A Comparison of Select Cost-Benefit Studies on the Impacts of H.R. 2454 on the Agriculture Sector of the Economy

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Executive Summary

In response to concerns over the impact that carbon emissions have on the climate, the United States Congress is currently considering the Clean Energy and Security Act of 2009. As of this writing (12/08/2009), the House of Representatives has passed its version of the bill (H.R. 2454, also known as the Waxman-Markey Bill). While the agricultural sector is excluded from emissions caps included in the bill, concerns over the impacts this legislation might have on the agricultural sector have generated numerous economic studies that predict a variety of outcomes. The purpose of this report is to provide a summary of the various assumptions, analytical methods, and major findings and implications of several of the key economic studies. The economic studies considered in this review are Agricultural and Food Policy Center (AFPC) at Texas A&M University (2009), Agricultural Policy Analysis Center (APAC) at University of Tennessee (2009), Babcock at Center for Agricultural and Rural Development (CARD), at Iowa State University (2009), Food and Agricultural Policy Research Institute (FAPRI) at University of Missouri (2009), Nicholas Institute for Environmental Policy Solutions (NIEPS) at Duke University (2009) and USDA (2009).

Whether the agricultural sector of our economy will be a net gainer or loser from climate change policy will depend on the details contained in the final legislation. For the most part, the sources of agricultural costs and benefits have been identified, and numerous studies have predicted how agriculture might be affected. These studies vary from farm-level analysis, such as AFPC (2009), to regional and national level analysis, such as NIEPS (2009).

Each study reviewed suggests that costs would be expected to increase with the implementation of H.R. 2454, but the size of the increase is relatively small. Further, a portion of this cost increase will be passed on to the consumer in the form of higher prices. In the short run, per-acre profitability for both crop and livestock producers may decline, but for the most part the research suggests the declines will be modest. If other countries adopt similar legislation, in the long run, the market for agricultural commodities will adjust and return producers' profits to pre-H.R.2454 levels.

H.R. 2454 will encourage the continued development of carbon credits for the offset market and low carbon renewable energy to satisfy the renewable energy standard (RES). At the present time it is not completely clear how renewable energy legislation and climate offset markets will function together. The viability of these markets will depend upon the policies that regulate/foster/develop/cause such carbon trading to occur and how they complement or conflict with future renewable fuels policies. What is clear is that these markets have the potential to provide significant financial benefits to agricultural producers. We suggest that these key research assumptions on which agricultural practices qualify for offset credits, the price of those offset credits, and their contribution to producer net revenue explain the majority of variation found in the reports analyzed.

The economic impacts will vary regionally and by crop and livestock sub-sector. The impacts will depend on cultural and management practices and the farm-specific ability to sequester carbon and receive offset income. While on a national level agriculture appears to be positively affected, on a farm level some sub-sectors, such as rice production, appear to be worse off.

Overall, the research suggests U.S. agriculture has more to gain than lose with the passage of H.R. 2454. The bill specifically exempts production agriculture from emissions caps, provides provisions to ease the transition to higher fertilizer prices and fosters the development of carbon offset markets which likely will enhance agricultural revenues.

A Comparison of Select Cost-Benefit Studies on the Impacts of H.R. 2454 on the Agriculture Sector

Introduction

In response to concerns over the impact that carbon emissions have on the climate, the United States Congress is currently considering the Clean Energy and Security Act of 2009. As of this writing, the House of Representatives has passed its version of the bill (H.R. 2454, also known as the Waxman-Markey Bill). This legislation limits greenhouse gas emissions to 17 percent below current levels by 2020 and 83 percent below current levels by 2050 (NIEPS, 2009). Although the agricultural sector is excluded from these emissions caps, concerns over the impacts this legislation might have on the agricultural sector have generated numerous economic studies that predict a variety of outcomes. The purpose of this report is to provide a summary of the various assumptions, analytical methods, and major findings and implications of several of the key economic studies. The economic studies considered in this review are AFPC (2009), APAC (2009), Babcock (2009), FAPRI (2009), NIEPS (2009) and USDA (2009). This comparison is being provided at the request of, and with funding provided by, American Farmland Trust.

The Impacts of H.R. 2454 on the Agriculture Sector

The primary industries targeted for emission reductions by H.R. 2454 are electric utilities, oil refiners and natural gas producers. Undoubtedly, the price of electricity, gasoline, diesel fuel and natural gas will increase. Essentially, H.R. 2454 will raise energy prices for all economic sectors that use energy. This will generate direct cost impacts on the agricultural producers by increasing the costs of inputs such as diesel, gasoline, natural gas and electricity. Indirect cost impacts to agricultural producers also will occur. As suppliers of production inputs experience cost increases, they will raise prices on such inputs as fertilizer, seed, other farm chemicals, farm equipment and other farm service sectors that use energy as an input to their production processes.[1] Input substitution will mitigate some of the cost impacts. To some extent, producers will substitute lower cost inputs in place of higher cost inputs. There also may be a shift in cropping patterns to those crops that are more profitable. Technology adoption by the agricultural sector also will play a role in reducing costs over time. No-till production and precision technologies may both reduce costs and raise productivity. The cost increases will impact all crops in all geographical settings, which will initially reduce supply. This will generate positive price effects. As supply decreases, producers will be able to pass-through a portion of the higher costs to consumers in the form of higher prices for their production.

In addition to the impacts that are generated due to higher production costs, there also will be a biofuel impact. H.R.2454 establishes a Renewable Energy Standard (RES) that mandates that a portion of all of U.S. electricity be produced from renewable energy sources. As the price of conventional fuel rises (diesel, gasoline, natural gas and electricity) the demand for biofuels and other renewable energy sources will increase. The main feedstocks for biofuel production will be supplied by the agriculture and forestry sectors. As the market for these feedstocks expands, the financial benefits will accrue to the agricultural sector. These benefits include not only expanding markets for biofuel feedstocks, but as land formerly used for

[1] Nitrogen fertilizer will be impacted somewhat differently as a result of the energy-intensive trade-exposed entities (EITE) provisions in H.R. 2454.

commodity production shifts to feedstock production, the supply will decline, which will induce positive price effects for agricultural commodities.

Embedded within H.R. 2454 is a national cap-and-trade system on carbon emissions. Under this market-based system, overall U.S. emissions will be capped. Although each company will receive an allocation for a portion of the overall emission cap, they will be free to emit as much greenhouse gas as they want so long as they have or can obtain a permit for each ton of emission. Companies will be allowed to trade (buy and sell) the permits. Those companies that can easily reduce emissions will reduce emissions and sell their excess emission permits to those companies that find it too expensive to reduce emissions. Under the current legislation, agriculture will be exempt from any cap, but will be allowed to sell emissions permits, more commonly called agricultural offset credits. Producers will be in a position to receive agricultural offset revenues by sequestering carbon through no-till practices, and converting cropland to pastureland or trees (typically referred to as aforestation of land).[2] Producers can receive agricultural offset revenues by reducing field emissions of nitrous oxide (from fertilizer and manure/livestock) and methane (from livestock, manure handling and rice cultivation), as well. Reducing field emissions of nitrous oxide and methane will have costs associated with it. Similar to the biofuel impact, as land formerly used for commodity production shifts to pasture and forest production, supply will decline, inducing positive commodity price effects.

As new markets develop for bioenergy and agriculture offsets, and assuming the increased revenues exceed the increased costs, we would expect to see crop prices rise and the returns to agricultural land increase. Insofar as H.R. 2454 fosters the development of these alternate markets it is often assumed that there will be positive land value impacts. Those producers that own their land will experience an increase in their net worth. On the other hand, producers that rent their land may experience an additional cost in the form of an increased rental rate.

Research Choices that Impact Economic Findings

Economists often are called upon to analyze the impacts of proposed policies. The choices researchers make in defining the research question, choosing an appropriate modeling framework, and the selection of data and assumptions, invariably will impact their research results. Additionally, the economic performance metrics used to convey the results to the general public impact the public's perception of what the results mean.

Researchers must choose the geographic scope of the study. Studies can be conducted at the farm level, county level, state level, the regional level, or for the entire United States. Researchers also must choose the economic scope of the study. As previously discussed, the proposed climate change legislation may generate a variety of economic impacts. Depending on the research question, the economic scope might be narrowly defined, such as including only direct cost impacts, or could be more broadly defined and include a more comprehensive list of impacts. While the focus of all the studies is on the agricultural sector of the economy, it is important to remember that the agricultural sector is composed of many agricultural sub-sectors (corn and other feed grains, soybeans and other oilseed crops, cotton, rice, dairy, beef, swine, etc.). Because the economic impacts may vary by sub-sector, a researcher must choose which ones to include in the analysis. The time frame of analysis is another important consideration. Some stakeholder groups may be more focused on the immediate economic consequences that

[2] Cropland requirements for carbon dioxide sequestration specify that land must be engaged in a minimum or no-till cropping program (AFPC, 2009).

occur in the short run. Since the economic impacts may increase or decrease with time, other stakeholder groups may be more interested in those economic impacts that occur in the long run. Table 1 reports the geographic scope, economic scope, agricultural sub-sectors, and time frames used in the studies examined here.

There are a variety of analytical frameworks that would be useful in analyzing the economic impacts of H.R. 2454 on production agriculture. A budgeting approach would be useful in identifying short-run impacts on the direct and indirect costs for individual sub-sectors in specific geographic areas. Simulation models would be appropriate for predicting the long-run aggregate impacts of changing cropping patterns, technology adoption, and the emerging markets for biofuels and agriculture offsets. The economic performance metric (changes in costs, revenues, net income, net worth, etc.) used by researchers to present their results can have a large impact on how stakeholders perceive the results. As an example, while the cost impacts are important, by themselves they may present an incomplete picture of the net impact on agriculture. Because different stakeholder groups may be more interested in one economic measure than another, it is appropriate to conduct research on each. Regardless of the geographic scope, economic scope, agricultural sub-sectors, time frames, analytical frameworks and economic performance metric applied, the key assumptions and data sources employed by the researcher will have a significant impact on the appropriate interpretation of their results. Table 2 reports the analytical frameworks, economic performance metrics and key assumptions employed in the studies being analyzed.

Summary of Studies

Agricultural and Food Policy Center (AFPC), Texas A&M University (2009): Economic Implications of the EPA Analysis of the CAP and Trade Provisions of H.R. 2454 for U.S. Representative Farms

This analysis applied a simulation model (FLIPSIM) to state level representative crop and livestock producers to assess the overall economic impacts on U.S. agriculture of H.R. 2454.[3] The study included direct costs, indirect costs, the impacts of input substitution, cropping pattern changes, technology adoption, price effects, biofuel impacts, agricultural offsets and the impacts associated with changing land values. The study provides estimates for three cap-and-trade scenarios. Based on a short-run analysis of the impact on net farm income the authors concluded:

> In general, the feedgrain/oilseed farms located in or near the Corn Belt and wheat farms located in the Great Plains, have higher average annual net cash farm income under the three cap-and-trade alternatives. Most cotton and dairy farms and all of the rice farms and ranches will likely experience lower net cash farm incomes under the cap-and-trade alternatives. The rice farms and cattle ranches are assumed to be unable to participate in carbon sequestration activities so they experience higher costs, without carbon revenue and their commodity prices do not increase enough to offset higher costs (page 32).

AFPC (2009) provides a detailed study of the distributional impacts (how the economic impacts vary by location and agricultural sub-sector) and the economic scope of their model is very complete. This study provides insights into how cost and revenues from crop and livestock

[3] AFPC (2009) describes FLIPSIM (Farm Level Income and Policy Simulation Model) as a risk-based whole farm simulation model.

production will impact individual producers. As reported in Table 3, the list of possible agricultural offsets considered in their analysis is somewhat limited, compared to the other studies reviewed, and thus this study may understate the benefits to agriculture, relative to the other studies.[4]

Agricultural Policy Analysis Center (APAC), University of Tennessee (2009): Analysis of the Implications of Climate Change and Energy Legislation to the Agriculture Sector

This analysis applied a simulation model (POLYSYS) at the state level, as well as the aggregated U.S. agriculture crop and livestock sectors to assess the overall economic impacts of H.R. 2454.[5] The study included direct and indirect costs, cropping-pattern-change-induced price effects, biofuel impacts and agricultural offsets. The primary focus of the study was to model how various combinations of allowed carbon offsets impact producer net revenue and the environment. The study provides estimates for four scenarios. Based on a short-run analysis of the impact on net farm income, the authors concluded:

> The impacts of cap-and-trade policies upon the agricultural sector could have dramatically different outcomes depending upon how the policy is constructed. However, a well-constructed cap-and-trade program that allows multiple offsets for agriculture (including bioenergy crop production) and manages residue removal to be carbon neutral, can generate positive net returns to agriculture while yielding carbon benefits (page 18).

APAC (2009) provides both aggregate and the distributional impacts. The authors did not report the economic scope of their model. As reported in Table 3, the list of possible agricultural offsets considered in their analysis is very extensive. This study discounted agricultural offsets for transaction costs and risk, and provide an excellent rationale for the decision.

Babcock, Center for Agricultural and Rural Development Center (CARD), Iowa State University (2009): Costs and Benefits to Agriculture from Climate Change Policy

This analysis applied a representative farm level budget approach to the Iowa crop (corn and soybeans) and livestock (swine) sectors to assess the impacts of H.R. 2454. The study included only the direct and indirect cost impacts. Based on a short-run analysis of the impact on cost, the author concluded "…the negative impacts on agriculture will likely be relatively small, particularly if agricultural emissions remain uncapped" (page 11) and "Similarly, the benefits from providing carbon offsets to capped sectors of the economy will be modest as well" (page 11). The author suggested that his cost estimate might be overstated as input substitution and technology adoption effects were not considered.

This was somewhat of a limited study from both a geographic and economic scope, and the results should not be extrapolated to other areas. However, the study provided insights into the economic costs and benefits that a typical Iowa producer is likely to experience. Additionally, this report suggested that, assuming producers in other countries face similar cost increases, markets will adjust and U.S. producers will not lose their competitive advantage.

[4] See http://www.chicagoclimatex.com/ for a listing of agriculture offsets currently traded on the Chicago Climate Exchange.

[5] APAC (2009) describes POLYSYS as a robust agricultural policy simulation model of the US agricultural sector that includes national demand, regional supply, livestock, and aggregate income modules.

Food and Agricultural Policy Research Institute (FAPRI), University of Missouri (2009): The Effects of Higher Energy Prices from H.R. 2454 on Missouri Crop Production Costs

This analysis applied a representative farm level budget approach to the Missouri corn, soybean and wheat sectors to assess the cost impacts of H.R. 2454. The study included only the direct and indirect cost impacts. Based on a short-, medium- and long-run analysis of the impact on cost, the authors concluded "…by 2050 as a result of H.R. 2454, estimated Missouri crop operating costs increase by 8.1 percent, 8.8 percent, 4.4 percent and 10.4 percent for dryland corn, irrigated corn, soybeans and wheat, respectively" (page 4). The authors noted that:

> This report is not a full analysis of the impact of H.R. 2454 on Missouri crop producers. This study does not incorporate likely responses by producers to these changes in production costs. As input costs increase, producers could adjust input usage and the mix of crops produced, with implications for crop yields, production and prices. Crop prices also would be affected by any impacts of H.R. 2454 on biofuel production. This analysis also does not consider any gains that Missouri crop producers could receive by selling carbon credits. All of these issues remain important to include in any overall analysis of H.R. 2454 (page 1).

FAPRI (2009) provides a limited study from both a geographic and economic scope, and the results should not be extrapolated to other areas. As reported in Table 3, and stated in their report, the authors did not consider revenues from carbon credit offsets. As a result, the report likely understates the benefits to production agriculture. However, the study is very insightful as it depicts a scenario where market failure may limit carbon offset revenues and U.S. producers face an un-level playing field with other countries.

Nicholas Institute for Environmental Policy Solutions (NIEPS), Duke University (2009): The Effects of Low-Carbon Policies on Net Farm Income

This analysis applied a simulation model (FASOMGHG) to the agriculture and forestry sectors to assess the overall economic impacts on U.S. agriculture of H.R. 2454.[6] The study included direct and indirect costs, the impacts of input substitution, cropping pattern changes, technology adoption, price effects, biofuel impacts, agricultural offsets and the impacts associated with changing land values. The study provides estimates for three cap-and-trade scenarios. Based on a long-run analysis of the impact on producer surplus, the authors concluded "We find higher input costs, higher output prices, modest consumer response, increased bioenergy supply, and offset income opportunities. On net, we find that the U.S. agricultural sector would benefit from a U.S. climate policy" (page 4).

Several items need to be brought to the reader's attention prior to comparing the NIEPS (2009) results to other studies. While the study implicitly predicted short- and medium-run values, the authors chose to summarize the findings based on annualized annuity values. This is a reasonable method as it condenses a multi-year series of varying values into a single annualized constant value. However, as costs and revenues may be expected to increase over time, the method may overestimate what may occur in the short run and underestimate what may occur in the long run, relative to other studies that did not use this approach. As such, the values purported in this study may not be directly comparable to the values presented in other studies.

[6] NIEPS (2009) describes FASOMGHG (Forest and Agricultural Sector Optimization Model with Greenhouse Gases) as a partial equilibrium economic model of the U.S. forest and agricultural sectors, and can simulate agricultural and forestry production responses to carbon prices.

Additionally, although the authors noted that agriculture would be exempt from the cap restrictions, they included the cost of emissions in their agriculture annualized annuity values for costs. As noted by the authors, this would have the impact of underestimating offset revenues, or conversely, overestimating input costs. Of the studies examined here, this was the only one that included the cost of emissions and thus costs in this study are relatively higher.

NIEPS (2009) provides a very detailed study of the distributional impacts and the economic scope of their analysis is quite extensive. This study provides insights into how cost and revenues from crop and livestock production will impact the United States and regional economies. As reported in Table 3, the list of possible agricultural offsets considered in their analysis is comprehensive. Relative to other studies, this study considered relatively high carbon prices and did not discuss discounts for transactions costs. As such, some scenario results may be overly optimistic.

USDA (2009): A Preliminary Analysis of the Effects of H.R. 2454 on U.S. Agriculture

This analysis applied a simulation model (FAPSIM) to the aggregated U.S. agriculture crop and livestock sectors to assess the overall economic impacts of H.R. 2454.[7] The study included the direct and indirect cost impacts as well as the impacts on cropping pattern and the price effects generated by the changing cropping pattern. Based on a short-, medium- and long-run analysis of the impact on net farm income, the authors concluded "While total receipts increase marginally—due to higher crop and livestock prices—they are not sufficient to offset the increase in farm expenses. As a result, net farm income is estimated to decline by as much as 7.2 percent from baseline levels" (page 10). The authors suggest that the estimates were very conservative since no attempt was made to model the positive benefits of expanding bioenergy demand, technological change, changing production inputs or agricultural offsets.

Relying on studies that did include the impacts of expanding bioenergy demand, technological change, changing production inputs or agricultural offsets, the authors believed "… that the agricultural sector will have modest costs in the short-term and net benefits – perhaps significant net benefits – over the long-term" (page 1).

Comparison of Studies

Each of the studies examined different geographic scopes. Babcock (2009) and FAPRI (2009) provide state level analyses of Iowa and Missouri, respectively. USDA (2009) considered the U.S. in aggregate. AFPC (2009) based their approach on representative farms at the state level, which were then aggregated to the U.S. level. NIEPS (2009) and APAC (2009) modeled at the U.S. level and then disaggregated the results for multi-state regions. Similarly, all of the studies had different economic scopes. Babcock (2009) and FAPRI (2009) primarily focused on direct and indirect costs while USDA (2009) considered those impacts plus the price effects. AFPC (2009) and NIEPS (2009) considered all the economic impacts that were listed in the section titled "The Impacts of H.R. 2454 on the Agriculture Sector." Babcock (2009) and FAPRI (2009) considered a short list of specific agricultural sub-sectors, while USDA (2009) and AFPC (2009) considered all major crop and livestock sub-sectors. NIEPS (2009) chose to aggregate all crop sub-sectors into a single category and followed a similar process with the livestock sector.

FAPRI (2009), NIEPS (2009) and USDA (2009) each provided medium- and long-run analysis. The models used to make these predictions are typically calibrated with in-sample

[7] USDA (2009) describes FAPSIM (Food and Agricultural Policy Simulator) as an annual econometric model of the U.S. crop and livestock sectors that includes cross-commodity linkages and dynamic effects.

(what we have actually observed in the past) statistical techniques. When making out-of-sample predictions (what we expect to observe in the future) an implicit assumption is that the structure of the economy and associated market linkages in the future are similar to what we observe today. Since the pending legislation has the potential to generate a new market for carbon, cellulosic biofuel feedstocks and significantly impact current market linkages, we believe the short-run estimates are more believable than some of the longer-term predictions. Described another way, slight changes in underlying assumptions likely would greatly change such long-term economic benefits to agriculture, either positively or negatively.

Many of the studies constructed a 'baseline' scenario based on their expectations of what would occur without the implementation of H.R. 2454 and compared their baseline to scenarios that included impacts of H.R. 2454. The baseline and alternate scenarios require assumptions about trends in technology growth, trends in crop yield, possible impacts of climate change on crop production, a producer's reaction to price changes, etc. Since the reports were written for a lay audience, many of these assumptions were not reported. For an individual research project these assumptions are the same for both the baseline and alternate scenarios, which allows a direct analysis of the policy impacts. However, since the research reports reviewed in this paper may not have employed the same assumptions, some difference in results across studies should be expected.

Each study required estimates of future energy prices. Both EPA (2009) and CRA (2009) were used as the basis for these estimates. Table 2 reports the energy prices used in the short-run analyses. It should be noted that the difference in the estimated change in natural gas price is quite large. Research that relies on CRA (2009) may have larger cost impacts than those that rely on EPA (2009).

The indirect cost impacts to agricultural producers, discussed in this report, include possible nitrogen fertilizer cost increases. While most of the indirect energy price increases will be felt immediately, some fertilizer costs may be unaffected until 2025 (USDA, 2009). That is because H.R. 2454 will distribute 'emissions allowances' to "energy- intensive, trade exposed entities" (EITE), which include nitrogen fertilizer manufacturers. These 'emissions allowances' will be phased out over time which will allow the full indirect cost increases to nitrogen fertilizer to be phased in over time. As reported in Table 2, AFPC (2009) and USDA (2009) included EITE impacts in their analyses. Analyses that do not include the impact of EITE provisions may overstate the short-run cost impacts. USDA (2009) performed its analysis both with and without EITE provisions. Based on that analysis, the EITE provisions are very favorable to the agricultural sector in the short run.

With the exception of APAC (2009), all of the studies offered estimates of the short-run impacts to direct and indirect costs, which are reported in Table 4. The estimates appear reasonable and relatively consistent. These data clearly suggest that the cost to produce agricultural products will increase with the implementation of H.R. 2454. Based on AFPC (2009), USDA (2009), and NIEPS (2009) it is clear the magnitude of these increases will vary considerably depending on crop type and geographical location.

AFPC (2009) and USDA (2009) offered estimates of the short-run impacts to crop production revenue, which are reported in Table 4. USDA (2009) provided these estimates in its report. We aggregated sub-sector specific representative farms, as reported in AFPC (2009), to provide the ranges reported in Table 4. Both reported slight increases in commodity prices. Given the differences in geographic scope, the estimates appear reasonable and relatively consistent. These data suggest that production revenue might have modest increases with the implementation of H.R. 2454. Based on AFPC (2009) and USDA (2009) it is clear the magnitude of these increases will vary considerably depending on crop type and geographical location.

Although changes in costs and revenues are important economic metrics, we believe that the change in net income from crop and livestock production is the best economic metric for assessing the impact of H.R. 2454 on agriculture. We also believe that evaluating a worst-case scenario, where the agricultural offset markets do not exist, to be highly informative. AFPC (2009) and USDA (2009) provide aggregated estimates of a scenario where carbon offsets markets might not exist. APAC (2009) evaluated a comparable scenario where EPA regulates greenhouse gas emissions under the Clean Air Act. The numbers reported in Table 4 are the APAC (2009) and USDA (2009) estimates from their reports. We aggregated sub-sector specific representative farms, as reported in AFPC (2009), to provide the ranges reported in Table 4. These data suggest that in general and in the short run, changes in production net income might have modest decreases with the implementation of H.R. 2454 if revenues from agriculture offsets do not become a reality. Based on USDA (2009), net farm income from production will be negative in the medium and long run. Based on the AFPC (2009) and USDA (2009) studies it is clear the magnitude of these increases will vary considerably depending on crop type and geographical location. Based on AFPC (2009), it appears that this scenario could be very detrimental to the rice and cotton sub-sectors.

AFPC (2009), APAC (2009) and USDA (2009) included an analysis of the rice and cotton sub-sectors. AFPC (2009) reported that, based on their representative farm analysis, 100 percent of the rice producers and over 92 percent of the cotton producers have lower ending cash reserves relative to their baseline.[8] AFPC (2009) suggests that the cost of production likely will increase without sufficient price increases for both commodities, and the rice sub-sector will have little opportunity to benefit from carbon offset revenues. USDA (2009) suggests that per-acre energy expenses for rice and cotton are generally higher than per acres expenses for other commodities. APAC (2009) suggests that, on average, rice producers will experience negative returns.

As reported in Table 1, all studies, with the exception of FAPRI (2009), considered at least one livestock sub-sector. AFPC (2009) reported that, based on their representative farm analysis, 100 percent of the beef sector and over 95 percent of the dairy have lower ending cash reserves relative to their baseline.[9] USDA (2009) suggests that the removal of cropland and pastureland for aforestation may be beneficial to crop producers but also will lead to higher livestock input costs and higher producer prices for livestock and milk. NIEPS (2009) provides a more positive outlook for the livestock sub-sectors, assuming carbon offset revenues will be generated from pastureland. In general, NIEPS (2009) suggests that the positive impacts for livestock will be less than those accruing to the crop sector, and for some regions the impact will be a net loss to producer surplus.[10] APAC (2009) suggests that the beef cattle sub-sector will not experience major disruptions in net returns. All the studies suggest that the livestock sub-sectors will have difficulty adapting to H.R. 2454 as the cost of production likely will increase without sufficient price increases, and the sub-sectors will have less opportunity to benefit from carbon offset revenues.

[8] This interpretation is based on Table 11 in AFPC (2009).
[9] This interpretation is based on Table 11 in AFPC (2009).
[10] This interpretation is based on Figure 3 in NIEPS (2009).

The long-run impact of H.R. 2454 on agriculture land values were considered by AFPC (2009) and NIEPS (2009). As markets for bioenergy and agricultural offsets expand, and if net income increases, then land prices will rise as a result of H.R. 2454. While this will increase the net worth of landowners, it will also increase the cash cost of land renters. In general, the cash flow benefit to landowners will only be realized if the land is sold. AFPC (2009) appropriately did not include this factor within its cash accounting framework but chose to report it in their net worth summaries. Studies that include both cash-flow and net worth benefits into a single economic metric may present an overly optimistic picture.

Each study required estimates of future carbon prices. AFPC (2009) used estimates from EPA (2009) and suggests an average (2010 – 2016) of $11.17 per metric ton; Babcock assumed $20 per ton; APAC (2009) assumed $27 per metric ton; and NIEPS constructed three scenarios that assumed $15, $30 and $50 per ton. All else equal, studies that assume a higher carbon price may have higher input cost and carbon offset revenue estimates. Discounting the gross value of carbon credits to represent net revenues ultimately received by the producer is important. Both AFPC (2009) and APAC (2009) suggest the net receipts per metric ton will be discounted for transaction costs and the risk. These discounts could be large.

The proposed legislation also will provide opportunities for the forestry sector of our economy to receive payments for carbon offsets. The purpose of this report is to provide a summary focusing on the impacts to the agriculture sector. USDA (2009) excluded revenues generated from forest management offsets while NIEPS (2009) included revenues generated from forest management offsets. NIEPS (2009) reports that "…we find that forest management incentives to landowners and aforestation offset payments to agricultural producers dominate other mitigation options in terms of annualized offset revenues" (page 10). We are unable to disaggregate the impacts to agriculture sector from the total, and caution readers not to attribute the positive impacts of carbon offset revenues solely to the agriculture sector.

Impacts on Land Use

Of key interest to policy makers and stakeholders is how H.R. 2454 will impact current land use. Undoubtedly, we will see some shift in cropping practices accompanied by an increase in acreage devoted to the production of bioenergy crops. APAC (2009) suggests that cropland will remain stable with only minor shifting between conventional crops. The authors also predict that bioenergy crops will be produced on pastureland and there will be very little aforestation. On the other hand, NIEPS (2009) suggests that aforestation offset payments dominate other mitigation options in terms of annualized offset revenues and predicts a rather large acreage shift from crop and pasture land to forest production. Apparently, these studies made significantly different assumptions relative to the cost and returns of different offset possibilities. Surprisingly, as reported in Table 4, both studies had similar predictions of the net benefits of H.R. 2454. Due to the rather large differences in predicted land use changes, we suggest that additional research is needed to fully understand why these two studies get similar results in terms of net benefits.

The Importance of Agricultural Offset Revenue Opportunities

There currently exist voluntary markets for carbon offsets (e.g., the Chicago Climate Exchange) that are generating positive benefits to agricultural producers. H.R. 2454 will expand these markets and provide significant opportunities for the agricultural sector of our economy to receive carbon offsets revenues. As reported in many of these studies, the magnitude of these revenues could be substantial. Defining which agricultural practices qualify for offsets and their contribution to producer net revenue are critical issues when estimating how H.R. 2454 impacts agricultural revenues. We suggest that these key research assumptions explain the majority of variation found in the studies examined here.

A comparison of AFPC (2009) and APAC (2009) highlights the impact assumptions regarding which agricultural practices qualify for offsets and their contribution to producer net revenue have on net benefit estimations. As reported in Table 3, AFPC (2009) uses a very limited subset of possible carbon offset opportunities. Specifically, they did not include 'Pastureland Sequestration' or 'Production of Bio-energy Crops.' The research discounts gross revenues from offsets by approximately 13 percent. If additional carbon offset opportunities had been included in their analysis, then in all likelihood their estimate of net benefits would have been higher. On the other hand, APAC (2009) applied a more comprehensive list of carbon mitigation strategies and discounted gross revenues by 60 percent to 80 percent. While APAC (2009) projects large benefits, they also suggest that if practices associated with bioenergy crop production are not included as approved offsets then it may be very expensive for agriculture to produce sufficient feedstocks.

Markets Will Adjust With a Level Playing Field

Many of the studies suggest that, in the absence of carbon offset revenues, net farm income will decline with the implementation of H.R. 2454. This is due to the assumptions that direct and indirect cost increases will exceed the impact that positive price effects have on revenue. If we assume a level playing field in the international market, that is, that all other countries have similar cost and price effects, then in the long run the market will return reasonable profits to agriculture producers. However, if proposed legislation results in an un-level playing field, U.S. producers may experience negative returns and lose their competitive advantages.

The Benefits of Climate Change Legislations Are Not Distributed Uniformly

The studies agree that the positive benefits associated with H.R. 2454 will not be distributed uniformly across agricultural sub-sectors or geographical areas. While the feed grain and wheat sub-sector tend to receive positive benefits, there are areas of the country where they will see negative returns. The estimated impacts to the livestock and cotton sub-sectors are mixed, but the research suggests that only minor impacts are anticipated. All the studies agree that the rice sub-sector will experience negative returns and in some cases these will be quite large. The magnitudes of these gains or losses depend upon the ability of producers to receive carbon offset credits. As an example, it is generally assumed that rice producers will not be able to participate in the carbon offset markets. Since the distribution of impact is dependent on farm-level economics, we suggest that representative farm models, such as those utilized by AFPC (2009), Babcock (2009) and FARPI (2009), may be the appropriate modeling framework to analyze individual agricultural sub-sectors.

Conclusions

Whether or not the agriculture sector of our economy will be a net gainer or loser from climate change policy will depend on the details contained in the final legislation. For the most part, the sources of agricultural costs and benefits have been identified, and numerous studies have predicted how agriculture might be affected. These studies vary from farm-level analysis such as AFPC (2009) to regional- and national-level analysis such as NIEPS (2009).

All studies reviewed suggest that costs would be expected to increase with the implementation of H.R. 2454, but that a portion of this cost increase will be passed on to the consumer in the form of higher prices. In the short run, per-acre profitability may decline, but for the most part the research suggests the declines will be modest. If other countries adopt similar legislation, in the long run, the market for agricultural commodities will adjust and return reasonable profits to producers. As suggested by Babcock (2009), "If other major agricultural producers also face increasing production costs because their countries adopt carbon-reducing policies, then U.S. producers will not lose their competitive advantage. Furthermore, if production costs do rise significantly, and if most of the world's farmers face these higher production costs, then most, if not all, of the higher costs will soon be reflected in higher commodity prices that will compensate farmers for their higher costs."

HR 2454 will encourage the continued development of carbon offset markets. At the present time it is not completely clear how renewable energy legislation and climate offset markets will function together. The viability of these markets will depend upon the policies that regulate/foster/develop/cause such carbon trading to occur and how they complement or conflict with future renewable fuels policies. What is clear is that these markets may provide significant financial benefits to agricultural producers. We suggest that these key research assumptions on which agricultural practices qualify for offset credits, the price of those offset credits, and their contribution to producer net revenue explain the majority of variation found in the reports analyzed.

The economic impacts will vary regionally and by crop and livestock sub-sector. The impacts will be dependent on cultural practice and the farm-specific ability to sequester carbon and receive offset income. While on a national level, agriculture appears to be positively affected; at the farm level some sub-sectors such as rice production, appear to be worse off.

Overall, the research suggests U.S. production agriculture has more to gain than lose with the passage of H.R. 2454. The bill specifically exempts agriculture from emissions caps, provides EITE provisions to ease the transition to higher fertilizer prices, and fosters the development of carbon offset markets which will enhance agricultural revenues.

References

AFPC. "Economic Implications of the EPA Analysis of the CAP and Trade Provisions of H.R. 2454 for U.S. Representative Farms" Agricultural and Food Policy Center. AFPC Research Paper 09-2. August 2009. Found at: http://www.afpc.tamu.edu/pubs/2/526/rr%2009-2%20paper%20-%20for%20web.pdf

APAC. "Analysis of the Implications of Climate Change and Energy Legislation to the Agriculture Sector" Agricultural Policy Analysis Center. November, 2009. Found at: http://www.25x25.org/storage/25x25/documents/ut_climate_energy_report_25x25_november11.pdf

Babcock, Bruce A. "Costs and Benefits to Agriculture from Climate Change Policy" Center for Agricultural and Rural Development, Iowa Ag Review, Summer 2009, Vol. 15 No. 3. Found at: http://www.card.iastate.edu/iowa_ag_review/summer_09/article1.aspx

CRA. "The American Clean Energy and Security Act of 2009." (H.R. 2454). Charles River Associates. August, 2009. Found at: http://www.nationalbcc.org/images/stories/documents/CRA_Waxman-Markey_%205-20-09_v8.pdf.

EPA. "The United States Environmental Protection Agency's Analysis of H.R. 2454 in the 111th Congress, the American Clean Energy and Security Act of 2009," U.S. Environmental Protection Agency, June 2009. Found at: http://www.epa.gov/climatechange/economics/economicanalyses.html#hr2452

FAPRI. "The Effects of Higher Energy Prices from H.R. 2454 on Missouri Crop Production Costs" Food and Agricultural Policy Research Institute (FAPRI) University of Missouri. FAPRI-MU Report #05-09, July 2009. Found at: http://www.fapri.missouri.edu/outreach/publications/2009/FAPRI_MU_Report_05_09.pdf

NIEPS. "The Effects of Low-Carbon Policies on Net Farm Income". Nicholas Institute for Environmental Policy Solutions. Working Paper NI WP 09-04. September 2009. Found at: http://nicholas.duke.edu/institute/ni.wp.09.04.pdf

USDA. "A Preliminary Analysis of the Effects of H.R. 2454 on U.S. Agriculture" Office of the Chief Economist, U.S. Department of Agriculture, July 22, 2009. Found at: http://www.usda.gov/documents/PreliminaryAnalysis_HR2454.pdf

Tables

Table 1. Geographic Scope, Economic Scope, Agricultural Sub-Sectors and Time Frames

Item	Agricultural and Food Policy Center (AFPC) at Texas A&M University (2009)	Agricultural Policy Analysis Center (APAC) at University of Tennessee (2009)	Babcock at Center for Agricultural and Rural Development (CARD) at Iowa State University (2009)	Food and Agricultural Policy Research Institute (FAPRI) at University of Missouri (2009)	Nicholas Institute for Environmental Policy Solutions (NIEPS) at Duke University (2009)	USDA (2009)
Geographic Scope	U.S. coverage based on state level representative farms	U.S. coverage with state level analysis	Iowa	Missouri	US level by multi-state regions	US level
Economic Scope	Direct Costs Indirect Costs Input Substitution Cropping Pattern Technology Adoption Price Effects Biofuel Impacts Agricultural Offsets Land Values	NR	Direct Costs Indirect Costs Agricultural Offsets	Direct Costs Indirect Costs	Direct Costs Indirect Costs Input Substitution Cropping Pattern Technology Adoption Price Effects Biofuel Impacts Agricultural Offsets Land Values	Direct Costs Indirect Costs Cropping Pattern Price Effects Agricultural Offsets
Agricultural Sub-Sectors	Feed Grains Soybeans Wheat Rice Cotton Dairy Beef Cattle	Feed Grains Soybeans Wheat Rice Cotton Beef Cattle Dairy Swine Bio-Energy Crops	Corn Soybeans Swine	Corn Soybeans Wheat	Aggregated Crop Sector Aggregated Livestock Sector	Feed Grains Soybeans Wheat Rice Cotton Dairy Beef Cattle Other Livestock
Time Frame	Short Run (2007-2016)	Short Run (2010-2025)	Short Run (2009)	Short Run (2020) Medium Run (2030 & 2040) Long run (2050)	Long Run (2000-2080) Converted to an annual annuity value	Short Run (2012-2018) Medium Run (2027-2033) Long run (2042-2048)

Table 2. Analytical Framework and Key Assumptions

Item	Agricultural and Food Policy Center (AFPC) at Texas A&M University (2009)	Agricultural Policy Analysis Center (APAC) at University of Tennessee (2009)	Babcock at Center for Agricultural and Rural Development (CARD) at Iowa State University (2009)	Food and Agricultural Policy Research Institute (FAPRI) at University of Missouri (2009)	Nicholas Institute for Environmental Policy Solutions (NIEPS) at Duke University (2009)	USDA (2009)
Analytical Framework	Simulation Model (FLIPSIM)	Simulation Model (POLYSYS)	Representative Farm Level Budget	Representative Farm Level Budget	Simulation Model (FASOMGHG)	Simulation Model (FAPSIM)
Economic Performance Metrics	Avg. Annual Cash Revenue Avg. Annual Cash Costs Avg. Annual Cash Income Ending Cash Reserves Ending Net Worth	Net Farm Income	Percent Increase in Costs	Percent Increase in Costs	Producer Surplus Processor Surplus Consumer Surplus	Farm Cash Receipts Production Expenses Net Farm Income
Source of Energy Prices	EPA (2009)	EPA (2009)	NA	CRA (2009)	EPA (2009)	EPA (2009)
Source of Carbon Price	EPA (2009)	EPA (2009)	NR	NA	Model Assumptions	EPA (2009)
Carbon Price (per metric ton)	$11.17[1] (2010 – 2016 average)	$27[2]	$20	NA	$15 (Scenario 1) $30 (Scenario 2) $50 (Scenario 3)	NR
Source of Commodity Price	EPA (2009)	Endogenous to Model	NA	NA	Endogenous to Model	USDA
Source of Production Costs	Extension Budgets	NR	NR	FAPRI Budgets	Estimated Based on the Price of Carbon	USDA
Source of Land Prices	EPA (2009)	NA	NA	NA	Endogenous to Model	NA
Assumed EITE provisions would be in force	Yes	NR	No	NR	NR	Estimated Both Scenarios
Dollar Basis	2009$	NR	2009$	2009$	2004$	2005$
Assumed Agriculture Would be Exempt from Cap	Yes	Yes	Yes	Yes	No	Yes

NA: Not Applicable to the Study
NR: Not Reported in the Study
1: This represents the 2010 – 2016 average as reported in Table 5 of AFPC (2009).
2: The EPA Led scenario assumed $160

Table 3. Agricultural Offsets Considered

Item	Agricultural and Food Policy Center (AFPC) at Texas A&M University (2009)	Agricultural Policy Analysis Center (APAC) at University of Tennessee (2009)	Babcock at Center for Agricultural and Rural Development (CARD) at Iowa State University (2009)	Food and Agricultural Policy Research Institute (FAPRI) at University of Missouri (2009)	Nicholas Institute for Environmental Policy Solutions (NIEPS) at Duke University (2009)	USDA (2009)
Conversion to No-Till	Yes	Yes	Yes	No	Yes	No
Methane Capture	Yes	Yes	Yes	No	Yes	No
Nitrous Oxide Reduction	No	No	Yes	No	Yes	No
Pastureland Sequestration	No	Yes	No	No	Yes	No
Production of Bio-energy Crops	No	Yes	No	No	Yes	No
Aforestation	NR[1]	Yes	Yes	No	Yes	No
Forestry Sector Offsets	No	NR	No	No	Yes	No
Wind and Solar	No	No	No	No	No	No

1: AFPC (2009) does not specifically mention carbon credits for aforestation, but includes the impact of aforestation on commodity prices.

Table 4. Results

Item	Agricultural and Food Policy Center (AFPC) at Texas A&M University (2009)	Agricultural Policy Analysis Center (APAC) at University of Tennessee (2009)	Babcock at Center for Agricultural and Rural Development (CARD) at Iowa State University (2009)	Food and Agricultural Policy Research Institute (FAPRI) at University of Missouri (2009)	Nicholas Institute for Environmental Policy Solutions (NIEPS) at Duke University (2009)	USDA (2009)
Change in Direct and Indirect Costs	Short Run (2.6% to 6.4%) [1]	NR	Short Run (1.5%)[2]	Short Run (1.6%-4.1%) Medium Run (2.8%-7.4%) Long Run (4.4%-10.4%)	Short Run (0.85%)[3]	Short Run (0.3%) Medium Run (1.1%) Long Run (2.2%)
Change in Production Revenue (Without Offsets)	Short Run (1.5% to 3.4%) [4]	NR	Modest Improvement	Did Not Evaluate	NR	Short Run (0.0%) Medium Run (0.1%) Long Run (0.3%)
Change in Production Net Income (Without Offsets)	Short Run (2.6% to -54%)[5]	-$155 Billion[6]	Unchanged	Did Not Evaluate	NR	Short Run (-0.9%) Medium Run (-3.5%) Long Run (-7.2%)
Change in Production Net Income (With Offsets)	Short Run (6.0% to -58.1%)[7]	$13.1 Billion[8]	Modest Improvement	Did Not Evaluate	$12 Billion[9]	Substantial Improvement[10]

1. The range is based on crop specific sub-sectors and is the percent change between the baseline and cap-and-trade scenario with no offset revenues as reported in Table 8.
2. Babcock (2009) reported a $4.52 cost increase relatively to a $300 baseline which has been calculated as approximately a 1.5% increase.
3. Based on Scenario 1 which had a carbon price equivalent of $15 per ton.
4. The range is based on crop specific sub-sectors and is the percent change between the baseline and cap-and-trade scenario with no offset revenues as reported in Table 7.
5. The range is based on crop specific sub-sectors and is the percent change between the baseline and cap-and-trade scenario with no offset revenues as reported in Table 9.
6. The number is based on the difference in Ag Net Returns between the Baseline scenario and the EPA Led scenario reported in Table 2.
7. The range is based on crop specific sub-sectors and is the percent change between the baseline and cap-and-trade scenario with offset revenues as reported in Table 9.
8. APAC (2009) reports, in Table 2, that during the 16 year period between 2010 and 2025 an accumulated value of $209 billion for gains in Ag Net Returns between the baseline and cap-and-trade scenario with multiple offset revenues.
9. As reported in Figure 2, this number is based on Scenario 1 which had a carbon price equivalent of $15 per ton.
10. USDA (2009) did not provide an estimate, but relied on the EPA estimate to conclude that offset revenues could substantially exceed net costs in the long run.