be included (or blended) with transportation fuel increases each year until 2022. The economic effects of the mandate are complex because of mandates for different types of renewable fuels and the "blend wall" (i.e., the limit imposed because most vehicles in the United States cannot use fuel with more than 15 percent ethanol), among other factors. The ultimate effects of the mandate depend on whether the mandate is binding—that is, whether the required quantity is above or below the market equilibrium (Schnepf and Yacobucci 2013).

Ethanol policies have had a significant effect on the corn market. The percentage of US corn disappearance (domestic corn use plus exports) used in ethanol production has risen from about 6 percent in the 2000–2001 corn marketing year to more than 40 percent today, as shown in figure 5. The ethanol policies have primarily shifted corn use away from livestock feed and toward biofuel production, although some byproducts from the ethanol production process (e.g., distillers grain) are fed to livestock.

Although some individuals originally argued that ethanol production would result in improved environmental outcomes as people moved away from fossil fuels, corn and ethanol production requires energy use as well, with the net effect on energy use being only slightly positive or even negative (Farrell et al. 2006). Others have argued that the complicated mix of policies affecting agriculture can result in unintended consequences. De Gorter and Just (2010) studied the interaction effects of multiple policies aimed at promoting ethanol. Although they find that mandates outperform subsidies, when a production mandate is coupled with an ethanol subsidy, societal welfare falls. Moreover, they find that whatever benefits might arise from ethanol policies are partially offset from effects of existing farm subsidies, and likewise existing farm subsidies increase the inefficiency of ethanol policies. Perhaps the biggest concerns surrounding ethanol policies, however, have come about because of the food and agricultural price spikes that have occurred in recent years.

Figure 5. US Corn Disappearance Attributable to Ethanol Use, 2000–2012



Source: United States Department of Agriculture, Economic Research Service, Feed Grains: Yearbook database, http://www.ers.usda.gov/data-products/feed-grains-database/feed-grains-yearbook-tables.aspx.

A large number of studies have analyzed time-series relationships between corn, ethanol, and gasoline prices, typically finding evidence of strong price links (for a review, see Zilberman et al. 2012). De Gorter and Just (2010, p. 26), for example, argue that "biofuel policy can have a large impact on corn prices." Hochman, Rajagopal, and Zilberman (2010) estimate that ethanol policies contributed to about 10 to 15 percent of the commodity price increases witnessed in 2007. In a recent summary, Wright (2014a, p. 75) argues the following:

> The rises in food prices since 2004 have generated huge wealth transfers to global landholders, agricultural input suppliers, and biofuels producers. The losers have been net consumers of food, including the large numbers of the world's poorest peoples. The cause of this large global redistribution was no perfect storm. Far from being a natural catastrophe, it was the result of new policies to allow and require increased use of grain and oilseed for production of biofuels. Leading this trend were wealthy countries, initially misinformed about the true global environmental and distributional implications.

As discussed by Zilberman et al. (2012), however, the relationship between the price of ethanol and the price of food is somewhat ambiguous. The correlation can be either negative or positive, depending on the underlying reason for the change in ethanol price. Nonetheless, they argue that there is less ambiguity in the relationship between policy-induced impacts of biofuel *production* and food prices. In countries like the United States, where new farmland is scarce, Zilberman et al. (2012) argue that expansion of corn-based ethanol is likely to increase food prices. Roberts and Schlenker (2013), for example, estimate that the RFS mandate has led to a 20 percent increase in world commodity prices. Other studies, such as that by Chakravorty et al. (2011), estimate that biofuel mandates have increased food prices by only about 5 percent.

Other research has looked at the distributional effects of ethanol policies across countries and commodities. For example, ethanol policies in the United States, in conjunction with similar policies in other countries, are likely to affect the incentives to produce sugar-based ethanol from countries like Brazil, where rain forest is cleared to gain access to productive agricultural lands.

Several studies have suggested that ethanol policies have implications for land use and serve to bring more farmland into production. Estimates of such effects range from an extra 0.72 hectares to 1.8 hectares of new cropland per 1,000 gallons of ethanol (Hertel et al. 2010; Searchinger et al. 2008).

Another contentious issue in the debate is the extent to which ethanol policies adversely affect livestock producers. Using a worldwide general equilibrium model, Taheripour, Hertle, and Tyner (2011) find that ethanol policies result in a reduction of livestock production (often in regions where the ethanol policies were not implemented), in part by grazing lands being converted to croplands. Although livestock producers in the United States are able to partially mitigate the adverse effects of ethanol policies by gaining access to cheaper feed substitutes, such as distillers grains, the authors find that the combined effect of the US and European Union biofuel mandates results in a worldwide reduction in food demand of about $10 billion, including a $2.2 billion reduction from US consumers. Although livestock producers—particularly beef cattle producers—can substitute distillers grain for corn, the two are not perfect substitutes. According to one set of USDA projections (Westcott 2007), the amount of usable livestock feed after ethanol production (distiller's grains) is only one-fifth of that provided directly by a bushel of corn.

Methods and Procedures

To accomplish the study objectives, a partial equilibrium model of the agricultural sector is constructed. The model focuses on food-related agricultural commodities and links farm production of disaggregated farm commodities with final consumption of different foods. More specifically, prices and quantities are specified as a displacement (or change) from an initial equilibrium, as a function of exogenous shocks (e.g., the removal of crop insurance) to the supply–demand system. Those types of so-called equilibrium displacement models are widely used in food and agricultural policy analysis and have been discussed in details by authors such as Alston (1991) and Wohlgenant (2011). The models are useful because they use preexisting estimates of supply and demand elasticities, data on commodity cost and consumption shares, and assumptions about the sizes of exogenous policy changes to derive changes in quantities, prices, and welfare.

This study builds on the model constructed by Okrent and Alston (2012) and expands it in several respects. They specified a model consisting of consumer demands for nine foods, such as meat, dairy, and fruits and vegetables, and farmer supply of 11 commodity inputs, such as sugarcane and grains. Production and consumption are linked by a series of factor-demand and retail markup equations. The result is a system of equations with 40 endogenous variables (changes in 9 retail prices, 9 retail quantities, 11 farm prices, and 11 farm quantities) specified as a function of elasticities of supply and demand, factor shares, and exogenous shifters.

Okrent and Alston's primary innovation was the linking of farm commodity production to final food consumption (and a set of estimated food demands) through the use of Bureau of Economic Analysis (BEA) input–output tables in a way that allowed money metric measures of changes in economic welfare. My model preserves that feature of Okrent and Alston's model, but I also make a number of important changes. First, I use more disaggregated farm commodity categories to better link key policy shocks with the associated crops. Second, because of the heavy use of grains in livestock production (and the potential for differential policy effects on crops and livestock), I explicitly model the link between grain production and livestock feeding. Third, given that a large fraction of grain production is exported or used for nonfood purposes (particularly corn for ethanol), I add those features to the model. Fourth, unlike Okrent and Alston, the results of the model are used to determine disaggregated effects accruing to different states.

A few caveats are in order. The model focuses on only the food-related crops. As such, the model ignores some major agricultural commodities, such as cotton and tobacco. Because demand for those products is likely unrelated to food demand, it is possible to model the effects of policies on those crops separately if so desired.

The model analyzes the ceteris paribus effects of a particular set of shocks (e.g., removal of crop insurance). Agriculture is characterized by a host of complicated and overlapping policies, and the model ignores the effects of most of those policies that exist in conjunction with the policies being analyzed (e.g., marketing loan programs, milk-pricing policies, the Conservation Reserve Program, etc.).

I am able to use data on differences in crop insurance payments, SNAP benefits, food consumption, and values of production to draw inferences about differences in effects to different states; however, no good data exist on differences in the underlying structural parameters (e.g., elasticities of supply and demand) by state or region. As such, the model is a national aggregate model, the effects of which are disaggregated to different locales after the aggregate solutions are found.

Relatedly, I assume that the price changes are uniform across states, an assumption justified by arbitrage possibilities. Thus, differences in welfare effects accruing to different states come about not because of different prices faced by producers in different states but because of differences across states in the mix of commodities grown and differences in subsidies received.

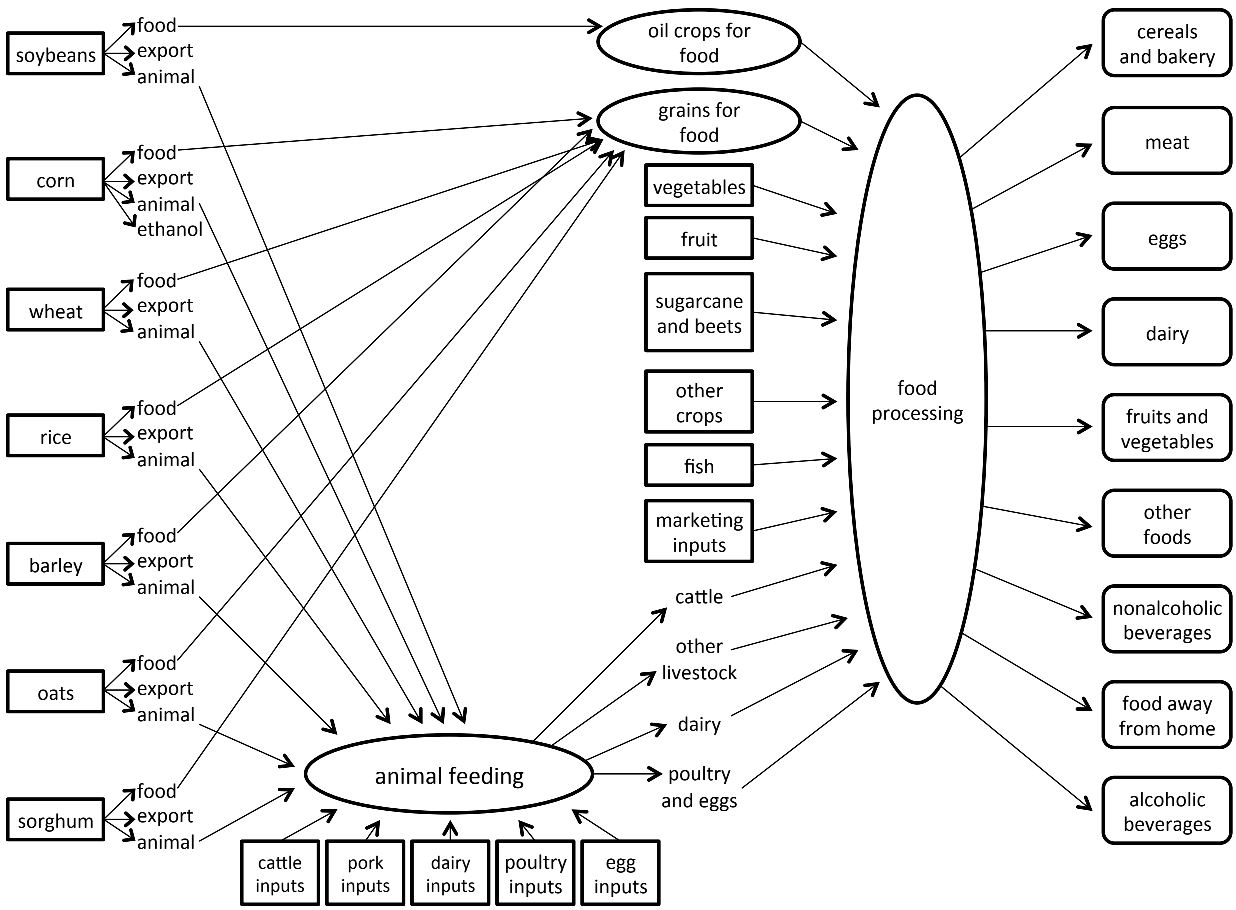
My models do not consider variability in outcomes or the value that producers may derive from reducing risk per se. Finally, my model, like all models, is a simplified depiction of reality. My approach carries with it all the assumptions that typically come along with using equilibrium displacement models, such as constant elasticities, the assumption that the empirical values used for the elasticities used are "correct," linear and parallel policy shifts, constant returns to scale, perfect competition, and the assumption that one can abstract from the details of the policies and treat them as ad valorem tax or subsidy equivalents, among others (see Alston 1991 and Wohlgenant 2011).

It should also be noted that if one were interested in only the aggregate economic welfare effects of a policy action (e.g., the removal of crop insurance), it would be unnecessary to fully specify the supplies and demands of individual foods and commodities as I do in what follows. Just, Hueth, and Schmitz (2005) show that if one is in possession of general equilibrium elasticities of supply and demand for a single market affected by the policy, then it is possible to identify the total welfare effects accruing to all related markets. However, such an approach would yield little insight about the incidence of the policy—that is, the price and quantity changes in different markets and the distribution of benefits and costs that accrue to different parties. Because it is precisely that heterogeneity in policy impacts that interests me, I undertake the more laborious task of constructing a disaggregate model of crop production and food consumption in the United States.

Model Overview

The model is characterized by 88 supply–demand equations linking the interrelated production of 23 agricultural commodities, a composite marketing input (comprising labor, management, capital, and so forth) to produce nine retail foods, as shown in figure 6.

Figure 6. Overview of the Partial Equilibrium Model of the Agricultural Sector



The particular aggregation of retail food categories and inputs entering the processing sector follows that of Okrent and Alston (2012) and is a result of an attempt to match the categories defined by the BEA input–output tables (which assume fixed-proportions production technology).

In the following model presentation, superscripts are used to denote different retail foods. Using the order shown in figure 6, I index the retail foods as follows: 1 = cereals and bakery, 2 = meat, 3 = eggs, 4 = dairy, 5 = fruits and vegetables, 6 = other foods, 7 = nonalcoholic beverages, 8 = food away from home (FAFH), and 9 = alcoholic beverages.

There are 24 inputs (the first 12 of which are directly involved in retail food production, and the latter 12 of which are involved in the production of some of the first 12 inputs). Again, the commodities are segregated and ordered in this way to use the BEA input–output tables. They are indicated with subscripts: 1 = oil crops, 2 = grains, 3 = vegetables and melons, 4 = fruit and tree nuts, 5 = sugarcane and beets, 6 = other crops (peanuts), 7 = cattle, 8 = other livestock (pork), 9 = dairy, 10 = poultry and eggs, 11 = fish, and 12 = marketing inputs. The remaining 12 commodities are used to (at least partially) produce the preceding commodities, and they are indexed as 13 = soybeans, 14 = corn, 15 = wheat, 16 = rice, 17 = barley, 18 = oats, 19 = sorghum, 20 = cattle inputs, 21 = pork inputs, 22 = dairy inputs, 23 = poultry inputs, and 24 = egg inputs.

The Model

Retail demand equations. There are nine retail demand equations of the form

(1)–(9) $$\hat{Q}^j = \sum_{k=1}^{9} \eta^{jk}(\hat{P}^k + \delta^k) + \eta^{jE}\delta^E \qquad \text{for } j = 1 \text{ to } 9,$$

where $\hat{Q}^j$ is the proportionate change in retail quantity of good j (i.e., $\hat{Q} = \Delta Q/Q \approx \text{dln}Q/Q$), $\hat{P}^j$ is the proportionate change in retail price of good j, η^{jk} is the elasticity of demand for good j with respect to the price of good k, η^{jE} is the expenditure elasticity of demand for good j, δ^k is a demand shock representing the proportionate increase in consumer willingness to pay for the jth commodity, and δ^E is an expenditure shock representing a proportionate increase in expenditure (i.e., $\delta^E = 0.1$ would imply a 10 percent increase in expenditures).

Inverse supply of retail products. Assuming constant returns to scale in production of retail foods, there are nine food supply equations of the form

(10)–(18) $$\hat{P}^j = \sum_{k=1}^{12} SR_k^j \hat{w}_k \qquad \text{for } j = 1 \text{ to } 9,$$

where $\widehat{w}_k$ is an endogenous variable indicating the proportionate change in price of commodity, k, SR_k^j is the share of the total cost of producing retail product j attributable to input-commodity k as indicated by the BEA input–output table, and $\sum_{k=1}^{12} SR_k^j = 1$ for each $j = 1$ to 9.

Demand for commodities used in food production. Assuming constant returns to scale and fixed proportions technology, 12 Hicksian demands for the commodities used in food production take the form

(19)–(30) $\hat{x}_k = \sum_{j=1}^{9} SC_k^j \hat{Q}^j$ for $k = 1$ to 12,

where $\hat{x}_k$ is the proportionate change in quantity of commodity k, SC_k^j is the share of the total cost of commodity k used by retail product j as indicated by the BEA input–output table, and $\sum_{j=1}^{9} SC_k^j = 1$ for each $k = 1$ to 12.

Supply of products with no intermediate processing. The model assumes direct supplies from the farm to the processing–retail sector for vegetables, fruit, sugar, peanuts, fish, and other marketing inputs (inputs 3, 4, 5, 6, 11, and 12) of the form

(31)–(36) $\hat{x}_k = \varepsilon_k(\widehat{w}_k + s_k)$ for $k = 3, 4, 5, 6, 11$, and 12,

where ε_k is the own-price elasticity of supply for commodity k, and s_k is an exogenous supply shifter that can be interpreted as a price subsidy. If commodity k receives a proportionate price subsidy equal to s_k such that the price producers receive, w_k^S, is $(1 + s_k)$ times the amount buyers pay, w_k^D, then $w_k^S = (1 + s_k)w_k^D$. In differential form, that implies that $\widehat{w}_k^S = \widehat{w}_k^D + s_k$. Substituting that relationship into the equation above yields

(31′)–(36′) $\hat{x}_k = \varepsilon_k(\widehat{w}_k^D + s_k)$ for $k = 3, 4, 5, 6, 11$, and 12.

Soybean supply and soybean demand from food producers and importers. Demand for soybeans is a derived demand from oil crops used in food processing. The following identity holds, as soybean demand for food is assumed to vary in fixed proportions with oil-crop food demand:

(37) $$\hat{x}_{13}^{F} = \hat{x}_1.$$

The inverse supply of soybeans for oil food is

(38) $$\hat{w}_1 = S_1 \hat{w}_{13},$$

where S_1 is the share of the total cost of producing oil crops attributable to soybeans.

The total supply of soybeans is

(39) $$\hat{x}_{13} = \varepsilon_{13}(\hat{w}_{13}^{D} + s_{13}),$$

where $\hat{w}_{13}^{D}$ is the amount buyers pay, $\hat{w}_{13}^{S}$ is the amount producers receive, $\hat{w}_{13}^{D} = \hat{w}_{13}^{S} + s_{13}$, and s_{13} is the subsidy rate.

Total soybean supply is allocated to food (F), exports (X), and animal feed (A) as follows:

(40) $$\hat{x}_{13} = S_{13}^{F}\hat{x}_{13}^{F} + S_{13}^{X}\hat{x}_{13}^{X} + S_{13}^{A}\hat{x}_{13}^{A},$$

where S_{13}^{j} represents the share of soybeans produced used in making output j.

Demand for soybeans for food use is given by equation 37. Export demand for soybeans is

(41) $$\hat{x}_{13}^{X} = \eta_{13,X}(\hat{w}_{13} + \delta_{13,X}),$$

where $\eta_{13,X}$ is the own-price elasticity of demand for soybean exports, and $\delta_{13,X}$ is an exogenous shock to export demand.

Feed grain supply and demand from food producers, importers, and ethanol manufacturers. The feed grain sector is modeled as a multiple-input (items 14–19; corn, wheat, rice, barley, oats, sorghum), single-output production process. The inverse output supply to the food sector is given by

(42) $$\hat{w}_2 = \sum_{k=14}^{19} S_{2,k}\hat{w}_k.$$

Factor demands for grains from this food production process (F) are of the form

(43)–(48) $$\hat{x}_k^F = \sum_{j=14}^{19} \sigma_{k,j}\hat{w}_j + \hat{x}_2$$ for $k = 14$ to 19,

where $\sigma_{k,j}$ is the Hicksian (output constant) input-demand elasticity for grain k for use in food production with respect to a change in the price of grain j.

Total supply of each type of feed grain is

(49)–(54) $$\hat{x}_k = \varepsilon_k(\hat{w}_k^D + s_k)$$ for $k = 14$ to 19,

where $\hat{w}_k^D$ is the amount buyers pay, $\hat{w}_k^S$ is the amount producers receive, $\hat{w}_k^D = \hat{w}_k^S + s_k$, and s_k is the subsidy rate.

Changes in feed grain supply are allocated to food (F), exports (X), animal feed (A), and ethanol (E) sectors as follows:

(55) $$\hat{x}_{14} = S_{14}^F\hat{x}_{14}^F + S_{14}^X\hat{x}_{14}^X + S_{14}^A\hat{x}_{14}^A + S_{14}^E\hat{x}_{14}^E.$$

(56)–(60) $$\hat{x}_k = S_k^F\hat{x}_k^F + S_k^X\hat{x}_k^X + S_k^A\hat{x}_k^A + S_k^E\hat{x}_k^E$$ for $k = 15$ to 19.

Export demands for feed grains are

(61)–(66) $$\hat{x}_k^X = \eta_{k,X}(\hat{w}_k + \delta_{k,X})$$ for $k = 14$ to 19.

Demand for corn by ethanol producers is

(67) $$\hat{x}_{14}^E = \eta_{14,E}(\hat{w}_{14} + \delta_{14,E}).$$

Animal feeding sector. The animal feeding sector is modeled as a multiple-input (items 13–19: soybeans, corn, wheat, rice, barley, oats, sorghum—plus items 20–24: cattle inputs, pork inputs, dairy inputs, poultry inputs, egg inputs), multiple-output (items 7–10: food cattle, other livestock, dairy, poultry) production process.

The outputs supplied to the food sector are given by

(68)–(71) $$\hat{w}_k = \sum_{j=13}^{24} SA_k^j\hat{w}_j$$ for $k = 7$ to 10.

Derived demands for animal feed are given by

(72)–(78) $\hat{x}_k^A = \sum_{j=13}^{24} \lambda_{k,j} \widehat{w}_j + \sum_{j=7}^{10} SM_k^j \hat{x}_j$ for $k = 13$ to 19,

and derived demands for other animal inputs are given by

(79)–(83) $\hat{x}_k = \sum_{j=13}^{24} \lambda_{k,j} \widehat{w}_j + \sum_{j=7}^{10} SM_k^j \hat{x}_j$ for $k = 20$ to 24,

where $\lambda_{k,j}$ is the Hicksian input-demand elasticity for input k with respect to a change in the price of input j. Supplies of animal inputs are

(84)–(88) $\hat{x}_k = \varepsilon_k (\widehat{w}_k^D + s_k)$ for $k = 20$ to 24.

Summary. The model consists of a total of 88 endogenous variables: proportionate changes in nine retail quantities, $\hat{Q}^j$, nine retail prices, $\hat{P}^j$, 24 aggregate commodity quantities, $\hat{x}_k$, 24 commodity prices, $\widehat{w}_k$, seven grain commodities used in food product, $\hat{x}_k^F$, seven grain commodities exported, $\hat{x}_k^X$, seven grain commodities used in animal feed, $\hat{x}_k^A$, and the quantity of corn used in ethanol, $\hat{x}_k^E$. Exogenous shocks consist of demand shifters, such as δ^k and δ^E, along with farm subsidies, s_k.

The model can be solved by using matrix algebra. Let *Y* represent the 88 × 1 vector of endogenous variables, *Z* give the 88 × 1 vector of exogenous shocks, and *B* be an 88 × 88 matrix of model parameters, such that the aforementioned equations can be written as $YB = Z$. The values for the endogenous variables (changes in prices and quantities) are given by $Y = B^{-1}Z$.

Model Parameterization

To implement the model, values for the various elasticities and shares must be assigned. The demand equations 1–9 are parameterized using the elasticities estimated by Okrent and Alston (2011), which are reproduced in table 2.

Table 2. Uncompensated Demand Elasticities

	1	2	3	4	5	6	7	8	9	10	Expenditure
1. Cereals and bakery	−0.93	0.04	0.02	0.14	0.13	0.45	−0.04	−0.42	−0.06	0.39	0.28
2. Meat	0.02	−0.40	0.05	0.00	0.16	−0.12	−0.09	0.23	0.20	−0.69	0.64
3. Eggs	0.24	1.00	−0.73	0.66	−0.47	−0.54	0.27	0.25	−0.20	0.22	−0.69
4. Dairy	0.16	0.00	0.08	−0.91	−0.09	0.26	0.20	−0.26	0.17	−0.59	0.97
5. Fruits and vegetables	0.14	0.32	−0.05	−0.07	−0.58	−0.15	0.11	0.20	−0.03	−0.16	0.27
6. Other food	0.33	−0.17	−0.04	0.15	−0.11	−0.62	0.05	0.12	0.00	−0.50	0.79
7. Nonalcoholic beverages	−0.06	−0.22	0.03	0.21	0.13	0.08	−0.77	−0.08	0.18	−0.37	0.86
8. FAFH	−0.15	0.13	0.01	−0.07	0.06	0.05	−0.02	−0.55	−0.12	−0.19	0.84
9. Alcoholic beverages	−0.05	0.24	−0.02	0.10	−0.02	0.00	0.10	−0.22	−0.50	−0.13	0.50
10. Nonfood	0.00	−0.03	0.00	−0.01	−0.01	−0.02	−0.01	−0.02	−0.02	−0.94	1.07

Source: A. M. Okrent and J. M. Alston, “Demand for Food in the United States: A Review of Literature, Evaluation of Previous Estimates, and Presentation of New Estimates of Demand” (Monograph no. 28, Giannini Foundation of Agricultural Economics, San Francisco, April 2011).

Note: FAFH = food away from home.

Data from BEA input–output tables are used to calculate the shares in equations 10–18 and 19–30. I use the tables constructed by Okrent and Alston (2012).

Few sources provide own-price elasticities of supply for the number of farm commodities used in this study. Thus, I primarily use the model constructed at the USDA Economic Research Service by Harrington and Dubman (2008), which combines the use of math programming techniques and an equilibrium displacement model to provide supply elasticities for a large number of disaggregate farm commodities. The supply elasticities implied by their model are somewhat more elastic than those often found in econometric analyses (e.g., Roberts and Schlenker 2013); however, they are not generally outside the upper bounds found in the nonparametric approach used by Chavas and Cox (1995). Assuming more elastic supplies is more conservative in the sense that the approach implies smaller price changes and smaller producer surplus changes than would result from a model that uses more inelastic supply elasticities.

It is also the case that long-run elasticities of supply are more elastic than those in the short run because producers can be more responsive as they have time to adjust and make changes in fixed assets, and so forth. In that sense, the use of more elastic supply responses would be more consistent with effects one is likely to expect in the longer run, which may understate the more immediate effects that would occur were a policy change to happen. The supply elasticities used to parameterize the model are shown in table 3. I also make use of the results in Harrington and Dubman (2008) to parameterize most of the export elasticities of demand, as shown in table 4.

Table 3. Supply Elasticities

Commodity	Supply elasticity	Source
Vegetables	1.257	Harrington and Dubman (2008)
Fruit and tree nuts	1.650	Chavas and Cox (1995)
Sugarcane and beets	0.957	Harrington and Dubman (2008)
Peanuts	0.866	Harrington and Dubman (2008)
Fish	0.400	Okrent and Alston (2012)
Marketing inputs	10,000.000	Assumed
Soybeans	1.402	Harrington and Dubman (2008)
Corn	1.246	Harrington and Dubman (2008)
Wheat	1.265	Harrington and Dubman (2008)
Rice	1.222	Harrington and Dubman (2008)
Barley	2.345	Harrington and Dubman (2008)
Oats	1.508	Harrington and Dubman (2008)
Sorghum	3.100	Harrington and Dubman (2008)
Cattle	1.069	Harrington and Dubman (2008)
Pork	0.785	Harrington and Dubman (2008)
Dairy	0.886	Harrington and Dubman (2008)
Poultry	1.148	Harrington and Dubman (2008)
Eggs	1.044	Harrington and Dubman (2008)

Table 4. Other Demand Elasticities

Commodity	Elasticity	Source
Soybean exports	−2.500	Harrington and Dubman (2008)
Corn exports	−1.200	Harrington and Dubman (2008)
Wheat exports	−0.850	Harrington and Dubman (2008)
Rice exports	−2.620	Harrington and Dubman (2008)
Barley exports	−0.670	Harrington and Dubman (2008)
Oat exports	−3.930	Harrington and Dubman (2008)
Sorghum exports	−1.860	Harrington and Dubman (2008)
Corn ethanol	−0.127	Schmitz, Moss, and Schmitz (2007)

Although recognizing that large price swings can result in substitutability among feed sources, for the sake of simplicity (and, quite frankly, lack of estimates for the parameters), I assume fixed proportions in the animal feeding sector, meaning $\sigma_{k,j} = 0$ and $\lambda_{k,j} = 0$. Data on feed grain shares are taken from the Feed Grains Yearbook database of the USDA's Economic Research Service. It reports that, of all feed grains, 11.3 percent go toward dairy, 26.7 percent to cattle, 28.5 percent to hogs, and 32.7 percent to poultry and eggs. Table 5 uses additional data from the feed grains, oilseed, and rice yearbooks from the Economic Research Service to estimate the shares of each grain that goes toward food production, exports, animal feed, and ethanol (averaged over the past five years). As the table reveals, 39 percent of soybeans are estimated to be used in food, 44 percent are exported, and 13 percent are used in animal feed. The shares do not always sum precisely to one because of the use of the commodity for purposes other than those given in table 5 (e.g., grain being held back for use as seed).

Table 5. Shares of Commodities Used for Food, Export, Animal Feed, and Ethanol

Commodity	Food	Export	Animal feed	Ethanol
Soybeans	0.39	0.44	0.13	0.00
Corn	0.13	0.13	0.39	0.35
Wheat	0.41	0.46	0.09	0.00
Rice	0.50	0.44	0.05	0.00
Barley	0.70	0.04	0.23	0.00
Oats	0.38	0.01	0.56	0.00
Sorghum	0.28	0.34	0.37	0.00

Source: USDA Economic Research Service.

To calculate welfare effects (to be described momentarily), data are needed on the value of production for each commodity for each state and on food expenditures for each commodity. Value of production for each state is taken from the USDA National Agricultural Statistics Service and is averaged (when possible) over the years 2008–2012. The value of fish production is taken from the most recent BEA input–output tables. The value of marketing inputs is inferred by subtracting the total value of agricultural production from the total value of food expenditures. Table 6 provides the aggregate value of production for each commodity for the entire United States.

Table 6. Annual Value of Agricultural Production for Various Commodities, Average from 2008–2012

Commodity	Value of production ($ billions)
Vegetables and melons	14.19
Fruit and tree nuts	23.77
Sugarcane and beets	3.01
Peanuts	1.02
Fish	17.29
Marketing inputs	1,033.65
Cattle	39.79
Hogs	16.74
Dairy	33.23
Poultry	29.16
Eggs	7.57
Soybeans	36.25
Corn	62.39
Wheat	14.38
Rice	3.16
Barley	1.02
Oats	0.23
Sorghum	1.47

Source: USDA National Agricultural Statistics Service.

Data on expenditures by retail food category are inferred from the BEA calculation of personal consumption expenditures (data are averaged over the years 2008–2012 and are taken from the BEA personal consumption expenditures table 2.4.5U, detailed tables).

Application to Crop Insurance

Because the model calculates the effects of changes relative to an initial equilibrium, I analyze changes from the status quo when crop insurance exists. That is, I analyze the effects of the *removal* of crop insurance subsidies that existed in the most recent year that data are available, 2013. In the context of my model, that is accomplished by changing the subsidy parameters s_k. One way to conceptualize those parameters is that s_k represents the change in marginal cost

(MC) of commodity production due to subsidized crop insurance. The shocks represent the vertical shifts in the supply curves relative to initial equilibrium prices at given quantity levels: $s_k = dMC_k/w_k$.

In a competitive equilibrium, a change in marginal cost is equal to a change in per-unit cost, which implies that $s_k = (dc_k/x_k)/w_k$, where dc is the change in total cost resulting from the removal of subsidized insurance. Rearranging terms shows that the supply shock is given by the ratio of total subsidy to the commodity's total cost, $s_k = dc_k/w_k x_k$. Thus, I use the values in table 1, the ratios of the subsidies and A&O costs to the commodities' values of production to represent the supply shocks. Because I am modeling the removal of crop insurance, the ratios must be multiplied by negative one. For example, the soybean supply shock that enters the model, s_{13}, is equal to -0.0511 (see table 1). Once the aggregate price and quantity changes are determined, state-specific welfare effects can be determined, as described in the following subsection. As described in the next subsection, the mere fact that the farmers' implicit marginal cost shifts proportionately by s_k does not imply that farmers capture all the benefits (or costs) of the shift.

Given that there are no demand shifts, the change in compensating variation for consumers of retail product j in state s is approximated by

(89) $$\Delta CV^{j,s} = -P^{j,0,s}Q^{j,0,s}(\hat{P}^j)(1 + 0.5\sum_{k=1}^{9}\eta^{jk*}\hat{P}^k)$$

(see Okrent and Alston 2012 or Wohlgenant 2011), where η^{jk*} is the compensated elasticity of demand that is calculated as $\eta^{jk*} = \eta^{jk} + w^k\eta^{jE}$, where η^{jk} is the uncompensated elasticity, w^k is the expenditure share, and η^{jE} is the expenditure elasticity. $P^{j,0,s}$ and $Q^{j,0,s}$ are the prices and quantities of product j in the initial equilibrium (as indicated by superscript 0) for state s. Individual prices and quantities are unknown, but the product of the two, $P^{j,0,s}Q^{j,0,s}$, indicates expenditure on commodity j. Aggregate expenditures on each retail category are taken from the BEA personal consumption expenditures (averaged from 2008 to 2012), which are reported in table 7.

Table 7. Annual Personal Consumption Expenditures in Various Retail Food Categories, Average from 2008–2012

Food category	Expenditures ($ billions)
Cereals and bakery	122.74
Meat	149.88
Eggs	10.27
Dairy	61.51
Fruits and vegetables	93.55
Other food	172.14
Nonalcoholic beverages	82.60
Food away from home	462.39
Alcoholic beverages	183.25

Unfortunately, I am unaware of good data on food expenditures by retail category at the state level. However, the Bureau of Labor Statistics (2013) consumer expenditure survey reports average food expenditures by households by retail category for the four Census regions. I use those data to infer the total expenditures for each commodity, j, in each of the four regions. Then I use the share of a state's population (given by the Census Bureau) within a region to further allocate the expenditures on each commodity to each state, which provides a measure of $P^{j,0,s}Q^{j,0,s}$. Total change in consumer welfare for a state is obtained by summing across the welfare changes for each commodity within a state.

Changes in producer surplus to producers of commodity k in state s are given by

(90) $$\Delta PS_{k,s} = w_{k,0,s} x_{k,0,s} (\widehat{w}_k^D + s_{k,s})(1 + 0.5\hat{x}_k),$$

where $w_{k,0,s}x_{k,0,s}$ is the value of production of commodity k in state s, $\widehat{w}_k^D$ is determined by the solution to the model, and $s_{k,s}$ is the state-specific subsidy to commodity k (determined by the crop insurance subsidies paid to producers in the state plus attributed A&O divided by the value of production for the respective commodity in the state). As discussed by Just, Hueth, and Schmitz (2005), that producer surplus value will include the surplus that accrues to all agricultural producers and the suppliers of inputs to producers, including landowners, lenders, seed suppliers, *and* the sellers of crop insurance.

Although it is conceptually possible to separately calculate the incidence of those effects, such an approach would require models of demand for and supply of each input to the farm sector. To my knowledge, there are no econometric estimates of the elasticity of supply for crop insurance, in part because the government (rather than the market) sets prices and terms of trade. And although estimates of the elasticities of demand for crop insurance exist, it is unclear how well they would extrapolate to an environment free of crop insurance subsidies. As a result, I calculate my welfare measure at the level of the agricultural producer, while acknowledging that those surplus changes include welfare changes accruing to upstream firms in addition to farmers.

Changes in consumer surplus accruing to importers (or corn ethanol manufacturers) of agricultural commodity k are given by

(91) $$\Delta CS_k^X = w_{k,0}x_{k,0}^X\widehat{w}_k(1 + 0.5\hat{x}_k^X).$$

Mathematically, the change in government revenue (and effects accruing to taxpayers) from a subsidy to commodity k is

(92) $$\Delta G_k = -s_k w_{k,0}x_{k,0}(1 + \hat{x}_k).$$

However, rather than using equation 92, I simply use the actual total federal expenditures on crop insurance subsidies plus A&O to reflect the change in government revenue and effects to taxpayers (the two yield very similar values). To allocate changes in government revenue to states, I use data from the Internal Revenue Service on tax receipts from each state to proportionately allocate the savings from the removal of crop insurance subsidies to each state.

Application to SNAP

To simulate the effects of SNAP removal, it is first necessary to determine the shifts to demand that occur from the provision of SNAP. SNAP can be thought of as increasing expenditure, and thus affecting the parameters in the demand functions 1–9 equal to $\delta^{j,E}$.

However, that shift occurs only for SNAP recipients; nonrecipients' demands remain unchanged (except for what is caused by relative price changes). Thus, it is useful to disaggregate the demand curves 1–9 into SNAP recipients and nonrecipients, such that the demand for SNAP recipients is of the form

(93) $$\hat{Q}^{j,SNAP} = \sum_{k=1}^{9} \eta^{jk}(\hat{P}^k) + \eta^{jE}\delta^E,$$

and the demand for nonrecipients is of the form

(94) $$\hat{Q}^{j,non\text{-}SNAP} = \sum_{k=1}^{9} \eta^{jk}(\hat{P}^k).$$

That means that proportional changes in total quantity demanded are given by the weighted sum

(95) $$\hat{Q}^j = S^{j,SNAP}\hat{Q}^{j,SNAP} + S^{j,non\text{-}SNAP}\hat{Q}^{j,SNAP} = \sum_{k=1}^{9} \eta^{jk}(\hat{P}^k) + S^{j,SNAP}\eta^{jE}\delta^E,$$

where $S^{j,SNAP}$ is the share of purchases by SNAP participants in retail category j, $S^{j,non\text{-}SNAP} = 1 - S^{SNAP}$, and δ^E is the proportionate increase in the expenditures by SNAP participants.

The preceding discussion indicates that the shocks to the model consist of the term $S^{j,SNAP}\eta^{jE}\delta^E$. The term η^{jE} is the expenditure elasticity of demand for food j, which is reported in table 2. The variable S^{SNAP} is inferred from USDA data on the number of households participating in SNAP in 2013 divided by the total number of US households reported by the Census Bureau (2007–2011). For the entire United States, I calculate that 19.98 percent of US households participated in SNAP in 2013. That leaves the term δ^{E}, which is the proportionate increase in expenditures by SNAP participants.

I evaluated the model for Cases 1 and 2. Case 1 assumes that SNAP operates as a pure cash transfer; that is, recipients treat extra SNAP dollars the same as additional cash income. Since at least the work of Southworth (1945), it has been conjectured that for inframarginal SNAP recipients (those spending more on food than they receive in SNAP benefits), SNAP benefits will have the same effect as an unrestricted cash transfer. In that case, δ^{E} is equal to the total amount of SNAP dollars received, which was $75.89 billion in 2013, divided by total expenditures (including food and nonfood) by SNAP participants, which I extrapolate to be $2.074 trillion (the latter figure is obtained by taking total expenditures from the BEA personal consumption expenditures averaged from 2008 to 2010 and multiplying by the share of households on SNAP), resulting in $\delta^{E} = -0.03658$. The negative sign is added to reflect the fact that I am modeling the effects of the *removal* of SNAP benefits. Note that does *not* mean that eliminating SNAP would reduce food expenditures by 100 percent of the SNAP amount, but rather there is a relative change in food expenditures proportionate to the size of the SNAP benefit relative to all other expenditures. That is, if total income to SNAP recipients were cut by $75.89 billion, then they would reduce expenditures on *all* goods (food and nonfood) by $75.89 billion, which represents an approximate 3.658 percent reduction in all expenditures, food and nonfood alike. How much people adjust the consumption of each food depends on the expenditure elasticity of demand for the food. In sum, the shocks entering the model for retail food category j for Case 1 are $-0.03658 \times 0.1998 \times \eta^{jE}$.

The approach thus far has assumed that all nonfood prices and quantities are unaffected by changes occurring in food markets. That assumption is not unreasonable given the small cross-price demand elasticities for nonfood shown in table 2 and the small size of the food economy relative to the overall economy. Nonetheless, Case 1 assumes a decrease in total expenditures (food and nonfood), and as table 2 shows, the expenditure elasticity of demand for nonfood is estimated at the nontrivial value of 1.07. A very simple model of the nonfood economy (assuming separability between food and nonfood demands and supplies) is given by the aggregate nonfood demand

$$\hat{Q}^{NF} = -0.94\hat{P}^{NF} + 0.1998 \times 1.09 \times \delta^{E},$$

where the superscript *NF* implies nonfood, −0.94 is the own-price elasticity of demand for nonfood, 1.09 is the expenditure elasticity of demand (see table 2), and 0.1998 is the extrapolated share of nonfood expenditures by SNAP participants. Let the supply for nonfood in differential form be expressed as $\hat{Q}^{NF} = \varepsilon_{NF}\hat{P}^{NF}$, where ε_{NF} is the own-price elasticity of supply for nonfood. Setting supply equal to demand and solving results in the equilibrium change in nonfood price and quantity generate

$$\hat{P}^{NF} = (0.1998 \times 1.09 \times \delta^{E})/(\varepsilon_{NF} + 0.94), \text{ and}$$

$$\hat{Q}^{NF} = \varepsilon_{NF}[\frac{0.1998 \times 1.09 \times \delta^{E}}{\varepsilon_{NF}+0.94}].$$

Thus, if I let $\delta^{E} = -0.03658$, as described above, and assign $\varepsilon_{NF} = 1$, then $\hat{P}^{NF} = \hat{Q}^{NF} = -0.00411$.

Case 2 assumes that SNAP recipients spend all their SNAP benefits on food. That assumption is extreme, and it is shown here to present an upper-bound effect. I consider this scenario because of the existence of extramarginal consumers, and because there is evidence to suggest that some intramarginal food stamp beneficiaries treat SNAP dollars differently from cash and are more likely to direct them to food purchases than is assumed in many economic models (see discussion and citations in Barrett 2002). In this case, δ^E equals the total amount of SNAP dollars received, which was \$75.89 billion in 2013, divided by total *food* expenditures of SNAP participants, which I extrapolate to be \$267.4 billion (the latter figure is obtained by taking *food* expenditures from the BEA personal consumption expenditures averaged from 2008 to 2010 and multiplying by the share of households on SNAP), resulting in $\delta^E = -0.2838$, which again is made negative to reflect the removal of SNAP benefits. That is, if total income to SNAP recipients were cut by \$75.89 billion, then they would reduce expenditures on *food* (and only food) by \$75.89 billion, which represents an approximate 28.38 percent reduction in *food* expenditures. How much people adjust the consumption of each food depends on the expenditure elasticity of demand for the food, η^{jE}. Thus, the shocks entering the model for retail food category j for Case 2 are $-0.2838 \times 0.1998 \times \eta^{jE}$. Because all SNAP dollars are assumed to be spent on food, no first-order changes to the nonfood economy need to be considered in the context of the present model.

I calculate the consumer welfare effects separately for SNAP recipients and nonrecipients, and for each state. First, consider the effects on SNAP recipients. The demand for food category j in state s by SNAP recipients is

$$\hat{Q}^{j,SNAP,s} = \sum_{k=1}^{9} \eta^{jk} \hat{P}^k + \eta^{jE} \delta^{E,s},$$

where η^{jE} is the expenditure elasticity of demand for commodity j and $\delta^{E,s}$ is the proportional increase in expenditures by SNAP participants in state s resulting from SNAP payments (either for Case 1 or Case 2). To calculate welfare effects, it is useful to rearrange the demand equation above as an inverse demand. For example, inverse demand for the first commodity is

$$\hat{P}^{1,s} = \left(\frac{1}{\eta^{11}}\right) \hat{Q}^{j,SNAP,s} - \left(\frac{1}{\eta^{11}}\right) \sum_{k=2}^{8} \eta^{jk} \hat{P}^k - \left(\frac{\eta^{1E}}{\eta^{11}}\right) \delta^{E,s}.$$

Viewed in this way, the demand shift that occurs in the price direction (i.e., the vertical shift in consumers' willingness to pay at the initial equilibrium quantity) is $(\frac{\eta^{1E}}{\eta^{11}})\delta^{E,s}$. Because the term $\delta^{E,s}$ differs by state (i.e., different states receive different SNAP benefits and have different participation rates because of different eligibility and administrative rules, not to mention differences in levels of food and nonfood expenditures), the welfare effects will differ across states. Appropriately modifying the results in Okrent and Alston (2012) indicates that the consumers' compensating variation associated with food type j in state s is

$$\Delta CV^{j,SNAP} = -P^{j,0,SNAP,s}Q^{j,0,SNAP,s}(\hat{P}^j + (\frac{\eta^{jE}}{\eta^{jj}})\delta^{E,s})(1 + 0.5\sum_{k=1}^{9}(\eta^{jk\times}\hat{P}^k + \eta^{kE}\delta^{E,s})).$$

As before, I ascertain expenditures on food type j by SNAP participants in state s, $P^{j,0,SNAP,s}Q^{j,0,SNAP,s}$, by using data on regional food expenditure patterns, data on the share of a state's population within a region, and state-specific information on SNAP participation rates. Total change in compensating variation for SNAP participants in a state is obtained by summing across the welfare changes for each commodity within a state.

Non-SNAP participants receive no extra income from SNAP, so the only changes that result for nonrecipients are a result of relative price changes. Thus, compensating variation for nonparticipants for food type j in state s is

$$\Delta CV^{j,non-SNAP} = -P^{j,0,non-SNAP,s}Q^{j,0,non-SNAP,s}\hat{P}^j(1 + 0.5\sum_{k=1}^{9}\eta^{jk\times}\hat{P}^k).$$

For Case 1, the welfare calculations above include nonfood as one of the retail consumption goods (thus there are 10 rather than 9 items in the demand function). But for Case 2, only food items are considered as the price of nonfood is considered exogenous to the model. Changes in producer surplus are given by equation 90 with $s_{k,s} = 0$, and changes in exporter and ethanol buyer surplus are given by equation 91. Changes in taxpayer effects are calculated in the same way, as described earlier.

Application to Ethanol

As previously indicated, the precise welfare effects of the RFS are difficult to quantify given the uncertainty about the extent to which the mandate is binding. Rather than attempting to explicitly model the consumption requirement and the associated welfare effects, I simply ask what would happen should demand for corn from ethanol manufacturers fall. Although that approach does not provide an estimate of the welfare effects of the RFS, such an estimate can be found in the other sources discussed in the literature review. Rather, my look at the effects of changes in ethanol demand provides insight into the interlinkages of the farm-food economy and provides a sense of the extent to which there may be winners and losers across different commodities and states.

Equation 67 indicates the demand for corn by ethanol producers. The exogenous shock, $\delta_{14,E}$, indicates the vertical shift in ethanol manufacturers' willingness to pay for corn at the initial equilibrium quantity. A demand shift equal to $\delta_{14,E} = 0.20$ would imply a 20 percent reduction in ethanol manufacturers' willingness to pay for corn. I consider the effects of a 20 percent reduction; other values could be considered, but the results would be proportional to the demand shift assumed.

When considering the effects of a change in ethanol demand, it must be noted that uncertainty over a key parameter is likely to affect model results: the own-price elasticity of demand for corn by ethanol producers given by $\eta_{14,E}$ in equation 67. Under a binding consumption mandate, demand will be perfectly inelastic at the quantity mandated. However, without a mandate (or a nonbinding mandate), demand is likely to be much more elastic. As such, I consider two cases: first setting $\eta_{14,E} = -0.127$ as assumed by Schmitz, Moss, and Schmitz (2007) and then setting $\eta_{14,E} = -0.127$ as in Anderson and Coble (2010).

Welfare effects are given by equation 89, equation 90 with $s_{k,s} = 0$, and equation 91. I refrain from calculating the changes in consumer surplus for ethanol producers (and total welfare) because of uncertainty about whether the RFS mandate is binding. If the mandate is binding, ethanol consumers (including ethanol producers, gasoline blenders, and final consumers) benefit from a demand reduction because consumption can be reduced to the desired level. However, if the mandate is not binding, a reduction in demand likely implies a loss in those consumers' surpluses, because they must buy more than they would otherwise desire. It should also be noted that the present model does not quantify whatever environmental or national security benefits (or costs) might exist from the RFS.

Results

The following sections summarize the effects of removing crop insurance subsidies, removing SNAP under two different scenarios, and reducing the demand for corn for ethanol.

Removal of Crop Insurance Subsidies

Table 8 reports the aggregate simulated effects of the removal of crop insurance subsidies. As the table reveals, most segments of the economy appear to be harmed by the removal of crop insurance subsidies. Domestic food consumers are worse off by $2.4 billion, primarily, because the removal of crop insurance subsidies is projected to raise the price of all foods, from a high of about 1 percent for eggs to a low of about 0.048 percent for food away from home. Foreign buyers of US agricultural products and buyers of corn for use in ethanol are both projected to lose about $1 billion, again because of higher commodity prices. The estimates suggest that the removal of crop insurance subsidies would increase corn prices by 4.75 percent. In aggregate, US agricultural producers (and their input suppliers) are also projected to lose about $2.6 billion; although most commodity prices rise, the loss of the insurance subsidy, along with the reduction in quantity sold, results in a net loss for agricultural producers.

Table 8. Aggregate Effects of Removing Food-Related Crop Insurance Subsidies

Affected entities	Annual change in welfare ($ millions)
Taxpayers	8,005
Domestic food consumers	−2,421
Foreign consumers	−993
Ethanol producers/consumers	−1,029
Domestic agricultural producers*	−2,631
TOTAL	932

* Effects to producers also include all the benefits and costs accruing to suppliers of agricultural inputs, such as landowners, lenders, seed suppliers, sellers of crop insurance, and so forth.

The only beneficiaries (in aggregate) from the removal of crop insurance subsidies are taxpayers, who would gain about $8 billion (the amount spent on food-related crop insurance subsidies and overhead in 2013). As table 8 shows, the aggregate gain to the taxpayers more than offsets the losses to the other aggregate groups because of the deadweight loss of the subsidies. The total benefits of removing crop insurance subsidies are $932 million per year. Despite the aggregate net benefits of removing crop insurance, the results in table 8 perhaps reveal why they persist; virtually every aggregate group benefits from continuing the subsidy: domestic food consumers, foreign buyers, and agricultural producers. The only aggregate loser is the taxpayer, and the effects of crop insurance subsidies on taxes paid are probably more diffuse and much less transparent than the effects on food and commodity prices.

One of the problems with the results presented in table 8 (and the results of most previous studies on related issues) is that they mask a great deal of underlying heterogeneity in effects on producers and consumers of different commodities. Take, for example, the comparison of California, which generated about $32.6 billion in annual food-related agricultural output from 2008 to 2012, and Kansas, which generated about $11.2 billion over the same period. Despite the fact that California generates about three times as much agricultural output as Kansas, Kansas farmers received 2.65 times the amount of crop insurance subsidies and attributed overhead ($618 million vs. $233 million) in 2013. Moreover, the states are radically different in the types of agricultural commodities grown. Just under 70 percent of the value of all food-related agricultural output in California comes from fruits, vegetables, and tree nuts; for Kansas, the figure is only 0.04 percent.

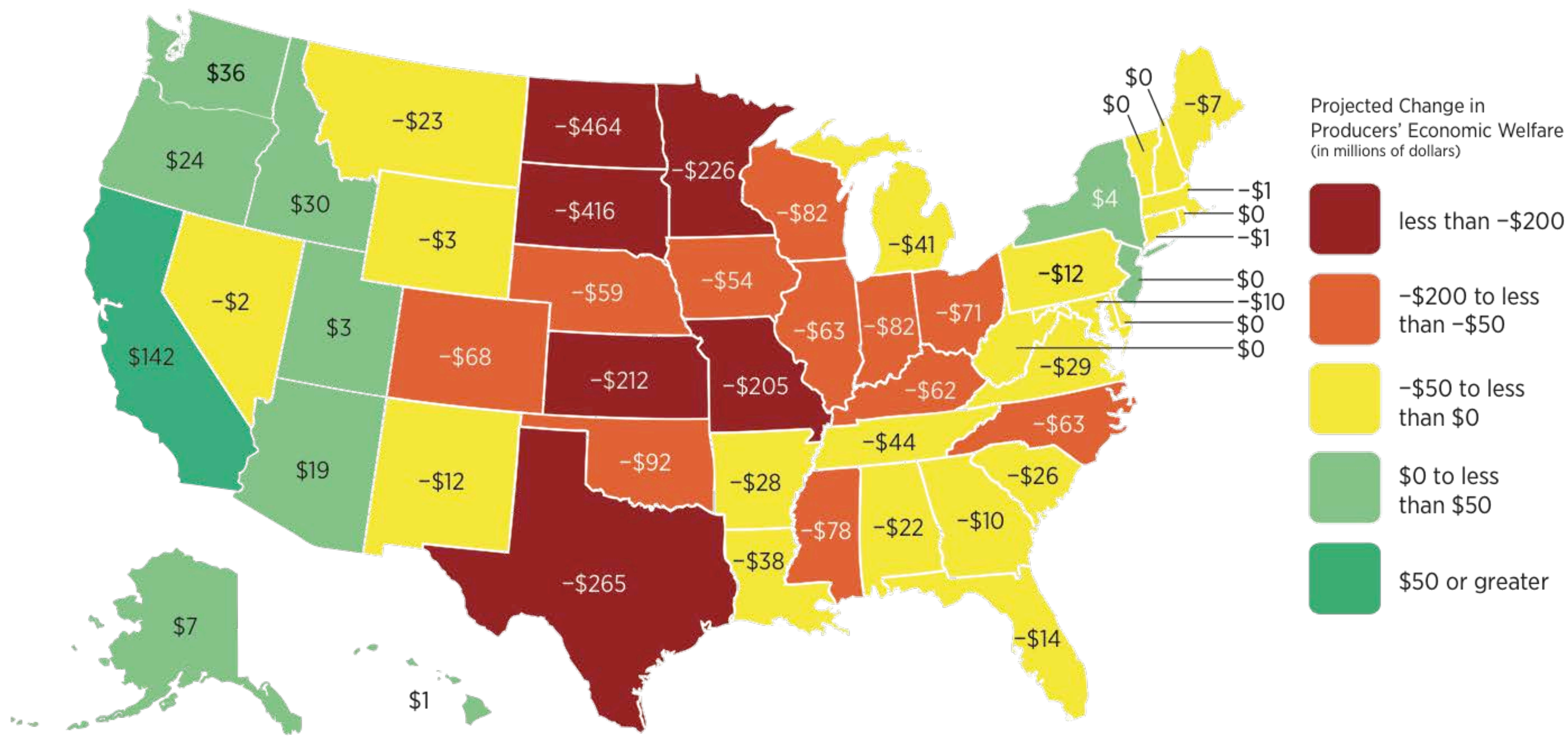
There are further differences across states in consumption and tax payments as well. For example, consumers in the western United States allocate about 15 percent of their food budget to alcoholic beverages, whereas the figure is only 12.4 percent for consumers in the South; by contrast, southerners allocate more of their food expenditures to meat than do consumers in the rest of the United States. As another example, per capita 2012 federal tax payments were $23,809 in Delaware and only $3,503 in Mississippi, which implies substantially different burdens of federal crop insurance subsidies on people residing in different states.

Figure 7 shows the distribution of projected effects of the removal of food-related crop insurance subsidies on agricultural producers and their input suppliers across the continental United States (detailed reporting of state-level output is provided in table A2 in the appendix). The biggest losers are agricultural producers in the Midwest and South. However, agricultural producers in several western and northeastern states are projected to be net beneficiaries from the removal of crop insurance subsidies. The states that benefit are generally characterized by higher levels of fruit and vegetable production along with lower levels of crop insurance subsidies relative to the value of production.

To illustrate how that heterogeneity comes about, again consider California and Kansas. Removing subsidies is projected to increase the prices of vegetables (major California crops) by 1.4 percent and wheat (a major Kansas crop) by 7.9 percent (aggregate reductions in quantities are 0.2 percent and 3.1 percent, respectively). The implicit subsidy lost by California producers of vegetables is only 0.16 percent, whereas the implicit subsidy lost by Kansas producers of wheat is 12 percent. Thus, California vegetable producers gain an effective price advantage of 1.24 percent (1.4 percent minus 0.16 percent), whereas Kansas wheat producers experience an effective price change of −4.1 percent (7.9 percent minus 12 percent). Therefore, California vegetable producers sell about the same amount of output at about 1 percent higher effective prices, but Kansas wheat growers sell less output at about 4 percent lower effective prices. As a result, California producers benefit and Kansas producers lose from the removal of food-related crop insurance subsidies.

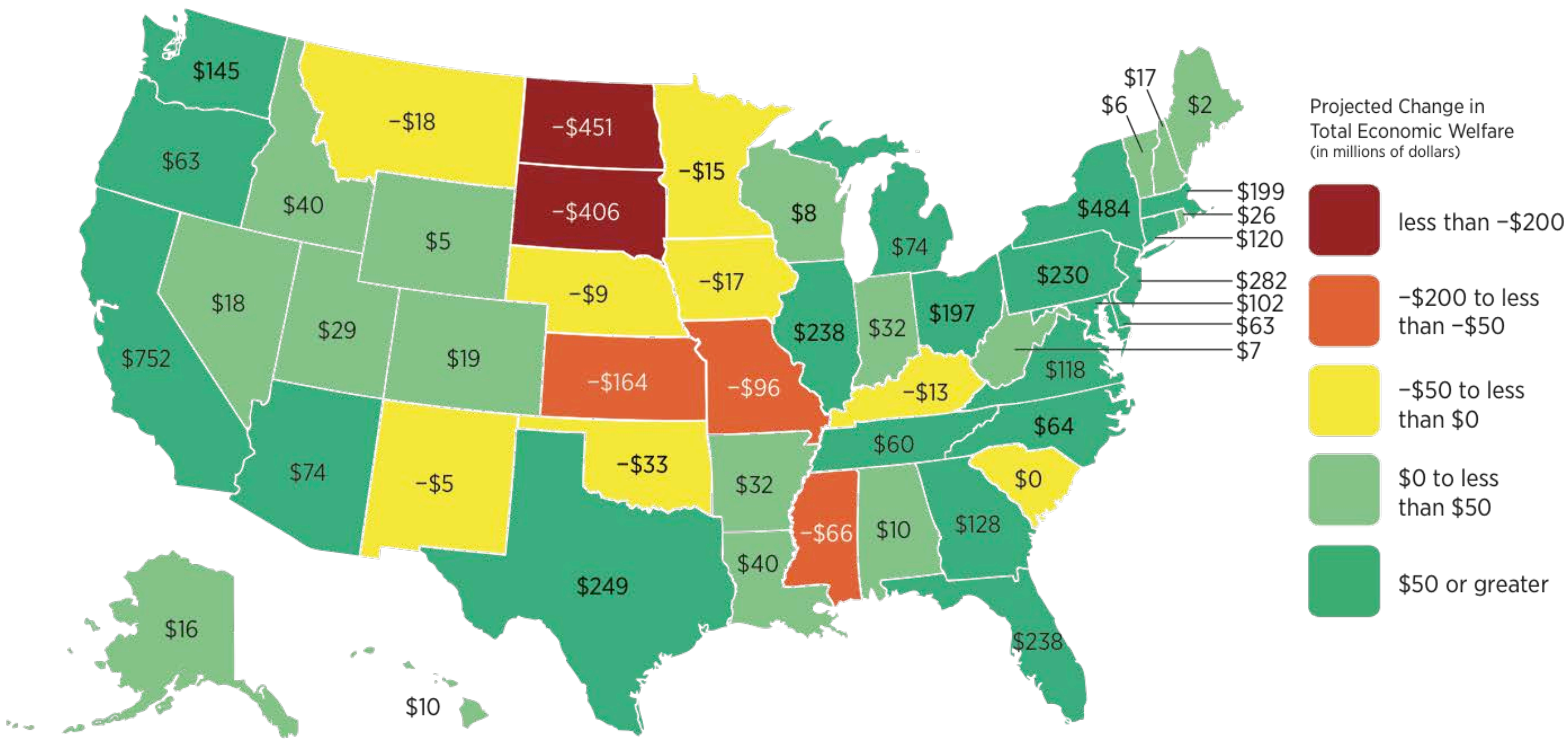
Even the results in figure 8 mask within-state heterogeneity. For example, despite the fact that Kansas wheat farmers are net losers, California wheat farmers are net winners. Why? Because the implicit price subsidy to California wheat farmers is much lower than the one to Kansas (3.6 percent vs. 12 percent). But not all California producers benefit. California's barley, hog, poultry, and egg producers are projected to be net losers from the removal of crop insurance subsidies. Within Kansas, wheat producers lose about $86 million, but cattle producers gain about $12 million annually from the removal of crop insurance subsidies.

Figure 7. How Removing Food-Related Crop Insurance Subsidies Would Affect State Agricultural Producers



Note: All values are in millions of dollars. The total change in agricultural producer welfare for the United States as a whole is −$2.631 billion.

Figure 8. How Removing Food-Related Crop Insurance Subsidies Would Affect the States



Note: All values are in millions of dollars. The total change in welfare for the United States as a whole is $932 million.

Figure 8 shows the distribution of the projected total effects of removing food-related crop insurance subsidies across the continental United States (detailed reporting of state-level output is provided in the appendix). Even in states like Texas, where agricultural producers are large net losers from the removal of crop insurance, the state as a whole is a large net gainer, primarily because of the impacts on taxpayers. Texas is home to 8.3 percent of the US population, but its residents pay 8.74 percent of all federal taxes; as a result, the benefits to Texas taxpayers outweigh the losses to Texas agricultural producers. States like North and South Dakota, Kansas, and Mississippi remain net losers from the removal of crop insurance subsidies because of the large benefits derived by producers of the state and the relatively low amount of federal taxes paid by the state.

Removal of SNAP

Table 9 reports the projected aggregate effects from the removal of SNAP under two different scenarios, reflecting different assumptions about how SNAP recipients spend their benefits.

First, consider Case 1. Case 1 assumes that SNAP acts as an unrestricted cash transfer that does not affect the marginal propensity to consume food. The common presumption is that the program simply moves money from richer taxpayers to poorer households with no aggregate deadweight loss. The results in table 9 suggest that may or may not be true. The estimated total aggregate benefits from the removal of SNAP are $12.66 billion. The winners are taxpayers and SNAP nonrecipient consumers (who now pay lower prices), and the losers are SNAP recipients and producers (who now receive lower prices). To provide a sense of the magnitude of the changes, the model estimates that removal of SNAP in Case 1 would result in a fall of retail meat prices of −0.19 percent (the most dramatic change). Most commodity prices are projected to fall (e.g., −0.15 percent for corn, −0.20 percent for vegetables, and −0.66 percent for dairy; soybeans are the one exception at a projected price increase of 0.07 percent).

Table 9. Aggregate Effects of a Removal of the Supplemental Nutrition Assistance Program

Affected entities	Annual change in welfare ($ millions) Case 1[(a)]	Annual change in welfare ($ millions) Case 2[(b)]
Taxpayers	75,891	75,891
Domestic food consumers (SNAP recipients)	−10,216	−31,333
Domestic nonfood consumers (SNAP recipients)	−45,493	–
Domestic food consumers (nonrecipients)	535	4,154
Domestic nonfood consumers (nonrecipients)	29,821	–
Foreign consumers	12	94
Ethanol producers/consumers	34	260
Domestic agricultural producers[(c)]	−829	−6,293
Nonfood producers	−37,094	–
TOTAL	12,661	42,773

(a) Case 1 assumes that SNAP payments act as an income transfer and are proportionately allocated to food and nonfood items.
(b) Case 2 assumes that SNAP payments are spent on food only.
(c) Effects to producers also include all the benefits and costs accruing to suppliers of agricultural inputs, such as landowners, lenders, seed suppliers, sellers of crop insurance, and so forth.

It must be noted that there is a sense in which those results are only static or partial equilibrium. What happens with the $75.9 billion in tax savings will determine the ultimate welfare effects. If those savings are transferred back to the tax-paying consumer, then, presumably, consumer expenditures and welfare will increase (though the effects will be partially offset by inflationary pressure on prices). If the $75.9 billion in tax savings are instead spent on some other project (e.g., reducing long-term national debt or building roads), then a benefit-cost analysis of those specific projects must be conducted (one cost of which would be the opportunity costs of not returning the tax savings to the public).

Despite those complications, the results in table 9 illustrate a couple of key points. SNAP recipients do not receive the full benefit of the transfer ($75.9 billion is transferred, but SNAP recipients receive roughly only $10.2 + $45.5 = $55.7 billion in benefits), because (a) increased expenditures have an inflationary effect, pulling up prices and causing SNAP recipients and nonrecipients to pay more; and (b) producers capture some of the benefits. Indeed, the inclusion of SNAP in the *Farm* Bill is (at least partially) a result of a belief that SNAP spending helps support agricultural commodity prices. However, the results of Case 1 in table 9 suggest that SNAP is a very inefficient form of farm support: for every $1 spent by taxpayers, farmers benefit by only $0.01.

Disaggregated effects are reported in table A3. Some states, such as Alabama, New Mexico, Mississippi, and West Virginia—which have lower tax burdens, have more SNAP recipients, and receive a higher level of SNAP funding relative to expenditures than other states—are projected to be net losers from the removal of SNAP. However, most states are projected to benefit from SNAP removal in Case 1.

Table 9 shows the aggregate effects (and table A4 in the appendix shows the disaggregate effects) for Case 2, which assumes that SNAP recipients spend their benefits only on food. Removal of SNAP benefits in this case is projected to result in aggregate benefits of $42 billion. The losses to SNAP participants (and the gains to nonparticipants) are larger than in Case 1, as a result of the larger impact on food prices. For example, removal of SNAP in Case 2 is projected to result in a 4.8 percent reduction in the price of food away from home; corn and wheat prices would both fall by about 1 percent.

Reduction in Demand for Corn for Ethanol

Table 10 shows the projected effects of a 20 percent reduction in demand for corn used in ethanol production. Overall, consumers are net winners from a reduction in corn-ethanol demand, with the primary winners being meat consumers who now pay lower prices for meat (about 0.04 percent lower). There are small improvements in producer surplus for the suppliers of poultry and livestock inputs. The biggest losers are corn producers, who lose $379 million. The model shows that corn prices would fall 0.61 percent following the 20 percent reduction in demand for corn ethanol. That relatively small price change for corn likely comes about from the assumption about the highly inelastic demand for corn by ethanol producers (see table 4). I use the value of −0.127 utilized by Schmitz, Moss, and Schmitz (2007). Inelastic demand makes sense if the RFS mandate is binding or nearly binding, as a certain quantity of corn is mandated to be purchased regardless of price. However, other authors have used more elastic demand estimates when considering the removal of the RFS. Agricultural economists John Anderson and Keith Coble (2010), for example, use a demand elasticity of −1.75. If I use that elasticity in the model, I find that a 20 percent reduction in demand for corn used in ethanol production results in a 7.54 percent reduction in the price of corn, a 0.41 percent reduction in the price of retail meat products, and a 0.92 percent reduction in the retail price of eggs. In this scenario, the welfare effects are more pronounced: consumers benefit by $855 million, corn producers lose $3.6 billion, and suppliers of inputs to cattle production benefit by $22 million. The losses attributed to foreign consumers come about primarily because of the higher prices paid by importers of US corn.

Table 10. Effects of a 20 Percent Reduction in Demand for Corn for Ethanol

Affected entities	Annual change in welfare ($ millions) $\eta_{14,E} = -0.127$	Annual change in welfare ($ millions) $\eta_{14,E} = -1.75$
Domestic food consumers	86.26	855.41
Cereals and bakery	5.57	55.25
Meat	62.55	620.31
Eggs	9.55	94.69
Dairy	6.86	68.01
Fruits and vegetables	2.32	23.00
Other food	−13.85	−137.27
Nonalcoholic beverages	0.08	0.79
Food away from home	11.19	110.87
Alcoholic beverages	1.99	19.75
Foreign consumers	−26.62	−208.69
Domestic agricultural producers*	−201.72	−1,936.59
Vegetables and melons	−0.81	−8.05
Fruit and tree nuts	−0.84	−8.31
Sugarcane and beets	0.06	0.55
Peanuts	0.02	0.22
Fish	2.40	23.77
Marketing inputs	0.00	−0.01
Soybeans	171.47	1,634.58
Corn	−379.48	−3,633.55
Wheat	0.10	0.99
Rice	0.01	0.13
Barley	0.01	0.11
Oats	0.01	0.06
Sorghum	0.01	0.12
Cattle input suppliers	2.26	22.45
Pork input suppliers	0.70	6.97
Dairy input suppliers	0.98	9.71
Poultry input suppliers	1.07	10.63
Egg input suppliers	0.31	3.03

* Effects to producers also include all the benefits and costs accruing to suppliers of agricultural inputs, such as landowners, lenders, seed suppliers, sellers of crop insurance, and so forth.

Appendix table A5 shows the effects at the state level. The states that would lose the most from a reduction in corn-ethanol demand are, not surprisingly, large corn-producing states, such as Illinois, Indiana, Iowa, and Nebraska. Producers in some states that generate a relatively large share of soybeans compared with other crops in the state, such as Alaska and Mississippi, are projected to benefit from a reduction in corn-ethanol demand.

Conclusions

This paper considers the economic effects of three food and agricultural policies: subsidized crop insurance, SNAP, and ethanol promotion. Using a model that links production of individual crops with nine retail food categories, I can trace the effects of those policies to producers and consumers in different US states. Overall, the results reveal that each of the policies significantly distorts food and agricultural markets.

Removal of subsidized crop insurance is projected to generate $932 million in annual economic benefits. Producers in midwestern grain-producing states would lose from the removal of the subsidies, but producers in western states are projected to actually benefit from the removal of subsidized crop insurance. The results reveal the “concentrated benefits–diffuse costs” principle often thought to explain the existence of farm subsidies. Agricultural producers in several states reap the lion’s share of the benefits from subsidized crop insurance, and food consumers also benefit from the subsidies through lower food prices. The costs, which are likely to be less than transparent, fall on taxpayers.

Although the recent Farm Bill transitioned away from direct payments to farmers and attempted to place more emphasis on crop insurance, both the premium and the deductible of the insurance products are heavily subsidized. Whether those subsidies will be reduced in future years remains to be seen. Although producers have often failed to buy nonsubsidized crop insurance, it is unclear whether that is simply a result of preexisting policies that mitigated downside risk or a belief that the federal government would provide ad hoc disaster payments if a drought or other shock occurs. One interesting idea was recently advanced by Colson, Ramirez, and Fu (2014). They suggest the creation of crop insurance savings accounts, in which farmers can place earnings (that grow tax free) in plentiful years. In years of revenue or yield declines, farmers can withdraw from their own savings.

Depending on how SNAP recipients allocate their SNAP dollars, the removal of SNAP is projected to generate net economic benefits ranging from $12.7 billion to $42.8 billion. Of course, concerns for equity or food insecurity might justify SNAP; however, it is important to recognize the distributional costs and consequences of the program. Moreover, the estimates here suggest that the effects may be more than a simple transfer from wealthier taxpayers to poorer SNAP recipients. In particular, SNAP benefits likely have an inflationary effect, pulling up the prices of food and nonfood items. Moreover, depending on the expenditure elasticities of demand for different foods, the benefits may shift consumption toward some items and away from others. The ultimate effects of the removal of the program likely depend on what happens to the tax savings. A macroeconomic model of taxes, savings, investment, and growth would be needed to project such effects.

Finally, I show that policies that pulled up demand for corn for use in ethanol likely had adverse effects on food consumers and livestock producers. Reducing demand for corn-based ethanol would reduce food prices (particularly meat prices) and would benefit producers of poultry, eggs, livestock, and crops such as soybeans. Corn farmers would be the biggest losers from a reduction in corn-ethanol demand, and as a result, states such as Iowa and Illinois that are heavy corn producers are projected to be most affected by a corn-ethanol demand reduction.

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Appendix: Additional Information on State-Level Data and Model Results

Table A1. Crop Insurance Subsidies Paid to Producers ($ Millions) by State and Commodity, 2013

State	State rank	TOTAL	Other crops	Veg-etables	Fruit & tree nuts	Sugar-cane & beets	Pea-nuts	Fish & sea-food	Soy-beans	Corn	Wheat	Rice	Barley	Oats	Sor-ghum	Cattle	Swine	Dairy
Ala.	27	51.10	17.99	0.14	0.54	0.00	5.35	0.00	10.60	8.82	6.91	0.00	0.00	0.03	0.12	0.59	0.00	0.05
Alaska	49	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.01	0.00	0.01	0.00	0.00
Ariz.	36	11.45	5.70	0.34	1.26	0.00	0.00	0.00	0.00	1.01	1.38	0.00	0.86	0.00	0.01	0.83	0.00	0.94
Ark.	19	108.49	3.66	0.70	0.10	0.00	0.14	0.00	43.44	23.00	14.14	19.71	0.00	0.03	3.22	0.36	0.00	0.10
Calif.	11	193.50	11.60	9.35	148.11	0.04	0.00	0.00	0.00	1.94	9.10	5.86	1.01	0.02	0.01	5.52	0.00	0.01
Colo.	15	145.77	8.55	8.46	0.52	1.19	0.00	0.00	0.20	44.83	60.30	0.00	1.79	0.04	11.44	8.34	0.00	0.00
Conn.	41	3.71	2.82	0.13	0.45	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39
Del.	38	8.17	0.02	0.39	0.00	0.00	0.00	0.00	2.66	3.94	0.87	0.00	0.27	0.00	0.02	0.00	0.00	0.15
Fla.	23	84.62	21.74	18.84	32.13	1.93	2.75	0.19	0.62	1.09	0.42	0.04	0.00	0.01	0.01	4.47	0.00	0.00
Ga.	22	94.73	49.12	7.16	6.71	0.00	12.01	0.00	4.25	9.01	5.05	0.00	0.00	0.03	0.44	0.79	0.00	0.17
Hawaii	47	1.07	0.23	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Idaho	31	46.07	1.09	15.83	1.06	1.69	0.00	0.00	0.00	1.01	19.87	0.00	5.24	0.03	0.00	0.09	0.00	0.10
Ill.	7	455.90	0.37	0.51	0.96	0.00	0.00	0.00	138.95	293.79	20.45	0.03	0.04	0.01	0.46	0.18	0.00	0.16
Ind.	10	255.94	0.60	0.40	0.25	0.00	0.00	0.00	93.65	152.63	8.20	0.00	0.00	0.00	0.10	0.00	0.00	0.07
Iowa	5	507.90	0.08	0.11	0.00	0.00	0.00	0.00	149.14	357.45	0.28	0.00	0.01	0.08	0.00	0.58	0.00	0.02
Kans.	4	513.09	3.50	0.79	0.00	0.00	0.00	0.00	77.42	134.20	216.38	0.00	0.08	0.11	77.71	2.83	0.00	0.00
Ky.	21	105.39	8.53	0.00	0.02	0.00	0.00	0.00	39.50	40.77	16.34	0.00	0.14	0.00	0.07	0.00	0.00	0.01
La.	26	72.75	4.31	0.82	0.02	1.76	0.01	0.00	28.04	22.22	7.31	5.42	0.00	0.05	2.80	0.00	0.00	0.01
Maine	39	7.26	0.04	5.53	1.03	0.00	0.00	0.00	0.00	0.32	0.03	0.00	0.10	0.21	0.00	0.00	0.00	0.00
Md.	33	25.49	0.42	0.49	0.69	0.00	0.00	0.00	8.88	11.64	2.79	0.00	0.33	0.00	0.20	0.05	0.00	0.55
Mass.	45	2.38	0.87	0.19	1.11	0.00	0.00	0.01	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11
Mich.	17	130.18	0.66	8.09	12.86	2.35	0.00	0.00	34.07	60.45	10.17	0.00	0.04	0.07	0.00	0.87	0.00	0.00
Minn.	6	504.43	3.08	12.36	0.09	17.10	0.00	0.00	146.48	286.99	32.01	0.18	1.66	0.49	0.00	2.88	0.01	0.03
Miss.	20	105.95	8.39	0.00	0.08	0.00	0.33	0.00	50.08	32.41	9.40	3.32	0.00	0.00	1.93	0.00	0.00	0.00
Mo.	9	272.45	3.15	0.39	0.40	0.00	0.00	0.00	110.05	132.89	20.23	3.37	0.01	0.00	1.13	0.80	0.00	0.00

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State	State rank	TOTAL	Other crops	Veg-etables	Fruit & tree nuts	Sugar-cane & beets	Pea-nuts	Fish & sea-food	Soy-beans	Corn	Wheat	Rice	Barley	Oats	Sor-ghum	Cattle	Swine	Dairy
Mont.	16	131.16	2.35	10.05	0.07	0.74	0.00	0.00	0.03	1.22	90.33	0.00	15.11	0.21	0.00	11.06	0.00	0.00
Neb.	8	404.84	3.73	5.93	0.00	1.61	0.00	0.00	94.07	260.36	29.57	0.00	0.03	0.23	3.12	6.18	0.00	0.00
Nev.	43	3.19	0.01	0.57	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.00	1.41	0.00	0.48
N.H.	48	0.36	0.01	0.02	0.23	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N.J.	40	6.32	0.20	0.09	1.92	0.00	0.00	0.00	1.82	2.03	0.23	0.00	0.02	0.00	0.00	0.00	0.00	0.00
N.Mex.	34	23.69	1.90	0.76	1.86	0.00	0.08	0.00	0.00	1.97	11.99	0.00	0.17	0.00	2.13	2.83	0.00	0.00
N.Y.	32	30.23	0.23	5.01	7.79	0.00	0.00	0.00	2.73	12.77	1.00	0.00	0.01	0.06	0.00	0.17	0.00	0.00
N.C.	18	126.90	36.85	1.44	4.08	0.00	2.10	0.00	37.83	25.38	17.87	0.00	0.13	0.04	0.95	0.22	0.00	0.12
N.Dak.	1	717.54	65.85	43.26	0.00	7.79	0.00	0.00	143.26	236.97	192.83	0.00	18.11	1.97	0.00	7.50	0.00	0.07
Ohio	12	193.07	0.85	0.27	0.68	0.00	0.00	0.00	82.46	99.14	9.54	0.00	0.00	0.02	0.00	0.00	0.00	0.01
Okla.	14	159.55	12.69	0.06	0.20	0.00	0.29	0.00	8.10	10.43	116.03	0.00	0.19	0.04	7.52	3.95	0.00	0.16
Ore.	35	23.03	3.32	2.77	2.62	0.09	0.00	0.00	0.00	0.38	13.12	0.00	0.44	0.01	0.00	0.26	0.00	0.00
Pa.	29	46.64	0.12	0.89	5.44	0.00	0.00	0.00	8.18	30.06	0.86	0.00	0.13	0.07	0.01	0.72	0.00	0.00
R.I.	50	0.07	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
S.C.	28	49.69	14.15	0.17	6.27	0.01	1.34	0.00	9.15	13.21	5.14	0.00	0.00	0.03	0.18	0.05	0.00	0.01
S.D.	3	551.68	17.24	0.64	0.00	0.00	0.00	0.00	123.22	302.93	79.42	0.00	0.42	1.62	5.02	21.05	0.00	0.07
Tenn.	25	77.44	11.58	0.46	0.06	0.00	0.00	0.00	31.65	21.72	11.72	0.03	0.02	0.00	0.19	0.00	0.00	0.06
Tex.	2	707.22	312.84	12.61	7.27	1.78	2.68	0.00	3.49	74.95	162.47	4.51	1.67	0.47	64.44	57.99	0.00	0.04
Utah	42	3.53	0.21	0.08	0.26	0.00	0.00	0.00	0.00	0.22	2.06	0.00	0.10	0.00	0.00	0.53	0.00	0.03
Vt.	44	2.41	0.02	0.02	0.65	0.00	0.00	0.00	0.06	1.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
Va.	30	46.15	4.20	0.88	2.45	0.00	0.40	0.25	15.15	15.43	6.17	0.00	0.70	0.00	0.13	0.35	0.00	0.00
Wash.	24	83.86	7.40	7.29	39.15	0.02	0.00	0.00	0.00	0.37	28.19	0.00	1.23	0.00	0.00	0.12	0.00	2.41
W.Va.	46	1.77	0.00	0.00	0.32	0.00	0.00	0.00	0.29	1.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wis.	13	182.67	0.36	6.61	1.95	0.00	0.00	0.00	35.77	123.74	5.31	0.00	0.07	0.13	0.00	6.32	0.00	0.00
Wyo.	37	10.99	0.49	1.07	0.00	0.85	0.00	0.00	0.00	2.33	2.19	0.00	0.59	0.05	0.00	3.42	0.00	0.00
TOTAL		7,291.82	653.11	192.02	292.54	38.92	27.47	0.46	1535.32	2859.33	1248.89	42.47	50.79	6.16	183.34	153.32	0.01	7.66

Source: Risk Management Agency.

Table A2. Projected State-Level Effects from the Removal of Federal Crop Insurance Subsidies ($ Millions per Year)

State	Farmers	Food consumers	Taxpayers	TOTAL
Alabama	−22.01	−34.38	66.56	10.17
Alaska	6.66	−6.21	15.61	16.07
Arizona	18.89	−55.63	111.08	74.35
Arkansas	−27.69	−21.03	80.64	31.92
California	142.39	−322.91	932.47	751.95
Colorado	−68.26	−44.03	131.48	19.18
Connecticut	−0.83	−29.48	150.64	120.32
Delaware	−0.34	−6.54	69.59	62.72
Florida	−13.73	−137.73	389.64	238.18
Georgia	−9.71	−70.73	208.76	128.32
Hawaii	0.57	−11.82	20.75	9.50
Idaho	29.50	−13.55	24.29	40.25
Illinois	−62.69	−96.15	396.59	237.76
Indiana	−82.39	−48.82	163.31	32.10
Iowa	−53.59	−22.96	59.77	−16.78
Kansas	−211.90	−21.55	69.82	−163.64
Kentucky	−61.64	−31.23	79.95	−12.91
Louisiana	−38.38	−32.81	110.95	39.76
Maine	−6.82	−10.91	19.85	2.11
Maryland	−9.54	−41.96	153.33	101.84
Massachusetts	−1.03	−54.58	254.43	198.82
Michigan	−41.19	−73.80	188.72	73.72
Minnesota	−225.57	−40.17	250.79	−14.95
Mississippi	−77.56	−21.28	33.33	−65.50
Missouri	−205.07	−44.97	154.30	−95.73
Montana	−23.07	−8.53	13.97	−17.63
Nebraska	−58.61	−13.86	63.09	−9.37
Nevada	−1.91	−23.42	43.75	18.42
New Hampshire	−0.07	−10.85	28.07	17.16
New Jersey	0.28	−72.79	354.99	282.47
New Mexico	−12.27	−17.70	25.07	−4.90
New York	3.76	−160.70	641.17	484.22
North Carolina	−63.08	−69.53	196.33	63.73
North Dakota	−463.92	−5.22	18.06	−451.09
Ohio	−71.06	−86.21	354.08	196.82
Oklahoma	−92.05	−27.20	86.33	−32.91
Oregon	23.53	−33.10	72.40	62.84

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State	Farmers	Food consumers	Taxpayers	TOTAL
Pennsylvania	−12.02	−104.81	347.29	230.46
Rhode Island	−0.14	−8.62	35.04	26.27
South Carolina	−25.74	−33.68	59.15	−0.27
South Dakota	−415.86	−6.22	16.37	−405.71
Tennessee	−43.78	−46.03	149.83	60.02
Texas	−264.81	−185.80	699.47	248.86
Utah	3.11	−24.24	49.86	28.73
Vermont	−0.47	−5.14	11.23	5.63
Virginia	−28.85	−58.36	204.93	117.71
Washington	36.01	−58.54	167.15	144.62
West Virginia	−0.35	−13.23	20.71	7.14
Wisconsin	−81.52	−42.76	132.26	7.98
Wyoming	−2.52	−4.89	12.20	4.79
District of Columbia	–	−4.51	66.13	61.62
Unattributed/rest of world	−13.87	−2,021.64	0.00	−2,035.52
TOTAL	−2,631.19	−4,442.80	8,005.62	931.63

Table A3. Projected State-Level Effects from the Removal of SNAP: Case 1 ($ Millions per Year)

State	Farmers	Food consumers (SNAP recipients)	Food consumers (SNAP nonrecipients)	Nonfood consumers (SNAP recipients)	Nonfood Consumers (SNAP nonrecipients)	Taxpayers	TOTAL
Alabama	−7.99	−188.74	7.39	−851.26	406.80	630.96	−2.83
Alaska	0.25	−25.24	1.44	−113.38	80.80	148.01	91.88
Arizona	−7.94	−227.65	12.09	−983.39	680.51	1,052.98	526.60
Arkansas	−8.18	−97.92	4.70	−440.31	258.62	764.41	481.33
California	−87.03	−1039.58	74.54	−4,519.10	4,194.70	8,839.57	7,463.11
Colorado	−12.32	−112.87	10.58	−493.01	595.61	1,246.42	1,234.41
Connecticut	−0.54	−93.38	6.71	−422.97	385.79	1,428.00	1,303.62
Delaware	−1.50	−31.63	1.43	−141.33	78.68	659.74	565.38
Florida	−15.00	−799.26	27.98	−3,547.02	1,539.37	3,693.67	899.73
Georgia	−14.39	−426.86	14.63	−1,918.45	804.84	1,978.98	438.75
Hawaii	−0.64	−66.11	2.53	−295.93	142.34	196.74	−21.06
Idaho	−18.68	−47.76	3.07	−207.22	172.50	230.31	132.22
Illinois	−18.53	−453.85	20.70	−2,026.27	1,133.46	3,759.59	2,415.10
Indiana	−13.26	−194.48	11.11	−876.53	608.73	1,548.13	1,083.71
Iowa	−38.96	−79.19	5.26	−351.51	288.11	566.62	390.34
Kansas	−22.39	−63.77	5.10	−284.44	279.41	661.83	575.74
Kentucky	−5.75	−178.73	6.55	−801.92	360.38	757.95	138.48
Louisiana	−4.49	−197.36	6.86	−890.28	377.34	1051.79	343.85
Maine	−0.99	−48.36	2.29	−219.70	131.75	188.21	53.20
Maryland	−3.03	−159.96	9.56	−707.12	526.01	1,453.51	1,118.97
Massachusetts	−0.53	−185.15	12.03	−827.80	691.75	2,411.91	2,102.20
Michigan	−15.86	−391.00	15.38	−1,746.56	842.25	1,788.99	493.20
Minnesota	−32.13	−104.85	9.55	−461.13	523.24	2,377.42	2,312.10
Mississippi	−5.33	−133.63	4.27	−597.20	235.12	316.00	−180.77
Missouri	−11.82	−191.14	10.02	−857.32	548.71	1,462.77	961.21
Montana	−6.22	−26.43	1.98	−114.97	111.67	132.45	98.48
Nebraska	−29.58	−35.35	3.37	−158.78	184.72	598.10	562.49

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State	Farmers	Food consumers (SNAP recipients)	Food consumers (SNAP nonrecipients)	Nonfood consumers (SNAP recipients)	Nonfood Consumers (SNAP nonrecipients)	Taxpayers	TOTAL
Nevada	−1.41	−74.68	5.26	−316.55	295.96	414.76	323.34
New Hampshire	−0.36	−21.53	2.65	−97.31	152.65	266.12	302.23
New Jersey	−0.82	−186.85	17.27	−849.87	993.65	3,365.18	3,338.57
New Mexico	−11.03	−93.73	3.58	−405.69	201.33	237.67	−67.87
New York	−16.46	−738.26	33.68	−3,372.28	1,937.56	6,078.13	3,922.37
North Carolina	−15.37	−334.79	15.27	−1,498.36	840.26	1,861.20	868.21
North Dakota	−9.10	−11.40	1.30	−51.31	70.99	171.16	171.63
Ohio	−12.92	−390.39	18.98	−1,753.88	1,039.30	3,356.62	2,257.71
Oklahoma	−12.94	−128.14	6.07	−576.79	334.19	818.42	440.82
Oregon	−6.57	−174.78	6.33	−737.53	356.10	686.36	129.91
Pennsylvania	−16.77	−360.58	23.73	−1,649.78	1,364.91	3,292.18	2,653.70
Rhode Island	−0.03	−39.88	1.79	−181.33	102.86	332.12	215.53
South Carolina	−3.63	−184.99	7.18	−831.32	395.20	560.69	−56.87
South Dakota	−13.34	−21.83	1.46	−98.92	80.04	155.19	102.60
Tennessee	−4.06	−285.18	9.40	−1,280.01	517.14	1,420.38	377.66
Texas	−40.66	−797.94	41.96	−3,569.10	2,308.62	6,630.80	4,573.68
Utah	−3.42	−52.54	5.85	−224.36	329.04	472.61	527.18
Vermont	−2.88	−19.76	1.12	−89.84	64.64	106.50	59.79
Virginia	−5.61	−194.56	13.81	−867.04	759.96	1,942.69	1,649.25
Washington	−15.84	−234.63	12.35	−990.77	695.21	1,584.55	1,050.89
West Virginia	−1.05	−67.74	2.86	−303.46	157.42	196.35	−15.62
Wisconsin	−34.50	−162.20	9.56	−717.60	523.81	1,253.83	872.91
Wyoming	−2.51	−7.81	1.24	−34.12	69.54	115.67	142.01
District of Columbia	0.00	−31.63	0.86	−141.33	47.51	626.87	502.29
Unattributed/rest of world	−214.60		45.50				−169.10
TOTAL	−828.68	−10,216.06	580.20	−45,493.44	29,821.10	75,891.13	12,659.71

Note: Assumes that SNAP payments act as an income transfer and are proportionately allocated to food and nonfood items. The table omits the $37,094 projected loss to producers of nonfood items.

Table A4. Projected State-Level Effects from the Removal of SNAP: Case 2 ($ Millions per Year)

State	Farmers	Food consumers (SNAP recipients)	Food consumers (SNAP nonrecipients)	Taxpayers	TOTAL
Alabama	−61.19	−451.88	57.44	630.96	175.33
Alaska	1.96	−44.34	11.16	148.01	116.79
Arizona	−60.64	−804.62	93.95	1,052.98	281.66
Arkansas	−62.81	−249.30	36.52	764.41	488.81
California	−665.65	−3,461.80	579.08	8,839.57	5,291.20
Colorado	−94.16	−356.54	82.22	1,246.42	877.94
Connecticut	−4.09	−354.39	52.10	1428.00	1,121.62
Delaware	−11.55	−89.93	11.11	659.74	569.37
Florida	−114.75	−2,499.82	217.35	3,693.67	1,296.45
Georgia	−110.07	−1,098.58	113.64	1,978.98	883.96
Hawaii	−4.87	−131.42	19.65	196.74	80.10
Idaho	−142.33	−162.14	23.81	230.31	−50.35
Illinois	−142.27	−1,280.72	160.78	3,759.59	2,497.38
Indiana	−101.56	−460.50	86.35	1,548.13	1,072.42
Iowa	−298.44	−242.74	40.87	566.62	66.31
Kansas	−171.45	−182.72	39.63	661.83	347.30
Kentucky	−44.04	−474.46	50.88	757.95	290.33
Louisiana	−34.29	−470.81	53.28	1,051.79	599.97
Maine	−7.55	−179.28	17.79	188.21	19.17
Maryland	−23.20	−523.77	74.27	1,453.51	980.81
Massachusetts	−4.03	−766.28	93.42	2,411.91	1,735.02
Michigan	−121.05	−1,094.42	119.47	1,788.99	692.99
Minnesota	−245.72	−356.32	74.22	2,377.42	1,849.59
Mississippi	−40.90	−379.01	33.20	316.00	−70.71
Missouri	−90.45	−498.97	77.83	1,462.77	951.19
Montana	−47.62	−87.41	15.42	132.45	12.83
Nebraska	−226.62	−89.70	26.20	598.10	307.98
Nevada	−10.73	−301.76	40.86	414.76	143.14
New Hampshire	−2.72	−82.99	20.62	266.12	201.03
New Jersey	−6.26	−686.36	134.20	3,365.18	2,806.76
New Mexico	−84.03	−325.37	27.79	237.67	−143.94
New York	−125.39	−2,611.18	261.68	6,078.13	3,603.24
North Carolina	−117.60	−928.07	118.64	1,861.20	934.16
North Dakota	−69.75	−27.92	10.07	171.16	83.56
Ohio	−98.77	−988.09	147.42	3,356.62	2,417.20

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State	Farmers	Food consumers (SNAP recipients)	Food consumers (SNAP nonrecipients)	Taxpayers	TOTAL
Oklahoma	−98.94	−319.83	47.18	818.42	446.84
Oregon	−50.19	−723.97	49.16	686.36	−38.63
Pennsylvania	−127.88	−1,255.75	184.34	3,292.18	2,092.89
Rhode Island	−0.25	−146.91	13.89	332.12	198.85
South Carolina	−27.80	−476.95	55.80	560.69	111.73
South Dakota	−102.17	−45.03	11.35	155.19	19.34
Tennessee	−31.05	−752.28	73.02	1,420.38	710.06
Texas	−310.63	−2,233.33	325.96	6,630.80	4,412.80
Utah	−26.12	−202.71	45.42	472.61	289.20
Vermont	−21.92	−72.91	8.73	106.50	20.40
Virginia	−42.90	−575.61	107.30	1,942.69	1,431.48
Washington	−121.16	−968.15	95.97	1,584.55	591.22
West Virginia	−8.01	−184.96	22.23	196.35	25.60
Wisconsin	−262.96	−517.06	74.30	1,253.83	548.11
Wyoming	−19.20	−24.53	9.60	115.67	81.54
District of Columbia	0.00	−89.90	6.71	626.87	543.69
Unattributed/rest of world	−1,597.67		354.62		−1,243.05
TOTAL	−6,293.45	−31,333.46	4,508.51	75,891.13	42,772.72

Note: Assumes that all SNAP payments are spent on food.

Table A5. Projected State-Level Effects from 20 Percent Reduction in Demand for Corn for Ethanol ($ Millions per Year)

State	Case 1: $\eta_{14,E} = -0.127$			Case 2: $\eta_{14,E} = -1.75$		
	Farmers	Food consumers	TOTAL	Farmers	Food consumers	TOTAL
Alabama	−0.08	1.28	1.19	−0.78	12.66	11.89
Alaska	6.71	0.21	6.92	63.96	2.11	66.07
Arizona	−0.19	1.91	1.72	−1.78	18.91	17.13
Arkansas	−2.40	0.78	−1.62	−22.96	7.75	−15.22
California	−1.69	11.07	9.38	−16.38	109.77	93.39
Colorado	−4.77	1.51	−3.26	−45.60	14.97	−30.63
Connecticut	0.00	1.06	1.07	0.03	10.56	10.59
Delaware	−0.41	0.24	−0.16	−3.90	2.41	−1.49
Florida	−0.17	5.12	4.95	−1.64	50.73	49.09
Georgia	−1.03	2.63	1.59	−9.88	26.05	16.18
Hawaii	0.00	0.41	0.41	0.02	4.02	4.03
Idaho	−0.55	0.46	−0.09	−5.27	4.60	−0.66
Illinois	−33.32	3.30	−30.02	−320.07	32.75	−287.32
Indiana	−12.31	1.68	−10.63	−118.39	16.63	−101.77
Iowa	−43.10	0.79	−42.32	−413.68	7.82	−405.86
Kansas	−8.58	0.74	−7.84	−82.31	7.34	−74.97
Kentucky	−1.73	1.16	−0.57	−16.68	11.50	−5.18
Louisiana	−0.33	1.22	0.89	−3.25	12.09	8.83
Maine	0.00	0.39	0.40	0.04	3.91	3.95
Maryland	−0.70	1.56	0.86	−6.70	15.45	8.75
Massachusetts	0.00	1.97	1.97	−0.03	19.54	19.51
Michigan	−5.45	2.54	−2.91	−52.35	25.14	−27.21
Minnesota	−22.79	1.38	−21.41	−218.81	13.68	−205.13
Mississippi	0.96	0.79	1.75	9.06	7.84	16.90
Missouri	−0.42	1.54	1.12	−4.41	15.32	10.90
Montana	−0.10	0.29	0.20	−0.91	2.90	1.99
Nebraska	−31.76	0.48	−31.28	−304.51	4.72	−299.79
Nevada	0.01	0.80	0.81	0.09	7.96	8.05
New Hampshire	0.00	0.39	0.39	0.01	3.88	3.90
New Jersey	−0.17	2.63	2.46	−1.62	26.06	24.44
New Mexico	−0.24	0.61	0.37	−2.24	6.02	3.78
New York	−2.29	5.80	3.52	−21.91	57.53	35.63
North Carolina	0.26	2.58	2.84	2.46	25.61	28.07
North Dakota	−1.50	0.18	−1.32	−14.60	1.78	−12.82
Ohio	−4.26	2.96	−1.29	−41.21	29.36	−11.84

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State	Case 1: $\eta_{14,E}$ = −0.127			Case 2: $\eta_{14,E}$ = −1.75		
	Farmers	Food consumers	TOTAL	Farmers	Food consumers	TOTAL
Oklahoma	−0.41	1.01	0.60	−3.84	10.02	6.18
Oregon	−0.29	1.13	0.84	−2.79	11.25	8.46
Pennsylvania	−2.84	3.78	0.94	−27.24	37.52	10.28
Rhode Island	0.00	0.31	0.31	0.00	3.09	3.09
South Carolina	−0.29	1.25	0.96	−2.79	12.41	9.61
South Dakota	−9.95	0.21	−9.73	−95.55	2.12	−93.43
Tennessee	−0.02	1.71	1.69	−0.28	16.96	16.68
Texas	−6.58	6.90	0.32	−62.83	68.44	5.61
Utah	−0.12	0.83	0.71	−1.15	8.24	7.09
Vermont	0.02	0.19	0.20	0.16	1.84	2.00
Virginia	−0.03	2.17	2.14	−0.29	21.50	21.20
Washington	−0.89	2.01	1.12	−8.56	19.90	11.34
West Virginia	−0.06	0.49	0.43	−0.56	4.87	4.31
Wisconsin	−10.14	1.47	−8.67	−97.22	14.57	−82.66
Wyoming	−0.21	0.17	−0.04	−2.02	1.66	−0.36
District of Columbia		0.17	0.17	–	1.66	1.66
Unattributed/rest of world	2.48	−26.63	−24.15	24.57	−208.68	−184.11

Note: Totals do not include effects on ethanol producers and consumers.