General Equilibrium Analysis of the Farm Bill: Food Versus Farm Subsidies

PRELIMINARY DRAFT – NOT FOR CITATION WITHOUT PERMISSION

Senal A. Weerasooriya and Jeffrey J. Reimer

Oregon State University

Abstract: Food and farm subsidies, in the form of SNAP and farm safety net programs, account for more than 90 percent of farm bill spending. The national impact of these programs is examined using a general equilibrium model calibrated to match the detailed structure of the U.S. economy, including multiple households and agricultural sectors, for the year 2010. Results show that SNAP increases and slightly decreases the economic welfare of low- and high-income households, respectively. It expands food and agriculture output, draws labor into these industries, and increases prices. Farm subsidies have relatively less impact on national output or welfare. When both types of subsidies are considered together, the impact of SNAP dominates, but the combination of the two modestly expands the size of the food and agricultural sector more than food or farm subsidies do on their own.

Keywords: agricultural and food policies, applied general equilibrium, farm bill

JEL: D58, E16, I38, Q18

General Equilibrium Analysis of the Farm Bill: Food Versus Farm Subsidies

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. Under the two most recent farm bills, approximately 80% of funding was for nutrition assistance programs, primarily the Supplemental Nutrition Assistance Program (SNAP), the nation's key anti-hunger program (Johnson and Monke 2014). Approximately 13% of farm bill spending, on the other hand, is for farm safety net programs (Johnson and Monke 2014). The design of these programs have changed markedly over time, but in recent years most of this spending has been in the form of subsidies for crop insurance or commodity programs that provide benefits based on price or revenue targets for producers of certain crops (Weber et al. 2015).

Food and farm subsidies are similar in that each increases the amount of taxes that the federal government needs to collect, thereby reducing the spending power of any entity that pays federal taxes. As the agents that pay taxes for these programs reduce their spending, the pattern of demand in the economy will change. These two major farm bill programs also have important differences. SNAP is more likely to affect the demand for food and agricultural products, while farm programs are more likely (if at all) to affect the supply of them. Although SNAP is a much larger program, the size of the benefits is reversed on a per-beneficiary level. For example, in 2012 SNAP provided the average beneficiary with $1,596 in benefits, while farm programs provided the average beneficiary with $9,925 in benefits (Lusk 2016).

The design of the programs affect the pattern of spending throughout the economy. SNAP beneficiaries are restricted to spend SNAP benefits on food products, but by covering most of their food expenses, SNAP frees up a portion of their resources for housing, transportation, health care, and other expenditures. Farm programs do not have such direct

effects but like SNAP can indirectly affect a wide range of sectors, including firms up and down the agricultural supply chain. 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 products. With so many "moving parts" there are effects on the efficient allocation of resources and overall economic welfare.

The goal of this article is to quantify these effects, and in particular to compare and contrast the U.S. economy-wide effects of SNAP and farm programs, including quantifying the effects on the supply, demand, and prices of numerous products. Effects on multiple households and agricultural enterprises are also quantified.

This research is important because recent high levels of spending for these programs have raised questions about their necessity and performance (Lusk 2016). There isn't a consensus on the effects of either program in isolation or in tandem. Gauging the impact of these two major components of the farm bill is of great importance in understanding how taxpayers' money is at work, and more broadly, about efficiency and equity with respect to the allocation of resources in the economy.

These two major components of the farm bill may also have important environmental and public health dimensions (Alston, Rickard, and Okrent 2010). However, this study will not examine those issues explicitly. In addition, farm bill programs related to conservation, research and other aspects are not considered. This allows for a sharpened comparison of the two major thrusts of the farm bill: SNAP and farm programs. It should also be made clear that the study does not account for heterogeneities among producers of a given commodity; the oilseed industry, for example, is represented by a single sector for the U.S. as a whole. However,

predictions are also made regarding how SNAP and farm programs affect farm cash receipts, farm cash expenses, farm net profits, and farm assets.

The novelty of this article is to evaluate the two programs within a single, theoretically consistent general equilibrium economic (GE) framework. A very important advantage of the GE approach is allowance for behavioral responses on the part of consumers, producers, and trading partners. The model adheres to widely tested economic theory while allowing for coverage of numerous agents and sectors (including exports and imports) that could be affected by the programs. This approach allows for far greater substitution effects and inter-sectoral linkages (including linkages to labor and capital) than in any previous study. The study arguably provides a more aggregate, comprehensive analysis of the farm bill than ever been done.

To carry out the analysis, a social accounting matrix (SAM) for the year 2010 is first created. The SAM distinguishes nine U.S. representative households that differ by income level, sources of income, consumption patterns, and transfers to and from other agents. The SAM also distinguishes 50 economic sectors with special focus on sectors directly affected by SNAP and farm programs.

Since it is for 2010, the SAM embodies the effects of the 2008 farm bill. In order to gauge the impacts of the two programs, a representation of the structure of the economy in the absence of these programs is required. Since this is unobservable, it must be simulated. The counterfactual scenario used here intentionally represents a situation that is not expected to occur; it is made with a GE model that is a modified version of the general approach described in Löfgren, Robinson, and Harris (2002) and Reimer, Weerasooriya, and West (2015). Once parameterized to the SAM, the GE model is used to compare the following numerical scenarios: (a) the U.S. economy in 2010 with both programs in place, (b) the U.S. economy simulated

without SNAP in place, (c) the U.S. economy simulated without farm programs in place, and (d) the U.S. economy simulated with neither of the above two programs in place.

Very few studies have attempted to analyze both of these programs at the same time within a common framework. The closest may be Lusk (2015) who investigates the distributional impact of three farm bill programs: crop insurance, SNAP and ethanol promotion. This study complements other strands of the farm bill literature, including studies of nutrition assistance (e.g., Gundersen and Oliveira 2001; Jensen 2002; Wilde and Nord 2005; Mykerezi and Mills 2010), and studies of farm programs more directly (e.g., Young and Westcott 2000; Whitaker 2009; Alston, Rickard, and Okrent 2010; Coble and Barnett 2013; Goodwin and Smith 2013). It also complements GE analysis of these two programs that have hitherto treated them in isolation (e.g., Hanson and Somwaru 2003; Reimer, Weerasooriya, and West 2015).

A brief preview of the results is as follows. Farm and food subsidies both serve to expand the size of the food and agricultural sector, if fairly modestly. SNAP is relatively important in terms of resource allocation, but its welfare effects are only economically significant for those who actually receive the benefits, along with selected food and agricultural sectors. This study also provides context to the above-mentioned studies; the analysis verifies and reconciles earlier results concerning the effects of farm programs on commodity prices while extending these findings in new and different ways.

The remainder of the article is as follows. The following section describes the data and model used in the study. The subsequent section describes the design and implementation of the counterfactual scenarios while providing an overview of SNAP and farm programs. The final sections report the results and provide analysis and conclusions in turn.

Data and Model

Data for the SAM and related economic variables comes from IMPLAN (2012), USDA FNS (2016), USDA ERS (2016a, 2016b), and Environmental Working Group (2011). While all nine IMPLAN households are maintained throughout the analysis, 440 IMPLAN sectors are aggregated to 50 economic sectors as described in the Appendix to this article.

The balanced SAM represents the U.S. economy in 2010 with the 2008 farm bill in place. In order to understand how SNAP and farm programs influence the economy, counterfactual scenarios without these programs are simulated with the GE model. The model is static and provides a rich neo-classical treatment of optimization and equilibrium. It is consistent with all of the payments recorded in the SAM, thereby incorporating general equilibrium with detailed national economic data. Space constraints prevent a formal mathematical development of the GE model in this article; an exposition is provided in Löfgren, Robinson, and Harris (2002) and to a lesser extent Reimer, Weerasooriya, and West (2015).

One important methodological aspect regards how equilibrium in factor markets and macroeconomic balances is established through closure rules. Investment is held fixed and savings adjusts endogenously to maintain the current account balance. Government balance is achieved by allowing government savings to be flexible while fixing all tax rates. In factor markets it is assumed that both capital and labor are fully employed, fixed in supply, and mobile across sectors. This is a conservative approach in the sense of precluding the programs from being able to affect unemployment. The model makes use of IMPLAN employment data by sector, which allows the model to directly calculate actual numbers of jobs. Information from the SAM is further used to calibrate a factor productivity factor index by sector that represents

sectoral differences in factor productivities. For example, it allows that labor is less productive in certain sectors and more productive in others, allowing for a sector specific wage.

As mentioned, the SAM is used 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. The model also contains a number of exogenous parameters that are set by the user. These are set at values commonly employed in GE analyses except for certain cases to be described below (Waters, Holland, and Weber 1997; Löfgren, Robinson, and Harris 2002).

Design of Counterfactual Scenarios

During the focus year 2010 the farm bill in effect was the Food, Conservation, and Energy Act of 2008. In the case of SNAP, 2010 federal expenditures were $68.3 billion and allocated to 40.3 million participants (USDA FNS 2016). An immediate question is how these 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 programs that are underfunded. In this study, however, the funds are returned to taxpayers at the rate they pay taxes. These values are given in Table 1 and were estimated using data from the U.S. Congressional Budget Office (2013). For example, households of type 1 (<$10,000 income) contributed 0.20% of federal household tax revenues, whereas households of type 9 (>$150,000 income) contributed 68.94% of federal tax revenues.

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 SNAP 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. The share of overall SNAP benefits that was received by each of the nine households is reported in Table 1. This was estimated using Survey of Income and Program Participation (SIPP) data from U.S. Census Bureau (2016).

Table 2 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 the federal taxes that are paid) but without SNAP benefits to offset the tax payments, their net transfer to the federal government would be $19,927 million. Household 9 in contrast received only 0.54% of total SNAP benefits and had net transfers to the federal government of $343,870 million. 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 assumptions capture in the model – effectively removes SNAP from the 2010 baseline data.

Another aspect of the SNAP counterfactual is the need to account for the fact that SNAP benefits are only useful for authorized items at eligible retailers. A review of the literature suggests the 'additionality' associated with SNAP is approximately 0.26, that is, 26 cents more food is purchased overall for every additional dollar of SNAP benefits (Levedahl 1995; Barrett 2002; Breunig and Dasgupta 2002; Wilde, Troy, and Rogers 2009; Hanson and Oliveira 2009; Beatty and Tuttle, 2015). Expenditure elasticities are calibrated such that the model replicates this evidence on additionality.

The counterfactual addressing farm programs is now considered. The agricultural safety net system during the time period of interest is complex but rendered manageable, at least to a first approximation, by estimates of the size of benefits compiled by Environmental Working

Group (2011). Table 3 reports the amount spent under farm programs in 2010 for the main farming sectors. Activities with the largest benefits were corn at $3,495 million, wheat at $1,732 million, and soybeans at $1,555 million. Livestock and dairy received a combined $301 million.

The counterfactual that eliminates farm programs is reported in Table 4. As in Hanson and Somwaru (2003), the indirect business taxes of a given sector are adjusted according to the level of support that the sector received in 2010. This is a way to characterize difficult-to-model agricultural policies that may have non-negligible effects on agricultural supply and prices (Young and Westcott, 2000; Goodwin and Mishra, 2006). Indirect business taxes for the production sectors effectively increase now that they receive no support from the federal government. In turn, the income tax rate of the nine representative households was adjusted based on the percentages in Table 1 to account for the fact that they no longer have to pay taxes to fund these programs. The oilseed sector, for example, transferred a net $870 million to the federal government in 2010 when farm programs were in place, but without these benefits they would have transferred a net $2,605 million (higher since there are fewer benefits to offset their taxes). On the household side, 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 effectively removes farm programs from the 2010 baseline data.

To estimate the joint impact of both SNAP and farm programs, similar assumptions to those made in the two earlier counterfactuals are used. By eliminating SNAP and farm programs simultaneously, households pay less in taxes, eligible households receive no SNAP benefits, and

eligible farms no longer receive farm program benefits. Due to lack of space and the similarity in structure to Tables 3 and 4, this counterfactual is reported in the Appendix.

Results

The results consist of new equilibrium values of the endogenous variables under the revised tax and transfer schemes identified above. For ease of presentation, results across the nine households are aggregated into three groups. 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 between $25,000 and $100,000, and households 8-9 are aggregated to a "high-income" household with income above of $100,000. A series of changes will be considered, including effects on consumption expenditure by household, production by firms, changes in relative prices, changes in the number of jobs in each sector, and labor wages. Once these are reported, changes to household welfare and GDP are reported, as well as standard performance measures of the agricultural sector including farm cash receipts and farm asset values. Three scenarios, the (i) impact of SNAP, (ii) impact of farm programs, and (iii) impact of both SNAP and farm programs, are compared side-by-side throughout the results section. The first scenario represents a move from not having SNAP to having it, while farm programs are intact. The second scenario represents a move from not having farm programs to having them, while SNAP is intact. The third scenario represents a move from not having either program, to having both of them, all else the same.

Changes in household consumption expenditure under the three scenarios are reported in Tables 5, 6, and 7. Table 5 reports the change in consumption for major consumption categories due to the implementation of SNAP. In low-income households, consumption increases in all

categories, with food-related categories increasing the most. Middle-income households also generally experience higher consumption expenditures, albeit slightly. They reduce spending on durable goods and wholesale and retail products, although the percentages are very small. This reflects that on average, the change in disposable income due to SNAP is small for middle-income households. The largest reduction in consumption expenditure is for high-income households. There is little change in food-related categories but non-food consumption falls by a substantial $3,238 per household. In percentage terms, however, these changes are not substantial. The largest proportional reduction regards spending on petroleum, transportation, and other services, each at 1.2%. Note that the result concerning petroleum, for example, need not literally imply that these households directly buy petroleum. This could reflect a drop in purchases for other goods and services, which rely on petroleum as an intermediate input. The Appendix reports these results at an even more disaggregated level for interested readers.

Changes in consumption expenditure across major categories due to the implementation of farm programs are reported in Table 6. Under these programs, consumption expenditure falls for all household groups. However, it should be noted that the percentages are very low due to the small monetary size of this program, at least relative to the size of the economy. Low-income households face the smallest change since their federal tax contributions are relatively low. As in Table 5, Table 6 shows that the change in non-food consumption is larger than for food-related consumption. With farm programs it will be seen that their supply tends to increase, lowering their price slightly and benefitting low-income households relatively more. (Detailed results for individual food and agricultural sectors are in the Appendix.)

Table 7 reports the change in consumption expenditure across major categories due to the implementation of both SNAP and farm programs. The impact of SNAP appears to dominate;

this can be seen by comparing Table 7 to Tables 5 and 6. For low- and middle-income households, there is an increase in consumption expenditure, although it is less than when SNAP is considered separately. However, for high-income households, consumption expenditures decline more than when SNAP is considered alone. The reason is that with both programs together, they must pay more taxes overall. Clearly, the highest income earners are the worst off as they on average gain no benefit from farm bill programs yet largely foot the bill (Table 1).

To sum up, SNAP clearly has a relatively strong effect on consumption expenditures, especially for the low-income groups at which the program is targeted. There are several observations to make in this regard. One is that when households receive SNAP benefits, they have money available for non-food related consumption since much of their food expenditures are now covered by SNAP benefits. This frees up resources that would otherwise would have been used for food (an essential) to be used for other (SNAP-ineligible) purchases, creating ripple effects through the economy. Conversely, for the households which pay taxes to fund these programs, it takes out money from their budget, and they adjust spending. Note that these changes are guided by elasticities of demand within the model.

A second observation is that consumption changes under farm programs have to do with direct, agricultural supply side effects (in which the supply curve shifts right) in addition to across-the-board disposable income effects in which the demand curve of higher-income households shifts left due to declining after-tax income. Below it will be shown that agricultural prices fall under farm programs, which modestly contributes to an increased consumption of agricultural and food products relative to other goods. SNAP, by contrast, tends to operate through the demand side, causing changes in quantity supplied.

A third observation regards aggregate spending differences across households. SNAP has a higher impact on most households compared to that of farm programs. This is because SNAP is a larger program, but also because SNAP is effectively a transfer among households. The impact is highest for low-income households since they receive 80% of SNAP receipts out of the households as a whole. The expenditure of low-income households increases by 6.24%, which is an average increase of $1,300 per household (Table 5). Middle-income households spend $17 more per household (0.15%). However, the spending of high-income households falls by $3,257 (0.35%) as they now have to pay more taxes and receive virtually no SNAP benefits.

Turning to the farm program scenario in Table 6, all households have a reduction in their disposable income (and thus consumption expenditures) due to the taxes that must be paid for these programs. Households with income less than $25,000 pay $12 per household, while households with income exceeding $100,000 pay $597 per household for farm subsidies. As a percentage of overall spending, these amounts are extremely small (<0.1%).

The pattern of effects when both programs are introduced is very similar in sign and magnitude to that of SNAP, since its size dominates that of farm programs. Table 7 shows that expenditures by low-income households increase by $1,283 (6.16%) which is slightly less than when only SNAP was considered. Expenditures for middle- and high-income households decrease by $94 (0.08%) and $3,860 (0.42%), respectively.

Other dimensions of the programs are reported in Tables 8-10. As SNAP alone is implemented, there is a rise in the value of output, prices and the number of jobs for most food and agricultural sectors, albeit by small percentages (Table 8). SNAP is associated with expansion in the value of output in the food processing (0.95%), food services (0.74%), and the farming sector (0.61%). The prices of commodities generally rise, although the percentages are

small. By contrast, there are declines in sectors such as wholesale and retail trade, manufacturing, finance and insurance, housing, health and education, transportation and other services. The declines are due to reduced demand by high-income households who pay the bulk of federal taxes.

As noted above, the model has been calibrated to match a SNAP additionality estimate for which there is an approximate consensus in the literature (0.26). If SNAP additionality was 1.0, by contrast, food expenditures would increase by the full amount of SNAP benefits and the effects would have been starker; in particular, food and agriculture would have expanded even more than they do. However, SNAP recipients use personal income previously spent on food for non-food purchases, keeping activity in these sectors from declining as much as it otherwise would due to the reduction in disposable income of higher income households. In terms of jobs, the farm and food sector draws labor from other sectors, although the percentages are small (<1%).

Results for the second scenario, which represents a move from no farm programs to farm programs, are reported in Table 9. The value of output and prices decline for most sectors. While physical quantities rise for sectors such as crop farming, livestock, and dairy, the values reported in Table 9 decline slightly due to falling prices, however modest (space constraints preclude full reporting of these results). Drops in values are larger in many non-agricultural sectors because physical output as well as prices decline; these firms receive few if any benefits from the programs and also sell slightly less to taxpayers who now face a higher tax burden. With regard to the employment effects of these programs, there is rising demand for labor in these sectors, especially those most directly targeted by farm programs. Crop farming as a whole requires 365,777 additional jobs under farm programs whereas livestock and dairy require 9,266

additional jobs. Another way to think about this is the following: if farm programs had not existed in 2010, labor requirements would have been less in these sectors by these amounts.

Table 10 reports the results of a change from no SNAP and farm programs, to having both in place. Output in all non-agricultural sectors falls but rises in all food- and agriculture-related sectors. In other words, the two programs are mutually reinforcing in some ways. The same holds for prices in most cases; prices of food and agriculture-related sectors rise while prices fall in most other sectors. The decline, however, is typically less in percentage terms compared to the scenario when farm programs were introduced in isolation. Some sectors, including food services, wholesale and retail trade, transportation, finance and insurance, health and education and other services, experience an increase in prices despite lower overall sales value. This is an example that highlights how these programs operate through different mechanisms to arrive at the outcomes seen in reality. Compared to the scenario where farm programs were introduced in isolation, the percentage changes are low. This implies that the impact of prices due to SNAP and farm programs moves in opposite direction; the results depicted in Table 10 are the net effect.

The implementation of both programs together leads to a decrease in jobs in many sectors, although this change in percentage terms is less than when farm programs are introduced in isolation. For other sectors, such as crop and livestock production, the increase in the number of jobs is higher than when farm programs are considered in isolation. This makes sense given that with both SNAP and farm programs, the number of jobs rises for these particular sectors. Overall, these programs jointly encourage production and increase the number of jobs in food and agriculture, while having the opposite effect on other sectors. Most of the change is due to SNAP, however, due to the greater size of the program, and since its effects are distributed even

more broadly across sectors of the economy than with farm programs. There are numerous other changes in the economy in addition to those highlighted above, such as changes in intermediate input usage, capital intensities by sector, and taxes and transfers. Space constraints prevent these from being reported in this article.

To understand the net effects of the above changes on households, welfare is reported in Table 11 in terms of equivalent variation and changes in utility by household. Equivalent variation is the amount of money a household would pay to avoid a change in prices or other market conditions that affect their economic well-being. According to the equivalent variation measure, the typical low-income household (income <$25,000) would require $1,300 to be as well off as without SNAP as with it. Middle-income households (income $25,000-100,000) require $17 to be as well off as without SNAP as they are with it. Equivalent variation for high-income households (income >$100,000) is negative $3,257, indicating they are worse off by this much when SNAP is implemented.

In the second scenario, all household types require a reimbursement ranging from $12 (low-income) to $597 (high-income) to be as well off with farm programs as they are without them. When both programs are considered, the results are similar to the case when only SNAP is implemented (Table 11). The low-income households require $1,283 to be as well off as without SNAP and farm programs as they are with them. This value is less than the case when only SNAP was introduced, suggesting that they do not gain from both programs together. The middle- and high-income households, meanwhile, require $94 and $3,860 respectively to be as well off with SNAP and farm programs as they are without them.

The percentage change in utility is also given in Table 11. SNAP increases the utility of low- and middle-income households, and decreases the utility of high-income households.

Utility falls for all household types under farm programs, albeit the changes are exceedingly small. When both SNAP and farm programs are implemented, the situation is similar to the case of SNAP. However, the proportionate improvements are smaller among low- and middle-income households and the proportionate decline is larger among high-income households.

In terms of gross domestic product (GDP), the effects of the two major farm bill programs are slightly negative. GDP falls by 0.016% when SNAP alone is introduced, by 0.183% when farm programs are introduced, and by 0.198% when both programs are introduced. One reason that SNAP has a smaller adverse effect is that SNAP benefits are essentially transfers among households and are likely to be spent in full, whereas farm subsidies can be capitalized into agricultural assets such as land and thus contribute little to GDP.

An important question so far neglected is how these programs influence the well-being of the farm sector more specifically. Results are reported in Table 12 and concern the aggregate farm sector (methodological details are provided in the Appendix). When SNAP by itself is implemented, total farm sector cash receipts rise by $2,712 million (0.81%), farm sector cash expenses rise by $2,107 million (0.84%), and total net cash income increases slightly at $605 million (0.60%). Total farm assets rise by $8,261 million (0.38%).

When farm programs by themselves are introduced there is a reduction in farm sector cash receipts of $379 million (0.11%) due to the net effect of change in prices and quantity supplied (Table 12). This does not imply that quantities fell, as demand for most products is largely inelastic, but that prices fall slightly. However, $9,038 million in subsidies is now received (Environmental Working Group, 2011) and cash expenses decline by $263 million (0.10%). As a result, net cash income rises by $8,921 million (8.80%). The total farm sector assets also increase by $52,126 million (2.41%).

Table 12 also shows that when SNAP and farm programs are simultaneously implemented, farm sector cash receipts increase by $2,331 million (0.70%). This is less than the case when SNAP is introduced by itself, and is due to the downward pressure on prices associated with farm programs. Cash expenses fall by $1,842 million (0.73%), while net cash income, total farm assets, and farm sector jobs increase by $9,527 million (9.45%) and $60,151 million (2.78%), respectively. These numbers are larger than the case when farm programs were introduced in isolation.

While many of the above results are new to the literature, others can be compared to those of existing studies. Many results concerning SNAP suggest a broad consistency with the past literature. Studies have found evidence that SNAP increases food consumption and increase overall food demand (Hanson et al. 2002; Hoynes and Schanzenbach 2009; Reimer, Weerasooriya, and West 2015), consistent with this study's results. Further, the price impact of SNAP was found to be small. This coincides with Lusk (2015), who finds that for every one dollar taxpayers spend on SNAP, farmers benefit by only a penny. Martinez and Dixit (1992) calculated that food assistance programs increase farm prices by less than 1%, while Barrett (2002) finds that SNAP has no substantive effect on farm prices.

It is harder to compare results concerning farm programs since the programs have changed substantially over time. Nonetheless, studies are fairly consistent in showing that previous generations of farm programs have had typically modest effects on farm prices and production of the primary farm commodities. Even across highly unique farm policy regimes, the evidence tends to be that there are modest supply shifts resulting from farm subsidies, resulting in increased production and reduced prices for food and agricultural commodities (Lee and Helmberger 1985; Chang et al. 1992; Hanson and Somwaru 2003). However, some other

studies find mixed results that are sensitive to the nature of the policies considered. Goodwin and Mishra (2006) finds that only decoupled policies tend to increase production and dampen prices, while Lusk (2016) and Alston, Sumner, and Vosti (2008) find that a broader set of farm policies have small and mixed effects on commodity prices. In a different context, Alston, Rickard, and Okrent (2010) quantify the effect of farm subsidies and conclude that they have negligible impacts on the cost of food; they do not contribute significantly to problems with obesity. In general this study does not find any remarkably different result from those studies above; however it is unique in evaluating farm and food subsidies together in a common framework, and extending the results to consumer welfare across household types, as well as employment outcomes, farm sector performance, and other measures of resource allocation and efficiency.

Conclusions

This study quantitatively assesses the impact of two distinct components of the 2008 farm bill, SNAP and farm safety net programs, for the U.S. economy in 2010. Few if any existing studies have attempted to simultaneously analyze both programs within a common framework. This study employs a state-of-the-art general equilibrium model with great detail on all the sectors and households potentially affected by these programs, tailored to make use of recent data for the U.S. as a whole. SNAP and the farm programs examined here account for more than 90% of farm bill spending and have a wide range of impacts on the U.S. economy as a whole. Due to these programs, a sequence of changes take place that reverberate throughout in the economy, tying together a wide range of households, business enterprises, and labor and capital markets. Using a general equilibrium model ensures that the numerous linkages of the economy are

captured, and behavioral responses are incorporated. This analysis may be the first major attempt to make a comparison among these programs and can serve as a basis for further research in this area.

Some important conclusions can be drawn. SNAP increases the disposable income of low-income households, but high-income households have less disposable income as they now have a greater tax burden under SNAP. Due to Engle effects and the restrictive nature of SNAP benefits, SNAP eligible and ineligible household expenditures change in distinct ways when SNAP is introduced. Agricultural and food sectors are positively affected under SNAP, with higher levels of output, prices, and jobs. Nonfood sectors that are ineligible for purchase with SNAP also expand in some instances, as SNAP beneficiaries have more money at their disposal now that their food expenditures are mostly covered through SNAP. On the other hand, many service sectors are somewhat smaller under SNAP than they otherwise would be because, for example, the disposable income of higher-income taxpaying households is lower. Overall, SNAP slightly expands the agricultural and food sectors, decreases labor earnings by a small amount, and also increases agriculture and food prices slightly.

Farm subsidies act more directly on the agricultural sector and have only modest – if negative – impacts on the nine U.S.-representative households. Farm programs cause very little change in disposable income and consumption expenditure for most households; the main effect is a slight decrease in disposable income reflecting the fact that financial support for farm programs comes through taxation. Although subsidies have a dampening effect on agricultural prices, causing cash receipts to fall slightly, net farm income rises due to farm programs. The farming sector absorbs a small amount of labor from other sectors due to increased production, with labor earnings in the economy falling slightly. Farm programs have a slightly more

negative effect on GDP than does SNAP since farm subsidies are partly capitalized into farm assets instead of being respent immediately within the larger economy.

The study also considers the impact of SNAP and farm programs when they are simultaneously introduced. The two programs reinforce one other in some ways and offset each other in other ways. Both programs increase federal tax burdens throughout the economy, and together raise overall labor use within agriculture. In contrast to SNAP, farm programs slightly reduce the well-being of low-income households, even as the price of agricultural and food items fall slightly. Again, this is due to the taxes needed to fund the program.

The upshot of the study is that farm and food subsidies do essentially what they are meant to do; SNAP makes a notably positive impact on the well-being of poor households while farm subsidies mainly benefit the farming sector and a few closely related industries. Although GDP declines slightly under both programs, economy-wide efficiency losses appear to be quite modest, due in large part to the small size of these programs relative to the size of the U.S. economy. That said, the programs induce a number of changes in the size, structure, and employment patterns of a wide range of economic sectors. In a nutshell, these programs are for the most part transfer programs that positively impact their intended beneficiaries while diffusing their costs broadly across the economy.

References

Alston, J.M., B.J. Rickard, and A.M. Okrent. 2010. “Farm Policy and Obesity in the United States.” *Choices* 25(3).

Alston, J.M., D.A. Sumner, and S.A. Vosti. 2008. “Farm Subsidies and Obesity in the United States: National Evidence and International Comparisons.” *Food Policy* 33(6):470–79.

Barrett, C.B. 2002. “Food Security and Food Assistance Programs.” In *Handbook of Agricultural Economics*, edited by B.L. Gardner and G. Rausser, 2:2103–90. Elsevier.

Beatty, T.K.M., and C.J. Tuttle. 2015. “Expenditure Response to Increases in In-Kind Transfers: Evidence from the Supplemental Nutrition Assistance Program.” *American Journal of Agricultural Economics* 97(2):390–404.

Breunig, R.V., and I. Dasgupta. 2002. “A Theoretical and Empirical Evaluation of the Functional Forms Used to Estimate the Food Expenditure Equation of Food Stamp Recipients: Comment.” *American Journal of Agricultural Economics* 84(4):1156–60.

Chang, C., B.A. McCarl, J.W. Mjelde, and J.W. Richardson. 1992. “Sectoral Implications of Farm Program Modifications.” *American Journal of Agricultural Economics* 74(1):38–49.

Coble, K.H., and B.J. Barnett. 2013. “Why Do We Subsidize Crop Insurance?” *American Journal of Agricultural Economics* 95(2):498–504.

Environmental Working Group. 2011. “The United States Farm Subsidy Information.” Environmental Working Group. https://farm.ewg.org/region.php?fips=00000&progcode=total&yr=2010

Goodwin, B.K., and A.K. Mishra. 2006. “Are ‘Decoupled’ Farm Program Payments Really Decoupled? An Empirical Evaluation.” *American Journal of Agricultural Economics* 88(1):73–89.

Goodwin, B.K., and V.H. Smith. 2013. “What Harm Is Done by Subsidizing Crop Insurance?” *American Journal of Agricultural Economics* 95(2):489–97.

Gundersen, C., and V. Oliveira. 2001. “The Food Stamp Program and Food Insufficiency.” *American Journal of Agricultural Economics* 83(4):875–87.

Hanson, K., E. Golan, S. Vogel, and J. Olmsted. 2002. “Tracing the Impacts of Food Assistance Programs on Agriculture and Consumers: A CGE Model.” United States Department of Agriculture: Economic Research Service, Report No. 18. Washington D.C.

Hanson, K., and V. Oliveira. 2009. “Economic Linkages between the WIC Program and the Farm Sector.” United States Department of Agriculture: Economic Research Service, Economic Brief No. 12. Washington D.C.

Hanson, K., and A. Somwaru. 2003. “Distributional Effects of U.S. Farm Commodity Programs: Accounting for Farm and Non-Farm Households.” In American Agricultural Economics Association. Montreal, Canada.

Hoynes, H.W., and D.W. Schanzenbach. 2009. “Consumption Responses to In-Kind Transfers: Evidence from the Introduction of the Food Stamp Program.” *American Economic Journal: Applied Economics* 1(4):109–39.

IMPLAN. 2012. “Data and Software.” Huntersville NC. www.implan.com.

Jensen, H.H. 2002. “Food Insecurity and the Food Stamp Program.” *American Journal of Agricultural Economics* 84(5):1215–28.

Johnson, R., and J. Monke. 2014. “What Is the Farm Bill?” Congressional Research Service Report RS22131. Washington D.C.

Lee, D.R., and P.G. Helmberger. 1985. “Estimating Supply Response in the Presence of Farm Programs.” *American Journal of Agricultural Economics* 67(2):193–203.

Levedahl, J.W. 1995. “A Theoretical and Empirical Evaluation of the Functional Forms Used to Estimate the Food Expenditure Equation of Food Stamp Recipients.” *American Journal of Agricultural Economics* 77(4):960–68.

Löfgren, H., S. Robinson, and R.L. Harris. 2002. “A Standard Computable General Equilibrium (CGE) Model in GAMS.” International Food Policy Research Institute. Washington D.C.

Lusk, J.L. 2015. “Distributional Effects of Selected Farm and Food Policies.” Mercatus Research, Mercatus Center at George Mason University, Working Paper. Arlington, VA.

Lusk, J.L. 2016. “The Evolving Role of the USDA in the Food and Agricultural Economy.” Mercatus Research, Mercatus Center at George Mason University. Arlington, VA.

Martinez, S.W., and P.M. Dixit. 1992. “Domestic Food Assistance Programs: Measuring the Benefits to Producers.” United States Department of Agriculture: Economic Research Service. Washington D.C.

Mykerezi, E., and B. Mills. 2010. “The Impact of Food Stamp Program Participation on Household Food Insecurity.” *American Journal of Agricultural Economics* 92(5):1379–91.

Reimer, J.J., S. Weerasooriya, and T.T. West. 2015. “How Does the Supplemental Nutrition Assistance Program Affect the United States Economy?” *Agricultural and Resource Economics Review* 44(3):233–52.

U.S. Census Bureau. 2016. “Survey of Income and Program Participation (SIPP).” United States Census Bureau. http://www.census.gov/sipp/.

U.S. Congressional Budget Office. 2013. “The Distribution of Household Income and Federal Taxes, 2010.” United States Congressional Budget Office. Washington D.C.

USDA ERS. 2016a. “Farm Income and Wealth Statistics.” United States Department of Agriculture: Economic Research Service. Washington D.C. http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx.

———. 2016b. “Supplemental Nutrition Assistance Program (SNAP) Data System.” USDA Economic Research Service. Washington D.C. http://www.ers.usda.gov/data-products/supplemental-nutrition-assistance-program-(snap)-data-system.aspx.

USDA FNS. 2016. “Supplemental Nutrition Assistance Program (SNAP) Program Data.” United States Department of Agriculture: Food and Nutrition Service. Washington D.C. http://www.fns.usda.gov/pd/overview.

Waters, E.C., D.W. Holland, and B.A. Weber. 1997. “Economic Impacts of a Property Tax Limitation: A Computable General Equilibrium Analysis of Oregon’s Measure 5.” *Land Economics* 73(1):72–89.

Weber, J.G., C. Wall, J. Brown, and T. Hertz. 2015. “Crop Prices, Agricultural Revenues, and the Rural Economy.” *Applied Economic Perspectives and Policy* 37(3):459-476.

Whitaker, J.B. 2009. “The Varying Impacts of Agricultural Support Programs on U.S. Farm Household Consumption.” *American Journal of Agricultural Economics* 91(3):569–80.

Wilde, P.E., and M. Nord. 2005. “The Effect of Food Stamps on Food Security: A Panel Data Approach.” *Review of Agricultural Economics* 27(3):425–32.

Wilde, P.E., L.M. Troy, and B.L. Rogers. 2009. “Food Stamps and Food Spending: An Engel Function Approach.” *American Journal of Agricultural Economics* 91(2):416–30.

Young, C.E., and P.C. Westcott. 2000. “How Decoupled Is US Agricultural Support for Major Crops.” *American Journal of Agricultural Economics* 82(3):762–67.

Table 1. Characteristics of the Representative Nine Households

#	Income category	Number of households	Contribution to federal revenue by each household[1]	Percentage of SNAP benefits received by each household[2]
HH1	< $10,000	11,208,871	0.20%	31.56%
HH2	$10,000–15,000	7,412,319	0.13%	14.90%
HH3	$15,000–25,000	15,072,384	0.27%	22.38%
HH4	$25,000–35,000	15,052,651	1.68%	11.77%
HH5	$35,000–50,000	19,425,102	2.16%	9.36%
HH6	$50,000–75,000	22,870,406	8.87%	5.89%
HH7	$75,000–100,000	12,024,141	10.11%	2.18%
HH8	$100,000–150,000	9,071,987	7.63%	1.43%
HH9	>150,000	5,371,952	68.94%	0.54%

Note: Revenue contribution shares are from the U.S. Congressional Budget Office (2013) and SNAP benefit shares are from the U.S. Census Bureau (2016).

Table 2. Counterfactual for the Impact of SNAP

Household type	Net transfers to the federal government ($ millions)		Total receipts ($ millions)	Income tax rate without SNAP	Income tax rate with SNAP
	Without SNAP	With SNAP			
HH1	19,927	-1,489	378,392	5.27%	-0.39%
HH2	3,278	-6,807	275,372	1.19%	-2.47%
HH3	10,252	-4,843	745,831	1.37%	-0.65%
HH4	21,806	14,915	916,646	2.38%	1.63%
HH5	63,201	58,282	1,484,986	4.26%	3.92%
HH6	159,522	161,561	2,460,850	6.48%	6.57%
HH7	137,224	142,646	1,690,885	8.12%	8.44%
HH8	186,742	190,977	1,844,040	10.13%	10.36%
HH9	297,158	343,870	2,850,626	10.42%	12.06%

Table 3. Amounts Spent in 2010 under Farm Programs for Different Farming Sectors

Farming sector	Amount spent ($ million)
Oilseeds	
Soybean	1,555
Peanut	87
Sunflower	62
Canola	31
Grains	
Corn	3,495
Wheat	1,732
Rice	402
Sorghum	246
Barley	87
Oats	7
Cotton	828
Other crops	11
Diary	74
Livestock	227
Tobacco	194

Note: Source is Environmental Working Group (2011).

Table 4. Counterfactual for the Impact of Farm Programs

Eliminating farm programs from the eligible farming sectors

Farming Sector	Net transfers to the federal government ($ millions)		Total receipts ($ millions)	Business tax rate without farm programs	Business tax rate with farm programs
	Without farm programs	With farm programs			
Oilseed farming	2,605	870	34,224	7.61%	2.54%
Grain farming	5,964	-4	60,974	9.78%	-0.01%
Cotton farming	828	-1	6,267	13.22%	-0.01%
Other crop farming	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 farming	9,575	9,380	49,236	19.45%	19.05%

Transferring the funds to the taxpaying households

Household type	Net transfers to the federal government ($ millions)		Total receipts ($ millions)	Income tax rate without farm programs	Income tax rate with farm programs
	Without farm programs	With farm programs			
HH1	-1,507	-1,489	378,392	-0.40%	-0.39%
HH2	-6,818	-6,807	275,372	-2.48%	-2.47%
HH3	-4,867	-4,843	745,831	-0.65%	-0.65%
HH4	14,763	14,915	916,646	1.61%	1.63%
HH5	58,087	58,282	1,484,986	3.91%	3.92%
HH6	160,759	161,561	2,460,850	6.53%	6.57%
HH7	141,731	142,646	1,690,885	8.38%	8.44%
HH8	190,287	190,977	1,844,040	10.32%	10.36%
HH9	337,639	343,870	2,850,626	11.84%	12.06%

Table 5. Changes in Consumption Expenditure due to SNAP

Consumption category	Per household change in expenditure					
	Households below 25K		Households 25-100K		Households above 100K	
	$	%	$	%	$	%
Food at home	148	8.43	4.8	0.18	-6	-0.07
Dairy, meat, fish	50	8.43	1.6	0.18	-2	-0.07
Fruit, vegetables	55	8.42	1.8	0.17	-2	-0.07
Miscellaneous food	44	8.44	1.4	0.18	-2	-0.07
Food away from home	127	8.45	3.1	0.18	-9	-0.07
Non-food consumption	1,006	2.91	8.5	0.11	-3,238	-1.00
Alcohol and tobacco	1	0.31	0.0	0.01	-2	-0.10
Clothing	11	2.41	0.0	0.10	-44	-0.93
Non-durables	55	3.01	2.7	0.12	-99	-1.13
Durables	54	3.06	-0.7	-0.12	-214	-1.14
Petroleum	31	3.22	0.5	0.13	-72	-1.20
Utilities	51	2.97	1.7	0.12	-98	-1.12
Finance and Insurance	76	3.06	-1.0	-0.12	-343	-1.13
Housing	162	2.85	1.2	0.13	-559	-1.06
Health and education	251	2.75	4.9	0.11	-677	-1.04
Transportation	30	3.21	0.3	0.13	-104	-1.21
Wholesale and retail	139	4.86	-4.2	-0.14	-456	-0.78
Other services	144	3.22	3.1	0.12	-571	-1.19
Miscellaneous	20	5.17	0.6	0.14	-4	-0.25
Total consumption	1,300	6.24	17	0.15	-3,257	-0.35

Note: This table concerns a move from a 2010 equilibrium without SNAP, all else the same, to the actual 2010 equilibrium that did incorporate SNAP. Values are in 2010 U.S. dollars.

Table 6. Changes in Consumption Expenditure due to Farm Programs

Consumption category	Per household change in expenditure					
	Households below 25K		Households 25-100K		Households above 100K	
	$	%	$	%	$	%
Food at home	-1.1	-0.05	-2.6	-0.07	-1	-0.02
Dairy, meat, fish	-0.4	-0.06	-0.9	-0.07	0	-0.02
Fruit, vegetables	-0.4	-0.05	-1.0	-0.07	-1	-0.02
Miscellaneous food	-0.3	-0.05	-0.8	-0.07	0	-0.02
Food away from home	-1.1	-0.08	-2.6	-0.08	-2	-0.02
Non-food consumption	-9.2	-0.02	-111	-0.12	-593	-0.21
Alcohol and tobacco	0.0	0.00	-0.1	-0.01	0	-0.02
Clothing	0.0	-0.01	-1.2	-0.10	-7	-0.18
Non-durables	-0.4	-0.02	-4.7	-0.13	-18	-0.23
Durables	-0.4	-0.02	-6.6	-0.13	-38	-0.24
Petroleum	-0.1	-0.01	-2.8	-0.13	-13	-0.24
Utilities	-0.4	-0.02	-4.4	-0.13	-18	-0.23
Finance and Insurance	-0.8	-0.03	-13.1	-0.14	-65	-0.25
Housing	-0.4	-0.01	-15.3	-0.11	-94	-0.21
Health and education	-3.3	-0.03	-24.5	-0.14	-127	-0.24
Transportation	-0.3	-0.03	-2.8	-0.15	-18	-0.26
Wholesale and retail	-1.7	-0.05	-17.9	-0.13	-90	-0.18
Other services	-1.5	-0.04	-17.7	-0.16	-104	-0.27
Miscellaneous	-0.1	-0.02	-0.4	-0.05	-1	-0.05
Total consumption	-12	-0.04	-117	-0.08	-597	-0.08

Note: This is scenario 2 and represents a move from a 2010 equilibrium without farm programs, all else the same, to the actual 2010 equilibrium that did incorporate farm programs.

Table 7. Changes in Consumption Expenditure due to SNAP and Farm Programs

Consumption category	Per capita change in expenditure					
	Households below 25K		Households 25-100K		Households above 100K	
	$	%	$	%	$	%
Food at home	146	8.32	2	0.11	-8	-0.09
Dairy, meat, fish	49	8.32	1	0.11	-3	-0.09
Fruit, vegetables	54	8.32	1	0.11	-3	-0.09
Miscellaneous food	43	8.33	1	0.12	-2	-0.09
Food away from home	125	8.32	1	0.11	-11	-0.09
Non-food consumption	992	2.87	-97	0.00	-3,837	-1.21
Alcohol and tobacco	1	0.31	0	0.00	-2	-0.12
Clothing	11	2.39	-1	0.01	-51	-1.11
Non-durables	55	2.98	-2	-0.01	-117	-1.36
Durables	53	3.02	-7	0.00	-252	-1.37
Petroleum	31	3.19	-2	0.01	-84	-1.44
Utilities	51	2.93	-3	0.00	-116	-1.35
Finance and Insurance	75	3.02	-14	-0.01	-408	-1.38
Housing	161	2.83	-13	0.02	-654	-1.27
Health and education	246	2.71	-18	-0.03	-806	-1.27
Transportation	30	3.17	-2	-0.02	-122	-1.47
Wholesale and retail	137	4.77	-21	0.02	-547	-0.95
Other services	142	3.17	-14	-0.03	-677	-1.46
Miscellaneous	20	5.11	1	0.09	-5	-0.31
Total consumption	1,283	6.16	-94	0.08	-3,860	-0.42

Note: This represents a move from a 2010 equilibrium without SNAP or farm programs, all else the same, to the actual 2010 equilibrium that did incorporate SNAP as well as farm programs.

Table 8. Changes in Production, Jobs, and Prices due to SNAP

Industrial sector	Change in				
	Labor Activity		Value of output		Commodity prices (%)
	# of jobs	%	Value ($ million)	%	
Food processing	14,505	0.95	7,136	0.96	0.0114
Animal origin	5,972	0.89	2,470	0.90	0.0102
Plant origin	5,750	0.92	2,650	0.93	0.0165
Other	2,782	1.05	2,017	1.07	0.0076
Food services (restaurants etc.)	78,274	0.74	4,358	0.74	0.0027
Alcohol and tobacco	58	0.04	65	0.05	-0.0045
Total farm	22,498	0.61	2,997	0.62	0.0118
Crop farming	11,087	0.66	1,390	0.64	0.0323
Animal farming	9,245	0.95	1,323	0.96	0.0012
Agricultural-services	2,166	0.22	284	0.25	0.0019
Manufacturing	-658	-0.02	1,061	0.00	0.0006
Clothing	-682	-0.14	-124	-0.13	0.0007
Petroleum	22	0.02	302	0.04	-0.0027
Durables	-3,164	-0.07	-994	-0.05	0.0005
Non-durables	3,166	0.12	1,877	0.14	0.0036
Wholesale and retail	-21,167	0.15	-1,724	0.16	0.0029
Transportation	-29	0.00	-60	-0.01	0.0009
Financial and Insurance	-18,529	-0.17	-3,530	-0.16	-0.0011
Housing	-9,698	-0.15	-2,806	-0.13	-0.0133
Health and Education	-11,154	-0.06	-913	-0.04	0.0046
Utilities	845	0.08	639	0.08	-0.0044
Other services	-54,037	-0.09	-3,103	-0.08	0.0032
Total	910	0.17	4,120	0.18	0.0012

Table 9. Changes in Production, Jobs and Prices due to Farm Programs

Industrial sector	Change in				
	Labor Activity		Value of output		Commodity prices (% change)
	# of jobs	%	Value ($ million)	%	
Food processing	-1,794	-0.12	-696	-0.09	-0.0067
Animal origin	-727	-0.12	-273	-0.10	-0.0037
Plant origin	-756	-0.13	-279	-0.10	-0.0093
Other	-311	-0.12	-143	-0.08	-0.0071
Food services (restaurants etc.)	-12,302	-0.12	-513	-0.09	0.0058
Alcohol and tobacco	243	0.33	-50	-0.04	-0.0167
Total farm	372,982	6.89	-558	-0.13	-0.0126
Crop farming	365,777	20.35	-225	-0.12	-0.0179
Animal farming	9,266	0.52	-154	-0.10	-0.0121
Agricultural-services	-2,061	-0.21	-178	-0.16	-0.0079
Manufacturing	-20,299	-0.21	-8,128	-0.18	-0.0161
Clothing	-991	-0.21	-185	-0.19	-0.0229
Petroleum	-293	-0.22	-1,285	-0.18	-0.0225
Durables	-13,224	-0.20	-4,029	-0.15	-0.0101
Non-durables	-5,791	-0.22	-2,630	-0.18	-0.0089
Wholesale and retail	-43,706	-0.16	-3,420	-0.13	0.0132
Transportation	-9,224	-0.21	-1,310	-0.18	0.0026
Financial and Insurance	-24,731	-0.23	-4,262	-0.19	0.0035
Housing	-15,895	-0.24	-4,201	-0.19	-0.0257
Health and Education	-40,828	-0.22	-3,483	-0.16	0.0148
Utilities	-6,282	-0.24	-2,231	-0.19	-0.0103
Other services	-180,327	-0.26	-13,920	-0.22	0.0119
Total	17,837	0.43	-42,772	-0.15	-0.0030

Table 10. Changes in Production, Jobs and Prices due to SNAP and Farm Programs

Industrial sector	Change in				
	Labor Activity		Value of output		Commodity prices (% change)
	# of jobs	%	Value ($ million)	%	
Food processing	12,700	0.83	6,432	0.87	0.0048
Animal origin	5,239	0.77	2,193	0.79	0.0065
Plant origin	4,991	0.78	2,368	0.83	0.0074
Other	2,470	0.93	1,871	0.99	0.0005
Food services (restaurants etc.)	65,805	0.62	3,832	0.65	0.0084
Alcohol and tobacco	302	0.37	15	0.01	-0.0210
Total farm	393,033	7.47	2,438	0.49	-0.0004
Crop farming	374,504	20.92	1,164	0.52	0.0152
Animal farming	18,411	1.46	1,167	0.85	-0.0106
Agricultural-services	118	0.01	107	0.10	-0.0059
Manufacturing	-20,776	-0.23	-6,991	-0.17	-0.0154
Clothing	-1,665	-0.35	-307	-0.31	-0.0219
Petroleum	-268	-0.21	-971	-0.13	-0.0249
Durables	-16,278	-0.26	-4,991	-0.20	-0.0095
Non-durables	-2,564	-0.10	-723	-0.04	-0.0051
Wholesale and retail	-64,606	-0.01	-5,119	0.03	0.0159
Transportation	-9,211	-0.21	-1,364	-0.19	0.0035
Financial and Insurance	-43,003	-0.40	-7,747	-0.35	0.0025
Housing	-25,468	-0.38	-6,976	-0.32	-0.0387
Health and Education	-51,624	-0.27	-4,366	-0.20	0.0193
Utilities	-5,374	-0.16	-1,570	-0.10	-0.0146
Other services	-233,170	-0.35	-16,931	-0.29	0.0150
Total	18,608	0.61	-38,348	0.04	-0.0017

Table 11. Equivalent Variation and Percentage Change in Utility

	Equivalent variation ($ per household)			% change in utility		
	SNAP	Farm programs	SNAP & farm programs	SNAP	Farm programs	SNAP & farm programs
Households below 25K	1,300	-12	1,283	0.446	-0.004	0.440
Households 25-100K	17	-117	-94	0.015	-0.014	0.002
Households above 100K	-3,257	-597	-3,860	-0.102	-0.022	-0.124

Table 12. Changes in Farm Income Statistics

Variable	Level change for 2010	Percent change
SNAP		
Total farm sector cash receipts ($ millions)	2,712	0.81
Total farm sector cash expenses ($ millions)	2,107	0.84
Total farm sector net cash income ($ millions)	605	0.60
Total farm sector assets ($ millions)	8,261	0.38
Farm programs		
Total farm sector cash receipts ($ millions)	-379	-0.11
Total farm sector cash expenses ($ millions)	-263	-0.10
Total farm sector net cash income ($ millions)	8,921	8.80
Total farm sector assets ($ millions)	52,126	2.41
SNAP and farm programs together		
Total farm sector cash receipts ($ millions)	2,331	0.70
Total farm sector cash expenses ($ millions)	1,842	0.73
Total farm sector net cash income ($ millions)	9,527	9.45
Total farm sector assets ($ millions)	60,151	2.78

Appendix

General Equilibrium Analysis of the Farm Bill: Food Versus Farm Subsidies

This appendix provides additional information about the study that cannot be placed within the article due to space constraints.

Appendix Table A presents the 50 sectors used in the model used in the model as intermediary inputs and final commodities.

Appendix Table B shows a macro SAM (social accounting matrix). This is a highly aggregated version of the actual SAM used in the study, which is too large to present visually. The SAM is a square data matrix; each cell entry corresponds to an income transfer from the account of its column to the account of its row for services rendered or goods supplied. In other words, each cell entry corresponds to a payment made from the account of its column to the account of its row. The sum of a column gives total expenditure made by that particular account to all other accounts. Similarly, the sum of a row represents all income payments to that particular account by all other accounts. Obeying the double-entry accounting principle, for each account in the SAM, the total revenue/row total equals total expenditure/column total.

Looking at Appendix Table B it is seen that the SAM consists of activities, commodities, factors of production, households, institutions, and rest of the world trade. Activities are the entities that are used as inputs or intermediary goods in production. Commodities refer to the final product or the activity output. Activities and commodities are separated which allows any commodity to be produced by multiple activities and any activity to be used in producing multiple commodities. The SAM allows all 50 sectors to act as an activity as well as a commodity. In the macro-SAM presented in Appendix Table B, these sectors are aggregated into six broad categories due to space constraints. They are numbered as 1-6 when referring to

an activity and 7-12 when referring to a commodity. Agricultural and natural resources use $162 billion of agricultural and natural resources, $5 billion of food and beverages, $117 billion of manufactured goods, and so on. This activity also used $119 billion of labor and $280 billion of capital.

The nine representative households are aggregated into one representative household in the macro-SAM. In Appendix Table B it is seen that households as a whole sold $7,041 billion of labor and $1,942 of capital. They purchased $117 billion of agriculture and natural resources, $4,500 billion of services, and so on. In the actual SAM there are nine households. These households differ in terms of: level of income, share of income from labor, capital and transfers, tax rates, and how they allocate discretionary spending across the 50 consumption categories, among other differences.

Appendix Table B shows in some detail the factors of production (labor and capital) as well as institutions, government, business taxes, investment, and trade with the rest of the world. Since column totals are equal to the row totals, the SAM is balanced and can be used to obtain economic parameters of interest. For example, gross domestic product (GDP) for the U.S. can be calculated two ways. First is final demand GDP, which can be obtained by adding household consumption, government consumption, investment and net exports and subtracting institutional sales ($10,461 + $3,448 + $2,032 - $673 – 746 billion) which results in $14,522 billion. Second is value added GDP, which is obtained by adding employer compensation, proprietor income plus other property type income and tax on production and imports ($7,981 + $5,545 + $997 billion), also resulting in $14,522 billion. One observation is that the value of the farm bill programs examined, at less than $81 billion, is but a fraction of the U.S. economy in 2010.

Appendix Table A. 440 IMPLAN Sectors Aggregated into 50 Sectors

Code	Description
OILSEED	Oilseed farming
GRAIN	Grain farming
FRUITVEG	Fruits and vegetables farming
COTTON	Cotton farming
TREENUT	Tree nut farming
OTHRCROP	Other crop farming
DAIRYFRM	Dairy farms
POULTFRM	Poultry farms
LVSTOCK	Miscellaneous livestock farms
RESOURCE	Forestry and mining except coal and crude oil
CRUDEOIL	Crude oil and natural gas
WHSAIL	Wholesale trade
FDSAIL	Retail trade for food and beverages
RETAIL	Retail trade other than food and beverage
DAIRY	Milk and milk based processed food
REDMEAT	Processed red meat
POULTRY	Processed poultry
SEAFOOD	Processed sea food
PROCGRN	Processed food grain based
PROCOIL	Processed oil
PROCFROZ	Processed frozen food
PROCSUGR	Processed sugar products
PROCFTVG	Processed fruit and vegetable
PROCOTHR	Processed food of plant origin other
PROCOTHER	Processed food other
AWAYFD	Food purchased away
ALCOHOL	Alcohol
TOBACC	Tobacco
APARL	Apparel and textiles
REFPETRO	Refined petroleum products
CHEMRUB	Chemical rubber and plastic products
IRON	Iron and other metal related manufacturing
COMP	Computer and electronic related manufacturing
ELECTRIC	Electric goods manufacturing
MACHINE	Machinery and equipment manufacturing
AUTOIND	Motor vehicles manufacturing
HHMNFS	Household related manufacturing
OTHNDURA	Other non-durable goods manufacturing
OTHDURA	Other durable goods manufacturing
CONSTRUC	Construction
REALEST	Real estate and owner occupied dwellings
TRANS	Transportation
FININS	Finance and insurance
EDUCHEALTH	Education and health
ELECUTIL	Electric utilities private and public
GASUTIL	Gas utilities private and public
OTHERUTIL	Other utilities water and sanitary radio tv and telephone
BUSSERV	Business related services
PERSERV	Personal services
OTHERSERV	Other services

Appendix Table B. Macro-SAM of USA in 2010 ($ billion)

	Activities								Commodities				Factors		Households	Institutions			ROW	
Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Activities																				
1. Agricultural & natural resources	0	0	0	0	0	0	861	0	30	0	0	2	0	0	0	0	0	0	0	894
2. Food & beverages	0	0	0	0	0	0	0	1,375	9	0	0	0	0	0	0	0	0	0	0	1,384
3. Manufactured goods	0	0	0	0	0	0	4	1	5,513	0	0	22	0	0	0	0	0	0	0	5,540
4. Wholesale-retail trade & transportation	0	0	0	0	0	0	0	0	0	2,717	0	0	0	0	0	0	0	0	0	2,717
5. Housing, construction & utilities	0	0	0	0	0	0	0	0	1	0	3,553	97	0	0	0	0	0	0	0	3,650
6. Services	0	0	0	0	0	0	0	8	0	18	135	10,723	0	0	0	0	0	0	0	10,885
Commodities																				
7. Agricultural & natural resources	162	198	458	4	86	19	0	0	0	0	0	0	0	0	117	7	110	0	86	1,246
8. Food & beverages	5	236	36	12	7	116	0	0	0	0	0	0	0	0	952	37	5	0	44	1,450
9. Manufactured goods	117	136	2,092	164	185	465	0	0	0	0	0	0	0	0	1,343	740	1,198	0	751	7,190
10. Wholesale-retail trade & transportation	30	85	294	94	72	131	0	0	0	0	0	0	0	0	1,584	79	149	0	267	2,785
11. Housing, construction & utilities	48	80	150	140	233	612	0	0	0	0	0	0	0	0	1,958	152	326	0	11	3,710
12. Services	84	164	688	456	395	2,295	0	0	0	0	0	0	0	0	4,506	2,433	245	0	431	11,696
Factors																				
13. Labor	119	271	1,032	1,079	371	5,109	0	0	0	0	0	0	0	0	0	0	0	0	0	7,981
14. Capital	280	159	749	407	1,992	1,959	0	0	0	0	0	0	0	0	0	0	0	0	0	5,545
Households																				
15. Households	0	0	0	0	0	0	0	0	5	0	0	137	7,041	1,942	173	2,528	820	0	0	12,648
Institutions																				
16. Government	0	0	0	0	0	0	5	0	5	0	18	361	940	130	1,271	2,499	2,307	997	0	8,532
17. Investment	0	0	0	0	0	0	17	8	189	0	0	0	0	3,477	743	57	618	0	668	5,777
18. Business taxes	48	56	41	361	311	180	0	0	0	0	0	0	0	0	0	0	0	0	0	997
Rest of the world (ROW)																				
19. Net exports	0	0	0	0	0	0	359	58	1,437	50	3	354	0	-5	0	0	0	0	0	2,257
Total	894	1,384	5,540	2,717	3,650	10,885	1,246	1,450	7,190	2,785	3,710	11,696	7,981	5,545	12,648	8,532	5,777	997	2,257	

Note: Income is the sum of employee compensation, proprietor income and other property income. Source: IMPLAN (2012)

Appendix Table C shows the counterfactual scenarios when both SNAP and farm programs are eliminated simultaneously. The same assumptions hold as in when SNAP or farm programs were treated in isolation.

Appendix Table C. Counterfactual for the Impact of SNAP and Farm Programs

Eliminating farm programs from the eligible farming sectors					
Production Sector	Net transfers to the federal government ($ millions)		Total receipts ($ millions)	Business tax rate without SNAP & farm programs	Business tax rate with SNAP & farm programs
	Without SNAP & farm programs	With SNAP & farm programs			
Oil seed farming	2,605	870	34,224	7.61%	2.54%
Grain farming	5,964	-4	60,974	9.78%	-0.01%
Cotton farming	828	-1	6,267	13.22%	-0.01%
Other crop farming	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 farming	9,575	9,380	49,236	19.45%	19.05%

Eliminating SNAP and FP and transferring the funds to taxpaying households					
Household type	Net transfers to the federal government ($ millions)		Total receipts ($ millions)	Income tax rate without SNAP & farm programs	Income tax rate with SNAP & farm programs
	Without SNAP & farm programs	With SNAP & farm programs			
HH1	19,891	-1,489	378,392	5.26%	-0.39%
HH2	3,254	-6,807	275,372	1.18%	-2.47%
HH3	10,204	-4,843	745,831	1.37%	-0.65%
HH4	21,503	14,915	916,646	2.35%	1.63%
HH5	62,810	58,282	1,484,986	4.23%	3.92%
HH6	157,918	161,561	2,460,850	6.42%	6.57%
HH7	135,396	142,646	1,690,885	8.01%	8.44%
HH8	185,363	190,977	1,844,040	10.05%	10.36%
HH9	284,696	343,870	2,850,626	9.99%	12.06%

Appendix Tables D, E and F report results for changes in consumption expenditure at a more disaggregated level for interested readers.

Appendix Table D. Changes in Consumption Expenditure of Major Food Categories due to SNAP

Consumption category	Change in consumption/expenditure ($ per household)					
	Households below 25K		Households 25-100K		Households above 100K	
	Value	%	Value	%	Value	%
Dairy and related products	15	8.4	0.5	0.2	-0.6	-0.1
Red meat	21	8.4	0.7	0.2	-0.9	-0.1
Poultry	12	8.4	0.4	0.2	-0.5	-0.1
Sea food	2	8.4	0.1	0.2	-0.1	-0.1
Grains	24	8.4	0.8	0.2	-1.0	-0.1
Fruits, vegetables	18	16.9	0.6	0.4	-0.8	-0.1
Frozen food	9	8.4	0.3	0.2	-0.4	-0.1
Other	47	8.4	1.5	0.2	-2.0	-0.1
Food away from home	127	8.4	3.1	0.2	-8.6	-0.1
Non-food consumption	1,026	3.6	9.1	0.1	-3,242	-0.8
Total consumption	1,300	6.2	17	0.2	-3,257	-0.3

Appendix Table E. Changes in Consumption Expenditure of Major Food Categories due to Farm Programs

Consumption category	Change in consumption/expenditure ($ per household)					
	Households below 25K		Households 25-100K		Households above 100K	
	Value	%	Value	%	Value	%
Dairy and related products	-0.1	-0.05	-0.3	-0.07	-0.1	-0.02
Red meat	-0.2	-0.06	-0.4	-0.07	-0.2	-0.02
Poultry	-0.1	-0.07	-0.2	-0.08	-0.1	-0.02
Sea food	0.0	-0.05	0.0	-0.07	0.0	-0.02
Grains	-0.2	-0.06	-0.4	-0.07	-0.2	-0.02
Fruits, vegetables	-0.1	-0.10	-0.3	-0.14	-0.2	-0.04
Frozen food	-0.1	-0.06	-0.2	-0.07	-0.1	-0.02
Other	-0.3	-0.04	-0.8	-0.07	-0.4	-0.02
Food away from home	-1.1	-0.08	-2.6	-0.08	-2.0	-0.02
Non-food consumption	-9	-0.02	-111	-0.10	-594	-0.16
Total consumption	-12	-0.04	-117	-0.08	-597	-0.08

Appendix Table F. Changes in Consumption Expenditure of Major Food Categories due to SNAP and Farm Programs

Consumption category	Change in consumption/expenditure ($ per household)					
	Households below 25K		Households 25-100K		Households above 100K	
	Value	%	Value	%	Value	%
Dairy and related products	14.6	8.33	0.3	0.12	-0.8	-0.09
Red meat	20.6	8.31	0.3	0.11	-1.1	-0.09
Poultry	11.4	8.30	0.2	0.11	-0.6	-0.09
Sea food	2.3	8.34	0.0	0.12	-0.1	-0.09
Grains	24.0	8.31	0.4	0.11	-1.3	-0.09
Fruits, vegetables	17.7	16.65	0.3	0.23	-0.9	-0.17
Frozen food	9.2	8.32	0.2	0.11	-0.5	-0.09
Other	46.2	8.32	0.8	0.11	-2.4	-0.09
Food away from home	124.8	8.32	0.7	0.11	-10.5	-0.09
Non-food consumption	1,012	3.52	-97	0.02	-3,842	-0.92
Total consumption	1,283	6.16	-94	0.08	-3,860	-0.42

Appendix Tables G, H and I report results for changes in production, jobs and prices at a more disaggregated level for interested readers.

Appendix Table G. Changes in Production, Jobs, and Prices of Selected Food and Agriculture Sectors due to SNAP

Industrial sector	Change in				
	Labor Activity		Value of output		Commodity prices
	# of jobs	%	Value ($ million)	%	(% change)
Oilseed	1,682	0.6	218	0.5	0.039
Grains	4,650	0.7	406	0.7	0.029
Cotton	62	0.2	10	0.1	0.045
Other crops	4,693	0.8	756	0.8	0.027
Poultry and livestock	7,317	1.0	1,031	1.0	0.003
Dairy	1,928	0.9	291	0.9	0.006
Agricultural services	2,166	0.2	284	0.3	0.002
Processed food of animal origin	5,972	0.9	2,470	0.9	0.010
Processed food of plant origin	5,750	0.9	2,650	0.9	0.017
Processed food other	2,782	1.1	2,017	1.1	0.008
Food services (restaurants etc.)	78,274	0.7	4,358	0.7	0.003
Alcohol and tobacco	58	0.0	65	0.1	-0.004
Non-food and agriculture	-114,426	0.0	-10,435	0.0	0.000
Total	910	0.6	4,120	0.6	0.014

Appendix Table H. Changes in Production, Jobs, and Prices of Selected Food and Agriculture Sectors due to Farm Programs

Industrial sector	Change in				
	Labor Activity		Value of output		Commodity prices
	# of jobs	%	Value ($ million)	%	(% change)
Oilseed	32,063	12.4	-54	-0.1	-0.026
Grains	308,664	45.0	-72	-0.1	-0.015
Cotton	25,510	65.0	-10	-0.2	-0.019
Other crops	-460	-0.1	-88	-0.1	-0.016
Poultry and livestock	8,152	0.5	-120	-0.1	-0.011
Dairy	1,114	-0.1	-34	-0.1	-0.006
Agricultural services	-2,061	-0.2	-178	-0.2	-0.008
Processed food of animal origin	-727	-0.1	-273	-0.1	-0.004
Processed food of plant origin	-756	-0.1	-279	-0.1	-0.009
Processed food other	-311	-0.1	-143	-0.1	-0.007
Food services (restaurants etc.)	-12,302	-0.1	-513	-0.1	0.006
Alcohol and tobacco	243	0.3	-50	0.0	-0.017
Non-food and agriculture	-341,293	-0.2	-40,955	-0.2	-0.005
Total	17,837	9.4	-42,772	-0.1	-0.011

Appendix Table I. Changes in Production, Jobs, and Prices of Selected Food and Agriculture Sectors due to SNAP and Farm Programs

Industrial sector	Change in				
	Labor Activity		Value of output		Commodity prices (% change)
	# of jobs	%	Value ($ million)	%	
Oilseed	33,532	12.9	163	0.4	0.014
Grains	311,213	45.4	334	0.6	0.016
Cotton	25,531	65.0	-1	0.0	0.028
Other crops	4,228	0.7	667	0.7	0.011
Poultry and livestock	15,383	1.5	910	0.9	-0.008
Dairy	3,028	0.8	257	0.8	0.000
Agricultural services	118	0.0	107	0.1	-0.006
Processed food of animal origin	5,239	0.8	2,193	0.8	0.007
Processed food of plant origin	4,991	0.8	2,368	0.8	0.007
Processed food other	2,470	0.9	1,871	1.0	0.001
Food services (restaurants etc.)	65,805	0.6	3,832	0.7	0.008
Alcohol and tobacco	302	0.4	15	0.0	-0.021
Non-food and agriculture	-453,231	-0.2	-51,064	-0.2	-0.005
Total	18,608	10.0	-38,348	0.5	0.004

Appendix Table J provides the data sources and methodology behind the farm sector calculations in the study. The base values of the data are either from IMPLAN or USDA/ERS Farm Income and Wealth Statistics. The variable in the model that records the change is also noted in the table. Additional information is available from the authors upon request.

Appendix Table J: Data Sources for Calculating the Determinants of Farm Well-Being

Variable	Base value for 2010	Source of base value	Corresponding variable in the general equilibrium modeling
Total farm sector cash receipts ($ millions)	335,698	IMPLAN	Total value of output (sales)
Total farm sector cash expenses ($ millions)	254,399	IMPLAN	Total labor and capital usage in agriculture and the intermediate inputs used in agriculture
Total farm sector assets ($ millions)	2,161,361	USDA/ERS Farm Income and Wealth Statistics	Percentage change in returns to capital
Jobs in total agri-food sector (# jobs)	3,559,974	IMPLAN	Quantity of labor demanded by agriculture activities