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Macroeconomic Impacts of U.S. Farm and Nutrition Programs

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This study estimates the economy-wide impacts of two components of U.S. federal spending—nutrition programs and farm support programs—using an applied general equilibrium model. Both programs slightly reduce overall economic output and have important distributional effects. Farm programs reduce expenditures on a wide array of goods and services throughout the economy, including agricultural products, primarily since the programs reduce the spending power of taxpayers in general. Nutrition programs also reduce expenditures for some goods and services but raise the demand for agricultural products as well certain sectors for which the marginal propensity to consume is high among low-income households.

Key words: agriculture and food policy, Farm Bill, nutrition, societal welfare, Supplemental Nutrition Assistance Program

Introduction

The U.S. Farm Bill is a wide-ranging piece of legislation that proposes to meet a variety of economic objectives pertaining to food and agriculture. Approximately 13% of authorized spending tends to be for farm "safety net" programs that are—at their core—intended to raise the average income of farmers (Weber et al., 2015; Smith et al., 2017). Meanwhile, approximately 80% of Farm Bill spending is for nutrition assistance programs, primarily the Supplemental Nutrition Assistance Program (SNAP), the nation's key anti-hunger program (Johnson and Monke, 2018). SNAP is intended to perform a countercyclical function for low-income households, allowing them to smooth their consumption across periods of instability. The Farm Bill typically involves many billions of dollars of spending per year and can be politically contentious (Center on Budget and Policy Priorities, 2016; Lusk, 2016; Smith et al., 2017). A close examination of these programs therefore warrants attention and analysis.

This study quantifies the economy-wide impacts of farm and nutrition programs, including the distributional effects for society at large and the allocative effects on resources within the economy. Although there are nutrition programs other than SNAP, SNAP is the specific form of nutrition programs we analyze here. We do not predict upcoming Farm Bill proposals but intend to capture the general tradeoffs associated with farm and nutrition programs from a relatively historical perspective. The study complements number of econometric analyses of these programs in the sense that it makes use of their evidence—along with data from the U.S. Bureaus of the Census, Labor Statistics, and Economic Analysis—to parameterize a simulation model of the U.S. economy. The objective is to compare in a general way the major program that operates largely on the *demand side* of food and agriculture (SNAP) versus the collection of farm programs that concern the *supply side* of food and agriculture.

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The analysis accounts for the higher tax rates and amount of tax revenue required to fund the programs (i.e., for the direct burden of the tax). Taxes also induce changes in behavior, as producers and consumers may change the quantities that they produce or consume in order to avoid paying a tax. This can create a loss in economic efficiency, which is known as the excess burden of the tax (Burfisher, 2011). The analysis is capable of accounting for such effects.

The study compares and contrasts the effects of farm and nutrition programs on the welfare of all U.S. households and allows for effects on sectors of the U.S. economy that are not directly affected by the programs. Both farm and nutrition programs affect the spending patterns of taxpayers in general since these programs are funded in large part through tax revenues. While farm programs are targeted to a specific set of farm sectors, they may indirectly affect a wide range of manufacturing and service sectors up and down the supply chain. These changes are uneven across the economy and can push and pull labor into and out of different sectors. Nutrition programs also have direct effects on food and agriculture because beneficiaries are restricted to spending benefits on food-related products. However, by covering most or all of their food expenses, nutrition programs free up a portion of their resources for housing, transportation, health care, and other expenditures. In summary, both types of programs affect not just direct beneficiaries but also those actors in the economy that pay for the programs and—in the midst of all this—the supply, demand, and price of numerous intermediate and final products. Accounting for this in an explicit manner has received little—if any—attention in the literature and forms one of the contributions of this study.

To properly account for effects that spill over many sectors and affect multiple households and factors of production, we build and calibrate an applied general equilibrium model for the United States. The model allows for behavioral responses on the part of consumers, producers, and trading partners, including substitution effects among households (for one good versus another), among firms (for one input versus another), and among regions (exports and imports between the United States and the rest of the world). While our approach adheres closely to standard general equilibrium approaches, it is a newly constructed model that relies on extensive data (representing 50 sectors and 9 U.S. households) that is able to measure economic relationships that no other approach in the literature appears to have measured. A contribution to the literature is being able to compare the large, important parts of the Farm Bill using a single economic model.

While farm programs do indeed deliver economic benefits to the agricultural sector (their primary purpose), they slightly reduce agricultural prices and the welfare of U.S. households generally. Nutrition programs expand the size of the food and agricultural sector through demand-side effects and act to raise agricultural prices. In this way they help—perhaps coincidentally—achieve the goals of farm programs. Ultimately, the effects of nutrition programs offset those of farm programs such that the net macroeconomic impact detected in this study is associated most closely with nutrition programs. Unlike farm programs, nutrition programs have a strongly positive welfare effect on low-income households. Both programs have an adverse welfare effect on high-income households, primarily through the direct effect on taxes as well as excess burden. Overall, there are small declines in GDP that arise from both programs. This results from inefficient activities undertaken in reaction to taxes, creating an excess burden of taxation.

As such, this study addresses a combination of effects from the Farm Bill that have not previously been addressed in the literature. Existing studies have quantified individual dimensions of these programs, such as farm programs in isolation (e.g., Young and Westcott, 2000; Whitaker, 2009; Coble and Barnett, 2013; Goodwin and Smith, 2013), nutrition programs in isolation (e.g., Hanson et al., 2002; Jensen, 2002; Wilde and Nord, 2005; Reimer, Weerasooriya, and West, 2015), or both programs in a partial equilibrium setting (Lusk, 2015). This study is meant to fill the resulting gaps in the literature. In addition, this study contrasts with input–output and multiplier studies of farm and nutrition programs. Although these latter studies may also use national accounts data, this study allows for household and firm behavioral responses, opportunity costs, and the possibility of excess burden from taxation. In contrast to the previous types of studies, ours is based around a social accounting matrix (SAM), which represents all transactions and transfers between different

production activities, factors of production, and institutions (households, corporate sector, and government) within the United States and with respect to the rest of the world. The model is based on the pioneering work of Löfgren, Harris, and Robinson (2001) and is related to—although distinct from—other adaptations such as Waters, Holland, and Weber (1997) and Holland, Stodick, and Devadoss (2010).

Data and Model

To carry out the analysis, we first create a social accounting matrix (SAM) for the year 2010. The SAM uses double-entry accounting to link together (i) the production of goods and services, (ii) the firms and people that buy them, and (iii) inputs such as labor and capital that are used in production. The households distinguished in the SAM differ by income level, sources of income, consumption patterns, and transfers to and from other agents. The SAM also distinguishes 50 economic sectors, thereby offering high resolution regarding the diffusion of impacts.

The SAM can be interpreted as a snapshot of the economy in which the effects of the two programs under investigation are already manifested. The general equilibrium model, on the other hand, is constructed in order to represent the structure of the economy without the two programs in place. As implied previously, the emphasis in this study is on the large economy-wide impacts of Farm Bill programs in general as opposed to modeling an evolution of small changes in the Farm Bill over time. Although the specific year examined is 2010, the following results are intended to be relevant, within reason, over longer spans of time.

We compare the following numerical scenarios: (i) the U.S. economy with both programs in place, (ii) the U.S. economy simulated without farm programs in place, and (iii) the U.S. economy simulated without nutrition programs in place.

Data for the SAM and related economic variables were compiled from IMPLAN (2012), the U.S. Department of Agriculture (2017a,b,c), and the Environmental Working Group (2011). Table 1 reports statistics for the nine households of the analysis in 2010, including the number of households and each household's estimated contribution to federal revenue, which is estimated from data from the U.S. Census Bureau (2017) and IMPLAN (2012). Table 1 also reports the share of income received from labor versus capital. Labor comprises 87.9% of earnings for households with income of $50,000–$75,000 per year but only 59.4% for households with income above $150,000.

The model is based on Löfgren, Harris, and Robinson (2001) and citations therein. We summarize the most salient equations. The model is consistent with the principals of optimization by firms and households, along with standard equilibrium conditions of economic theory. For example, the nine representative households maximize Stone–Geary utility, which yields final demand functions given by a linear expenditure system, as follows:

$$D_{ih} = \lambda_{ih} + \frac{\beta_{ih}\left[I_h - \sum_j \lambda_{jh}\left(1 + tc_i\right) p_j\right]}{\left(1 + tc_i\right) p_i}, \tag{1}$$

where D_{ih} is final demand for good i by household h, λ_{ih} is a subsistence-level parameter, β_{ih} is a marginal budget share, I_h is income, tc_i is a consumption tax, and p_i is the price of good i. Goods i and j are both indexed across 50 economic sectors. There are 50 corresponding representative firms that maximize profits according to individual constant elasticity of substitution (CES) technologies. The production function combines labor, capital, and intermediate inputs as

$$Y_i = \frac{\theta_i}{1 - tva_i - \sum_j ica_{ij}} \left(\sum_f \delta_{fi} F_{fi}^{-\rho_i} \right)^{-\frac{1}{\rho_i}}, \tag{2}$$

where Y_i is the output of good i, θ_i is a production shift parameter, tva is value-added tax, ica is the

Table 1. Characteristics of the Representative Nine Households, 2010

Household	Income Category	Number of Households	Contribution to Federal Revenue by Each Household	Percentage of SNAP Benefits Received by Each Household	Share of Income from Labor	Share of Income from Capital
1	<$10,000	11,208,871	0.20%	31.56%	82.0%	18.0%
2	$10,000–$15,000	7,412,319	0.13%	14.90%	78.4%	21.6%
3	$15,000–$25,000	15,072,384	0.27%	22.38%	83.9%	16.1%
4	$25,000–$35,000	15,052,651	1.68%	11.77%	84.9%	15.1%
5	$35,000–$50,000	19,425,102	2.16%	9.36%	85.5%	14.5%
6	$50,000–$75,000	22,870,406	8.87%	5.89%	87.9%	12.1%
7	$75,000–$100,000	12,024,141	10.11%	2.18%	85.4%	14.6%
8	$100,000–$150,000	9,071,987	7.63%	1.43%	80.9%	19.1%
9	>$150,000	5,371,952	68.94%	0.54%	59.4%	40.6%

Notes: Revenue contribution shares are from the U.S. Congressional Budget Office (2013) and SNAP benefit shares are from the U.S. Census Bureau (2017)

Table 2. Expenditure Shares and Expenditure Elasticities

	Low-Income Households (<$25,000)			Middle-Income Households ($25,000-$100,000)			High-Income Households (>$100,000)		
	Exp. Share	Exp. Elast. (LES)	Exp. Elast. (AIDS)	Exp. Share	Exp. Elast. (LES)	Exp. Elast. (AIDS)	Exp. Share	Exp. Elast. (LES)	Exp. Elast. (AIDS)
Food at home	0.154	0.426	0.721	0.111	0.620	0.594	0.075	0.921	0.398
		(0.031)	(0.006)		(0.045)	(0.009)		(0.068)	(0.014)
Food away from home	0.040	1.252	1.075	0.040	1.016	1.061	0.049	0.960	1.058
		(0.082)	(0.019)		(0.066)	(0.015)		(0.063)	(0.015)
Housing	0.251	1.036	1.013	0.219	1.217	1.016	0.217	1.251	1.016
		(0.034)	(0.009)		(0.041)	(0.011)		(0.042)	(0.011)
Utilities	0.118	0.398	0.719	0.087	0.537	0.620	0.057	0.801	0.433
		(0.038)	(0.007)		(0.051)	(0.010)		(0.076)	(0.015)
Health	0.087	0.790	0.848	0.078	0.838	0.839	0.050	1.289	0.753
		(0.076)	(0.017)		(0.081)	(0.018)		(0.124)	(0.027)
Education	0.014	0.834	1.992	0.014	0.711	1.845	0.035	0.278	1.331
		(0.308)	(0.087)		(0.262)	(0.074)		(0.102)	(0.029)
Transportation	0.140	1.459	1.279	0.167	1.136	1.217	0.154	1.181	1.225
		(0.079)	(0.018)		(0.061)	(0.014)		(0.064)	(0.014)
Services	0.065	1.268	1.143	0.067	1.173	1.133	0.081	0.961	1.109
		(0.095)	(0.017)		(0.088)	(0.016)		(0.073)	(0.013)
Miscellaneous	0.132	1.917	1.351	0.211	1.134	1.208	0.282	0.826	1.151
		(0.080)	(0.017)		(0.048)	(0.010)		(0.035)	(0.007)

Notes: Numbers in parentheses are standard errors. Number of observations in econometric analysis is 4,986.

quantity of good i used in good j, F_{fi} is the quantity of factor f demanded for good i, δ_{fi} is a share parameter, and ρ is the CES parameter. Equation (2) provides the basis of firm profit-maximization problems.

Capital and labor are assumed to be fully employed, fixed in supply, and mobile across sectors. Relaxing these assumptions (e.g., to allow nutrition programs to have an impact on labor participation) does not change any of the results that follow in a meaningful way. Factor demands by firm i is

$$\tau_{fi} w_f = \frac{pva_i \theta_i}{1 - tva_i - \sum_j ica_{ij}} \left(\sum_{ff} \delta_{ffi} F_{ffi}^{-\rho_i} \right)^{-\frac{1}{\rho_i}-1} \delta_{fi} F_{fi}^{-\rho_i - 1}, \tag{3}$$

where both f and ff index labor and capital, w_f is the rental rate for factor f, τ_{fi} is a wage-distortion factor, and pva_i is the value-added price for good i.

The model has other equations imposing equilibrium in product and factor markets, intermediate input use, savings and investment equilibrium, and trade relations with the rest of the world. These are not described here due to space constraints; the approach follows standard applied general equilibrium conventions such as those in Löfgren, Harris, and Robinson (2001) and the studies cited therein.

In addition to providing a baseline measure of the economy against which to make comparisons, we use the SAM to calibrate most model parameters. During calibration, all prices in the model are set to unity and the base-year factor levels of SAM flows are substituted into the model as equilibrium values of model variables. (This process is similar to maximum likelihood estimation with one observation.) The model also contains a number of exogenous parameters; these are set at values based on econometric estimates or for which there is a consensus value in the literature (Waters, Holland, and Weber, 1997; Löfgren, Harris, and Robinson, 2001; Reimer, Zheng, and Gehlhar, 2012; Reimer, Weerasooriya, and West, 2015).

One aspect for which this study generated new econometric evidence is the demand system parameters. The model's linear expenditure system was estimated using 4,986 observations from the Consumer Expenditure Survey of the Bureau of Labor Statistics for 2008–2011. Table 2 reports actual expenditure shares across household groups. Expenditure shares for necessities such as food at home, utilities, and health decrease with income. However, the expenditure shares for services increase with income.

Space constraints prohibit a full reporting of the estimating equations and model results, but Table 2 presents the estimated expenditure elasticities. For sake of comparison, we also estimated and reported a linear approximate almost ideal demand system (Deaton and Muellbauer, 1980) using the same data. Results are largely consistent across the two demand systems. Since the demand system was estimated for nine aggregated sectors, the results had to be allocated to the disaggregated sectors as appropriately as possible. We used additional results from Reimer and Hertel (2004, 2010) and Meade et al. (2014) for sectors that otherwise had incomplete information. The model code has a full representation of the estimates used.

Design of Counterfactual Scenarios

We now present the implementation of the scenarios. During the focus year (2010), the Farm Bill in effect was the Food, Conservation, and Energy Act of 2008. The first step is to represent the counterfactual associated with farm programs. While such programs are multiple and complex, farm programs in the 2014 Farm Bill were designed to have a limited effect on (i.e., be decoupled from) agricultural supply and prices, while ensuring that farms receive after-tax income higher than would occur otherwise. Economic studies have tended to find that farm program subsidies are largely capitalized into primary factors of production such as land, labor, and capital (Young and Westcott, 2000; Hanson and Somwaru, 2003; Goodwin and Mishra, 2006; Sumner, 2007; Smith et al., 2017).

Table 3. Average Change in Output for $1 of Spending on Farm Programs

Farming Sector	Net Transfer from Sector to Government ($millions)		Amount Spent in 2010 under Farm Programs ($millions)	Estimated Farm-Sector Response		
	Without Farm Programs	With Farm Programs		Change in Output Value ($millions)	Change in Commodity Prices (%)	Output Change for $1 of Spending
Oilseed	2,605	870	1,735	−55	−0.025	−0.03
Grains	5,964	-4	5,968	−70	−0.014	−0.01
Cotton	828	-1	829	−10	−0.019	−0.01
Other crops	1,283	1,272	11	−94	−0.015	−8.55
Dairy	439	365	74	−143	−0.010	−1.93
Livestock	1,921	1,694	227	−41	−0.006	−0.18
Tobacco	9,575	9,380	195	−134	−0.016	−0.69
Total	22,615	13,576	9,039	−547	−0.015	−0.06

Notes: Subsidies are from U.S. Congressional Budget Office (2013) and Environmental Working Group (2011). Oilseeds is an aggregate of soybeans ($1,555 million), peanuts ($87 million), sunflowers ($62 million) and canola ($31 million). Grains is an aggregate of corn ($3,495 million), wheat ($1,732 million), rice ($402 million), sorghum ($246 million), barley ($87 million) and oats ($7 million).

As a result, in this study, we represent farm programs as enhancing the value added of a given activity (e.g., oilseed production). This approach has precedent in the literature (e.g., Hanson and Somwaru, 2003) and is able to replicate existing evidence on the extent of coupling in agricultural markets. The counterfactual starts with the observation that farm businesses pay taxes on value added (i.e., on the income associated with primary factors of production [labor and capital, including land]). The taxes on value added for a given sector are recorded in the SAM and are used to calibrate their *ad valorem* rate in the model (parameter *tva* in equation 3). The subsidies are then viewed as keeping this rate artificially low. The counterfactual involves rerunning the model under a new *tva* rate that eliminates the level of support that a given sector received in 2010. This rate increases for those production sectors that received support from the federal government, according to the amount received.

Detailed data on farm subsidies are necessary to implement this counterfactual. Estimates of the size of benefits by production sector were obtained from sources including the U.S. Congressional Budget Office (2013), the U.S. Department of Agriculture U.S. Department of Agriculture (2017a,b), and the Environmental Working Group (2011). In 2010, federal expenditures on farm programs for commodity program and crop insurance totaled approximately $9.04 billion. Table 3 reports specific amounts received by production sector in 2010. Sectors with the largest benefits were grains ($5,968 million), oilseeds ($1,735 million), and cotton ($829 million). Livestock and dairy received a combined $301 million.

These values offset the value-added taxes paid by each sector as represented in the SAM, which incorporates data from IMPLAN (2012) and the U.S. Congressional Budget Office (2013). Table 4 reports how this was done in the counterfactual. Consider the oilseed sector. Producers in this sector transferred net $870 million to the federal government in 2010 when farm programs were in place (this is what was recorded in the SAM). The actual taxes were much higher, but these were offset by the subsidies that were provided. Without the subsidies, the oilseed sector would have transferred net $2,605 million, much higher than in the SAM.

Another part of this counterfactual is to characterize how taxpayers are affected. One issue is how taxpayer funds would be used if not in service of the Farm Bill. The funds could be used to reduce the deficit or be spent on other, currently underfunded programs. In this study, however, funds are returned to taxpayers at the rate at which they pay taxes. The taxes are recorded in the SAM and their *ad valorem* rate is represented in the model by parameters (denoted *ty*) that are calibrated to induce the changes.

Table 4. Counterfactual Design for the Impact of Farm Programs

Panel A. Eliminating Farm Programs from Eligible Farming Sectors

	Net Transfers to the Federal Government ($millions)			Value-Added Tax	
Farming Sector	Without Farm Programs	With Farm Programs	Total Receipts ($millions)	Without Farm Programs	With Farm Programs
Oilseed	2,605	870	34,224	7.61%	2.54%
Grains	5,964	−4	60,974	9.78%	−0.01%
Cotton	828	−1	6,267	13.22%	−0.01%
Other crops	1,283	1,272	44,408	2.89%	2.86%
Dairy	439	365	31,361	1.40%	1.16%
Livestock	1,921	1,694	74,618	2.57%	2.27%
Tobacco	9,575	9,380	49,236	19.45%	19.05%

Panel B. Assumptions for Taxpaying Households

	Net Transfers to the Federal Government ($millions)			Income Tax Rate	
Household	Without Farm Programs	With Farm Programs	Total Receipts ($millions)	Without Farm Programs	With Farm Programs
1	−1,507	−1,489	378,392	−0.40%	−0.39%
2	−6,818	−6,807	275,372	−2.48%	−2.47%
3	−4,867	−4,843	745,831	−0.65%	−0.65%
4	14,763	14,915	916,646	1.61%	1.63%
5	58,087	58,282	1,484,986	3.91%	3.92%
6	160,759	161,561	2,460,850	6.53%	6.57%
7	141,731	142,646	1,690,885	8.38%	8.44%
8	190,287	190,977	1,844,040	10.32%	10.36%
9	337,639	343,870	2,850,626	11.84%	12.06%

Notes: Households are defined in Table 1.

Based on this process, Table 4 reports how the counterfactual represents the absence of farm programs from the household perspective. For example, household category 9 paid a total of $343,870 million in 2010 with farm programs in place. Without farm programs, they would have had to pay only $337,630 million. Similar interpretations can be made for other farm sectors and households (Table 4). Solving for the model's endogenous variables under these new rates of transfer (and reflecting behavior of numerous agents) effectively removes farm programs from the 2010 baseline data.

In the case of nutrition programs (focusing on SNAP in this study), 2010 federal expenditures were $68.3 billion and were allocated to 40.3 million participants (U.S. Department of Agriculture, 2017c). While there are differences in how SNAP is administered across states and household types, this study is a national-level analysis and is focused on eligibility under federal guidelines (Hoynes and Schanzenbach, 2009). A household of three, for example, is considered to be eligible for benefits if it has a gross income at or below 130% of the poverty line (approximately $24,100 for a household of three), a net income of about $18,500 per year, and assets of $2,000 or less. Table 1 reports the share of SNAP benefits received by each of the nine households, estimated using Survey of Income and Program Participation (SIPP) data from the U.S. Census Bureau (2017).

Table 5 reports how the SNAP counterfactual is implemented. For example, household 1 transferred −$1,489 million to the federal government under SNAP (negative, since incoming transfers exceeded federal taxes paid); without SNAP benefits to offset the tax payments, their net transfer to the federal government would be $19,927 million. In contrast, household 9 received only 0.54% of total SNAP benefits and had net transfers to the federal government of $343,870 million.

Table 5. Counterfactual Design for the Impact of Nutrition Programs (SNAP)

	Net Transfers to the Federal Government ($millions)			Income Tax Rate	
Household	Without SNAP	With SNAP	Total Receipts ($millions)	Without SNAP	With SNAP
1	19,927	−1,489	378,392	5.27%	−0.39%
2	3,278	−6,807	275,372	1.19%	−2.47%
3	10,252	−4,843	745,831	1.37%	−0.65%
4	21,806	14,915	916,646	2.38%	1.63%
5	63,201	58,282	1,484,986	4.26%	3.92%
6	159,522	161,561	2,460,850	6.48%	6.57%
7	137,224	142,646	1,690,885	8.12%	8.44%
8	186,742	190,977	1,844,040	10.13%	10.36%
9	297,158	343,870	2,850,626	10.42%	12.06%

Notes: Households are defined in Table 1.

Without SNAP, they would have only needed to transfer $297,158 million. Similar interpretations hold for other households. Solving for the model's endogenous variables under these new rates of transfers—and under the behavioral characterizations of the model—effectively removes SNAP from the 2010 baseline data.

Another aspect of the SNAP counterfactual is the need to account for the restrictions that come with the benefits; they can only be used for authorized items (primarily food and beverages but also food-producing items such as vegetable starts). Despite these restrictions, this frees up money for spending by recipient households on other sectors. The marginal propensity to consume additional food under SNAP is therefore less than 1. This concept is often represented by an index, ranging from 0 to 1, that is called additionality and is the amount by which $1 of program spending results in additional food spending. Past studies suggest that additionality is approximately 0.30, meaning that $0.30 more food is purchased overall for every additional $1 dollar of SNAP benefits (Levedahl, 1995; Kramer-LeBlanc et al., 1999; Breunig and Dasgupta, 2005; Beatty and Tuttle, 2015). Expenditure elasticities are calibrated such that the model replicates this evidence on SNAP benefit restrictions and additionality.

As in any study, there will be uncertainty surrounding the results. To provide a measure of this uncertainty, we employ a sensitivity analysis following Arndt's (1996) approach. As implemented in what follows, the expenditure elasticities are treated as random variables with distributions. Where possible, the means and standard deviations of model results have been presented using these techniques. The approach to calculating the standard deviations involves assuming a normal distribution and making 100 draws per elasticity. Model simulations were carried out for each of these 100 draws.

Results

The results consist of new equilibrium values of the endogenous variables under the scenarios described previously. For ease of presentation, results across the nine households are aggregated. Households 1–3 are aggregated to a low-income household with annual income below $25,000, households 4–7 are aggregated to a middle-income household with income of $25,000–$100,000, and households 8–9 are aggregated to a high-income household with income above of $100,000.

We now compare the farm and nutrition program scenarios. The first scenario represents a move from not having farm programs to having them; nutrition programs are intact throughout. The second scenario represents a move from not having nutrition programs to having them; farm programs are intact throughout. This allows us to impute and analyze the joint impact of the programs. Due to

Table 6. Consumption Impacts on General Population from Farm Programs

	Household-Level Expenditure Change					
	Low-Income Households (<$25,000)		Middle-Income Households ($25,000–$100,000)		High-Income Households (>$100,000)	
Consumption Category	($)	(%)	($)	(%)	($)	(%)
Food at home	−0.45	−0.02	−3.33	−0.08	−9.39	−0.10
Food away from home	−0.34	−0.02	−3.16	−0.08	−12.79	−0.11
Non-food consumption	−10.61	−0.03	−110.64	−0.12	−572.67	−0.20
Alcohol and tobacco	−0.10	−0.02	−0.83	−0.09	−2.20	−0.12
Clothing	−0.05	−0.01	−1.15	−0.10	−7.42	−0.18
Nondurables	−0.56	−0.03	−3.80	−0.11	−13.90	−0.18
Durables	−0.49	−0.02	−5.17	−0.11	−28.67	−0.18
Petroleum	−0.14	−0.01	−2.12	−0.10	−9.02	−0.17
Utilities	−0.46	−0.02	−4.06	−0.12	−16.61	−0.22
Finance and Insurance	−0.91	−0.03	−14.42	−0.16	−64.34	−0.25
Housing	−0.55	−0.01	−14.22	−0.11	−89.76	−0.20
Health and education	−3.61	−0.04	−27.47	−0.16	−135.78	−0.25
Transportation	−0.31	−0.03	−2.45	−0.14	−16.65	−0.24
Wholesale and retail	−1.40	−0.03	−16.84	−0.12	−88.85	−0.20
Other services	−2.05	−0.05	−18.11	−0.17	−99.45	−0.26
Total consumption	−11.40	−0.02	−117.13	−0.08	−594.85	−0.12

Notes: The simulated impacts represent a move from a 2010 equilibrium without farm programs, all else the same, to the actual 2010 equilibrium that did incorporate farm programs. Values are in 2010 U.S. dollars. Standard deviations are not reported but are less than 0.01 in virtually every case.

space constraints, we don't present the joint impact of the two programs; it has been calculated as approximately the sum of the impacts of the two individual programs.

Effects on Consumption

Tables 6 and 7 report how the programs affect consumption of different products by household grouping. Table 6 reports changes in consumer expenditure across major expenditure categories due to the implementation of farm programs. Looking at the bottom row of Table 6, we see that the spending power of households with less than $25,000 in annual income falls by an average $11.40/year. The spending power of households with $25,000–$100,000 in annual income falls by $117.13/year, and the spending power of households with income over $100,000 falls by $594.85/year.

In each of these cases, the category with the largest decline in spending is health and education, with declines of $3.61/year, $27.47/year, and $135.78/year, respectively, across the three income classifications. These changes account for differing preferences by household type and the effects of farm programs on the supply and prices of food and agricultural commodities. The changes in Table 6 are the results of the linear expenditure system that has been estimated for each of the nine household types that underlie the three household groupings reported. This accounts for changes in both after-tax income and the prices of the 50 products distinguished in the model.

Table 7 reports, in similar fashion to Table 6, how nutrition programs (in the form of SNAP) affect households' purchasing decisions. Looking at the bottom row of Table 7, we see that the implementation of nutrition programs is associated with changes of $1,302.61/year, $19.41/year, and −$3,216.37/year in the effective spending power of low-, middle-, and high-income households,

Table 7. Consumption Impacts on General Population from Nutrition Programs (SNAP)

	Household-Level Expenditure Change					
	Low-Income Households (<$25,000)		Middle-Income Households ($25,000–$100,000)		High-Income Households (>$100,000)	
Consumption Category	**($)**	**(%)**	**($)**	**(%)**	**($)**	**(%)**
Food at home	336.53	16.94	10.60	0.35	−12.94	−0.10
Food away from home	25.27	1.70	−0.48	0.06	−68.52	−0.48
Non-food consumption	940.81	3.09	9.29	0.11	−3,134.91	−0.96
Alcohol and tobacco	13.65	2.90	0.20	0.08	−12.10	−0.60
Clothing	9.78	2.11	−0.07	0.08	−44.90	−0.95
Nondurables	55.54	2.98	1.91	0.09	−77.27	−0.87
Durables	50.78	2.89	−0.71	0.09	−165.18	−0.89
Petroleum	28.88	2.98	0.20	0.09	−51.82	−0.87
Utilities	47.85	2.93	1.33	0.11	−91.16	−1.05
Finance and Insurance	65.72	2.66	−1.00	0.13	−345.22	−1.14
Housing	133.67	2.35	−0.30	0.10	−542.86	−1.04
Health and education	207.59	2.28	6.29	0.12	−730.15	−1.11
Transportation	24.90	2.65	0.28	0.11	−94.75	−1.10
Wholesale and retail	157.23	7.27	−2.21	0.20	−430.44	−0.74
Other services	145.22	3.09	3.36	0.13	−549.05	−1.16
Total consumption	1,302.61	7.89	19.41	0.19	−3,216.37	−0.45

Notes: The simulated impacts represent a move from a 2010 equilibrium without nutrition programs, all else the same, to the actual 2010 equilibrium that did incorporate nutrition programs. Values are in 2010 U.S. dollars.

respectively. For households with income below $25,000, the single category with the most change is food at home, on which spending rises by $336.53, or 16.94%. Among households with income exceeding $100,000, the greatest change is a reduction of $730.15 in spending on health and education (a modest 1.11% decrease). Results for households in the middle-income category are mixed, but the biggest change is a $10.60 (0.35%) rise in spending on food, since some of these households receive nutrition benefits.

We would expect that households with less than $25,000 of income substantially increase food at home spending under nutrition programs, due to the nature of SNAP benefits. However, households in this group increase their nonfood consumption by a substantially larger amount, $940.81. A natural question concerns how nonfood expenditures can rise if SNAP does not explicitly permit spending on them. The answer is that program beneficiaries use personal income previously spent on food for nonfood purchases. Table 7 shows that households with incomes below $25,000 increase expenditure on housing ($133.67), health and education ($207.59), wholesale and retail trade services ($157.23), and other services ($145.22).

Under nutrition programs, the effective spending power of households making less than $25,000, $25,000–$100,000, and more than $100,000 changes by an average of 7.89%, 0.19%, and −0.45%, respectively (Table 7). While the percentage differences are moderate, these changes can be important from a sectoral perspective. For example, while households making less than $25,000 spend $65.72 more on finance and insurance, households making more than $100,000 spend $345.22 less on this sector. Similarly, households making less than $25,000 spend $25.27 more on food away from home (e.g., restaurants), while households making more than $100,000 spend $68.52 less on this sector. Households making less than $25,000 spend $336.53 more on food at home, but households making more than $100,000 spend $12.94 less on this sector. Thus, the demographic makeup of a given sector's customers changes.

These patterns alone do not tell the whole story about whether a particular industry gains or loses sales from either of the two programs. This is because the number of households varies greatly across income categories. For example, 11,208,871 households had income less than $10,000, but 22,870,406 households had income between $50,000 and $75,000 and 5,371,952 had income above $150,000 (Table 1). Since the number of households varies so much by grouping, the results of Tables 6 and 7 are not sufficient to understand changes on the supply side. We consider those results in what follows.

To summarize this section, we make several observations with respect to the two programs' effects on consumption expenditures. First, when households receive SNAP benefits, they have money available for nonfood related consumption since many of their food expenditures are now covered. This frees up resources to be used for other (SNAP-ineligible) purchases, creating ripple effects through the economy. Working against this tendency is the fact that these programs reduce higher-income households' disposable income. These changes are guided by the linear expenditure system that has been predicted for each of the nine households as well as price and factor income changes.

Second, consumption changes under farm programs work differently. These changes are driven by across-the-board disposable income effects, in which the demand curves of taxpaying households shift left due to declining after-tax income. We will show that agricultural prices fall under farm programs. Nutrition programs, by contrast, lead to slight increases in the prices of food and agricultural products.

Third, nutrition programs have a larger impact than farm programs on most households. This is partly because SNAP is a larger program but also because it largely involves transfers among households, some of which gain and some of which lose. The impact is highest for low-income households since they receive 80% of the nutrition program benefits provided to all households.

Supply-Side Changes

Table 8 reports supply-side changes for 38 of the 50 economic sectors distinguished in the SAM and in the model (space constraints preclude presentation of all results). The change in value of output (sales) is reported in both dollars and as percentages. The case of farm programs is fairly straightforward because the dominant effect is a reduction in sales regardless of sector. This happens since these programs increase the tax burden for many households, leaving them with less disposable income. The two sectors with the largest absolute decline under farm programs are for intermediary types of services. In particular, U.S. national sales of business-related services and other services decline by $6,285.0 million (0.17%) and $5,715.2 million (0.27%), respectively, due to farm programs. These are used as inputs into other activities. There is a decline under nutrition programs as well, but the effects are moderated; the declines in business-related services and other services are $116.3 million (0.003%) and $1,096.5 million (0.05%), respectively. It should be noted that nutrition programs are much larger, and the decline in higher-income households' purchasing power is much larger. However, in contrast to farm programs, nutrition programs increase lower-income households' spending power. These lower-income households make up for some—but not all—of the reduction in spending among higher-income households.

For some sectors, this effect is strong enough that nutrition programs lead to an increase in sales. For example, sales of other processed food decline by net $226.2 million (0.12%) under farm programs but rise by net $3,823.1 (2.02%) under nutrition programs. Nutrition programs are associated with higher food spending among low-income households, even food spending among high-income households falls. There is no comparable offsetting effect in the case of farm programs.

This happens not just for food products. For example, transportation services shrink by net $1,248.0 (0.17%) under farm programs but expand by $361.1 (0.05%) under nutrition programs. Higher-income households reduce spending in both cases, but low-income households increase spending by enough to more than make up the difference in the case of nutrition programs. The

Table 8. Changes in Value of Output by Sector

	Due to Farm Programs		Due to Nutrition Programs	
	($millions)	(%)	($millions)	(%)
Oilseed farming	−54.8	−0.14	393.8	0.98
Grain farming	−70.4	−0.12	768.0	1.30
Fruit and vegetable farming	−40.6	−0.10	802.0	2.01
Miscellaneous livestock farms	−105.5	−0.14	1,236.4	1.62
Forestry/mining except coal, crude oil	−175.5	−0.16	534.3	0.48
Crude oil and natural gas	−516.8	−0.15	427.8	0.13
Wholesale trade	−1,504.8	−0.15	37.5	0.00
Retail trade for food and beverages	−146.1	−0.09	2,751.1	1.63
Retail trade other than food and beverage	−1,657.3	−0.17	−3,049.3	−0.31
Milk and milk-based processed food	−100.6	−0.12	1,392.0	1.72
Processed red meat, beef and pork	−154.7	−0.13	1,962.3	1.63
Frozen food	−52.4	−0.13	702.5	1.78
Processed food, other	−226.2	−0.12	3,823.1	2.02
Food purchased away	−683.8	−0.12	−199.2	−0.03
Alcohol	−73.0	−0.12	122.3	0.20
Tobacco	−61.0	−0.11	225.2	0.41
Apparel and textiles	−179.6	−0.18	−115.5	−0.12
Refined petroleum products	−1,144.7	−0.16	855.6	0.12
Chemical, rubber, and plastic products	−1,791.5	−0.17	2,146.8	0.21
Iron/other metal-related manufacturing	−838.7	−0.17	620.5	0.12
Computer/electronics manufacturing	−606.8	−0.13	179.1	0.04
Electric goods manufacturing	−213.3	−0.15	57.4	0.04
Machinery and equipment manufacturing	−655.7	−0.12	239.8	0.04
Motor vehicle manufacturing	−610.8	−0.15	−297.6	−0.07
Household-related manufacturing	−149.6	−0.17	−127.7	−0.15
Construction	−1,644.0	−0.14	23.9	0.00
Real estate/owner-occupied dwellings	−4,055.7	−0.18	−3,405.3	−0.15
Transportation	−1,248.0	−0.17	361.1	0.05
Finance and insurance	−4,378.8	−0.20	−3,979.6	−0.18
Education and health	−3,850.4	−0.18	−3,229.7	−0.15
Electric utilities, private and public	−501.1	−0.17	497.8	0.17
Gas utilities, private and public	−258.7	−0.19	289.4	0.21
Other utilities, water, sanitary, radio, TV	−1,416.9	−0.20	10.6	0.00
Business-related services	−6,285.0	−0.17	−116.3	0.00
Personal services	−1,867.2	−0.20	−1,004.2	−0.11
Other services	−5,715.2	−0.27	−1,096.5	−0.05

Notes: We are unable to report 14 of the 50 sectors here because of space limitations. Standard deviations were calculated and are available upon request.

marginal propensity to consume transportation services is relatively high among households that receive nutrition assistance.

Many of the sectors with notable patterns of change are intermediary sectors (as opposed to final consumer goods). For example, chemical, rubber, and plastic product sales fall by $1,791.5 under farm programs but rise by $2,146.8 under nutrition programs, driven by changes in the demand for final goods and services that rely on chemical, rubber, and plastic products as an input into production. These results are examples of the unique insights provided by a general equilibrium model.

Effects on Prices and Factor Usage

Table 9 reports the effects of nutrition and farm programs on prices and labor usage. The magnitudes of changes tend to be small, in part because of the large size of the U.S. economy and the fact that offsetting effects drive net effects toward 0. That is, reduction in demand by some sectors is often offset by demand from other sectors. There are interesting patterns in the changes. For example, farm programs by themselves are associated with a fall in the price of most goods and services. Indeed, only 31% of the price changes reported in the table are positive as a result of farm programs.

By contrast, 69% of price changes associated with nutrition programs are positive (Table 9). In other words, introducing farm programs is associated with a decrease in the prices of most goods and services, whereas introducing nutrition programs is associated with an increase in the prices of most goods and services. Across sectors, the median price change is negative (-0.007%) under farm programs and positive (0.005%) under nutrition programs. Furthermore, price changes due to farm programs have a -0.49 correlation with those of nutrition programs. Clearly, the direction of changes tends to be different. Although farm programs are largely designed to increase the average profitability of farm enterprises, farm programs adversely affect household disposable income and thereby weaken the sales and prices of agricultural products.

These types of changes also affect the derived demand for factors of production such as labor. Total labor use does not change under model assumptions (an assumption that can be relaxed but does not substantially change the results). However, the results show how labor flows to different sectors of the economy based on program-induced changes to incentives. Farm programs are associated with labor reallocations from 89% of the sectors reported in Table 9 to the remaining 11% (particularly oilseed, grain, livestock, and tobacco farming). The first two industries tend to be fairly capital-intensive and experience 12.4% and 45.0% rises in labor usage, respectively. Nutrition programs are associated with 72% of the sectors in Table 9 experiencing a rise in labor usage. The remaining 28% of sectors (mostly services and manufactures) experience a small decline in labor usage.

In general, farm and nutrition programs have different economic effects. However, there is one similarity: They both cause labor usage to rise in commodity agricultural enterprises such as crop and livestock farming. But this is not for the same reason. Labor use is effectively subsidized under farm programs; demand for the products themselves actually falls under farm programs. By contrast, labor use in commodity agriculture rises under nutrition programs because of increasing demand for food products.

Effects on Society at Large

The two major Farm Bill programs have similar effects, in that they slightly reduce gross domestic product (GDP). This is caused by the small distortionary effect of the rises in taxes necessary to pay for the programs. GDP falls by 0.011% when nutrition programs alone are introduced and falls slightly more (0.183%) when farm programs alone are introduced. One reason that nutrition programs have a smaller adverse effect is that these benefits are likely to be spent in full. Farm

Table 9. Changes in Prices and Labor Usage by Sector

	% Change in Prices Due to		% Change in Labor Usage Due to	
	Farm Programs	**Nutrition Programs**	**Farm Programs**	**Nutrition Programs**
Oilseed farming	−0.025	0.089	12.367	1.181
Grain farming	−0.014	0.067	45.038	1.300
Fruit and vegetable farming	−0.018	0.037	−0.115	2.012
Miscellaneous livestock farms	−0.012	0.010	1.095	1.673
Forestry/mining except coal, crude oil	−0.007	0.008	−0.203	0.445
Crude oil and natural gas	−0.019	0.009	−0.197	0.135
Wholesale trade	0.010	−0.007	−0.184	0.011
Retail trade for food and beverages	0.015	−0.004	−0.114	1.642
Retail trade other than food and beverage	0.013	−0.004	−0.195	−0.309
Milk and milk-based processed food	−0.006	0.015	−0.148	1.714
Processed red meat, beef and pork	−0.005	0.031	−0.136	1.626
Frozen food	−0.003	0.021	−0.164	1.828
Processed food, other	−0.007	0.019	−0.160	2.032
Food purchased away	0.005	0.000	−0.143	−0.032
Alcohol	−0.008	0.009	−0.160	0.213
Tobacco	−0.024	0.003	0.669	0.464
Apparel and textiles	−0.021	0.011	−0.203	−0.126
Refined petroleum products	−0.021	0.008	−0.202	0.119
Chemical, rubber, and plastic products	−0.011	0.008	−0.215	0.208
Iron/other metal-related manufacturing	−0.005	0.005	−0.203	0.134
Computer/electronics manufacturing	−0.014	0.007	−0.164	0.043
Electric goods manufacturing	−0.011	0.006	−0.190	0.045
Machinery and equipment manufacturing	−0.004	0.002	−0.163	0.053
Motor vehicle manufacturing	−0.015	0.006	−0.172	−0.077
Household-related manufacturing	−0.010	0.005	−0.226	−0.171
Construction	0.004	−0.001	−0.166	0.006
Real estate/owner-occupied dwellings	−0.024	0.000	−0.229	−0.147
Transportation	0.002	−0.002	−0.200	0.087
Finance and insurance	0.003	−0.004	−0.231	−0.170
Education and health	0.014	−0.004	−0.234	−0.169
Electric utilities, private and public	−0.011	0.000	−0.214	0.178
Gas utilities, private and public	−0.012	0.004	−0.223	0.246
Other utilities, water, sanitary, radio, TV	−0.005	−0.002	−0.247	0.009
Business-related services	0.005	−0.003	−0.209	0.002
Personal services	0.006	−0.003	−0.239	−0.109
Other services	0.023	−0.006	−0.306	−0.045

Notes: We are unable to report 14 of the 50 sectors here because of space limitations. Standard deviations were calculated and are available upon request.

Table 10. Welfare Impacts for General Population of the United States

	Equivalent Variation ($ per household)		Change in Utility (%)	
	Farm Programs	Nutrition Programs	Farm Programs	Nutrition Programs
Low-income households	−11	1,303	−0.003	0.456
(<$25,000)	(<0.01)	(0.08)	(< 0.01)	(< 0.01)
Middle-income households	−117	19	−0.014	0.015
($25,000-$100,000)	(0.02)	(0.28)	(< 0.01)	(< 0.01)
High-income households	−595	−3,216	−0.022	−0.101
(>$100,000)	(0.04)	(1.27)	(< 0.01)	(< 0.01)

Notes: Numbers in parentheses are standard deviations.

subsidies are not necessarily fully spent out, however, as they do not act directly upon consumption. Rather, they are modeled as reducing firms' tax burdens and are typically viewed as being partly capitalized into farm assets.

Note that the analysis also accounts for the administrative costs of the programs, but these are so minor within the context of the entire U.S. economy that to make little measurable economic difference.

Calculating equivalent variation and changes in utility provides an alternative means to evaluate the effects of the programs on society at large. Table 10 reports the net effect on households' welfare as equivalent variation and changes in Stone–Geary utility by household. Equivalent variation is a monetary measure of the change in utility resulting from the imposition of a program, evaluated at before-change prices. Under farm programs, the equivalent variation measure is −$11, −$117, and −$595 for low-, middle-, and high-income households, respectively. The negative value signals the approximate annual amount by which each household type was worse off under farm programs. The adverse effect largely reflects what these household groupings individually contribute, on average, to the farm program budget. Equivalent variation for nutrition programs was $1,303 and $19 for low- and middle-income households, respectively, indicating that they are better off under nutrition programs than without them (Table 10). Equivalent variation for high-income households is −$3,216, however, indicating that they are worse off by this much per year.

Table 10 also reports the welfare impacts as percentage changes in utility. Utility falls for all household types under farm programs, although the changes are proportionally small. Nutrition programs are associated with a decrease in the utility of high-income households but are different from farm programs in that they are associated with an increase the utility of low- and middle-income households (by 0.45% and 0.015%, respectively). A general conclusion is that very-low-income households are the only ones affected by the Farm Bill in an economically significant way, at least when measured in percentage terms. In other words, the Farm Bill has distributional effects across households at large, but they would only be economically substantial for the poorest households. To be clear, these measures reflect not just transfers but also behavioral responses, changes in factor income, and efficiency changes for the economy as a whole.

Effects on the Agricultural Sector

The sector of the economy perhaps most affected by the Farm Bill is the farm or agricultural sector itself. Table 11 reports results concerning this sector. When farm programs alone are introduced, farm-sector cash receipts fall by $413 million (0.12%), primarily due to a decrease in prices. This is not because of a rightward shift of the supply curve of these goods; rather, taxpaying households have less spending power (due to the cost of the program), which corresponds to a leftward shift of the demand curve for these goods. In terms of profitability, this matters little, however, since net

Table 11. Impacts Specific to the Farm Sector

Variable	Level Change for 2010	Percentage Change
Farm programs		
Total farm-sector cash receipts ($millions)	-413	−0.12
	(8.91)	(0.01)
Total farm-sector cash expenses ($millions)	-314	−0.11
	(0.73)	(< 0.01)
Total farm-sector net cash income ($millions)	8,928	8.8
	(8.22)	(0.01)
Total farm-sector assets ($millions)	51,923	2.4
	(15.00)	(< 0.01)
Nutrition programs		
Total farm-sector cash receipts ($millions)	5,150	1.56
	(163.00)	(0.05)
Total farm-sector cash expenses ($millions)	3,900	1.55
	(124.00)	(0.05)
Total farm-sector net cash income ($millions)	1,250	1.25
	(39.30)	(0.04)
Total farm-sector assets ($millions)	14,981	0.69
	(453.00)	(0.02)

Notes: Numbers in parentheses are standard deviations.

cash income for farming as a whole rises by $8,928 million (8.80%). Total farm-sector assets also increase by $51,923 million (2.40%).

By contrast, nutrition programs have notably distinct effects on this particular sector: Total farm-sector cash receipts rise by $5,150 million (1.56%), farm-sector cash expenses rise by $3,900 million (1.55%), and total net cash income increases by $1,250 million (1.25%). While the latter is positive, this is much less than the 8.80% rise under farm programs. Total farm assets also rise by $14,981 million (0.69%), which is substantially less than under farm programs.

One conclusion is that both programs enhance net returns to agricultural enterprises on the whole, but for very different reasons. Farm programs weaken sales and prices of agricultural products (Tables 8 and 9) but nonetheless increase profitability because they involve direct payments and related assistance to farmers (Table 11). Nutrition programs, by contrast, are associated with increases in both demand for food and the sales and prices of agricultural products. The effect on farm profitability is more modest than the effect of direct payments associated with farm programs.

Comparison to Other Studies

While many of our results are new to the literature, some can be compared to those of existing studies. There are, of course, differences in the specific policy instruments across time, but—as argued previously—there is basis for broad comparison of economy-wide effects. Previous studies are consistent with this one in suggesting that farm programs typically have modest effects on farm prices and production of primary farm commodities (Sumner, 2007; Alston, 2007; Weber and Key,

2012). Withdrawal of support is consistent with reductions both in output for most crops and in prices. Some price changes appear to reflect complex cross-commodity effects that a multimarket model allows (Alston, 2007). Overall, the results that can be compared are broadly consistent with other studies, including Hanson and Somwaru (2003), Goodwin and Mishra (2006), and Lusk (2016).

It is important to emphasize that this study provides many other new results, however. We find that the Farm Bill as a whole has a positive effect on agricultural prices, but this effect is due solely to nutrition programs, as farm programs have a slightly depressing effect on prices. This study is unique in evaluating farm and food subsidies together in a common framework and extending the results to consumer welfare across household types, farm-sector performance, and other measures of resource allocation and efficiency. This study also provides the first evidence, previously described, of how either type of programs affects other parts of the economy.

It is also possible to compare the results on nutrition programs with previous results. For those measures that are comparable, there is a broad consistency with the past literature. In general, econometric studies have found evidence that SNAP is associated with increases in both food consumption and overall food demand (Hanson et al., 2002; Hoynes and Schanzenbach, 2009). Further, the impact of SNAP on food prices is generally found to be small. This coincides with Lusk (2015), who found that farmers benefit by only \$0.01for every \$1 taxpayers spend on SNAP. Martinez and Dixit (1992) calculated that food assistance programs are associated with an increase in farm prices of less than 1%, while Barrett (2002) found that SNAP has no substantive effect on farm prices. On these points, this study is largely consistent, providing an additional measure of credibility for our results that extend beyond those of existing studies.

Limitations

There are a number of dimensions that this analysis has left unexamined that should be acknowledged. First, of the nutrition programs authorized by the Farm Bill, this study considers only SNAP because it is by far the largest of the programs. Second, the study does not attempt to quantify programs' potential impacts on human health, work incentives, or environmental. These may be important, but to keep the study tractable it was not possible to include them. Third, while the study accounts for different types of agricultural enterprises, it does not account for heterogeneities among producers of a given commodity. Oilseed production, for example, is represented by a single sector for the United States. This means the study overlooks within-sector distribution issues, such as the possibility that larger farms get most of the benefits from a particular program. The study, by contrast, concerns market impacts, distributional impacts, and efficiency losses for society at large, including the many sectors potentially influenced by both programs. Farm and nutrition programs have notably different effects for many of the 50 sectors examined herein. Fourth, while the study distinguishes nine general types of U.S. households, it does not account for certain household demographics such as age or family structure. Related to this, the study does not focus on who does and does not participate in the programs. Rather, this study is focused at larger scales. In short, numerous dimensions of these programs could be (and have been) studied, but the study at hand necessarily simplifies some dimensions in order to capture the broad macroeconomic impacts. Finally, the well-known Lucas (1976) critique applies to this study since many model parameters were calibrated using historical data when the programs were in place. In the absence of these programs, certain parameters could have been different than they were calibrated to be. This is a common problem of trying to predict the effects of economic policy using outcomes observed in historical data.

Conclusions

This study quantitatively assesses the economy-wide impact of two distinct government programs that act principally upon the U.S. food and agricultural sectors. The methodological innovation is a new general equilibrium model of the U.S. economy that disaggregates households into nine representative groups with distinct rates of taxation, income sources, and individual consumption behavior, while disaggregating production into 50 sectors with different technologies and inter-industry linkages. We analyze the sensitivity of results to alternative values of key parameters and provide additional structure to ensure that the model is consistent with available econometric evidence on farm and nutrition programs.

The model can account for the incentive effects of the programs, the direct effects of the associated taxes (including tax revenue), and the excess burdens associated with taxation for the programs. By analyzing the two programs using a common framework, we drew several conclusions:

First, farm and nutrition programs have a slightly negative effect on overall U.S. economic efficiency. The associated taxes may cause changes in the quantities of different goods and services that producers and consumers produce and consume. As a result of these excess burdens, farm and nutrition programs have a slightly negative effect on GDP: 0.183% and 0.011%, respectively.

Second, farm programs reduce the utility of the nine representative households used to characterize society at large. The primary reasons are the direct and indirect tax burdens associated with the programs. Nutrition programs also reduce the utility of high-income households but raise the utility of households with income below $25,000 by approximately 0.5% because of their increase in purchasing power, even as they are constrained to limit their purchases to food-related items authorized under SNAP.

Third, both programs provide overall economic benefits to the agricultural and food sectors, but the reasons for these benefits differ by program. Farm programs have a dampening effect on agricultural prices because there is less demand owing to the fall in disposable income among households that are the ultimate purchasers. This result can be traced back to the changes in tax structure required to fund the programs. It is important to note, however, that aggregate net cash income for agricultural enterprises rises more (8.80%) under farm programs. Nutrition programs also improve agricultural and food sector outcomes (e.g., net cash income rises by 1.25%) but through a very different channel. The higher levels of output and prices under nutrition programs are demand driven. In contrast to farm programs, certain households increase their spending on food as a result of nutrition programs.

Fourth, these programs affect a wide array of sectors other than food and agriculture. For example, sales of transportation services rise when nutrition programs alone are implemented but fall by approximately 4 times as much when farm programs alone are implemented (i.e., evaluating the two as separate, distinct programs). In both cases, spending among higher-income households is reduced. However, in the case of nutrition programs, low-income households increase spending by enough to more than make up the difference. This is possible since lower-income households get most of their food purchases covered and so do not need to expend as much of their own money on food. Beyond this example, service sectors typically face lower overall demand under both programs, primarily because the disposable income of higher-income taxpaying households is lower and spending on these sectors is relatively income elastic.

Another aspect of this change in consumption is that there is change in the demographic makeup of a given sector's customers. For example, under nutrition programs, households making less than $25,000 spend more on food away from home (e.g., restaurants) while households making more than $100,000 spend less on this sector. The decline among high-income households is roughly twice as large as the increase among low-income households. The net effect on this sector is therefore moderated, although slightly negative overall.

In general, farm and nutrition programs have different effects on the economy. However, there is one similarity: They both cause labor usage to rise in commodity agricultural enterprises such

as crop and livestock farming. Yet the underlying reason is not the same. Farm programs cause labor usage to rise because labor use is effectively subsidized under farm programs; demand for the products themselves actually falls under farm programs. By contrast, labor use in commodity agriculture rises under nutrition programs because of increasing demand.

Future work could improve or extend this study in several dimensions. However, we hope that the study has shed light on some of the more fundamental, time-invariant features of farm and nutrition programs. In particular, the comparison of supply-side-oriented farm programs and demand-side-oriented nutrition programs reveals that despite their very different orientations, these programs sometimes achieve the same net result through different mechanisms. At other times, they tend to be at odds with each other, and it is the larger program (SNAP) that drives the major effects on the economy.

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