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BEFORE THE HOUSE AGRICULTURE COMMITTEE,
SUBCOMMITTEE ON CONSERVATION, CREDIT, ENERGY, AND RESEARCH

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Mr. Chairman, members of the Subcommittee, thank you for the opportunity to review the potential economic impacts of proposed climate change legislation to the farm sector. Specifically, my comments today focus on how changes in energy prices under a cap-and-trade system for greenhouse gas (GHG) emissions would likely affect farmers and ranchers based on analyses of the American Clean Energy and Security Act of 2009 (H.R. 2454), which included a cap-and-trade system for GHG emissions. The economic impacts of climate change on the farm sector are broad, complex and will evolve slowly over the next decades. Impacts will be influenced by the timing and extent of climate change, the efficacy of actions to mitigate emissions and adapt to changes, the form of the actions taken within the United States and in other countries, and the extent to which mitigation within the farm sector can be compensated through GHG offsets or other mechanisms.

We have not been able to quantify all of these factors and their influence on the farm economy. Our preliminary analysis of H.R. 2454, published in July[1], focused on the economic impacts of changes in energy prices associated with the cap imposed on domestic emissions.

[1] U.S. Department of Agriculture, Office of the Chief Economist and Economic Research Service. "A Preliminary Analysis of the Effects of H.R. 2454 on U.S. Agriculture" July 22, 2009. Available at http://www.usda.gov/oce/newsroom/archives/releases/2009files/HR2454.pdf

We have refined and expanded that analysis and my comments today will summarize preliminary findings focusing on the effects of higher energy prices. The findings suggest that under the energy price scenario estimated by the Environmental Protection Agency, price and income effects due to higher production costs will be relatively small, particularly over the short run (2012-25) when fertilizer producers will be eligible for significant rebates. Separate testimony will address the role of GHG offset markets and their effects on farm income, the analysis of which suggest that the cap-and-trade as a whole likely will have a positive effect on net farm income.

Agriculture and forestry are not covered sectors under the cap-and-trade system of H.R. 2454. Therefore producers in these sectors are not required to hold allowances for GHG emissions. Nonetheless, U.S. agriculture would be affected in a variety of ways. Energy providers' compliance with GHG emissions reductions legislation will likely increase energy costs. Higher prices for fossil fuels and inputs would increase agricultural production costs, particularly for more energy-intensive crops. This would, in turn, affect plantings and production, which would affect the livestock sector through higher feed costs. Higher energy prices could also result in increased biofuel production. It is worth noting that fertilizer prices will likely show little effect until 2025 because of the H.R. 2454's provision to help energy-intensive, trade exposed industries mitigate the burden that the emissions caps would impose.

Though the effects are not incorporated into the main findings of this testimony, H.R. 2454 would also provide opportunities for farmers and ranchers to receive payments for carbon offsets. Revenue from offsets for changes in tillage practices, reductions in methane and nitrous oxide emissions, and tree plantings, for example, could mitigate the effects of higher energy prices for many producers.

Lastly, H.R. 2454 could have significant land use effects. Though this analysis does not include bioenergy production effects or changes in land use due to added biofuel production or carbon sequestration through afforestation, both could further affect output prices and farm income.

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Energy Use by U.S. Agriculture

Agriculture is an energy intensive sector with row crop production particularly affected by energy price increases. Direct energy consumption in the agricultural sector includes use of gasoline, diesel fuel, liquid petroleum, natural gas and electricity. Indirect use involves agricultural inputs such as nitrogen and other fertilizers which have a significant energy component associated with their production. Over 2005-08, ERS data show that expenses from direct energy use averaged about 6.7 percent of total production expenses in the sector, while fertilizer expenses represented another 6.5 percent. With the more recent increases in energy costs, the combined share of these inputs reached nearly 15 percent in 2008.

In general, energy costs as a percent of total operating costs are highest for wheat and feed grains. Based on cost of production data for 2007 and 2008, wheat, sorghum, corn, barley and oats have energy input shares between 55 and 60 percent (table1). Cotton and soybeans are among the least energy intensive crops, with total energy costs representing only about 30 percent of total production costs.

A somewhat different distribution of energy costs by commodity results if looked at in terms of per-acre costs for energy-related inputs rather than shares of operating costs. Rice, corn, and cotton have the highest per-acre expenses for these inputs. Again, energy-related costs for soybean production are low among these crops.

There is also variation in the regional distribution of energy-input costs. Figure 1 illustrates this for wheat and soybeans, two sectors at the opposite end of the energy-input share spectrum. For wheat, the regions with the largest share of input costs allocated to energy are the Fruitful Rim and the Heartland (71 percent), followed by the Prairie Gateway (69 percent).

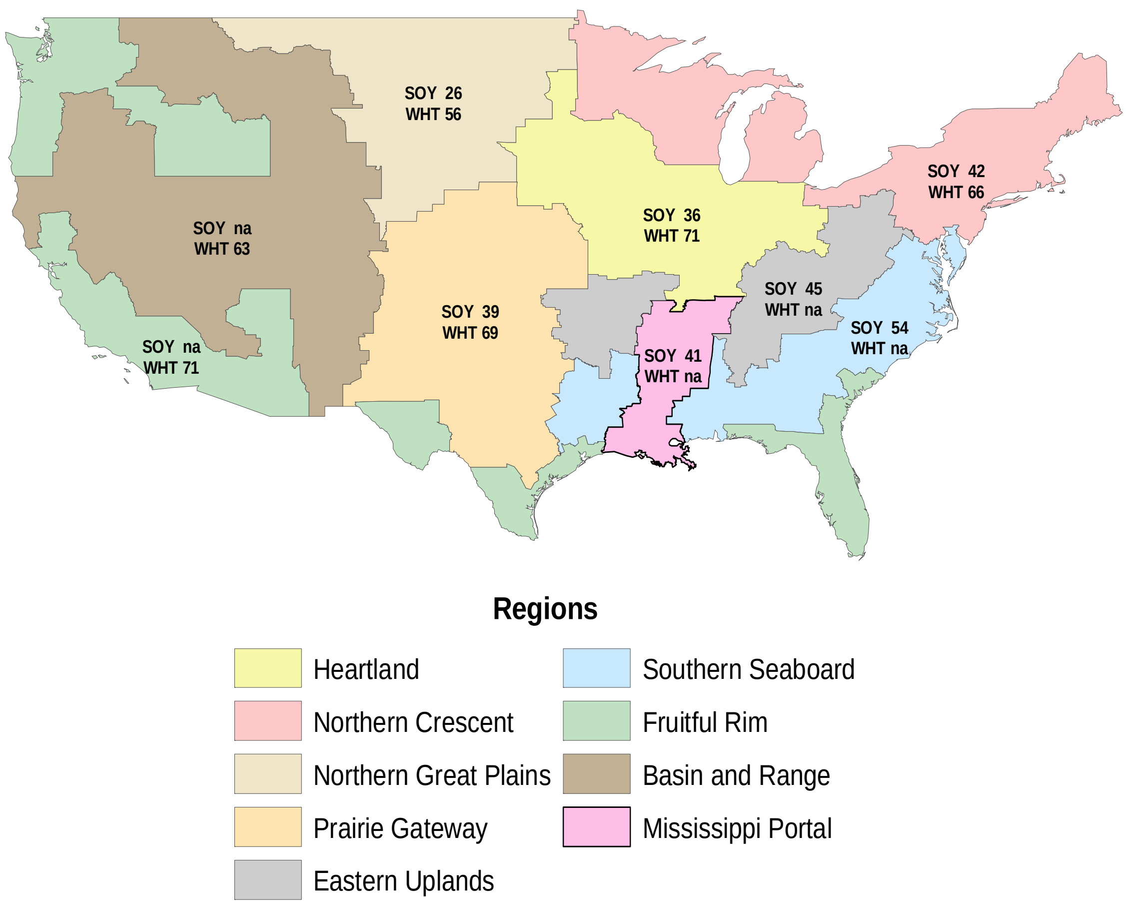
Wheat production cost relationships for the Northern Great Plains and the Prairie Gateway, where the majority of the crop is grown, present an interesting contrast in operating expenses. While the 2 regions have a similar share of production costs attributable to fertilizer expense in 2008 (44-45 percent), the shares of costs that are for fuel, lubrication, and electricity are much different (25 percent for the Prairie Gateway, while only 11 percent for the Northern Great Plains). This is likely due to the high level of irrigation used in the Prairie Gateway.

For soybeans, the region with the largest share of input costs allocated to energy is the Southern Seaboard (54 percent), followed by the Eastern Uplands (45 percent). The region with the largest soybean plantings is the Heartland, which has the second lowest share of energy inputs in total operating expenses, at 36 percent.

Direct energy costs make up a small share of total operating costs on livestock operations, comprising less than 10 percent of total operating costs for dairy, hogs and cow-calf operations (table 2). However, these operations experience higher energy costs indirectly through higher feed costs. Feed costs ranged from less than 11 percent of a cow-calf operator's total operating costs to almost 77 percent for dairy.

Trends in energy-related inputs could themselves change in the future in response to climate change impacts, as shifts in temperature and precipitation alter the need for fertilizer, pesticides, and irrigation. USDA's production cost modeling framework does not reflect these future changes in agroclimatic conditions.

Figure 1. Total energy input costs as a percentage of total operating costs, 2008, by ERS Farm Resource Region (soybeans and wheat).



Effects of Higher Energy Costs on U.S. Agriculture

To represent the effects on the U.S. agricultural sector of higher energy costs resulting from the emissions cap-and-trade system in H.R. 2454, estimated energy price changes from EPA's (June 2009) and EIA's (August 2009) analyses were used to derive implications for crop-specific production costs.[2] Cost categories in the USDA-ERS cost of production framework included in this analysis were fertilizer and fuel, lube, and electricity. As shown in the previous section, these production inputs represent a significant portion of operating expenses for major field crops. We use the Food and Agricultural Policy Simulator Model (FAPSIM) to analyze the effect of H.R. 2454 on national level production costs. This model allows farmers to change acreage decisions in response to higher energy prices, but does not allow for changes in input mix. Though FAPSIM is only designed to examine short-term impacts, we extrapolate to the intermediate and long-term to make an initial assessment of how higher energy prices in those years would affect farmers if they made identical decisions to those modeled in the short term. We know this is not the case due to changes in productivity over time as well as farmers ability to adapt to higher energy prices by shifting away from energy-intensive inputs. Regional effects are discussed only for the short-term impacts.

For the short-term scenarios, agricultural sector impacts were derived for 2012-18 based on energy price changes from the EPA and EIA analyses. While most of the direct energy price increases would be felt immediately by the agricultural sector, fertilizer costs would likely be unaffected until 2025 due to provisions in H.R. 2454 that would

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[2] For the June EPA H.R. 2454 analysis, scenario 2 was used. The EPA analysis of H.R. 2454 can be found at: http://www.epa.gov/climatechange/economics/economicanalyses.html.
For the EIA analysis, the basic case was used. The EIA analysis of H.R. 2454 can be found at: http://www.eia.doe.gov/oiaf/servicerpt/hr2454/index.html .

distribute specific quantities of emissions allowances to “energy- intensive, trade exposed entities” (EITE).[3] Additionally, EPA analysis indicates that the allocation formula would provide enough allowances to cover the increased energy costs of all presumptively eligible EITE industries. Based on these considerations, the USDA analysis assumes H.R. 2454 imposes no uncompensated costs on nitrogen fertilizer manufacturers related to increases in the price of natural gas through 2024. These allocations are terminated beginning in 2025. This reflects an assumption that enough foreign countries have adopted similar GHG controls to largely eliminate the cost advantage for foreign industries. These assumptions are consistent with the treatment of EITE industries, including nitrogen fertilizer manufactures, in the EPA analysis of H.R. 2454.

Medium-term and long-term impacts are based on EPA estimated changes in energy prices. Years covered in this analysis for these periods are 2027-33 and 2042-48. Since EPA results were presented in 5-year increments, results for other years covered in the analyses were derived by interpolation and extrapolation. EITE rebate scenarios are not covered for these periods since the rebates are assumed to end after 2025 in the EPA analysis. Because of the time horizons considered in the medium and long term analyses, there is much uncertainty surrounding the effects estimated here. Factors such as yield productivity, development of energy-saving technologies and weather can all have major effects on supply, demand and price outcomes, thus mitigating or exacerbating the effects estimated here.

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[3] Under Subtitle B of Title IV, “energy- intensive, trade exposed entities” (EITE) covers industrial sectors that have: 1) an energy or greenhouse gas intensity of at least 5% and a trade intensity of at least 15%; or 2) an energy or greenhouse gas intensity of at least 20%. Without these allocations, firms in EITE industries would incur energy-related costs that foreign competitors would avoid; hence, putting them at significant market disadvantage. The bill sets a maximum amount of allowances that can be rebated to EITE industries at, 2% for 2012 and 2013, 15% in 2014, and then declining proportionate to the cap through 2025. Beginning in 2026, the amount of allowance rebates will begin to be phased out and are expected to be eliminated by 2035. The phase-out may begin earlier or be delayed based on Presidential determination.

As emission caps become more stringent over time, allowance prices and corresponding energy price impacts become larger. Results for these scenarios illustrate some of these larger impacts. Table 3 shows selected energy-related impacts from the EPA and EIA analyses of H.R. 2454 that were used for the agricultural sector scenarios across each of the time periods. EIA results were available on an annual basis out to 2030.

Using the EPA and EIA results shown in the previously mentioned tables, changes in measures of energy-related agricultural inputs were estimated. Fuel price impacts are based on the EPA petroleum price changes and the EIA diesel fuel (transportation) price changes. Fertilizer price impacts in the EPA scenarios reflect price changes for natural gas and petroleum, while those in the EIA scenarios are based on price changes for natural gas (feedstock) and industrial distillate fuel oil.

Table 4 shows the average percent changes in the indexes of prices paid by farmers for fuels and fertilizer across the various time periods and scenarios analyzed. Reflecting the differences in the relative sizes of the EPA and EIA energy price impacts, effects on producer input prices during 2012-18 are about twice as large for the EIA-based scenarios compared to the EPA scenarios. The exception is the net fertilizer cost increase, reflecting in part different rebate sizes and inclusion within the EIA scenario of a greater shift from coal to natural gas under H.R. 2454.

National Impacts of Higher Energy Prices

The discussion of national impacts on the agricultural sector resulting from higher energy prices associated with the proposed emissions cap-and-trade policy is divided into two parts. First, an assessment of the impacts on major field crops and the livestock sector is discussed. This is followed by a discussion of impacts of higher energy costs on production expenses for the fruit and vegetable sector. Both discussions cover multiple short-term scenarios, as well as a medium-term and a long-term scenario, as discussed above. The analysis and discussion below does not include the effects of GHG offsets or other mechanisms to compensate farmers for emissions reductions and carbon sequestration. It also does not include the effect of other countries enacting policies mitigate GHG emissions. When revenues from offsets are considered in conjunction with production costs, net farm income is expected to be positive. These effects of offsets will be discussed briefly today, and in more detail in my testimony tomorrow.

To assess impacts on major field crops and the livestock sector, changes in agricultural production costs arising from higher energy prices are used as inputs to FAPSIM. This model covers commodity markets for corn, sorghum, barley, oats, wheat, rice, upland cotton, soybeans (including product markets for soybean meal and soybean oil), cattle, hogs, broilers, turkeys, eggs, and dairy. Fruit and vegetables are not modeled in FAPSIM but are analyzed using a separate model below. FAPSIM calculates the impacts of changes in production costs on supply, demand, and prices in each of these markets over the years 2009-18. At the aggregate level, the model also computes associated changes in production expenses in the sector and net farm income. The model simulations for the different scenarios and time periods assume no changes in technology or production practices (such as fertilizer application rates) beyond those implicit in the reference scenario's trends.[4]

[4] A more detailed description of FAPSIM is given in Appendix A.

Short-term Scenarios--EPA and EIA Energy Prices

Higher prices for energy-related agricultural inputs (fertilizer and fuel) raise the cost of production for all major crops. Table 5 shows the average nominal dollar impacts on variable production costs per acre for major field crops over 2012-18. For the EPA scenario (based on energy price increases consistent with EPA's CO_2-equivalent allowance prices for 2015 and 2020), the largest changes in per-acre production costs from baseline levels are for crops that use more energy-related inputs, most notably rice, corn, and cotton. However, compared with overall crop-specific production costs, high-cost rice and cotton are relatively less affected by the energy-related input changes (each up by less than 2 percent), while sorghum production costs are relatively more affected at 2.2 percent. This is due to the lower energy-input share relative to production costs for rice and cotton producers (as shown earlier in table 1). Whether looked at on a cost per acre basis or on a cost as share of production costs basis, soybean production costs are less affected than those of most other crops.

For the EIA scenario, energy-related production cost impacts for all crops are generally on the order of twice as large as those for the EPA scenario. However, the relative impacts among the crops are similar to those identified for the EPA scenario. For both price scenarios, the EITE rebates for fertilizer producers result in a significant reduction in potential costs since most of the impacts are limited to the increase in fuel costs.

Acreage effects, without offsets, are modest (table 6). Under the EPA price scenario, overall acreage planted to major field crops decreases by 133,000 acres, a less than 0.1 percent change from baseline levels over 2012-18. However, relative net returns among cropping alternatives, along with differences in producer responses to changes in economic incentives, result in varying impacts for each crop. Wheat acreage is down the most at 63,000 acres. While corn acreage also declines (less than 0.1 percent decline), its impacts are sharply reduced because of the importance of the EITE rebates in determining fertilizer costs. Also, the net shift of acres to soybean production is reduced relative to baseline levels as the relative cost advantage of the low-fertilizer input crop is diminished with the rebate.

Similarly, for the EIA scenario, a larger absolute decline in total acreage results, though still modest, with planted acreage down 354,000 acres. This represents a 0.1 percent decline in planted acreage. Wheat and corn acreage still experience the largest reductions. Again, there is a net switch in acreage to soybeans as their returns are affected the least among crops.

In general, crop production is down slightly, leading to higher prices (table 7). However, since production changes are small under the EITE rebates, price impacts are minimal, with no price change greater than 0.4 percent (0.2 percent and 0.4 percent are the highest price changes under the EPA and EIA scenarios, respectively). Under both scenarios, slightly higher corn prices, which are partially offset by lower soybean meal prices, lead to a a small increase in feed costs for the livestock sector (table 8). As a result, livestock production declines slightly. The impacts on livestock production vary across livestock species reflecting the relative shares of corn and soybean meal in the typical feed ration. Because corn is large part of their feed ration, pork and beef are affected more than poultry. Feed costs under the EIA scenario experience a larger increase than those from the EPA scenario, resulting in slightly larger livestock production declines.

Net farm income in the agricultural sector declines from the FAPSIM baseline on average by $0.76-$1.72 billion (0.9-2.1 percent) over 2012-18 (table 9). This change is due primarily to higher production expenses, although higher cash receipts partly offset the increases in production expenses. These income effects do not reflect revenues from GHG offsets nor do they reflect the related effects of land use changes associated with GHG offsets. These effects will be examined in more detail in tomorrow's testimony.

Effects on Production Expenses for the Fruit and Vegetable Sector

Fruits and vegetables are not included in FAPSIM. Instead, data from USDA's 2007 Agricultural Resources Management Survey (ARMS) were used to estimate the effects of H.R. 2454 on the fruit and vegetable sector. Average per farm effects on variable costs of production were estimated based on the increased input prices for fuels, electricity and fertilizer estimated under the FAPSIM runs described above.

Unlike for most row crops and livestock production, labor is the single largest variable cost for vegetable, melon, fruit and tree nut farms. However, the second largest expense component is fertilizer and agricultural chemicals. In 2007, fertilizer and agrichemicals accounted for about 18 percent of the variable cash expenses of vegetable and melon farms and 13 percent for fruit and tree nut farms. Motor fuels and oil used to run tractors, generators, and irrigation pumps accounted for 5 percent of vegetable cash costs and 4 percent of cash costs for fruits and tree nuts. In this analysis, per-acre fertilizer application rates are assumed to remain unchanged. Over the medium- and long-run, this is unrealistic since most growers would adjust application methods, amounts, timing, or the mix of crops produced to reduce expenses.

In addition, electricity is required by these farms to run irrigation pumps, ice makers, lights, and sorting and packing equipment in packing sheds. Although the exact share is not certain, electricity likely accounts for a significant share of the 4-5 percent of cash costs accounted for by expenditures for utilities. This analysis for the fruit and vegetable sector assumes that the entire utility expense category consists of electricity costs since there was no way to break out electric costs from telephone, water, and other utility expenses. Like fertilizer and other fuel expenses, no adjustments were assumed in electricity use; thus, the results for energy costs assumed here are likely high estimates.

Impacts of higher fertilizer, fuel, and electricity prices on variable costs within the fruit and vegetable complex are generally small in terms of percentages (table 10). Across the EPA and EIA short-term scenarios, impacts on costs for all fruits and vegetables were 2 percent or less. Over the long-term, the total impact under the EPA energy price scenarios was estimated to be 3.8 percent, or $7,747 per farm that specializes in fruits and vegetables (farm for which more than half of all sales come from fruits and vegetables).

Impacts across Farm Types and Regions

Regional and farm type impacts are based on results from the Farm-Level Partial Budget Model. The model operates on individual farm data for farm businesses from ARMS. The model reflects historic production patterns and farm structure within each region. Any potential structural or production responses by farms are not included within the model.

The model uses results from the FAPSIM scenarios discussed earlier as inputs to derive regional and farm type impacts consistent with the national outcomes. Results can be summarized across various groupings of farms such as by resource region, commodity specialization, or farm size categories. Nonetheless, since farm business performance varies within these groupings, results do not indicate performance of individual farms within a group.

The overall impacts reported in this section can differ from those in the national farm income accounts due to a number of factors. This section reflects, in part, on farm businesses[5] so the concentration of expenses is higher than for all farms. Further, part of the differences relates to the treatment of rent—the national accounts use net rent, while rent comes directly out of net cash income at the farm level.

A simulation of how the legislation will impact agriculture by farm type reveals that some segments of agriculture will be more impacted by the legislation than others. The analysis focuses on results for 2014 and this one year analysis serves as an example of regional and commodity differences in the short run.

Rebates to the fertilizer industry as an EITE to compensate for higher natural gas prices significantly lessens the impact of the higher energy prices across all farm types. With EITE rebates, 2014 net cash income for all farm businesses is estimated to be 1-4 percent lower than in the 2014 baseline level compared to the 1-2 percent decline in net farm income presented in the previous section. Wheat, cotton, rice, and “other crop” producers have a decrease in net income of 2-8 percent across the EPA-based and EIA-based scenarios (figure 2). Except for “other livestock” producers, most other farm types

[5] Farm businesses are defined as family and non-family operations that report farming as their principal occupation.

have a net income decrease of around 1-3 percent. As in the previous sections, these impacts do not include revenue from GHG offsets or increased biomass production.

The impact of higher energy prices under a fertilizer rebate scenario is not evenly distributed. Other cash grains, wheat, corn, soybeans, cotton, rice, specialty crops, and hogs account for nearly 49 percent of all farms, but these farms also account for over 63 percent of the projected decrease to net cash income relative to 2014 baseline levels. As was the case in analyzing farm types, net cash farm business incomes under both the EPA- and the EIA-energy price scenarios are reduced across all regions. All regions can expect a decrease in net cash income, ranging from less than 2 percent to about 7 percent (figures 3 and 4), with the biggest decrease in the Mississippi Portal region under the EIA scenario. Again, it is important to note that these estimated income effects do not reflect management decisions about changes in inputs, revenues from GHG offsets nor do they reflect the related effects of land use changes.

Figure 2—Reduction in farm business net cash income by farm production specialty, 2014, with EITE rebate

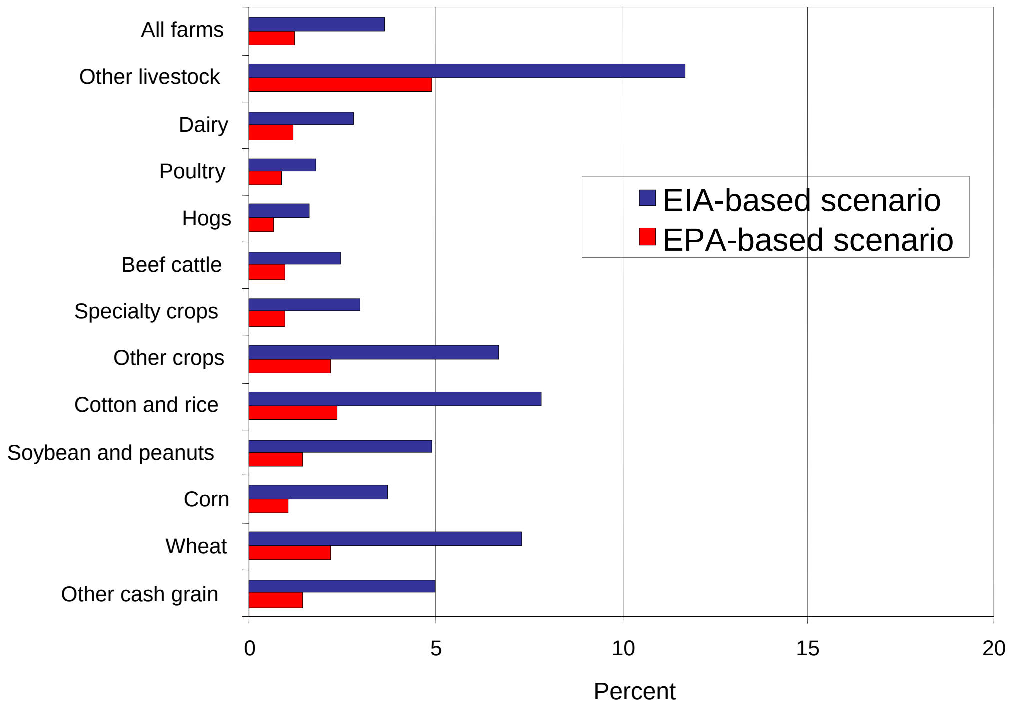


Figure 3--Reduction in farm business net cash income by resource region, EPA-based results, 2014, with EITE rebates.

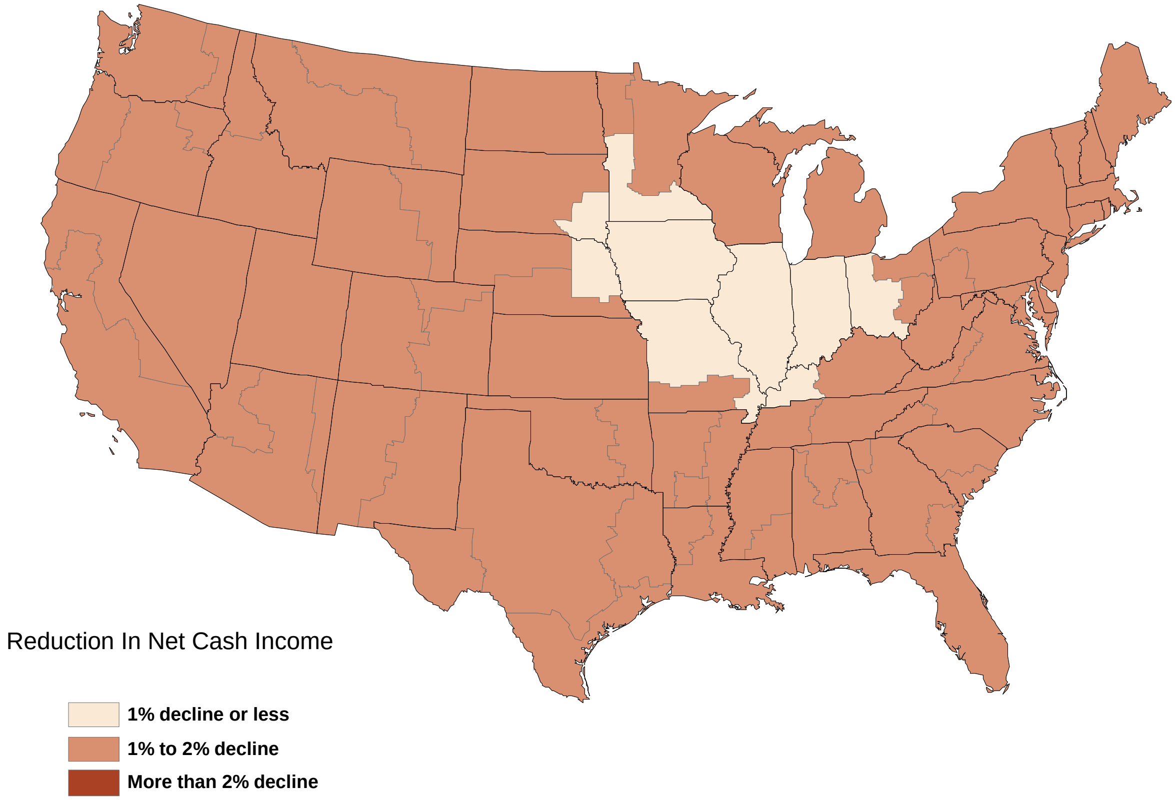
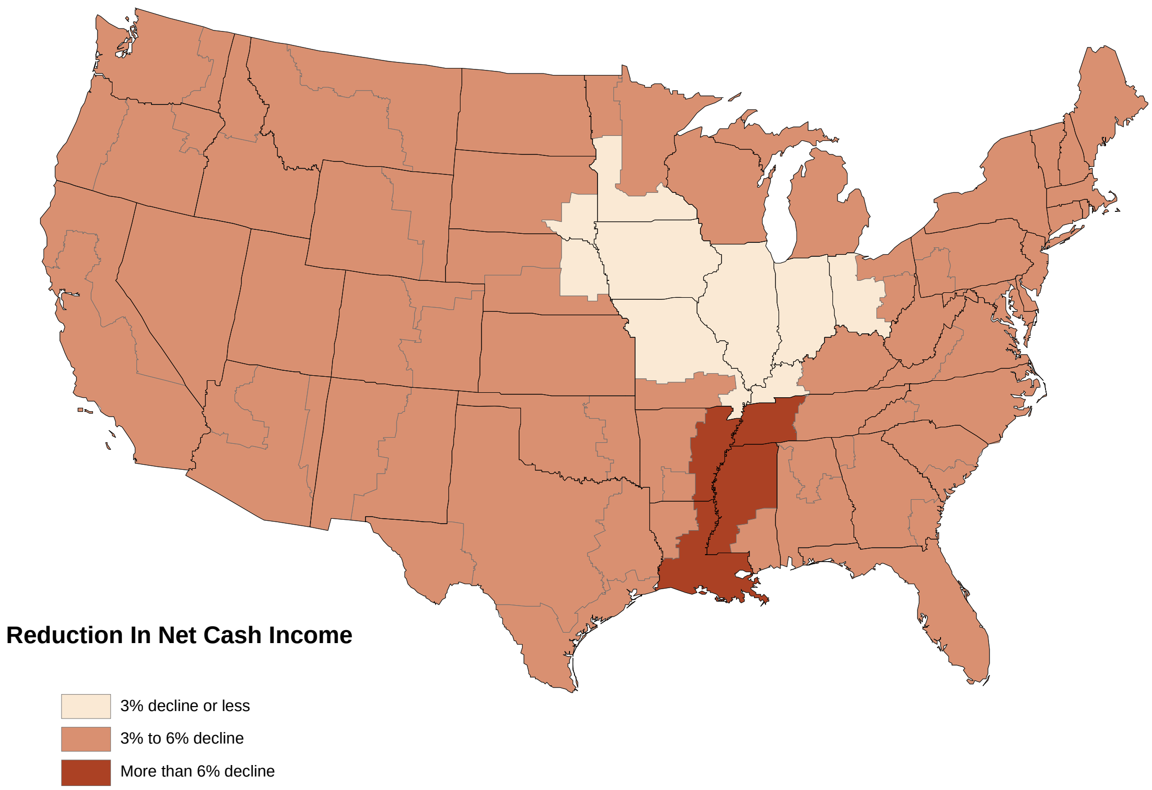


Figure 4-Reduction in farm business net cash income by resource region, EIA-based results, 2014, with EITE rebates



Medium-term and Long-term Impacts

As cap levels become more stringent over time, allowance prices and corresponding energy price impacts become larger. FAPSIM is designed to evaluate short-term impacts. It is therefore difficult to make accurate statements about the medium and longer-term. Nonetheless, to make some initial assessment of the effects of higher energy prices on agriculture beyond the initial short-term focus, the estimated impacts of energy prices for selected periods from the EPA analysis were used to look at 2 additional time periods using the FAPSIM framework. First a medium-term scenario was based on EPA estimated changes in energy prices for 2027-33. Then a long-term assessment was based on EPA results for 2042-48.

The methodological approach used was similar to that used earlier. However, given the assumptions necessary to extrapolate beyond the FAPSIM time frame, these should be viewed with full acknowledgement of the limitations of this analysis. Since these two additional time periods are beyond the horizon of the FAPSIM model, results were generated within the FAPSIM time horizon based on percent changes for affected variables and then inflated to the medium- and long-term time periods based on the annual inflation rate from the EPA analysis, 1.8 percent. This implies a constant real price assumption for those two additional time periods. Additionally, no additional changes in production practices beyond those implicit in underlying trend yields between now and these time periods is assumed. While these assumptions are analytical simplifications, they provide a vehicle for simulating representative impacts were they to occur in the short run. For the medium-term and long-term periods, there are no EITE rebate simulations included as those rebates are assumed to end after 2025 in the EPA analysis. For comparison purposes, results shown in this section repeat some of the earlier short-term impacts.

This approach has limitations given the observation that energy per unit of output has drastically declined over the last several decades. These estimates are likely an upper bound on the costs because they fail to account for farmer's proven ability to innovate in response to changes in market conditions.

Table 11 presents the impacts of higher energy prices on average annual production costs in the medium and long term along with those from the short-term (no-rebate case) discussed earlier. The medium- and long-term impacts on production costs have a relatively larger impact on fertilizer intensive crops such as corn compared to less fertilizer intensive crops such as soybeans. In the long-term, corn production costs are estimated to increase by more than $25 per acre (in $2005), representing an increase of almost 10 percent. In comparison, soybean production costs rise by $5.19 per acre, on average, 4.6 percent. Wheat, sorghum, barley, and oats would see increases similar to corn in percentage terms. Rice is estimated to have the largest average per-acre increase in the long term at $28.08 per acre, although its percentage increase would be less than that for wheat, corn, and the other feed grains. Likewise, cotton has a relatively high absolute increase in production costs, but this represents a smaller share of operating expenses. Soybean production costs remain the least affected.

Resulting adjustments in the agricultural sector to these higher production expenses follow the same dynamics as discussed earlier for the short-term results. Acreage shifts would lead to changes in commodity prices and adjustments through the livestock sector.

Table 12 presents the projected impacts of the higher energy costs across the different time periods for farm cash receipts, production expenses, and net farm income. In the long-term results, fuel, oil, and electricity expenses are estimated to increase, on average, 22 percent above baseline levels, while fertilizer and lime expenses are estimated to rise, on average, by almost 20 percent. While total receipts increase marginally—due to higher crop and livestock prices—they only partly offset the increase in expenses. As a result, higher energy prices associated with H.R. 2454 would lower net farm income by as much as 7.2 percent from baseline levels in the long term scenario. These results do not include the effects of GHG offsets.

Lastly, it is important to note that the medium to long term analyses are conservative given that energy use per unit of output has declined significantly over the past several decades. Because of this, the estimates in table 11 are likely an upper bound estimate on the costs because they fail to account for farmers' ability to fully respond to changes in market conditions. In addition, the analysis is also conservative because it does not account for revenues provided by GHG offsets, expanded renewable energy markets, or the effects GHG offsets and biofuel production have on land use, production and prices.

In my testimony tomorrow I will address the effects of GHG offsets on the U.S. agriculture, including effects on farm income. The results are drawn from modeling results provided by EPA from an economic model, developed by Bruce McCarl at the Texas A&M University.[6] Table 13 provides a summary of those findings on farm income. Modeling results provided by EPA show the annuity value of changes in producer surplus over the entire simulation period.[7] When the effects of GHG offsets are taken into account, it is estimated that the annuity value of the change in producer surplus is expected to be almost $22 billion higher; an increase of 12 percent compared to baseline producer surplus. About 78 percent of this increase is due to higher commodity prices as a result of the afforestation of cropland, with the remainder due to GHG related payments. Almost 30 percent of the gains would occur in the Corn Belt followed by the

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[6] The results presented in table 13 reflect simulation output from March 2009. A more complete description of FASOM modeling framework and a complete list of commodities can be found at: http://agecon2.tamu.edu/people/faculty/mccarl-bruce/FASOM.html

[7] The EPA model estimates the impact on producer surplus, a concept similar to net farm income.

South East region (16 percent of the gains), Great Plains region (13 percent), and South Central region (10 percent).

The producer surplus impacts exclude earnings from the sale of carbon from afforestation. The annuity value of the gross revenues associated with the sale of afforestation offsets would result in approximately $3 billion of additional farm revenue. About 90 percent of that additional revenue would be generated in four regions of the country: the Corn Belt (40 percent), Lake States (25 percent), South Central (14 percent), and Northeast (11 percent). However, part of that increase in revenue will be offset by the continued costs associated with maintaining afforestation projects.

Conclusions

Mr. Chairman, I appreciate the opportunity to discuss how a cap-and-trade system would likely affect farmers and ranchers. In today's testimony I have focused almost exclusively on how higher energy prices would affect the agriculture sector. Separate testimony will discuss the role of GHG offsets in much greater detail and how a properly designed offset program can both mitigate energy price impacts of a cap-and-trade system and provide significant benefits to farmers and ranchers. I am happy to answer any questions.

Table 1--Energy related inputs relative to total operating expenses for selected crops, 2007-08

Commodity	Fuel		Fertilizer	
	$/acre	Percent of operating costs	$/acre	Percent of operating costs
Corn	37.11	14.1	116.16	44.3
Soybeans	17.71	15.1	20.22	17.2
Wheat	22.51	20.6	42.60	39.0
Cotton	54.98	12.6	76.88	17.6
Rice	122.28	27.7	93.35	21.2
Sorghum	48.83	34.3	38.02	26.7
Barley	26.06	20.5	44.31	34.8
Oats	20.26	20.8	38.97	40.0
Peanuts	76.88	16.6	88.04	19.0

Source: Economic Research Service. Available at http://www.ers.usda.gov/data/CostsandReturns/

Table 2--Energy related inputs relative to total operating expenses for selected livestock, 2007-08

Commodity	Unit	Fuel		Feed	
		$/unit	Percent of operating costs	$/unit	Percent of operating costs
Milk	Per cwt sold	0.76	5.2	11.16	76.5
Hogs	Per cwt gain	1.81	3.5	29.61	57.6
Cow-calf	Per bred cow	66.42	10.1	71.52	10.8

Source: Economic Research Service.

Table 3--Estimated Impacts of H.R. 2454 on Energy Prices

	2015	2020	2025	2030	2035	2040	2045	2050
	$ per ton CO_2e (2005 $)							
Allowance price: EPA 1/	12.64	16.31	20.78	26.54	33.92	43.37	55.27	70.40
EIA 2/	20.96	29.95	42.80	61.16				
	Percent change from baseline							
Electricity price EPA	10.7	12.7	14.0	13.3	16.9	24.0	29.1	35.2
EIA	6.1	4.1	2.7	19.7				
Natural gas price EPA	7.4	8.5	8.6	10.4	14.3	18.9	24.1	30.9
EIA	2.2	4.7	6.2	17.1				
Petroleum price EPA	3.2	4.0	4.7	5.6	7.2	9.0	11.4	14.6
EIA	7.3	8.4	10.0	13.8				

1/ Source: EPA, June 23, 2009. The EPA analysis of H.R. 2454 can be found at: http://www.epa.gov/climatechange/economics/economicanalyses.html.
2/ Source: EIA, August 4, 2009. The EIA analysis of H.R. 2454 can be found at: http://www.eia.doe.gov/oiaf/servicerpt/hr2454/index.html

Table 4--Prices paid by farmers, energy related agricultural inputs, various scenarios

Item	EPA short term (2012-18)	EIA short term (2012-18)	EPA medium term (2027-33)	EPA long term (2042-48)
	Average annual percent change from reference scenario			
Fuel	2.6	5.3	4.6	9.3
Fertilizer	0.3	1.7	8.4	17.6

Table 5--Effects of energy price increases on nominal per-acre costs of production, 2012-18 averages (percent change shown in parentheses)

Commodity	EPA price scenario	EIA price scenario
Corn	1.44 (0.4%)	4.72 (1.5%)
Sorghum	1.52 (0.9%)	3.71 (2.2%)
Barley	0.85 (0.6%)	2.41 (1.6%)
Oats	0.69 (0.6%)	1.97 (1.7%)
Wheat	0.80 (0.6%)	2.31 (1.7%)
Rice	3.74 (0.7%)	9.14 (1.7%)
Upland cotton	1.76 (0.3%)	4.56 (0.9%)
Soybeans	0.55 (0.4%)	1.43 (1.0%)

Table 6--Effects of energy price increases on planted acres, 2012-18 averages (in 1,000 acres, percent change shown in parentheses)

Commodity	EPA price scenario	EIA price scenario
Corn	-27 (-0.0%)	-89 (-0.1%)
Sorghum	-26 (-0.3%)	-48 (-0.7%)
Barley	-2 (-0.1%)	-6 (-0.1%)
Oats	-10 (-0.3%)	-25 (-0.7%)
Wheat	-63 (-0.1%)	-176 (-0.3%)
Rice	-3 (-0.1%)	-8 (-0.3%)
Upland cotton	-7 (-0.1%)	-20 (-0.2%)
Soybeans	4 (0.0%)	19 (0.0%)
Total	-133 (-0.1%)	-354 (-0.1%)

Table 7--Effects of energy price increases on farm level prices, 2012-18 averages (percent change shown in parentheses)

Commodity	EPA price scenario	EIA price scenario
Corn ($/bu)	0.00 (0.1%)	0.01 (0.3%)
Sorghum ($/bu)	0.01 (0.2%)	0.01 (0.4%)
Barley ($/bu)	0.00 (0.1%)	0.01 (0.3%)
Oats ($/bu)	0.00 (0.1%)	0.01 (0.4%)
Wheat ($/bu)	0.01 (0.1%)	0.02 (0.3%)
Rice ($/cwt)	0.01 (0.1%)	0.03 (0.3%)
Upland cotton (cents/lb)	0.04 (0.1%)	0.11 (0.2%)
Soybeans ($/bu)	0.00 (0.0%)	0.00 (0.0%)
Soybean meal ($/ton)	0.00 (0.0%)	0.03 (0.0%)
Soybean oil (cents/lb)	0.00 (0.0%)	0.01 (0.0%)

Table 8--Effect of energy price increase on feed costs and livestock production, 2012-18 average (percent change from baseline)

Commodity	EPA price scenario	EIA price scenario
Beef Feed costs	0.1%	0.3%
Production	-0.0%	-0.1%
Pork Feed costs	0.1%	0.2%
Production	-0.0%	-0.0%
Young chickens Feed costs	0.0%	0.2%
Production	-0.0%	-0.0%
Milk Feed costs	0.1%	0.3%
Production	-0.0%	-0.0%

Table 9--Effects of energy price increase on farm income, 2012-18 average (billion dollars, with percent change from baseline in parentheses)

Commodity	EPA price scenario	EIA price scenario
Cash receipts:		
Crops	0.02 (0.0%)	0.08 (0.0%)
Livestock	0.03 (0.0%)	0.12 (0.1%)
Total cash Receipts	0.05 (0.0%)	0.20 (0.1%)
Total production expenses	0.80 (0.3%)	1.91 (0.6%)
Net farm income	-0.76 (-0.9%)	-1.72 (-2.1%)

Table 10--Effects of energy price increases on per-farm variable cash production expenses for fruit and vegetable sector

Scenario	Vegetable and melons		Fruit and tree nuts		Fruits, tree nuts, and vegetables	
	Dollars	Percent	Dollars	Percent	Dollars	Percent
Short term: EPA, with rebate	1,275	0.44	758	0.45	909	0.44
EIA, with rebate	2,616	0.91	1,398	0.82	1,754	0.86
Medium term	6,134	2.13	2,933	1.72	3,869	1.89
Long term	12,387	4.29	5,831	3.42	7,747	3.78

Table 11--Estimated impacts on per acre variable costs of production of higher energy prices under an emissions cap-and-trade system ($2005/acre, percent change from baseline in parentheses)

Crop	Short-term (with rebate)	Medium-term (no rebate)	Long-term (no rebate)
Corn	1.19	12.02	25.19
	(0.4%)	(4.6%)	(9.6%)
Sorghum	1.26	5.45	11.30
	(0.9%)	(3.9%)	(8.0%)
Barley	0.70	5.00	10.44
	(0.6%)	(4.1%)	(8.5%)
Oats	0.57	4.12	8.66
	(0.6%)	(4.4%)	(9.3%)
Wheat	0.66	4.94	10.34
	(0.6%)	(4.5%)	(9.5%)
Rice	3.09	13.48	28.08
	(0.7%)	(3.1%)	(6.5%)
Upland cotton	1.46	7.90	16.44
	(0.3%)	(1.8%)	(3.7%)
Soybeans	0.45	2.50	5.19
	(0.4%)	(2.2)	(4.6%)

Table 12--Estimated impacts on net farm income of higher energy prices under an emissions cap-and-trade system ($2005 billion, percent change from baseline in parentheses)

Item	Short-term	Medium-term	Long-term
Total receipts	0.0	0.4	0.9
	(0.0%)	(0.2%)	(0.3%)
Total expenses	0.7	2.7	5.6
	(0.3%)	(1.1%)	(2.2%)
Fuel, oil and electricity	0.7	1.3	2.6
	(6.4%)	(11.1%)	(22.2%)
Fertilizer and lime	< 0.1	2.0	4.3
	(0.3%)	(9.5%)	(19.9%)
Net farm income	-0.6	-2.4	-4.9
	(-0.9%)	(-3.5%)	(-7.2%)

USDA data based on EPA results, selected time periods.

Table 13. Annuity Impacts on Producer Surplus/Farm Income, by Region.

Region	billion (2004) dollars annualized annuity value
Corn Belt	6.4
Great Plains (no forestry)	2.9
Lake States	1.6
Northeast	0.4
Rocky Mountains	1.5
Pacific Southwest	0.7
Pacific Northwest	0.7
South Central	2.3
Southeast	3.4
South West (no forestry)	1.9
U.S. Total	22

USDA analysis based on FASOM simulations provided by EPA.

Appendix A--The Food and Agricultural Policy Simulator (FAPSIM)

The Food and Agricultural Policy Simulator (FAPSIM) is an annual, dynamic econometric model of the U.S. agricultural sector. The model was originally developed at the U.S. Department of Agriculture during the early 1980s.[8] Since that time, FAPSIM has been continually re-specified and re-estimated to reflect changes in the structure of the U.S. food and agricultural sector. The model includes over 800 equations.

The model contains four broad types of relationships: definitional, institutional, behavioral, and temporal. Definitional equations include identities that reflect mathematical relationships that must hold among the data in the model. For example, total demand must equal total supply for a commodity at any point in time. The model constrains solutions to satisfy all identities of this type.

Institutional equations involve relationships between variables that reflect certain institutional arrangements in the sector. Countercyclical payment rates calculations are example of this type of relationship.

Definitional and institutional equations reflect known relationships that necessarily hold among the variables in the model. Behavioral equations are quite different because the exact relationship is not known and must be estimated. Economic theory is used to determine the types of variables to include in behavioral equations, but theory does not indicate precisely how the variables should be related to each other. Examples of behavioral relationships in FAPSIM are the acreage equations for different field crops. Economic theory indicates that production should be positively related to the price received for the commodity and negatively related to prices of inputs required in the production process. Producer net returns are used in the FAPSIM acreage equations to capture these economic effects. Additionally, net returns for other crops that compete with each other for land use are included in the acreage equations. While the model covers the U.S. agricultural sector, trade for each commodity is included through econometrically-based export equations.

For the most part, FAPSIM uses a linear relationship to approximate the general functional form for each behavioral relationship. Generally, the parameters in the linear behavioral relationships were estimated by single equation regression methods. The large size of the model precludes the use of econometric methods designed for systems of equations. Ordinary least squares were used to estimate the majority of the equations. If statistical tests indicated the presence of either autocorrelation or heteroscedasticity in the error structure of an equation, maximum likelihood methods or weighted least squares were used.

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[8] Salathe, Larry E., Price, J. Michael, and Gadson, Kenneth E. “The Food and Agricultural Policy Simulator.” *Agricultural Economics Research*, (34(2)): 1-15, 1982.

Temporal relationships are empirical equations that describe the inter-relationships between variables measured using different units of time. For example, not all of the variables in FAPSIM are measured using the same concept of a year. Commodity data are reported on a marketing year basis; budgetary data are reported on a fiscal year basis; and farm income data are reported on a calendar year basis. As a result, empirical equations are sometimes needed to establish relationships among variables in these different temporal categories. For example, cash receipts for crops are reported on a calendar year basis, but production and price information for crops are on a marketing year basis. Equations are used in FAPSIM to estimate cash receipts using information from both marketing years that overlap the calendar year.

Commodities included in FAPSIM are corn, sorghum, barley, oats, wheat, rice, soybeans, (including product markets for soybean meal and soybean oil), upland cotton, cattle, hogs, broilers, turkeys, eggs, and dairy. The dairy model contains submodels for fluid milk, evaporated and condensed milk, frozen dairy products, cheese, butter, and non-fat dry milk. Each commodity submodel contains equations to estimate production, prices, and different demand components. FAPSIM also includes submodels to estimate the value of exports, net farm income, Government outlays on farm programs, retail food prices, and consumer expenditures on food. All of the submodels are linked together through the variables they share in common.