CHOICES
3rd Quarter 2008 • 23(3)
The magazine of food, farm, and resource issues
A publication of the Agricultural & Applied Economics Association
AAEA Agricultural & Applied Economics Association

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3rd Quarter 2008—Volume 23, Number 3

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A Statement from the Editors

We welcome you to the 3rd Quarter, 2008 issue of *Choices*. You will find two timely themes and an interesting individual article which present analyses of current importance to agricultural, food and environmental issues and policy. The first theme addresses bio-fuels issues starting with what has been learned over the past several years, environmental issues, a European perspective and food-fuel relationships. The second theme focuses on the 2008 Food, Conservation and Energy Act features beyond the traditional commodity titles. It covers average crop revenue insurance, conservation, specialty crops and trade. A final individual article addresses consumer's response to food safety issues. We trust that you will find these articles informative and insightful.

In addition to these quarterly *Choices* issues, AAEA has recently posted another in its *Policy Issues* series designed to present timely topical policy analyses. We hope that you will find the article on the proposed entry of the world's largest meatpacker, Brazil's JBS, into the U.S. meatpacking and cattle feeding with antitrust implications, informative and valuable in your work. If you have not seen it, please access it at http://www.aaea.org/outreach.

We encourage submissions of proposals for future themed sets of papers, individual articles and timely policy issues analyses. Submit theme proposals and policy issues propos-

Choices is the principal outreach vehicle of the Agricultural & Applied Economics Association (AAEA). Published quarterly, it is designed to provide current coverage regarding economic implications of food, farm, resource, or rural community issues directed toward a broad audience. *Choices* publishes thematic groupings of papers and individual papers. The broad themes we will repeatedly visit in *Choices* are agriculture and trade, resources and the environment, consumers and markets, and agribusiness and finance. Submitted manuscripts are subject to peer review for publication consideration.

AAEA will also publish monthly *Policy Issues* articles addressing particularly timely topics with peer-reviewed, brief economic analysis of potential interest to those involved in the policy dialogue.

Editorial Communications
Proposed manuscripts, thematic proposals, and comments may be emailed to the editors: Theme and policy issues suggestions or submissions, send to walt@farmfoundation.org; Submitted articles, send to clement.ward@okstate.edu. Editorial communications may be sent to keoughwilson_239@msn.com.

als to Walter J. Armbruster at walt@farmfoundation.org, and individual papers for the quarterly *Choices* to Clement Ward at clement.ward@okstate.edu. We look forward to working with you to address important economic and policy issues affecting food, farms, resources and rural communities.

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Agriculture and Biofuels Issues: Cellulose, Greenhouse Gases, and EU and U.S. Policies

Wallace E. Tyner

A number of issues have arisen around the production of biofuels from agricultural products. These include evaluation of alternative policies, price impacts, environmental considerations, and land use. This agriculture and biofuels theme covers some very important topics ranging from local to global in scope.

The first paper by Farzad Taheripour and Wally Tyner provides an assessment of what these authors have learned in economics and policy research related to biofuels over the past four years. It covers the linkage between energy and agriculture, and the linkage between biofuels and commodity prices. It summarizes some of the important conclusions with respect to the impacts of various U.S. ethanol policy alternatives. In addition it covers the importance of the blending wall, surveys some important cellulose ethanol issues, and describes a bit of the work on global land use change impacts of U.S. and European Union (EU) biofuels policies.

The second paper by Tom Elam argues that biofuels policies in the United States need to be re–examined in light of the unintended consequences that have arisen over the past couple of years. In particular, he argues that the food cost increases may be a heavy price to pay for the relatively small energy gains.

The third paper by Madhu Khanna covers the economic prospects for and carbon mitigation potential of cellulosic biofuels. She concludes that cellulosic based fuels are likely to be more expensive than grain based ethanol. However, if environmental externalities are taken into consideration, the cellulosic based fuels become more competitive because of their advantages in reducing greenhouse gases and otherwise enhancing ecosystem services.

Finally, the fourth paper by Martin Banse, Hans van Meijl, and Geert Woltjer examines the consequences of EU biofuels policies on agricultural production and land use. They make use of a general equilibrium model to estimate the impacts of EU biofuels policies and programs and conclude that targeted EU biofuels consumption levels would have a strong impact on agriculture both in the EU and globally. Furthermore, they conclude that without mandatory blending, the EU targets cannot be achieved as the increased demand for feedstocks would pull up agricultural prices to the point that biofuels would be very expensive and blended fuel prices would not be competitive. So, clearly, these papers cover some of the most important issues in the biofuels arena today.

It is interesting to note that there are sometimes important differences among the papers both in terms of value estimates and conclusions. For example, Khanna has a cost estimate range for corn stover of $82–$101 per metric ton, whereas Taheripour and Tyner (from Brechbill and Tyner, cited in that paper) use an estimate of $40 per short ton (about $44 per metric ton). Most of that difference comes from the fact that Khanna included a land opportunity cost of $34–$36. per metric ton, but Taheripour and Tyner assumed the land rent would be attributed to the corn. Elam attributes much of the food/feed price impact to the ethanol subsidy and mandate, whereas Taheripour and Tyner argue that a large share of the corn price increase is linked

Articles in this Theme:

to the oil price increase. Banse, van Meijl, and Woltjer find somewhat different impacts of EU policies than Taheripour and Tyner, although the approaches used were somewhat different.

These kinds of differences are to be expected. Readers will find others. The differences arise because of differences in data, assumptions, methods, etc. A better sense of the basis for these differences will help improve our understanding of these complex issues. We hope that this *Choices* theme helps advance that understanding.

Guest editor Wallace Tyner is Professor of Agricultural Economics, Purdue University.

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Ethanol Policy Analysis—What Have We Learned So Far?

Farzad Taheripour and Wallace E. Tyner

JEL Classifications: Q48, Q42

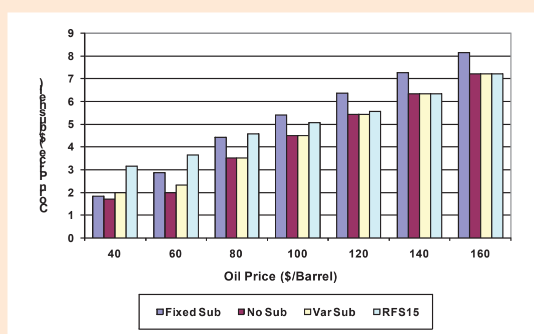
Having done research on various aspects of ethanol production and policy for several years, we decided to take stock of what we have learned so far for this paper. Of course, our research has benefitted from the work of many others, and we will try to capture some of that work as well. An assessment of where we are now is particularly important because so many changes have occurred in agriculture that are affected by ethanol growth and policy. Furthermore, the U.S. ethanol subsidy is set to expire in 2010, so Congressional action will be taken in 2009 to determine what form future U.S. ethanol policy will take. We will group the items under the following general categories: linkages between energy and agriculture, biofuels and commodity prices, policy analysis, the blending wall, cellulosic ethanol issues, and global biofuels impacts. We have done our research using firm level models, as well as partial and general equilibrium analysis.

Energy and Agriculture Linkages

Historically, the correlation between energy product and agricultural product prices has been quite low (Tyner and Taheripour, 2008a and 2008b). The forces determining crude oil and other energy product prices have largely been different from those determining agricultural commodity prices. However, today, with agriculture being called upon to produce not only food, feed, and fiber, but also fuel, that is all changing. We have shown that in the future, corn and crude oil prices can be expected to move together. Previously, we demonstrated that with break–even analysis at the firm level (Tyner and Taheripour, 2008c), and more recently with partial equilibrium analysis (Tyner and Taheripour, 2008a and 2008b). The Iowa State group among others reach similar conclusions (Elobeid et al., 2007; Tolgoz et al., 2007; McPhail and Babcock, 2008a and 2008b). Figure 1 illustrates the combination of corn and crude oil prices which maintain the U.S. ethanol industry at the break–even condition under alternative policy options. Policy options in this figure are: 45 cent fixed subsidy effective January 2009 (Fixed Sub); no ethanol subsidy (No Sub), a subsidy which varies with the price of curde oil (Var Sub), and the 15 billion gallon ethanol Renewable Fuel Standard (RFS) (U.S. Congress, 2007). The fixed blender's credit was changed in the 2008 Farm Bill (U.S. Congress, 2008) from 51 to 45 cents for corn ethanol. In addition, for cellulosic ethanol, there is now an additional production tax credit of 46 cents, a small producer credit of 10 cents and the standard blender's credit of 45 cents bringing the total cellulose credit to $1.01.

Figure 1 shows that the crude and corn prices move up together under all alternative policy options. We have called this a revolution in American and global agriculture. Since ethanol is a near perfect substitute for gasoline, higher gasoline price means more demand for ethanol and induces investment in ethanol plants. More ethanol plants and production means more demand for corn, which, in turn, means higher corn prices. The same is true going in the downward direction. If oil price were to fall, less ethanol would be demanded, corn would be freed up for other uses, and corn price would fall.

Figure 1. Break–even corn and crude oil prices at the market level



Biofuels and Commodity Prices

There is no doubt that ethanol production in the United States has contributed to higher corn prices. A large portion of the growth in corn demand is associated with growth in ethanol production. In the European Union (EU), the same is true for biodiesel and vegetable oils. Between 2004 and earlier in 2008, crude oil went from $40 to $120. Over that same time period, corn went from about $2 to about $6. With the results from our prior work (Tyner and Taheripour, 2008a, 2008b, and 2008c) one can partition the $4 corn price increase into two parts: price increase due to the U.S. ethanol subsidy and price increase due to the demand pull of higher crude oil price. The result is that about $1 of the increase is due to the US subsidy and $3 to the crude oil price increase. The crude oil price increased due to many factors such as higher demand for crude oil, devaluation of the U.S. dollar, political instability in the Middle East, and many other factors. So the crude oil price is the major driver in corn price increases, and the U.S. ethanol subsidy less so. Of course that was not the case before the surge in crude oil prices. Prior to 2005, the ethanol industry would not have existed without the subsidy. In our earlier work (Tyner and Taheripour, 2007), we estimated that with corn around $2 and no subsidy, $60 oil would be required for profitable ethanol production. Oil did not reach $60 until 2006, so the whole development of the ethanol industry was enabled by the subsidy. Today, the oil price is the larger driver.

Policy Analysis

In addition to the subsidy, the United States has other policies in effect as well—a renewable fuel standard (RFS) and a tariff on imported ethanol. The RFS (U.S. Congress, 2007) has to date not been binding; that is, the market plus the subsidy have always produced a higher amount than the level of the RFS. Our analysis indicates that if oil stays above $120, the mandate will not become binding under normal circumstances. The market would produce more than the amount dictated by the mandate. Of course, if weather events such as the 2008 flood occurred, the mandate could become binding in any given year. However, the EPA administrator has authority to waive or reduce the RFS under that type of circumstance. The major qualification to this conclusion would be a continuation of very high corn production input prices such that the market would be unwilling to produce enough corn to meet the ethanol, food, feed, and export demands without substantially higher corn prices. Under that condition, especially if oil prices were relatively lower, ethanol plants would bring production down to the mandate level, and the mandate would become binding.

Another U.S. policy is the import tariff. The import tariff originally was established to offset the U.S. ethanol subsidy, which applies to both domestic and imported ethanol. Clearly, Congress wanted to subsidize domestic but not imported ethanol, so the tariff accomplished that objective. Early on, the specific tariff was equal to the domestic subsidy of 54 cents per gallon. However, since then the subsidy was reduced to 51 cents and will be reduced again in January 2009 to 45 cents per gallon. In addition to the specific tariff of 54 cents per gallon, there is also an ad valorem tariff of 2.5%. The total tariff today for an import price of $2/gal. is 59 cents/gal., quite a bit more than the 45 cent U.S. subsidy. Brazilian sugarcane based ethanol is much cheaper to produce than U.S. corn ethanol, especially at today's corn prices. Three years ago, Brazilian ethanol was in the range of $1.10–$1.20, but with depreciation of the U.S. dollar, it is now about $1.70 even though the Brazilian domestic cost has changed little. Adding transport cost and the tariff to that cost figure makes Brazilian ethanol not generally competitive in the U.S. market today. Imports in 2008 to date are far below the 2006 level. However, if the tariff were reduced significantly or eliminated, there could be substantial imports of Brazilian and Central American ethanol. If that were to happen, it would likely reduce pressure on corn prices. Thus, the import tariff is an important policy instrument.

The Blending Wall

The blending wall refers to the maximum amount of ethanol that could be blended at the current national blending level of 10%. Since we consume about 140 billion gallons of gasoline annually, the theoretical maximum amount of ethanol that could be blended as E10 is 14 billion gallons. The practical limit, at least in the near term, is more like 12 billion gallons (Tyner, Dooley, Hurt, and Quear, 2008). We already have in place or under construction 13 billion gallons of ethanol capacity. At present E85 is tiny, and it would take quite a while to build that market. There are only about 1,700 E85 pumps in the nation and few of the flex–fuel vehicles that are required to consume the fuel. We would need a massive investment to make E85 pumps readily available for all consumers, and a huge switch to flex–fuel vehicle manufacture and sale to grow this market. Without strong government intervention, it will not happen.

What options exist? The most popular among the ethanol industry is switching to E15 or E20 instead of E10. The major problem is that automobile manufacturers believe the existing fleet is not suitable for anything over E10. Switching to a higher blend would void warranties on the existing fleet and potentially pose problems for older vehicles not under warranty. In the United States, the automobile fleet turns over in about 14 years, so it is a long term process. We could not add yet another pump for E15 or

E20. The costs would be huge. So the blending wall in the near term is an effective barrier to growth of the ethanol industry. Without a breakthrough (such as cost effective butanol production), the EPA administrator will be forced to cap the RFS far below the planned levels—to the levels that can be blended at E10 plus whatever can be sold as E85.

Cellulosic Ethanol Issues

Cellulosic ethanol development is fraught with risks. There are at least four categories of risks: oil price uncertainty, technological uncertainty, RFS implementation uncertainty, and raw material supply and contracting uncertainty. A 100 million gallon cellulosic ethanol plant is expected to have a capital cost of at least $400 million at current prices. It is unlikely investment will occur without policies aimed at addressing these uncertainties. We will discuss each in turn.

Cellulosic ethanol is likely to be economic at oil prices of $140 and higher. However, there is absolutely no assurance oil price will remain that high. Indeed, at this writing it is substantially below that level. A policy, such as a variable subsidy, could help alleviate the oil price uncertainty risk. Investment is unlikely without some change in policy. There are no commercial ethanol plants today. The increase in the cellulose subsidy described above is set to expire in 2012, before cellulosic production will occur, so it will not provide an incentive to invest unless promptly extended. Many companies and universities are doing path–breaking work to develop viable technologies. However, moving from laboratory or even demonstration scale to commercial scale is quite a leap. It is difficult for government policy options to provide protection against technical risk. Over time, the market will accomplish that with firms which are able to produce economically being the survivors.

The third risk is RFS implementation. Each year, EPA in consultation with DOE and USDA must decide the level of the RFS for the next year for cellulosic ethanol (and the other categories included in the RFS). It is unclear how this will be done. Given the rules of the RFS, it appears if the level is set high enough to absorb all cellulosic ethanol produced, the firms would be able to market the ethanol at a price a bit higher than energy equivalent gasoline, but not substantially higher. There is an option for blenders to pay 25 cents per gallon for a Renewable Fuel Identification Number (RIN) in lieu of actually blending the fuel. Again, it is not clear how this will be implemented. The bottom line is that there is considerable policy uncertainty, and that uncertainty also will impede investment.

Finally, there will be difficulties securing raw material supply. It is likely that potential cellulosic investors will want to be assured raw material supply before sinking steel and laying concrete. Cellulosic ethanol plants will have to source locally, unlike corn ethanol plants. Two potential sources are corn stover and switchgrass. They are quite different in many ways. First, according to our analysis (Brechbill and Tyner, 2008) corn stover is substantially cheaper that switchgrass. It costs about $40 per dry ton compared with $60 for switchgrass. This cost includes fertilizer replacement but does not place a value on soil carbon reduction. The literature on this topic is not consistent, but our reading is that most scientists who have worked on the issue conclude that one–third to one–half of the residue could be removed without subsequent adverse yield effects (Barber, 1979; Benoit and Lindstrom, 1987; Karlen, Hurt, and Campbell, 1984; Linden, Clapp and Dowby, 2000; and Lindstrom, 1986). Second, corn stover and other residues or waste products clearly and unequivocally reduce GHG emissions (because there is little or no direct or indirect land use change). It might be argued that the additional revenue stream from corn stover would induce more corn planting. There might be a very small effect, but we argue that the incremental net revenue would not be sufficient to cause a significant area shift.

Third, corn (and thus corn stover) is an annual crop, whereas switchgrass and similar crops are perennials, meaning in this case that they are planted and harvested over a period of about 10 years. Ethanol plants will want to contract with farmers for supply of raw materials. It should be easier to come up with contracting and risk sharing mechanisms for corn stover than for a crop like switchgrass that will require long–term contracts. This will be new territory for farmers and ethanol producers alike. And unlike corn ethanol, all the raw material must be sourced locally—normally within 50 miles of the plant. Therefore, we must develop new contracting and risk sharing mechanisms to protect both farmers and ethanol producers.

The 2008 Farm Bill contains a provision providing incentives for farmers to plant and grow cellulosic feedstock. It is sort of a plant it, and they will come provision. In our view, it is ill–conceived in that it will not ensure the supply for a plant. The only way dedicated cellulose crops will get off the ground is if adequate private contracting mechanisms are developed. The University of Tennessee is doing good work on this issue.

We will need to deal with all these issues to successfully launch a cellulose ethanol industry. In terms of policy, perhaps a variable subsidy would be first choice since that is the main mechanism for reducing oil price risk at low cost. Extension services might be used to help bring farmers and ethanol producers together to hammer out acceptable contract terms for raw material supply. Consideration might be given to providing better information on RFS implementation for cellulosic ethanol to help reduce the government policy uncertainty.

Global Biofuels Impacts

Many countries have announced and implemented plans and programs to increase production and use of biofuels renewable energy. In both the United States and the EU programs are already in effect that either require or provide incentives for significant production of bioenergy. China, India, Indonesia, and Malaysia, among others, also have announced and implemented biofuels initiatives. More than 13 billion gallons of bio–ethanol and about 2 billion gallons of biodiesel were produced globally in 2007. The ethanol production is driven by a combination of high oil prices and government support. Biodiesel production is driven mainly by government support, as it is further from being economic without policy support (OECD, 2008).

This large–scale global implementation of bioenergy production causes global economic, environmental, and social consequences. It can affect the global economy in several ways. In addition, it induces major land use changes across the whole globe which may lead to significant environmental impacts. To assess the global impacts of biofuel production, a computational general equilibrium (CGE) framework has been developed. This framework builds upon the standard Global Trade Analysis Project (GTAP) database and modeling framework and modifies it in several ways. Three types of biofuels (ethanol from sugarcane, ethanol from crops, and biodiesel from oilseed) and their byproducts - distillers dried grains with soluble (DDGS) and biodiesel byproducts (BDBP) - are explicitly introduced into the standard GTAP model. The new framework has been used in several research activities to examine global impacts of biofuel production. In this short paper we address some key findings of these research activities. In particular, we report some results from Hertel, Tyner, and Birur (2008), and Taheripour et al. (2008).

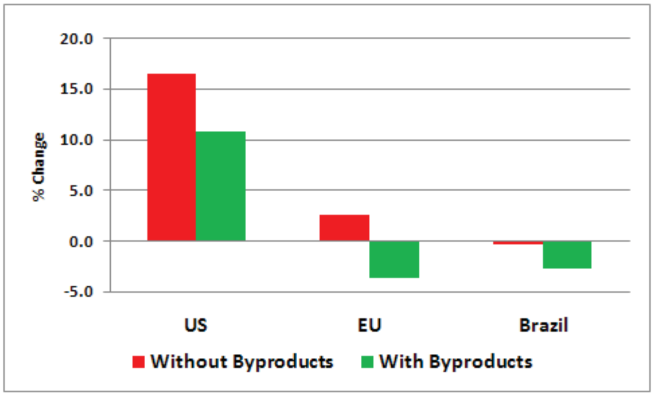
Hertel, Tyner, and Birur (2008) have examined the implications of U.S. and EU biofuel mandate policies for the world economy during the time period of 2006–2015. According to this paper, biofuel mandates sharply increase the production of coarse grains (mainly corn) in the United States and production of oilseeds in the United States, EU and Brazil. The United States and EU would use a large portion of their corn and oilseed outputs to meet their biofuel mandates for 2015. In the United States, the share of corn used in ethanol production could increase from 12.7% in 2006 to 29.9% in 2015, while the share of oilseeds going to biodiesel in the EU could increase from 23.3% in 2006 to 69.2% in 2015. The United States and EU mandates policies interact, and the most dramatic interaction between these policies is for the U.S. oilseed production. While, the U.S. mandates alone would reduce U.S. oilseed production, the combination of both the U.S. and EU mandates would increase oilseed production in the United States. In general, about one–third of the growth in the U.S. crop cover is attributed to the EU mandates. The U.S.–EU mandates affect the rest of the world as well. The combined policies have a much greater impact than just the United States or just the EU policies alone, with crop cover rising sharply in Latin America, Africa and Oceania as a result of the combined U.S.– EU biofuel mandates. These increases in crop cover come at the expense of pasture (first and foremost) as well as commercial forest.

Taheripour et al. (2008) have revealed the importance of incorporating biofuel byproducts into the economic analysis of biofuels policies. The model with byproducts reveals that production of DDGS and BDBP would grow sharply in the United States and EU. For example, the U.S. production of DDGS would grow from 12.5 million metric tons in 2006 to 34 million metric tons in 2015. A major portion of this byproduct would be used within the United States, and the rest would be exported to other regions such as Canada, the EU, Mexico, China, Africa and Asia.. On the other hand, the EU production of BDBP would grow from about 6.1 million metric tons in 2006 to 32.5 million metric tons in 2015. The EU production of BDBP would be mainly used within the region.

The CGE models with and without byproducts tell quite different stories regarding the economic impacts of the United States and EU biofuel mandates for the world economy in 2015. While both models demonstrate significant changes in the agricultural production pattern across the world, the model with byproducts shows smaller changes in the production of cereal grains and larger changes for oilseeds products in the United States and EU, and the reverse for Brazil. For example, as shown in Figure 2, the U.S. production of cereal grains increases by 10.8% and 16.4% with and without byproducts, respectively. The difference between these two numbers corresponds to 646 million bushels of corn which could be used to produce about 1.7 billion gallons of ethanol. This is really a big number to ignore and disregard in the economic analyses of biofuel production.

With byproducts included in the model, prices change less due to the mandate policies. For example, the model with no byproducts predicts that the price of cereal grains grows 22.7% in the United States during the time period of 2006 to 2015. The corresponding number for the model with byproducts is 14%. Introducing byproducts into the model alters the trade effects of the U.S.–EU man-

Figure 2. Percentage change in coarse grain production due to the U.S. and EU biofuel mandate policies 2006–2015



date policies as well. For example, the model with no byproducts estimates that the U.S. exports of coarse grains to the EU, Brazil, and the Latin American region would drop sharply by –4.8%, –25.5%, and –12.7%, respectively. The corresponding figures for the model with byproducts are –2.1%, –15.7%, and –7.9%.

Next Steps

We have learned a lot in the economic analysis done to date, but there is much more work needed. Our next step is to improve the data and models such that we will be able to estimate global land use changes induced by national biofuels programs. Land use changes are important in estimating greenhouse gas emissions changes associated with biofuels.

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A publication of the Agricultural & Applied Economics Association

Food or Fuel? Choices and Conflicts

Thomas E. Elam

JEL Classification : Q28, Q11

The quiet world of farming and food production is undergoing a "sea change" of unprecedented proportions. Since 2005 we have seen a rise in energy prices coupled with policy decisions that have expanded biofuels markets for crops that were traditionally used almost exclusively to feed people and farm animals. In addition, a weak U.S. dollar and increasing global food demand have added to the upward price pressure and increased volatility in major crop markets.

Governments of the United States and the Economic Union (EU) have reinforced changing market conditions with policy choices that tilt the balance towards channeling crop production into biofuel production. The mandates and subsidies in these policies are not transparently linked to market forces. Debate over the wisdom of market–insensitive biofuels policy that adds to crop demand and price uncertainty in a time of record–high prices has become heated.

The basics of what is happening to market supply and demand forces are not difficult to understand. The wrinkles added by biofuels policy are, on the other hand, both significant and add complexity.

Energy Markets Alone Are Causing Major Changes in Agricultural Markets

For economists, the increase in oil prices and the resulting link to the energy value of crops has turned out to be a test of just how well our theories can predict the outcome. I am happy to report that the theories have passed the exam with flying colors. This is cold comfort for those paying historically high prices for gasoline, corn, soybean oil and soybean meal, but at least we know "how" and "why".

Market–based demand for crops used in food production is somewhat different from market–based demand for biofuel in one important sense. In the food market, as production increases price is expected to decline along a short–run demand curve. Price–inelastic demand for food generally leads to large changes in price for relatively small changes in production. Food demand for crops is also not strongly linked to other commodity sectors. This is not true for demand for food crops used as biofuels.

The global market for petroleum–based energy alone, in terms of energy production, is substantially larger that all the potential fuel energy that can be produced from the world's food crops. Unless we are willing to sharply reduce food consumption we can use only a fraction, and a small one at that, of the current world's food supply to produce fuel. In the world of energy, potential food–based biofuel production simply cannot come close to replacing a meaningful amount of petroleum, much less total fossil fuel consumption. (Including natural gas and coal)The 15 billion gallon U.S. ethanol RFS for 2012 would use about 6.2% of the 2008 global grain crop to replace about 6.8% of the 2008 U.S. gasoline supply and only 0.8% of global oil production. This creates an asymmetric situation where the biofuel supply is too small relative to the global energy market to have much effect on energy prices, but energy prices can have a major effect on food prices.

To put it simply, the limiting factor on expanding food–based biofuel production is the world's desire for food, not fuel demand. Even more simply, we like to eat. Open up the possibility of producing biofuels from other sources that do not compete for farmland (algae, wood waste, manure, solid waste, and others) and the limits on production can be expanded. That technology is still, after many years of work, "not quite" ready. It may be a factor in the long term biofuels market, but not today's.

If biofuels are priced competitively, they are a near–perfect substitute for petroleum fuels. A gallon of ethanol has about 66% of the BTU content of a gallon of gasoline.

Gallon–for–gallon methyl ester (the chemical name for the purified product extracted from fats and blended with diesel fuel to make bio–diesel) has very close to 100% of the BTU content of diesel.

For current engine technology that means that, at 66% of the price of gasoline, ethanol is a near–perfect substitute for gasoline. If E85 (85% ethanol, 15% gasoline) is priced at 71% of the price of gasoline, motorists will not care whether they buy regular gasoline or E85 as their fuel cost per mile will be about the same. Modified engines can take advantage of ethanol's higher octane rating and reduce the energy penalty through higher efficiency than is possible with today's gasoline–based technology. There are none of these engines on the market today. Diesel buyers can pay the same price for methyl ester as diesel and get the same fuel cost per mile.

Until oil prices passed about $70 per barrel the market economics of converting crops to fuel were not very favorable. Grains and fats were priced too high compared to their energy value to make it profitable to convert them into motor fuels. We did produce some ethanol and methyl ester, but only with the help of government subsidies. With oil at over $100 a barrel in 2008 the value of crops converted into fuels has been significantly higher than food–market values of just a few years ago. Subsidies are no longer required for biofuels to be a viable use of crops. That is a huge change in market fundamentals.

So, what happens if crop–based production of biofuels is limited to only a small fraction of the petroleum market and petroleum prices suddenly increase, setting values for crops that are higher than prevailing food–market prices? According to economics textbooks the classic market–based process should unfold something like this:

1. Biofuel prices will increase with energy prices, but crop prices will not immediately follow.
2. Biofuel producer profits will increase from higher biofuel prices.
3. Biofuel producers will expand production, but with a time lag.
4. Biofuel production increases are too small to have a material affect on overall fuel prices.
5. However, as biofuel production grows so does demand for the crops used.
6. Production of the biofuel crops is limited by available land and yields, less of those crops are available for food use.
7. The biofuel crops will take acres from other crops, and their prices will also increase.
8. With time lags, higher crop prices will be reflected in higher food prices and lower food production.
9. Higher demand for limited crop supplies will cause crop prices to increase until biofuel profits disappear and fuel value of crops equals food value.
10. Biofuel expansion will stop, and some marginal producers may exit.
11. If crop production increases enough to cause a crop price declines, loop back to Step 3.

Although it seldom happens in real life, the economics textbooks in this case predict what has happened up through Step 9. A marked slowing of new ethanol plant construction indicates that Step 10 is also in the process of occurring. Longer term implications of higher energy prices for agricultural markets include, but are not limited to:

1. Energy markets and food markets become tightly coupled. That is, increases (decreases) in energy prices will cause crop prices and food production costs to increase (decrease).
2. Prices for crops and feedstuffs other than those used for biofuels will also be affected due to competition for land and substitution in use.
3. Land prices and rents will move in tandem with changing energy prices; landowners are potentially the major beneficiaries in the form of higher land prices.
4. High (relative to pre–2007) energy prices will cause increased demand for farm inputs and will cause crop production costs to increase.
5. Food production volume will be affected by the demand and price for energy via the biofuels market.

Bruce Babcock of Iowa State University and Wallace Tyner of Purdue University have come to essentially these same conclusions (Babcock) (Tyner).

Energy Policy Reinforcing the Energy Market Linkage to Agriculture and Food

Energy policy affects food and agriculture through biofuels and their links to both energy production and crop demand and use. The biofuel policy tools commonly used are subsidies for biofuel producers, mandated production and/or use, and tariffs designed to protect the domestic market. Current U.S. policy makes use of all three of the tools. EU policy is focused in mandates.

Mandated use of ethanol in the United States was first proposed in 2003, but not enacted until 2005. The Energy Policy Act of 2005 had an ethanol mandate (the Renewable Fuel Standard, or RFS) that was relatively modest and did not have a significant effect on agricultural markets. However, enacted on December 19, 2007, the Energy Independence and Security Act of 2007 (EISA) set forth a much higher RFS.

To put the higher EISA RFS in perspective, the crop year 2008/2009 EISA RFS is about 10 billion gallons of ethanol. It would require at least 91 million tons of corn be used from the 2008 U.S. crop. USDA is currently (as of August 12, 2008) forecasting 104 million metric tons of corn use, about 4% of total global grain production, for ethanol production from the 2008 corn crop. While the 2008/2009 ethanol mandate may be slightly smaller than forecast production, the presence of a market guarantee of this magnitude could be underpinning current corn prices.

In addition to the RFS mandate, U.S. policy also grants the biofuels industry tax credits, paid to the company that blends ethanol or biodiesel with petroleum fuels. The tax credits do not adjust with market conditions. Fixed cash infusions into biofuel use raise the value of biofuels to the blending company and raise the market price of biofuels without regard to energy or crop prices. With higher biofuels prices the biofuel producer has an advantage over other crop buyers. However, there can be only one market price for any crop, so the biofuels industry eventually bids much of the value they receive from the tax credits into crop prices. The tax credits are adding to the upward pressure on crop prices on top of the market pressures from higher energy prices.

The end result with both the tax credits and mandates is that much of their value will always eventually be bid into biofuel prices, and then crop prices. Crop farmers, not the ethanol industry, become the major beneficiaries of the tax credits. Eventually, higher crop prices will be capitalized into land prices, and the ultimate benefit will accrue to landowners.

Finally, the ethanol tariff of $0.54 per gallon is a barrier which helps protects U.S. ethanol producers from more efficient producers outside of the United States. However, in a sense the tariff and tax ethanol credit cancel each other, and the net effect is to deny foreign ethanol producers the value of the U.S. tax credit paid for all ethanol in the prices they receive.

There has also been political fallout over biofuels policy. The voice of agriculture is fracturing along lines of crop producers versus crop users. As the public sees crop farmer income grow while their food prices increase (MSNBC) support for farm programs and biofuels policy may erode.

What Happens When Policy Meets Cold Reality?

History teaches us that in most cases reality eventually wins. We also often see "unintended consequences." Energy policy can set any mandated level of ethanol production, but even the U.S. Congress or the President cannot change the weather or double crop yields overnight. Actually, to replace just 50% of U.S. gasoline consumption with E85 would take 100 billion gallons of ethanol. Including 9 billion for food, feed and exports, corn production would need to be over 40 billion bushels to make that happen. From 80 million acres of U.S. corn it would take a yield of over 500 bushels per acre. We are currently at about 160 bushels in a good year. We also would still be importing significant amounts of crude oil. When it appeared that the 2008 corn and soybean crops were at risk from flooding, corn prices soared to unprecedented highs. On June 18, 2008, several corn futures contracts closed at over $8 for the first time ever. Cash corn was selling for close to $9 per bushel in California. Prices of soybeans and wheat were also on the rise. Within a few weeks it became apparent that the crops were improving, and prices declined, but remained at historically high levels.

Why did this happen when even a damaged 2008 corn crop could still have been the 4th largest on record? A major factor was likely that for the first time in history we had $140+ crude oil prices coupled with an expanded biofuels industry with a RFS mandate large enough to use sufficient grain relative to production to make a substantial difference in crop prices.

While improved weather at least temporarily alleviated the 2008 supply crunch, it is not clear at this point just how such a scenario of tight crop supplies and EISA policy will interact. Corn prices at the levels of June, 2008 were not profitable for ethanol producers, food or animal feed users. We were, for a few weeks, in an unprecedented bidding process to determine who was to have access to a corn crop that was predicted to be much smaller than that of 2007. At some point we would have reached prices that would have rationed use, or the RFS would have been reduced. Had the RFS been reduced, prices may have dropped sharply overnight.

Finally, along with higher crop prices we have also seen a marked increase in price volatility. The coefficient of variation of monthly 2007–crop cash corn prices has been about three times the level of the 2000–2006 crops. The increased demand for biofuels, partly market driven and partly as a result of policies promoting their production, has reduced crop stocks levels, driving price volatility higher. Less stable crop prices raises another set of issues regarding how crop users will manage higher risks.

Why We May Need to Re–examine Current Energy Policy

Arguably, the biofuels features of the Energy Independence and Security Act of 2007 (EISA) will achieve few of the goals implied by the law's name. A recent Iowa State study of EISA policies concludes that they are in fact not designed to promote cleaner energy production, energy independence or energy security, but rather are intended to increase farm incomes and land prices (Rubin, Carriquiry, and

Hayes). The study examined a wide range of policy options, and concluded that the policy set contained in EISA had the largest benefit for agriculture of the options examined. In their conclusions the authors state "There is strong evidence to suggest that the primary purpose of these (EISA biofuel) polices was to remove land from food and feed production and in so doing to increase farmers' and landowners' incomes."

By establishing price–insensitive subsidies and mandates EISA also partially isolates a large portion of key crops from market forces, pushing adjustments in production and prices onto the food production sector. The result is higher, more volatile, food prices and reduced security of our world's food supply. Increased biofuel production, subject to the whims of weather, also arguably reduces even our overall fuel security.

The payoff for ESIA biofuels policy is small relative to the energy market. Even if the 36 billion gallon EISA mandate for 2022 could be met it would not make a material change in the country's dependence on foreign oil. The petroleum equivalent of the mandate is about 570 million barrels of oil per year, or only about 15% of 2008 U.S. oil imports. That still leaves the U.S. highly vulnerable to world oil market interruptions.

On equity grounds biofuels policy has helped promote a transfer of income and wealth from food consumers and crop users to crop producers and land owners (Taheripour and Tyner). In effect, biofuels policy can be seen as a regressive food tax, the proceeds of which largely go to farm owners.

Current U.S. biofuels policy deserves to be revisited by Congress and the Administration. Together with oil price instability, EISA's inflexible biofuel mandates, subsidies and tariffs have increased both costs of food production and price volatility. Both higher costs and higher risks have been imposed on the food production sector.

At a minimum, a more flexible biofuels policy that is responsive to agricultural and energy market realities should be preferable to the fixed tax credits, RFS and tariffs contained in EISA. An energy policy that more strongly emphasizes energy conservation and fuel production from nonfood sources, including incentives to increase U.S. oil and natural gas production, could also be part of that debate.

To solve the potential dilemma of "food vs. fuel" demands that we effectively address long– term energy consumption, production and prices. Failure to do so could lead to a future of significant increases in global food and energy costs, a marked decline in global living standards, and an increase in global poverty rates. If this happens the world will be neither a more independent nor secure place to live.

For More Information

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CHOICES
The magazine of food, farm, and resource issues
A publication of the Agricultural & Applied Economics Association
AAEA Agricultural & Applied Economics Association

Cellulosic Biofuels: Are They Economically Viable and Environmentally Sustainable?

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JEL Classification: Q01, Q54, Q55

Biofuels are being extensively promoted for their potential to contribute to energy security, stable energy prices, and climate change mitigation in the United States. A key constraint to our ability to expand biofuel production to significantly reduce dependence on fossil fuels is likely to be the limited amount of agricultural land available to produce food, feed and energy crops. The use of crop residues like corn stover, wood chips and high yielding herbaceous energy crops such as perennial grasses is being explored to mitigate this competition for land and achieve higher quantities of biofuel per acre of land than being achieved by corn–grain based ethanol. Among herbaceous energy crops, miscanthus and switchgrass have been identified as promising crops because they have higher yields than other perennial grasses, provide high nutrient use efficiency and require growing conditions and equipment similar to those for corn, which makes them compatible with conventional crop cultivation (Heaton et. al., 2004). They also have several positive environmental attributes.

To be economically viable, energy crops must compete successfully both as crops and as fuels. Biofuels produced from these energy crops (referred to as cellulosic biofuels) need to compete with fossil fuels and corn–based ethanol. Owners of cropland will produce cellulosic feedstocks only if they can receive an economic return that is equivalent to or preferably higher than the returns from the most profitable conventional crops, particularly if energy crop production is exposed to more price risks. The foregone returns from these conventional crops are the opportunity cost of using cropland for producing energy crops. Geographical variations in the costs of producing these crops and in the opportunity costs of land are likely to make the economic viability of cellulosic biofuels differ across locations.

Energy crops and the cellulosic biofuels produced from them offer the potential for various environmental benefits compared to the row crops they may displace and compared to grain–based ethanol. These include reduced soil erosion and chemical run-off, extended habitat for wildlife, stabilization of soil along streams and wetlands, sequestration of more carbon in the soil than row crops grown using conservation tillage, and lower input requirements for energy, water and agrochemicals per unit of biofuel produced (McLaughlin and Walsh, 1998; Semere and Slater, 2007). These environmental benefits tend to differ across different energy crops, due to differences in their energy input requirements, ability to sequester carbon in the soil, canopy cover and palatability of leaves for insects. There have been some concerns that miscanthus, as an introduced species, might be an invasive plant. However, most varieties used for biofuel production (like *Miscanthus x Giganteus*) are sterile hybrids and do not produce seed. Environmental groups are also concerned that demand for biofuels might lead to the dominance of single species of perennial grasses within a landscape rather than polycultures with mixed prairie grasses, like Indian Grass and Big Bluestem, which would enhance biodiversity.

The potential to mitigate greenhouse gas emissions by using biofuels for transportation is a key benefit, since there are few substitutes for transportation fuel given current vehicle technology. We will examine the costs of producing biofuels from alternative feedstocks (corn stover, switchgrass and miscanthus) using data for Illinois. Life–cycle analysis allows us to estimate the CO_2 mitigation potential of these feedstocks relative to gasoline. We will then discuss the implications of valuing these CO_2 mitigation benefits for the competitiveness of these feedstocks relative to each other and to gasoline.

Costs of Cellulosic Feedstocks

The economic potential of cellulosic feedstocks depends on their yields, input requirements and costs of production and is expected to vary spatially with differences in climatic and soil conditions. Corn (and thus corn stover) require good soil quality while perennial grasses require long growing periods and higher temperatures and can be grown on less fertile lands. Corn stover yields are expected to be in the ratio of 1:1 with corn yields and to range from a low of 2.25 t dm per acre (metric tons of dry matter per acre, with 1kg=0.001 metric ton) in southern Illinois to a high of 4 t dm per acre in northern and central Illinois; of this, the amounts that can be sustainably harvestable vary between 40% and 70% depending on tillage practice (Sheehan et al., 2004). In contrast to this historically observed pattern of corn yields, peak yields of miscanthus (simulated using a crop productivity model), are estimated to be lower in northern Illinois (12 t dm per acre) than in southern Illinois (18 t dm per acre) (Khanna, Dhungana and Clifton-Brown, 2008). The spatial pattern of switchgrass yields is expected to be similar to that of miscanthus, however, switchgrass yields are about a quarter of those of miscanthus based on field experiments conducted in Illinois and Iowa. Yields per acre of these crops influence not only their costs of production per ton but also the volume of biofuels that can be obtained per acre of land and thus the amount of land that would need to be diverted from row crops to meet a given level of biofuel production.

Table 1 presents an estimate of annualized costs of producing switchgrass and miscanthus and the annual costs of collection of corn stover in 2007 prices. These cost estimates are developed for average delivered yield levels for Illinois (for details about agronomic assumptions see Khanna, Dhungana and Clifton-Brown, 2008; Khanna and Dhungana, 2007). Switchgrass is assumed to have a life of 10 years, while miscanthus is assumed to have a life of 20 years.

Fertilizer and chemical input requirements for corn stover and energy crops relative to conventional crops are fairly low. In the case of corn stover, fertilizer applications are needed to replace the nutrients removed with the stover to sustain soil fertility (Sheehan et al., 2004). The largest component of the costs of producing cellulosic feedstocks is the cost of harvesting, baling and storing them, particularly if they are stored in an enclosed building for several months after harvest. Since there is considerable uncertainty about the methods of harvesting and storage of biomass, we consider two alternative scenarios for estimating baling and storage costs. In the high cost scenario, we consider baling costs per acre as linearly related to the yield per acre, while in the low cost scenario, we treat a portion of the baling costs (those related to the equipment, tractor and implements) as fixed and a portion as variable (fuel and labor) that depend on the biomass yield to be baled. The high cost scenario also considers storage of bales in an enclosed building, while the low cost scenarios assumes it is on the field on crushed rock and covered by tarp.

Another large component in the case of energy crops is the opportunity cost of the land, which is tied to the price of row crops such as corn and soybeans. In the case of corn stover, we assume that the use of stover

Table 1. Farmgate Costs of Production of Cellulosic Feedstocks in Illinois

Cost Items ($/Acre)	Switchgrass		Miscanthus		Corn Stover	
Scenario	High	Low	High	Low	High	Low
Fertilizer	66.7	66.7	29.8	29.8	15.3	15.3
Chemicals	7.7	7.7	0.5	0.5	-	-
Seed	7.0	7.0	70.8	70.8	-	-
Interest on operating inputs	5.7	5.7	7.1	7.1	1.1	1.1
Preharvest Machinery	14.1	14.1	11.0	11.0	-	-
Harvesting	86.8	64.0	277.5	151.6	69.5	60.2
Storage	54.2	10.2	199.3	37.6	41.7	7.9
Annualized Total Operating Cost	**242.2**	**175.4**	**595.9**	**308.4**	**127.3**	**84.1**
Annualized deliverable yield (t dm/acre)[a]	2.5	2.3	8.5	8.1	1.9	1.8
Opportunity cost of land ($/ t dm)[b]	179.4	189.0	51.9	54.7	43.9	46.3
Break–even total cost ($/t dm)	**277.8**	**264.2**	**122.0**	**92.9**	**111.3**	**93.1**

[a] Deliverable yield at the farm gate estimated after including losses during harvest and storage. Losses during storage are assumed to be 7% of harvested yield in the low cost scenarios and 2% in the high cost scenario.

[b] Opportunity cost of land is estimated assuming a price of $5 per bushel for corn and $12 per bushel for soybeans and a yield of 145 bushels/acre for corn and 50 bushels/acre for soybeans with a corn–soybean rotation.

for biofuels leads farmers to switch from a more profitable corn–soybean rotation to a corn–corn rotation with a 12% lower yield of corn, imposing an opportunity cost of land. As can be seen in Table 1, the per ton costs of producing switchgrass are more than two times higher than those of miscanthus and corn stover, in large part because of the high opportunity cost of using land given switchgrass yields. The per ton costs of producing miscanthus are similar to those of corn stover in the low cost scenario.

The costs of producing these feedstocks vary considerably spatially due to differences in their yields as well as differences in the costs of land as shown in the case of Illinois in Figure 1. Costs of producing corn stover are relatively lower in parts of northern and central Illinois where corn yields are high while those of miscanthus are relatively low in the southwestern and southern regions of Illinois where its yields are high. Costs of producing switchgrass in Illinois are much higher than those of corn stover and miscanthus (given its present yields). Thus, unlike the present generation of ethanol which is dominated by a single feedstock, corn, the next generation of (cellulosic) biofuels in the United States might be produced from a mix of feedstocks with more corn stover being used in central and northern Illinois and more miscanthus in southern and southwestern Illinois.

Figure 1. Farmgate Costs of Producing Cellulosic Feedstocks in Illinois

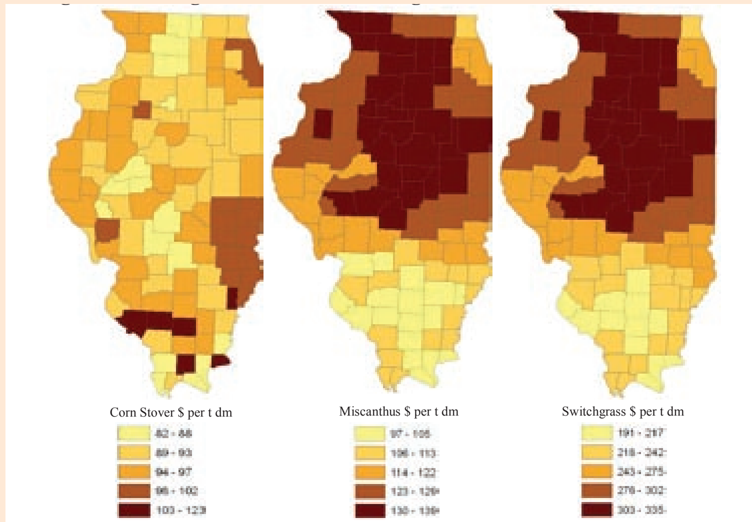

Table 2. Quantity and Costs of Production of Biofuels

	Gallons per Acre	Feedstock Cost	Cost of Conversion	Coproduct Credit	Total[a]
		Dollars per Gallon of Ethanol			
Corn Ethanol	398.75[b]	1.82	0.78[c]	0.48	2.12
Corn Stover	165.04[d]	1.27	1.46	0.12	2.62
Miscanthus	742.45	1.40	1.46	0.12	2.74
Switchgrass	214.74	3.18	1.46	0.12	4.53

[a] Wholesale costs at the refinery including zero return to equity. Feedstock cost for corn ethanol assumes $5/bu corn.

[b] Assuming an average yield of 145 bushels/acre under a corn-soybean rotation; [c] http://farmdoc.uiuc.edu;

[d] Assuming average yield under a corn-corn rotation.

Table 2 shows the quantity of ethanol per hectare of land with different feedstocks with current yield of 2.8 gallons of corn ethanol per bushel of corn and projected yield of 87.3 gallons per delivered metric ton dm of cellulosic feedstocks (Wallace, Ibsen, McAloon and Yee, 2005). Costs and yield estimates in Table 2 are under the high cost scenario described above. Miscanthus can produce more than twice as much ethanol as corn can per unit of land and more than three times as much as corn stover or switchgrass. Miscanthus can produce at least 30% more ethanol per acre of land than combined ethanol production from corn grain and corn stover.

Costs of Producing Cellulosic Biofuels

The per gallon cost of producing biofuel in Table 2 includes farmgate cost of the feedstock (including cost of land), cost of converting the feedstock into fuel, and credit for the value of coproducts produced during the conversion process (for example, dried distillers grains in the case of corn ethanol and electricity in the case of cellulosic biofuels). The technology for producing cellulosic biofuels is not yet commercially available. Projected estimates of these costs for cellulosic biofuels produced in a biorefinery with a 25 million gallon a year capacity are obtained from Wallace, Ibsen, McAloon and Yee (2005) and updated to 2007 prices using the GDP deflator. As can be seen from Table 2, delivered feedstock costs per gallon for corn stover and miscanthus are lower than those for corn. However, even optimistic projections of costs of conversion for cellulosic fuels ($1.46/gallon) are about twice as high as those of corn ethanol ($0.78/gallon) making cellulosic biofuels from corn stover and miscanthus 24% and 29% more expensive than corn ethanol, respectively. Biofuel from switchgrass is more than twice as expensive as corn ethanol making it very unlikely that current varieties of switchgrass will be competitive on cropland in Illinois unless their yields improve dramatically.

The market demand for cellulosic biofuels will depend on their competitiveness relative to corn ethanol and gasoline. The market price of denatured corn–ethanol is increasingly being determined by its energy content (which is about two–thirds of that of gasoline) and the blender's tax credit (Tyner and Taheripour, 2008). The recently enacted Energy Bill and Farm Bill provide several new incentives to encourage production of cellulosic biofuels while lowering the blenders' tax credit for corn ethanol from $0.51 per gallon to $ 0.45 per gallon.

Current Policy Incentives for Cellulosic Biofuels

To induce a market demand for cellulosic biofuels, the Energy Independence and Security Act of 2007 has imposed a renewable fuels standard of 36 billion gallons of ethanol by 2022. It mandates 21 billion gallons of advanced biofuels that can reduce life–cycle greenhouse gases by 50% relative to baseline levels. The recent Food, Conservation and Energy Act of 2008 includes more than $1 billion to provide incentives to farmers to grow cellulosic feedstocks and to biofuel producers to use cellulosic feedstocks. This includes a $1.01 per gallon tax credit for producers of cellulosic biofuels and cost share payments (up to 75% of establishment costs, plus annual payments to cover the cost of the land during establishment and $45 per ton to cover costs of harvest, storage and transport). It also provides assistance for cellulosic biorefineries and for research and development, and incentives for using biomass (instead of fossil fuels) to power existing ethanol plants, thus creating a market for biomass feedstocks. Whether these incentive payments will stimulate production of cellulosic biofuels will depend on the price of gasoline, the costs at which it will be commercially viable to convert cellulosic feedstock into fuel and the costs of producing corn–based ethanol.

Policy Incentives to Encourage a Sustainable Mix of Biofuels

From a social efficiency perspective, the case for government intervention in biofuel markets is arguably justified, if biofuels reduce market failures caused by environmental externalities. If market prices of biofuels do not reflect environmental benefits then they are likely to lead to under–production of biofuels. Market based policies that reward environmental services are preferable to arbitrarily set mandates or subsidies. Biofuels not only provide a renewable source of energy but also a range of other environmental benefits. These benefits differ across biofuels from different feedstocks. While some feedstocks such as switchgrass may provide better habitats for wildlife, others such as miscanthus may have greater greenhouse gas mitigation potential. Feedstock derived from native mixed prairie grasses such as Indian grass and Big Bluestem contribute to enhanced biodiversity in the agricultural landscape and other ecological benefits but have much lower yields than even switchgrass. We estimated the average greenhouse gas mitigation potential of alternative biofuels in Illinois relative to gasoline using the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model (http://www.transportation.anl.gov/software/GREET/) (Table 3). The estimates below are illustrative based on current knowledge and reasonable assumptions about input application rates, energy requirements and emissions coefficients.

While corn and corn stover reduce greenhouse gas emissions (including soil sequestration) by 37% and 94%, respectively, relative to energy equivalent gasoline, miscanthus and switchgrass can serve as net carbon sinks. These estimates show that corn ethanol produced with the current production technology would not qualify as being an advanced biofuel.

Table 3: Life Cycle Carbon Emissions Kg CO_2 per Gallon of Ethanol

	Feedstock Production	Biorefinery Phase	Coproduct Credit	Displacement due to change of land use[a]	Total Above Ground CO_2 Emissions	Soil Carbon Sequestration[b]	Total CO_2 Emissions Net of Soil Sequestration	Emissions Reduction Compared to Gasoline[c]
Corn	2.42	4.93	-1.99	0.00	5.36	-0.62	4.75	2.79
Corn Stover	1.22	0.28	-0.40	0.45	1.54	-1.09	0.46	7.08
Miscanthus	0.97	0.28	-0.40	-0.88	-0.04	-2.25	-2.29	9.83
Switchgrass	3.78	0.28	-0.40	-2.89	0.76	-6.40	-5.63	13.17

[a]These emissions include those due to direct land use changes from conversion of cropland to energy crops (column 5) but do not include those due to indirect land use changes in other countries due to diversion of U.S. cropland to energy crops.

[b]Of the estimated soil carbon sequestration by corn under conservation till, 50% is allocated to corn ethanol and 50% to stover ethanol.

[c]Emissions from gasoline are 7.54 Kg CO_2e per energy equivalent gallon of ethanol.

While volumetric subsidies and cost–share payments are market–based policies, they do not distinguish among biofuels based on their environmental sustainability and are likely to encourage production of feedstocks that have high yields per acre and low costs of production. They also tend to make fuel cheaper and lower cost of vehicle miles for consumers which tends to increase vehicle miles travelled and can reduce or even negate any greenhouse gas mitigation benefits due to substitution of renewable fuels for gasoline (Khanna, Ando and Taheripour 2008). Subsidies for corn–ethanol have also tended to expand production of corn grain ethanol and contributed to the rise in corn prices (Abbott, Hurt and Tyner, 2008). An alternative approach would be to provide carbon mitigation subsidies, the magnitude of which would depend on the market price of CO_2. Most analysts expect the price of CO_2 to be around $34 per metric ton over the 2008–2012 period in Europe (http://www.euractiv.com/en/climate-change/european-co2-emissions-2007/article-171327). At this price, the carbon mitigation (including sequestration) provided by biofuels relative to gasoline (indicated in Table 3) would imply a subsidy of $0.09, $0.24, $0.33 and $0.45 per gallon ethanol from corn, corn stover, miscanthus and switchgrass, respectively. Other environmental services provided by cellulosic feedstocks could be similarly monetized using appropriate values to correct the market prices of biofuels.

A Final Note

Crop residues can be used for cellulosic biofuel production without creating a food–fuel competition for land. A USDA/USDOE (2005) report estimates that 68 million metric tons of corn stover could be sustainably harvested from existing corn acres in the United States with a potential to produce 7 billion gallons of cellulosic biofuels. This would meet only about a third of the ethanol mandate for advanced biofuels in 2022 in the United States necessitating the development of other feedstocks such as switchgrass and miscanthus that are promising due to their relatively high yields per acre and low input requirements. This article explores the economic viability of these feedstocks using data for Illinois and finds that it is likely to differ across geographic locations. A mix of cellulosic feedstocks is, therefore, likely to be more economically viable than a single feedstock. Current estimates suggest that cellulosic biofuels are likely to be more expensive to produce than grain–based biofuels. However, the advent of new technologies for harvesting, storing, and converting cellulosic sources into biofuels could make them more competitive. Rewarding biofuels based on their environmental services would help to internalize environmental externalities and promote a sustainable mix of feedstocks. Aligning energy policy and climate policy through tax credits that are inversely related to their carbon footprint can provide incentives to produce low carbon cellulosic feedstocks. Policy incentives could also be created to encourage feedstocks that increase biodiversity and enhance ecosystem services.

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This study was funded by the USDA, the USDOE and the Energy Biosciences Institute, University of Illinois. The author thanks Basanta Dhungana, Xiaoguang Chen and Haixiao Huang for assistance with the data underlying this research.

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Consequences of EU Biofuel Policies on Agricultural Production and Land Use

Martin Banse, Hans van Meijl, and Geert Woltjer

JEL Classifications: D58, Q13, Q24, Q27,Q28

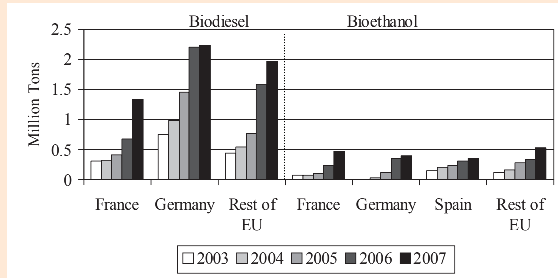
World–wide expansion in the production of biofuels is currently one of the hot topics on the agenda of agricultural and food research. On the one hand the development is welcomed as an additional source of income for farmers on otherwise saturated markets for agri–food products. One the other hand, however, there are growing concerns that with biofuels the level and volatility of agricultural world prices which are now linked to the development of the crude oil price will increase further. A few papers study the causes of the current increase in prices and contribution of biofuels (see, e.g. Von Braun, 2008; Banse, Nowicki, 2008; OECD–FAO, 2008; Trostle, 2008).

For the European Union (EU) the driver in biofuel production is mainly political, including tax exemptions, investment subsidies and obligatory blending of biofuels with fuels derived from mineral oil. Increasing biofuel production either due to 'pure' market forces and/or 'policy' has significant impacts on agricultural markets, including the trade in agricultural raw materials. Linkages between food and energy production include the competition for land, but also for other production inputs. For instance, the effect of an increasing supply of by–products of biofuel production such as oil cake and gluten feed also affects animal production.

EU Biofuel Markets and Policies

European biofuel production is based more on biodiesel production compared to ethanol production. At the current level biodiesel accounts for more than 6.0 million t while ethanol production in Europe is about 3.0 million t. Almost half of the EU biodiesel is produced in Germany where it was stimulated by tax exemptions, Figure 1. In the European Union in 2004, about 0.4% of the EU cereal and 0.8% of the EU sugar beet production was used for bioethanol, and more than 20% of oilseed production was

Figure 1. Biodiesel and bioethanol production in selected regions of the EU, in million tons, 2003 to 2007



Source: Data derived from F.O. Licht (2007).

processed into biodiesel. The annual growth rate between 2005 and 2007 was 53% and 44% for bioethanol and biodiesel, respectively, see F.O. Licht (2007).

Biofuels are just one element in the complex EU strategy to meet the future energy demand. The EU Biofuels Directive presented by the EU Commission in 2003, set out indicative targets for Member States. To help meet the 2010 target—a 5.75% market share for biofuels in the overall transport fuel supply—the EU Commission has adopted an EU Strategy for Biofuels. The 'European Union Biofuel Strategy' (European Commission, 2003) and the 'Renewable Energy Road Map' (European Commission, 2008) propose an overall binding target of 20% renewable energy by 2020 and a 10% biofuels target by 2020.

These goals are not yet mandatory, but this might be changed and a discussion about higher shares in the future is ongoing. These measures were accompanied by measures giving additional leeway to member states for tax exemptions in favor of biofuel. Germany, for example, subsequently made use of the full tax exemption which has been a key determinant for the remarkable growth of its biofuel use. The German tax exemption stopped at the beginning of 2007. We did not take this elimination of the tax exemption into account in our baseline. However, the impact of that elimination was a clear decline in the use of biofuels in Germany. This example underpins the importance of policy measures to enhance biofuel consumption in the EU. Most of the EU member states are far from reaching the target of 5.75% in 2010 with a current average use of biofuels in transport of around 1.5%.

However, in many EU member states the biofuel shares for transportation purposes increased during recent years. This development can be explained by the above mentioned introduction of tax exemptions for renewable energies but also by an increase in oil prices which changes the relative prices in favor of biofuels. This endogenous growth can be expected to continue under a continuously increasing price for fossil fuels. However, the question to be considered is whether the objective can be reached in 2010.

Table 1. Progress in the Use of Biofuels in the EU Member States, 2003–2005

	2003	2004	2005
	Member State Biofuel share		National Indicative Target
Austria	0.06	0.06	2.50
Belgium	0.00	0.00	2.00
Cyprus	0.00	0.00	1.00
Czech Republic	1.09	1.00	3.70[1]
Denmark	0.00	0.00	0.10
Estonia	0.00	0.00	2.00
Finland	0.11	0.11	0.10
France	0.67	0.67	2.00
Germany	1.21	1.72	2.00
Greece	0.00	0.00	0.70
Hungary	0.00	0.00	0.60
Ireland	0.00	0.00	0.06
Italy	0.50	0.50	1.00
Latvia	0.22	0.07	2.00
Lithuania	0.00	0.02	2.00
Luxembourg	0.00	0.02	0.00
Malta	0.02	0.10	0.30
The Netherlands	0.03	0.01	2.00[2]
Poland	0.49	0.30	0.50
Portugal	0.00	0.00	2.00
Slovakia	0.14	0.15	2.00
Slovenia	0.00	0.06	0.65
Spain	0.35	0.38	2.00
Sweden	1.32	2.28	3.00
UK	0.03	0.04	0.19
EU25	0.50	0.70	1.40

[1] 2006; [2] Estimate.

Source: European Commission (2007). Biofuels Progress Report

Consequences of EU Biofuels Policies

To analyze the impact of enhanced use of biofuels as the consequence of the EU Biofuels Directive requires an analytical tool which considers not only the agricultural but also the energy markets. Within the last two years many existing models focusing on agriculture and food processing have been extended to represent the production and consumption of biofuels. All results show that a shift in demand for agricultural products as a consequence of increasing biofuel demand leads to substantially increased agricultural market prices and increased land use. However, whether this increase in production takes place within or outside the EU depends on the underlying assumptions on the degree of openness of the EU. Therefore, two different baseline scenarios have been calculated up to 2020 which describe different visions of the future. This analysis is part of the EUruralis project (Wageningen UR and Netherlands Environmental Assessment Agency, 2007). A detailed description about the background, definition and set-up of the Eururalis scenarios can be found in (Westhoek, van den Berg et al. 2006) and the quantification of the scenarios are described in (Eickhout and Prins 2008). The scenarios have been calculated with the LEITAP model which is an extended GTAP model. The 'Global Economy' scenario depicts a world with fewer borders and regulation compared with today. Trade barriers are removed and there is an open flow of capital, people and goods, leading to a rapid economic growth, from which many (but not all) individuals and countries benefit.

The other vision, called 'Regional Communities' depicts a world of regions with people having a strong focus on their local and regional community and prefer locally produced food. Economic growth is lower compared to the 'Global Economy' scenario. Furthermore under the 'Regional Communities' scenario it is assumed that agricultural subsidy increases of some 10%, linked to environmental and social targets and export subsidies, are eliminated. Import barriers remain in place to protect local markets against cheap imports while imported goods have to comply with high EU standards regarding health, environment, and animal welfare.

For both scenarios two simulations with and without mandatory blending for biofuel use have been calculated. Even without mandatory blending, the use of biofuel crops changes due to shifts in relative prices (biofuel crops vs. fossil fuel).

Ambitious goals have been set by the EU Biofuel Directive (BFD) for the transport sector: the minimum share of biomass or other renewable transport fuels must be 2% in 2005 and 5.75% in 2010. For 2020 the EU target has been put at 10% under the condition that the so–called second generation biofuel technology will be available then. Currently bio–energy is coming from both waste material and growing first generation biofuel crops. To meet the ambitious future targets large scale production of crops used specifically for biofuel production in Europe will be necessary. In the 'Global Economy with BFD' scenario the demand for such biofuel crops used in the petrol sector will be $7.3 billion U.S. dollars (USD) (in 2001 values). Around 42% of these inputs will be produced domestically and 58% of biofuel crops used in the petrol sector will come from imports.

If mandatory blending is not enforced, the use of biofuel crops is much lower in all scenarios; only $2.5 billion USD under the 'Global Economy' scenario and only $1.7 billion USD under the 'Regional Communities' scenario. The lower demand under 'Regional Communities' is due to a smaller increase in income compared to the 'Global Economy' scenario. The degree of openness under both scenarios is also reflected in this figure. Under the 'Global Economy' scenario without mandatory blending, the share in imported biofuel crops used for biofuel production is 53.5% while under the higher protection under the 'Regional community' scenario imported biofuel crops contribute only by 28.5% to total biofuel production.

With these strong changes in import demand world prices for biofuel crops are affected by EU policies. The impact of the EU biofuel policies on world prices is illustrated in the following figure. With an enhanced biofuel consumption as a consequence of the EU biofuel directive prices of agricultural products tends to increase. Banse, van Meijl and Woltjer (2008) show that under a scenario 'Biofuel, global' which includes biofuel policies in the United States, Canada, South Africa, Japan, Korea and Brazil the real price of oilseeds shows an increase of 26% in contrast to the long–term trend projected in the reference scenario, see Figure 3. The mandatory targets in the scenario 'Biofuel, global' are set in the EU and in other countries. Based on IEA (2008), we assume a 10% blending target for the United States, Canada, Japan and South Africa. In IEA (2008), a 25% blending target for Brazil is also indicated. Compared to the United States and Brazil, where ethanol consumption dominates the biofuel sector, EU biofuel is based on bio–diesel, which is reflected by the increase in prices of the bio–based inputs in the production of biofuels. The increase in world prices for cereals is more than

Figure 2. Biofuel crops used in the EU (in mill. USD, 2001), 2020

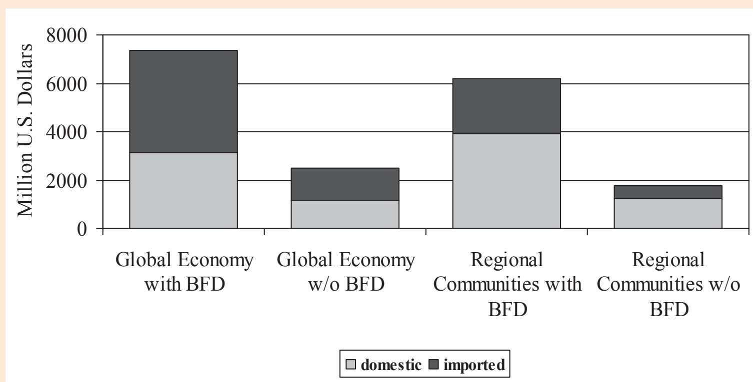
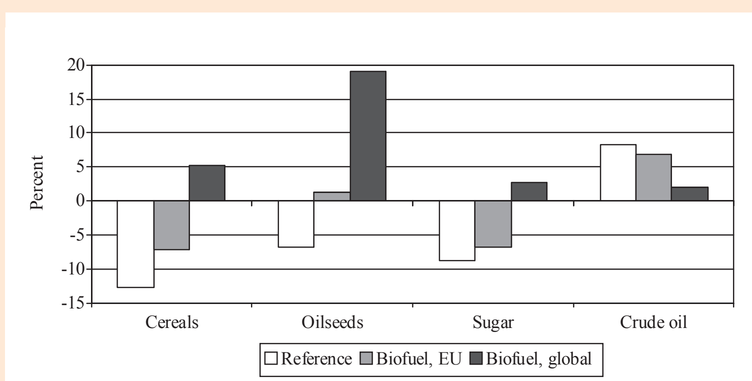


Figure 3. Changes in real world prices, in %, 2020 relative to 2001



18% under the 'Biofuel, global' scenario. The increase in crude oil price is smaller under the 'Biofuel, global' scenario as demand for crude oil diminishes due to the introduction of the BFD.

Without mandatory blending, real world prices for agricultural products decline and confirm their long–term trend, see Figure 3. This is caused by an inelastic demand for food in combination with a high level of productivity growth. Under an EU mandatory blending target the oilseed sector has the highest price difference, because biofuels in EU transport are dominated by biodiesel from oilseeds.

Even without enforced use of biofuel crops through mandatory blending, the share of biofuels in fuel consumption for transportation purposes increase, see Figure 4. This endogenous increase in biofuel production is due to the fact that the ratio between crude oil price and prices for biofuel crops changes in favor of biofuel crops (see Figure 3). The highest increase is in the already integrated market of Brazil where the initial 2005 share of more than 29% expands to more than 42% in 2010. In Germany and France the endogenous growth of biofuel share leads to biofuel consumption for transportation in 2010 of 4.0% in Germany and 3.4% in France. These results reveal that without mandatory blending the 5.75% biofuel share will not be reached in the EU member states.

With mandatory blending the EU member states fulfill the required targets of 5.75% at the expense of non–European countries, Figure 4. Under the BFD scenario the share of biofuel use declines in Brazil by around 6%. Under the 'EU Biofuels Directive' scenario the biofuel share in petrol used for transportation decreases by more than 20% in the North American Free Trade Agreement (NAFTA) countries. This decline in biofuel production in non–European countries is due to the increase in relative prices between biofuel crops and crude oil.

The enhanced demand for biofuel crops in the EU under the BFD scenarios leads to an increase in world prices for these products and hence to a decline in the profitability in fuel production compared to crude oil. However, the increase in biofuel crop demand in the EU over–compensates the decline in non–EU countries and at a global level the use of biofuel crops for fuel production increases under the BFD scenario. A good indicator for this development is the decline in crude oil price under the BFD scenario compared with reference scenario, see Figure 3.

Figure 5 shows that the EU will increase its trade deficit in agricultural commodities used for the production of biofuels under the biofuel scenarios. South and Central America as well as other high income countries expand their net–exports in agricultural products for biofuel production.

Compared to world income growth, the annual growth rates of agricultural production are quite moderate in the reference scenario. In the EU and in the region of high income countries, production of biofuel crops is also negatively affected by the liberalization which is also implemented in both scenarios. At the aggregated level, total agricultural production increases in both the reference and policy scenario. In all regions, mandatory blending also leads to an increase in total agricultural output. EU biofuel policies have a strong impact on agricultural production inside the EU but also on agricultural output in

Figure 4. Development of share of biofuels in fuel consumption for transportation for selected regions, in %, 2005 and 2010

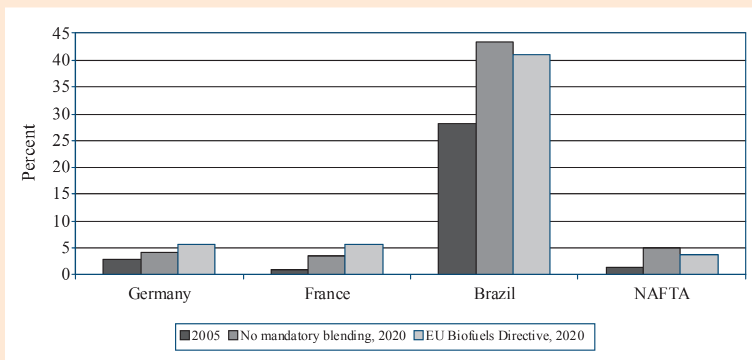
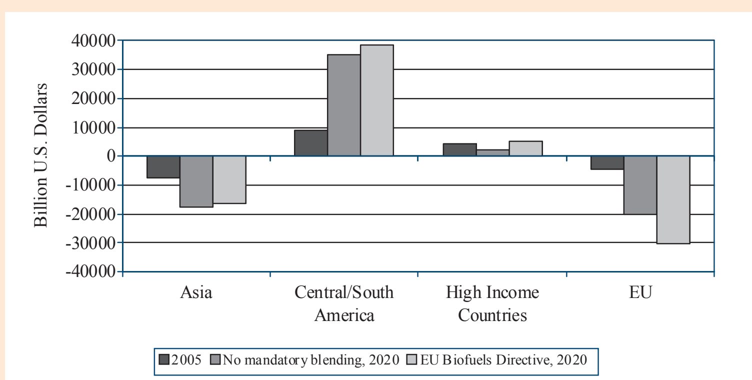


Figure 5. Balance in biofuel crop trade, in bill. US$, base situation and 2020 under different scenarios



South and Central America. Without mandatory blending, EU oilseed production increases by 7.6% compared to 26% under a mandatory blending scenario.

These production developments lead to a similar pattern of land use developments (Figure 6). Land use increases in all regions when comparing the impact of the EU Biofuels Directive and biofuel policies outside Europe. This expansion of agricultural land use on a global scale and especially in Southern America might lead to a decline in biodiversity in these countries as land use is an important driver for biodiversity.

The mandatory blending requirement for the petrol sector implies an increase in petrol price because biofuels are more expensive than crude oil. To meet the 5.75% obligations in 2010, the petrol price will rise by 2%, and a 6% petrol price increase accompanies the 10% BFD target in 2020. The subsidies on biofuel crops in the petroleum sector, which are required to meet the targets by making feedstock competitive with crude oil, are high and range from 30% in Sweden to almost 60% in the UK in 2020. These additional subsidies indicate the difficulties that most EU member states will have in trying to meet the BFD targets.

Concluding Comments

The analysis shows that enhanced demand for biofuel crops has a strong impact on agriculture at the global and European level. Biofuel policies contribute to the current rise in world food prices, especially for those products which are in direct competition in final consumption for food and fuel, e.g. corn, sugar and oilseeds. With increased biofuel consumption, the long term trend of declining real world prices of agricultural products slows down or might even be reversed for the feedstocks used for biofuels. This positive effect on world agricultural prices has consequences especially for poor urban populations in low–income countries with food and energy deficits. Those consumers will suffer most in any sudden or rapid price shift for basic commodities, of which foremost is food.

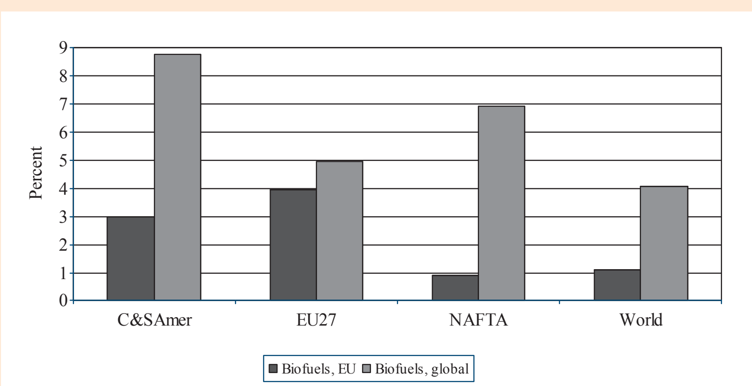
In principle, higher agricultural prices provide additional income opportunities for farmers. As shown in this article, the incentive to increase production in the EU will tend to increase land prices and farm income in the EU and other regions. The EU will not be able to produce the feed stocks needed to produce the biofuels according to the BFD domestically and will run into a higher agricultural trade deficit. Biofuel crop production expands in other highly industrialized countries and especially in South and Central America (Brazil). Whether farmers in developing countries will benefit from higher prices of crops used for biofuel production remains questionable and depends on the degree of integration of regions in global food markets.

Apart from income effects, the environmental effects of higher biofuel production are also not clear, (see, e.g. Searchinger et al. 2008). These biofuel crops need scarce resources such as land, water and agricultural inputs like fertilizers. This will impact the environment—CO_2 balance, soil erosion, and biodiversity. The GHG balance of biofuels varies dramatically depending on such factors as feedstock choice (lowest for corn and wheat and highest for switchgrass and poplar), associated land use changes, feedstock production system, and the type of processing energy used.

The results presented here depend heavily on the level of crude oil price. The higher the crude oil price the more competitive biofuel crops become versus petroleum production. Therefore, biofuels create a more direct link between food and fuel prices. High feedstock prices make biofuels less profitable, as does a low oil price. Even at the current level of crude oil prices of $120 USD per barrel, almost no biofuels are economically viable without support policies. A low oil price implies that biofuels will be produced only under mandates or that they are heavily subsidized.

Without mandatory blending to stimulate the use of biofuel crops in the petroleum sector the targets of the EU Biofuel directive will not the reached. Mandatory blending leads to higher petrol prices as feedstocks are not profitable to use in fuel production given the current technologies. The increased demand for feedstock raises their price relative to the oil price and adds to the challenge of making biofuels competitive. Therefore, if biofuels have to be competitive in the long run, investments in

Figure 6. Changes in agricultural land use, in %, 2020 relative to 'No mandatory blending'



R&D are needed to obtain higher yields or better conversion technologies. Decisions on R&D investments should take into account the second generation biofuels as these promise to be more cost–effective and more effective in reducing greenhouse gas emissions. However, the current high food prices in combination with the disputed environmental benefits fuel the debate inside the EU whether the Biofuels Directive is desired at all or whether the target of the Biofuels Directive should be made dependent on the degree of technical progress (first and second generation), environmental benefits and impact on world prices.

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The authors gratefully acknowledge support from the Netherlands Ministry of Agriculture, Nature and Food Quality. This work builds upon the methodology developed in the EUruralis project.

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Commodity Programs and Beyond in the 2008 Farm Bill

James L. Novak

Not since 1985 have the words agriculture, farm or some recognition of production agriculture been omitted from the title of a farm bill. Some see this as a sign of the decline in Congressional support for agricultural programs. In the Food, Conservation and Energy Act of 2008 (FCEA), commodity funding was cut by an estimated $12 billion from the 2002 Farm Bill. Despite cuts in programs affecting production agriculture, the FCEA still contains authorization for substantial spending on commodities, conservation, and specialty crops, and contains sufficient implications for trade agreements, to be properly called a farm bill.

The articles in this theme discuss major new and renewed provisions of the 2008 FCEA affecting traditional and specialty agricultural production and trade. ACRE a new commodity program based on state and farm revenue shortfalls, and increased spending on conservation programs are discussed in two separate articles. Provisions for specialty crops, which for the first time gained their own farm bill title, are also highlighted. A final article discusses commodity program implications for U.S. trade and trade agreements.

A state revenue based commodity program included in the farm bill provides a new and untested program for producer consideration. In this issue Carl Zulauf, Michael Dicks and Jeffrey Vitale describe "ACRE" and what it means in comparison to more traditional farm support programs.

James Pease, David Sweickhardt and Andrew Seidl follow up with a discussion of major conservation program provisions of the farm bill and implications for future funding for "working lands" programs. The relative increase in the importance of conservation over 2002 is highlighted.

Articles in this Theme:

For the first time, specialty crops have their own farm bill Title X ("Horticulture and Organic Agriculture.") Mechel Paggi and Jay Noel explore key provisions of this title and the potential benefit to U.S. specialty crop agriculture.

In the final article, Eric Wailes and Parr Rosson look at the implications of the farm bill for international trade agreements. Issues such as how domestic agricultural supports in the legislation affect U.S. trade commitments and how they are likely to affect future trade negotiations are explored.

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ACRE (Average Crop Revenue Election) Farm Program: Provisions, Policy Background, and Farm Decision Analysis

Carl R. Zulauf, Michael R. Dicks, and Jeffrey D. Vitale

JEL Classification: H100

Farm support programs based on price have been an integral part of farm policy since the 1930s. However, two concerns have emerged with existing price–based programs. One is that the current marketing loan and counter–cyclical programs provide little protection when yields are low. Widespread reduction in yields raises prices and reduces or eliminates payments from these two programs while localized reduction in yields reduce marketing loan payments for affected individual farms because marketing loan payments are based on production. The second concern is that farmers can receive marketing loan and counter–cyclical payments even when revenue is above average because high yields more than offset low prices.

After decades of debate, a revenue assurance program finally became a reality in the new *Food, Conservation and Energy Act of 2008*. Specifically, farmers are offered the choice of the following program options:

Traditional Suite of Farm Programs
Direct Payments
Marketing Loans
Counter–Cyclical Payments

ACRE Suite of Farm Programs
Direct Payments at 80% of full rate
Marketing Loans at 70% of loan rate
ACRE State Revenue Program

Many concepts included in the ACRE state revenue program were first contained in the Integrated Farm Revenue Proposal by Carl Zulauf. American Farmland Trust was the first organization to endorse these concepts, followed by the National Corn Growers Association. Senators Richard Durbin of Illinois and Sherrod Brown of Ohio provided initial congressional support and co–authored the first bill (S.1872) containing a program that became ACRE.

This article describes the legislative provisions and policy background of the new ACRE state revenue program, as well as some analytical results that provide insights into the farmer decision regarding which suite of programs to choose.

Comparison: Current Programs vs. ACRE State Revenue Program

The direct payment program pays farmers a fixed dollar amount per historical base acre. This dollar amount does not change with market prices or with production on the farm. Like direct payments, counter–cyclical payments are based on historical production. In contrast, marketing loan payments are based on current production. Both the counter–cyclical and marketing loan programs are price–based programs. Congress specifies the marketing loan rates and counter–cyclical target prices in the Farm Bill. These fixed support rates essentially establish a floor or lower bound on the per unit value of the crop, as payments are triggered when market price drops below them. The creation of a floor reflects the policy objective of traditional price support programs, which is to assist farmers with managing the systemic risk of chronically low market prices that extend over a long period of years. A systemic risk is a risk beyond the control of an individual producer. The combination of direct payment, counter–cyclical, and marketing loan programs will be referred to in this article by the acronym DCP+ML.

In contrast, ACRE's policy objective is to assist farmers with managing the systemic risk of a decline in revenue of a crop over a short period of years. Revenue is defined as

U.S. price times state yield. ACRE's policy objective is implemented by establishing the following revenue guarantee for each state and crop combination (crops are barley, corn, upland cotton, oats, peanuts, pulse crops, rice, sorghum, soybeans and other oilseeds, and wheat):

(90%) x (2–year moving average of U.S. crop year cash price) x (5–year Olympic moving average [excludes high and low values] of state yield per planted acre)

A state revenue payment is triggered for a given crop and year when actual state revenue (state yield per planted acre times U.S. crop year price) is less than the state's ACRE revenue guarantee. This difference is the state's ACRE payment rate. For any crop in any year, the payment rate cannot exceed 25% of the crop's state revenue guarantee. ACRE's state revenue guarantee cannot increase or decrease more than 10% from the prior year's guarantee. Over time, the guarantee will follow prices and yields up and down. Thus, ACRE's revenue guarantee is not a floor, implying that ACRE will not provide protection against chronically low prices.

Receipt of an ACRE payment also requires that a farm's revenue for the crop and year be less than its benchmark revenue for the crop. The latter equals (1) the product of the farm's 5–year Olympic average yield per planted acre times the 2–year U.S. average price, plus (2) the farm's insurance premium if the farmer bought insurance for the crop.

The ACRE revenue protection payment is made on acres planted to eligible crops, but total planted acres covered by ACRE are capped at the farm's total base acres. Total payment a farm receives from ACRE is the sum of (1) 80% of the farm's current direct payment, (2) ACRE revenue protection payments, and (3) marketing loan payments at a 30% lower loan rate.

This discussion focuses on ACRE's basic features. Additional details on ACRE are contained in the appendix.

ACRE's Policy Innovations Relative to Current Programs

The ACRE state revenue program has several important departures from DCP+ML:

- **ACRE's target is revenue not price**. Revenue is more closely related to financial position and risk than price because revenue includes both price and yield.
- **ACRE's revenue target is not fixed**; it changes with U.S. prices and state yields.
- **A farm level revenue loss condition must be met for a farm to receive an ACRE payment.** This requirement is an attempt to address the concern that a farm can receive marketing loan and counter–cyclical payments even when it has above–average revenue.
- **ACRE is partially coordinated with crop insurance.** Historically, farm support and crop insurance programs have been enacted independently, creating the potential for overlapping payments and for farm programs to reduce the incentive to buy crop insurance. ACRE's farm revenue benchmark includes crop insurance premiums, thus providing an incentive to buy crop insurance.

In addition, capping the state revenue payment at 25% of the state revenue guarantee is an attempt to minimize double payments from crop insurance and ACRE because farmers commonly buy crop insurance with a 75% or lower coverage level.

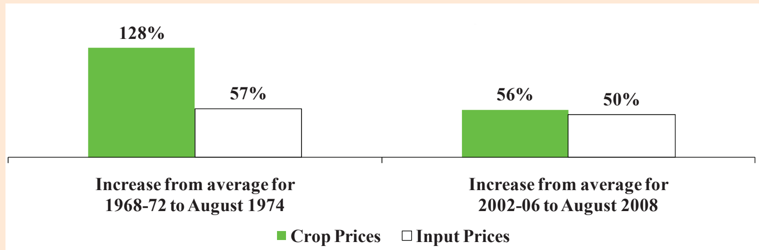
Policy Foundation For ACRE

A rarely–discussed hole exists in the traditional farm safety net. The combination of higher prices, higher production costs, and fixed support prices provide the foundation for farm financial stress.

History and economic theory tell us that high farm prices will decline as supply responds to incentives and expands faster than demand. But, history and economic theory do not tell us if the decline will occur in one, two, five, etc. years. Moreover, high farm prices, especially when based on strong growth in demand, increase the demand, and in turn price, for farm inputs. Because costs are increasing and support prices are fixed at levels substantially below market prices, a large price decline that lasts a year or two can lead to financial stress in the agricultural sector.

This stylized story played out when the farm boom of the 1970s became the farm crisis of the 1980s. Today, most people are aware that many crop prices have increased substantively since 2006. Fewer people are aware that the cost of farm pro-

Figure 1. Prices for U.S. Crops and Crop Production Imputs are Increasing... Just as in the 1970's



Notes: (1) Crop prices include all crops. (2) Crop production inputs include interest, taxes, and wages. (3) Source: U.S. Department of Agriculture, National Agricultural Statistics Service duction inputs is rising rapidly as well (see Figure 1). In fact, relative to crop prices, input prices are increasing faster today than in the 1970s. Moreover, most crop prices are well above the price support rates enacted in the 2008 Farm Bill. The similarities with the 1970s do not mean that a farm financial crisis will emerge as in the 1980s, but it does suggest that policy should not ignore this possibility.

In the 1980s crisis, we learned that providing immediate assistance is critical to minimizing financial stress. Providing immediate assistance requires an appropriate policy mechanism for identifying when revenue is low. Given its objective of addressing systemic revenue risk, ACRE's mechanism is to calculate a revenue guarantee using moving averages of recent U.S. prices and state yields. ACRE focuses on revenue because revenue incorporates changes in costs of production, productivity, supply response, and price response over time, unlike a price–based safety net fixed at politically–determined levels. For example, if costs increase faster than production efficiency, supply will decline. Given that demand for crops responds relatively slowly to changes in price in the short–term, price and revenue should increase, resulting in an increase in ACRE's revenue guarantee. On the other hand, if production efficiency increases faster than costs, ACRE's revenue guarantee should decline as the resulting increase in production leads to lower prices and revenue.

In conclusion, economic theory suggests that ACRE's support level is implicitly tied to the cost of production adjusted for gains in productivity. By following prices and yields, ACRE provides protection in situations when costs increase faster than production efficiency (such as is happening now). In contrast, ACRE's support level will decline when productivity increases faster than costs. However, due to the use of historical moving averages and a 10% limit on year–to–year changes in its revenue guarantee, ACRE should provide farmers a somewhat longer period of time in which to adjust to declining revenue.

Analysis of ACRE from the Farmer Decision Perspective

For farmers making a decision on participation in ACRE, a key question will be: "Does the ACRE suite of farm programs provide revenue to fill the gap in years when actual farm revenue is significantly below average farm revenue?"

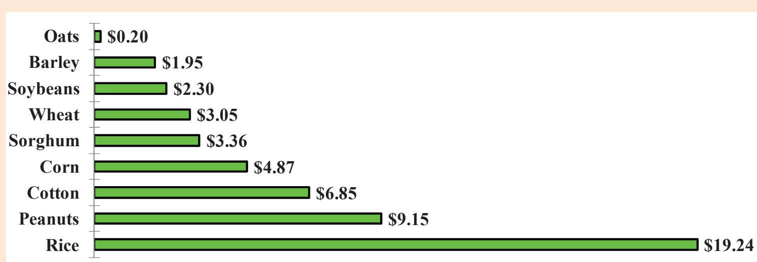
One key factor in answering this question is the 20% reduction in direct payments under ACRE. This reduction can be thought of as ACRE's risk management fee. Using the average U.S. direct payment yield for program crops, the 20% reduction ranges from \$0.20 per acre for oats to \$19.24 per acre for rice (see Figure 2).

A second key factor is the timing and size of payments from ACRE. The results presented below are from an analysis of average annual payouts of the ACRE and DCP+ML programs over a 30 year historical period for corn, sorghum, soybeans and wheat in the principle and marginal production areas. The analysis uses (1) historic variability in county level yields adjusted to current levels of yield as a proxy for future yield variability and (2) the historic relationship between state yield and national price to predict the variability of future price at the U.S. Department of Agriculture average annual forecasted price for 2009–12. In essence, the results are for the representative average acres in the county.

ACRE has both a farm level and a state level revenue loss trigger. Actual farm income must be less than 100% of the farm's benchmark revenue in order for the farm to receive an ACRE payment (see the appendix for specifics). The state trigger occurred in 5 to 15 years depending on the state and the crop, or on average in about one–third of the 30 historical observations. The county farm trigger occurred in roughly twice as many years as the state trigger. These findings are not surprising since (1) the state trigger is set at a more restrictive 90% level compared to the 100% level for the farm trigger and (2) yield is more variable at the county than at the state level. Last, in only about 10% to 20% of the observations in which the state trigger occurred did the representative county farm not trigger.

The higher the average annual price the more likely that the ACRE suite of farm programs will pay out a higher average payment than the DCP+ML suite of programs. As average annual market price increases, DCP+ML payments decline since counter–cyclical payments are tied to fixed target prices and marketing loan payments are tied to fixed loan rates. In contrast, expected revenue payments and thus total payments (80%

Figure 2. 20% of Average U.S. Direct Payment Per Acre



ACRE has both a farm level and a state level revenue loss trigger. Actual farm income of direct payments plus revenue payments) from ACRE increase as price increases. The reason is the associated increase in the state revenue guarantee and farm revenue benchmark. However, it is important to note that actual payments from ACRE may not equal expected payments. Actual payments depend on revenue declining for a state by at least 10%. Thus, if prices and revenue increase continuously in the future, ACRE revenue payments will be zero.

Figure 3 illustrates the importance of a producer's expectations of future prices. It contains the expected level of ACRE and DCP+ML payments at various average prices for 2009–12 using data for Champaign County, Ill. Payments are the same for ACRE and DCP+ML at average prices between $2.30 and $2.35. The higher are a producer's expectations of prices in the near future, the more likely is the ACRE program to generate larger income streams than the existing DCP+ML program.

Examination of the analytical results also indicate that expected payments from ACRE are larger (1) the lower is the correlation between changes in state yield and U.S. price and (2) the higher is predicted average annual (2009–12) state yield relative to the direct payment and counter–cyclical program yield. The lower is the yield–price correlation, the more likely that a decline in yield or price will trigger a revenue payment. The yield component of ACRE's revenue guarantee is continually updated since it is based on a moving average. In contrast, the payment yield for counter–cyclical and direct payments is fixed at a historical yield level. Thus, the higher are current yields relative to historical base yields, the greater is the expected payment advantage of ACRE.

Adding the crop insurance premium to a farm's revenue benchmark increases the revenue benchmark, and thus increases the chance of receiving

Figure 3. Effect of Corn Price on ACRE and DCP+ML Payments: Champaign County, Ill.

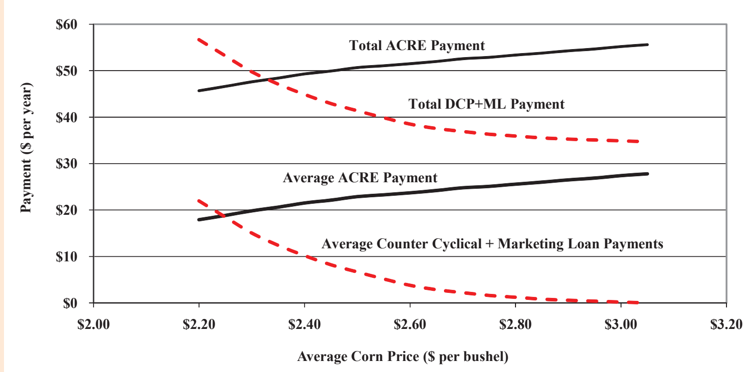


Figure 4. Comparison of ACRE and DCP+ML for Corn: De Kalb County, Ill.

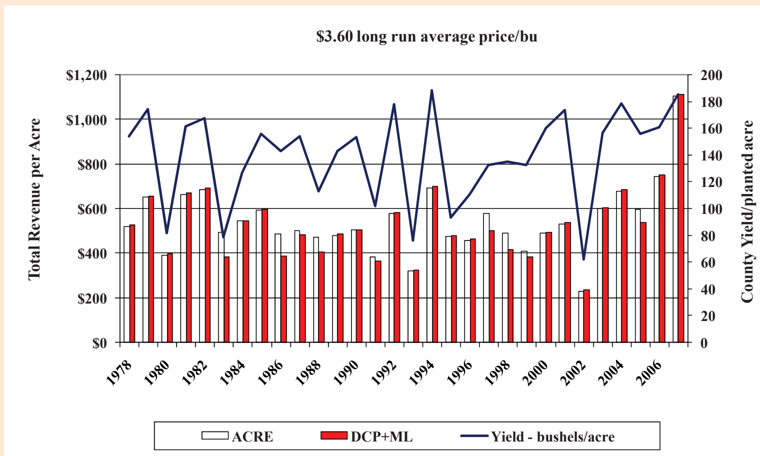
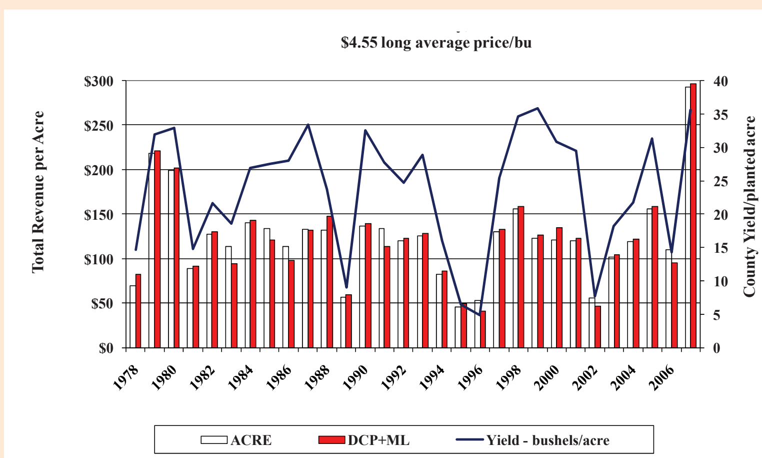


Figure 5. Comparison of ACRE and DCP+ML for Wheat: Texas County, Okla.



a payment from ACRE. The impact of adding the insurance premium is usually minimal, although the size of this impact increases as the insurance premium increases relative to the crop's revenue per acre.

Neither ACRE nor DCP+ML are substitutes for crop insurance. For the representative county farms, the lowest revenue years occurred when their yield was low and price had not increased sufficiently to offset the low yield. This situation most often occurred when yield–reducing weather events were on a geographical scale smaller than a state. Such declines in production generally are not large enough to cause price to increase. Figures 4 and 5 illustrate this discussion for corn in De Kalb County, Ill., and wheat in Texas County, Okla., respectively. The graphs are generated assuming U.S. Department of Agriculture average predicted prices for the 2009–12 crop years: $3.60 for corn and $4.55 for wheat. County average yields also are included in the figures. Significant yield shortfalls occur in six years in De Kalb County and 7 years in Texas County. The ACRE suite of programs provides higher revenue than the DCP+ML program in only two of the six years in De Kalb County and three of the seven years in Texas County. However, neither program provides much revenue protection in most of these years because the declines in yield occurred over a small area relative to the U.S. market. These findings clearly indicate a continued need for crop insurance.

Summary

Both ACRE and traditional price support programs address a systemic risk that occurs beyond the individual farm. However, ACRE addresses a risk associated with a market at or near equilibrium while traditional price programs address a risk associated with a market out of equilibrium. Compared with the current marketing loan and counter–cyclical price programs, ACRE has several policy innovations: (1) ACRE's target is revenue not price, (2) ACRE's revenue guarantee is not fixed, (3) a farm level revenue loss must occur to receive an ACRE payment, and (4) ACRE is partially coordinated with crop insurance.

For most farmers, a central question will frame their decision regarding ACRE: "Over the period of participation, does ACRE improve the management of systemic revenue risk relative to current programs enough to compensate for the 20% reduction in direct payments and 30% reduction in loan rates?" Our analysis finds that at prices and yields forecast by the U.S. Department of Agriculture through the 2012 crop year, ACRE generally provides larger expected average annual total revenue and smaller variation in total revenue. The differences can be small, depending on what other assumptions are made. However, exceptions occur. For example, if prices and revenue continue to increase, the current programs will provide higher payments than ACRE because of ACRE's 20% reduction in direct payments.

As with any analysis, assumptions are important. These assumptions involve not only prices and yields, but also how the regulations will interpret the Farm Bill's ACRE provisions. The importance of regulations is illustrated by the current debate over whether the phrase, "the most recent crop year prices," means the "most recent crop years for which complete information exists" or "includes the current crop year." For the 2009 crop, this debate translates into whether ACRE's revenue guarantee is based on U.S. average cash prices for crop years 2007 and 2008 or for crop years 2006 and 2007. To put the significance of this debate in numerical context, average U.S. cash corn price is $3.65 for 2006–07 vs. $4.83 for 2007–08, using the latest data from the U.S. Department of Agriculture. Clearly, using 2007–08 instead of 2006–07 prices makes ACRE more attractive to farmers.

This analysis and economic theory suggest ACRE is most likely to benefit the following:

(1) states with higher yield variability, which includes southeast and mid–Atlantic states; (2) crops with prices well above the loan rates—cotton prices are closest to the loan rate; (3) states with lower negative correlations between changes in state yield and U.S. price; (4) states and crops, notably corn, with larger increases in yields over last 25 years; and (5) producers whose planted and base acres differ substantively—ACRE better matches a farmer's production risk in this situation.

Decision aids to assess participation in ACRE are being developed and various analyses of ACRE have been completed or are underway. These will provide useful information to producers and share–renting landlords as they assess their decision. They also will need to consider the role of crop insurance as they put together their risk management plan. As this analysis clearly shows, neither ACRE nor the current set of programs will cover all low revenue situations on a farm, in particular those associated with localized weather conditions.

In conclusion, like any policy, ACRE's performance will be assessed in the real world. And, being a new policy, unintended consequences are likely. The combination of individual farmer decisions and policy experience will aid in more clearly defining policy objectives and will provide insights into the level and type of risk protection desired by producers across crops, states and regions. This information will provide vital input in future legislation. In short, ACRE will contribute to the evolutionary discussion that shapes and defines U.S. farm policy.

Appendix

ACRE (Average Crop Revenue Election) Provisions

ACRE is a farm program option for barley, corn, upland cotton, oats, peanuts, pulse crops, rice, sorghum, soybeans and other oilseeds, and wheat for 2009–12 crops. Once made, the election of ACRE is irrevocable through 2012; but, its election can be deferred to the next year. The election of ACRE applies to all the above crops grown on a farm, but payments are made on an individual crop basis. ACRE must be selected (current farm programs are the default selection).

ACRE consists of

- Direct payments equal to 80% of full direct payments
- Marketing loan payments with loan rates set at 70% of the marketing loan rates
- ACRE revenue protection payments

ACRE Revenue Protection Payment to a Farm Equals (yields are per planted acre)

a. [83.3% (85% for 2012 crop) of the farm's acres planted to a crop]

b. times lesser of [ACRE state revenue guarantee minus state actual revenue]
or [25% of ACRE state revenue guarantee]

c. times {[farm's Olympic average yield (removes high and low yield) for 5 most recent crop years] divided by [state's Olympic average yield for 5 most recent crop years]}

- **ACRE state revenue guarantee** for a crop per crop year equals
  [90% times (simple average of U.S. cash price for 2 most recent crop years)
  times (state's Olympic average yield for 5 most recent crop years)]
  - For 2010–12, revenue guarantee cannot change more than 10% from prior guarantee
  - Separate state revenue guarantees created for irrigated and nonirrigated land if a state's planted acres are at least 25% irrigated and at least 25% nonirrigated
- **ACRE actual state revenue** for a crop equals
  state yield times {higher of [U.S. average cash price for crop year] or [70% of crop's marketing loan rate]}

Limitation on Planted Acres that can receive an ACRE Payment

- Planted acres that receive an ACRE payment cannot exceed a farm's total base acres
  - If a farm's total acres planted to ACRE program crops exceed the farm's total base acres, the farmer chooses which planted acres to enroll in ACRE

ACRE's Farm Trigger (yields are per planted acre)**:**

- To receive an ACRE payment, a farm's actual revenue for the crop must be less than the farm's ACRE benchmark revenue for that crop year
  - Farm's actual revenue for a crop equals
    farm's actual yield times U.S market year price for crop for crop year
  - Farm's ACRE benchmark revenue equals
    [(farm's 5 year Olympic average yield) times (price in state's ACRE revenue guarantee)]
    plus (per acre crop insurance premium paid by farmer for the crop for the year)

ACRE Payment Limit for a Person or Legal Entity:

- For direct payments: $40,000 minus amount equal to 20% reduction in direct payments
- For ACRE revenue payments: $65,000 plus 20% reduction in direct payments

For More Information

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The authors thank Allan Lines, Joe Schultz, and three anonymous reviewers for their helpful comments on the presentation and content of the paper.

CHOICES
The magazine of food, farm, and resource issues
A publication of the Agricultural & Applied Economics Association
AAEA Agricultural & Applied Economics Association

Conservation Provisions of the Food, Conservation and Energy Act of 2008: Evolutionary Changes and Challenges

James Pease, David Schweikhardt, and Andrew Seidl

JEL Classifications: H59, Q58

The Food, Conservation and Energy Act of 2008 (FCE) continues the evolution of environmental conservation programs begun in the 1985 Farm Bill. This evolution was reflected in stakeholders' priorities as policy debate began with Farm Bill listening sessions in 2005, continued throughout the legislative debate, and culminated in the final version of the 2008 bill. Producers and citizen organizations identified conservation programs as central to future U.S. farm programs (Lubben, Bills, Johnson and Novak, 2006; Environmental Defense Fund, 2007). The Bush administration reinforced the importance of conservation in the farm bill debate with its proposals of January 2007, which included a $7.8 billion expansion of conservation programs (U.S. Department of Agriculture, 2007). However, the economic context of the debate became less favorable for conservation programs as an unusually long legislative process continued throughout 2007 and into 2008. In particular, low grain stocks, increasing corn demand from the ethanol industry, high commodity prices, and increasing food prices led some to question whether increasing production should have a higher priority than conserving natural resources.

FCE 2008 objectives shift the conservation portfolio focus from land retirement to environmental protection of agricultural lands in production (working lands). The conservation portfolio of Land Retirement, Working Lands, Agricultural Land Preservation, and Technical Assistance has been in place since the 1996 Farm Bill. Land Retirement programs such as the Conservation Reserve program (CRP, begun in 1985) remove land from production on a temporary or permanent basis and compensate agricultural landowners for a portion of the income forgone. Working Lands programs such as the Environmental Quality Incentives Program (EQIP, 1996) and the Conservation Security Program (2002) provide incentives to adopt conservation activities on agricultural lands and nonindustrial private forest lands currently in production. Agricultural Land Preservation programs preserve the agricultural production capacity of farmlands by public sector purchase of temporary or permanent easements of nonagricultural development rights. Technical assistance programs provide the institutional structure for agency personnel or approved third parties to deliver expertise for planning and implementing conservation activities. To better understand the conservation portfolio, it is useful to review the development of major programs.

Evolution of U.S. Conservation Programs

Prior to 1985, U.S. conservation programs focused primarily on soil conservation, with expertise provided by U.S. Department of Agriculture employees through the Conservation Technical Assistance Program. The current era of U.S. conservation programs began with Conservation Compliance Provisions and with creation of the Conservation Reserve Program in the 1985 Food Security Act, which retires agricultural land in exchange for 10 to 15 year annual payments based on estimated agricultural rental value. The primary stated goal of the CRP in its early years was to reduce soil erosion on highly erodible cropland (Sullivan, Hellerstein, Hansen, Johannson, Koenig, et al., 2004). CRP came to be directed at an evolving set of conservation objectives with only a single policy tool, long–term land retirement. This approach failed to address two issues of environmental protection in agriculture. First, CRP failed to address many environmental impacts of agricultural production such as water quantity and quality and wildlife habitat. Second, land retirement provided no means of achieving conservation objectives on land actively engaged in agricultural production. Consequently, these additional environmental policy objectives led policymakers to create new policy tools (Batie and Schweikhardt, 2007).

Because of CRP's narrow focus, the Federal Agriculture Improvement and Reform Act of 1996 established the Environmental Quality Incentives Program, which addresses a wider range of environmental concerns on agricultural lands in production. Environmental quality and agricultural production were considered compatible goals, and EQIP was designed to help producers meet new environmental standards (Zinn and Canada, 2007). The program provided cost–share and (optionally) incentive payments for producers to initiate and maintain conservation activities on working lands, with a specific focus on mitigating water pollution. Initially, 50% of EQIP funds were directed to solving resource problems on livestock operations, but waste management structures were ineligible for funding, and EQIP payment limits were so low that they discouraged participation by most large operations. The 1996 Act also introduced the Wildlife Habitat Incentives Program (WHIP) and the Farmland Protection Program (later changed to the Farm and Ranchlands Preservation Program) to purchase farmland development rights.

The 2002 Farm Bill increased both the funding and scope of issues addressed by conservation programs. CRP contract evaluations began to consider soil erosion, water quality protection, and wildlife habitat. The CRP acreage cap was increased, and other farm land retirement programs such as the CRP Farmed Wetlands pilot program, the Conservation Reserve Enhancement Program, and the Wetlands Reserve Program were continued and expanded. With funding of $4.6 billion in the 2002 Act, EQIP could enhance its response to livestock resource concerns and pursue broader conservation priorities of reducing nonpoint source water pollution, air quality impairments and erosion, as well as wildlife habitat deterioration. Eligibility was broadened, 60% of funding was directed to livestock resource concerns, and a new payment limit of $450,000 was established. The 2002 Act also created the Conservation Security Program, a working lands program designed to reward producers who achieve and maintain above–benchmark standards of conservation management. This "green payments" program offered both cost–share and incentive payments to reach, maintain, or improve land stewardship by participation in one of three contract performance tiers. Funding was restricted after enacting the 2002 Act, so the program was offered only in selected watersheds in FY2004–06.

The evolution of conservation policy and programs has changed expense outlays among Land Retirement, Working Lands, Agricultural Land Preservation, and Conservation Technical Assistance programs (Figure 1). Major conservation program expenditures have increased by 79%, from $2.56 billion in FY1996 to $4.59 billion in FY2007. Land retirement funding represented approximately 70% of total conservation expenses until FY2001, and, while continuing to increase in nominal terms, declined to 52% of total expenditures in FY2007. Working Lands program funding increased from an average of approximately $200 million per year during FY1996–01 to nearly $1.5 billion in FY2007. Funding for farmland preservation programs has become a significant and growing part of conservation spending. However, technical assistance has not kept pace with increased conservation program funding, and has fallen steadily in absolute terms since FY2004. Technical assistance is primarily funded through annual appropriations to the Conservation Technical Assistance program, but also receives payments for technical assistance to the CRP program and other program funding allocations. As such, Figure 1 underestimates to some extent actual expenditures for technical assistance.

Conservation Provisions in the 2008 Farm Bill

FCE increases conservation funding authority by $4 billion over FY2008–12, most of it as mandatory funding with no requirement for annual appropriations. FCE provisions reflect an evolution of the U.S. conservation program portfolio to emphasize conservation on working lands. The following presents selected changes in Title II of the 2008 FCE, along with additional detail on CRP, EQIP, and the Conservation Stewardship Program (CSP).

Land Retirement Programs Continue to Play a Major, but Diminishing Role

- As shown in Figure 1, land retirement program expenses are forecast to total $13.03 billion over FY2008–12 and average 8% higher than FY2007 expenses, but fall throughout the period as a percentage of total conservation program expenses.
- Currently, 766,000 active CRP contracts cover 34.7 million acres. Over FY2008–12, contracts will expire on an average of 3.8 million acres per year, raising questions about the environmental impacts of returning this land to production.
- The enrollment cap for CRP is continued at 39.2 million acres for FY2009, but will be reduced to 32 million acres for FY2010–12, while the Farmable Wetland Program cap is doubled to 1 million acres.
- Current CRP contracts can be amended to allow land uses such as biofuel production, wind turbines and grazing under certain conditions.

- New provisions will permit the transfer of lands under CRP contract to beginning, underserved or other special status farmers, with the existing owner receiving a bonus of up to two years of rental payments.
- The enrollment limit for the Wetlands Reserve Program is increased nearly one–third to 3.041 million acres, and the Wetlands Reserve Enhancement Program is established to address wetlands objectives at the watershed scale.

Working Lands Programs Receive Most Funding Emphasis

- As shown in Figure 1, working lands program funding is forecast to total $11.88 billion over FY2008–12; it averages 61% higher than FY2007 expenses and is 45% of total conservation expenses in FY2012.
- In FY2007, there were 41,700 EQIP contracts in 50 states and territories with over $784 million in contract commitments.
- EQIP funding is forecast to total $7.23 billion over FY2008–12 and is 74% higher in FY2012 than in FY2007.
- EQIP payments are based on incurred costs (up to 75% cost–share) and foregone income (up to 100%) associated with practice adoption/maintenance, except that socially–disadvantaged, limited resource, and beginning producers will receive cost–share payments that are 25% above those of other producers (up to a maximum of 90%).
- EQIP payments may be made for conservation practices related to organic transition or production, for forest management practices on private nonindustrial forest land, or for water conservation or irrigation practices.
- Payments under EQIP contracts may not exceed $300,000 in any 6–year period.
- The Conservation Security Program is reconstituted as the Conservation Stewardship Program (CSP). In FY2007, 19,391 active contracts covered approximately 15.4 million acres.
- The CSP receives total budget authority of $3.79 billion over FY2008–12, and FY2012 forecast expenditures are 199% of FY2007 expenses.
- CSP is given an enrollment target of 12.769 million acres per year, and over FY2009–12, USDA is directed to manage the CSP such that payments average no more than $18 per acre.
- The reconstituted CSP provides a simpler system for adopting, improving, and maintaining conservation practices rather than the 3–tier system used under the 2002 Farm Act.
- Funding authorization for the Wildlife Habitat Incentives Program is continued at $85 million per year, cost–share payments are increased to 25% of costs incurred, and eligible lands include private agricultural, nonindustrial private forest and tribal lands. In FY2007, WHIP had 358,000 acres under contract.

Agricultural Land Preservation Programs Expanded

- As shown in Figure 1, land preservation program forecast expenses total $1.04 billion over FY2008–12, averaging more than triple the actual FY2007 expenses for purchase of development rights. Farm and Ranchlands Preservation Program (FRPP) purchased development rights on 533,000 acres over FY1996–07.
- Funding for the FRPP is increased from $97 million to $200 million per year, and the objectives of the program are expanded to include protecting agricultural use and related conservation values and increasing the opportunities for partnership with government and nongovernment organizations.
- The Grasslands Reserve Program is authorized to expand ten–fold to enroll 1.22 million acres during FY2008–12, the definition of eligible lands is expanded to include those with historical or archeological importance, and up to 10% of enrollment may come from expiring CRP contracts.

Technical Assistance Funding Stable

- There are no new funding authorizations for technical assistance from Natural Resources Conservation Service (NRCS) or through Technical Service Providers, and because technical assistance is subject to annual appropriations, it is not expected to increase over FY2008–12.

Other Provisions

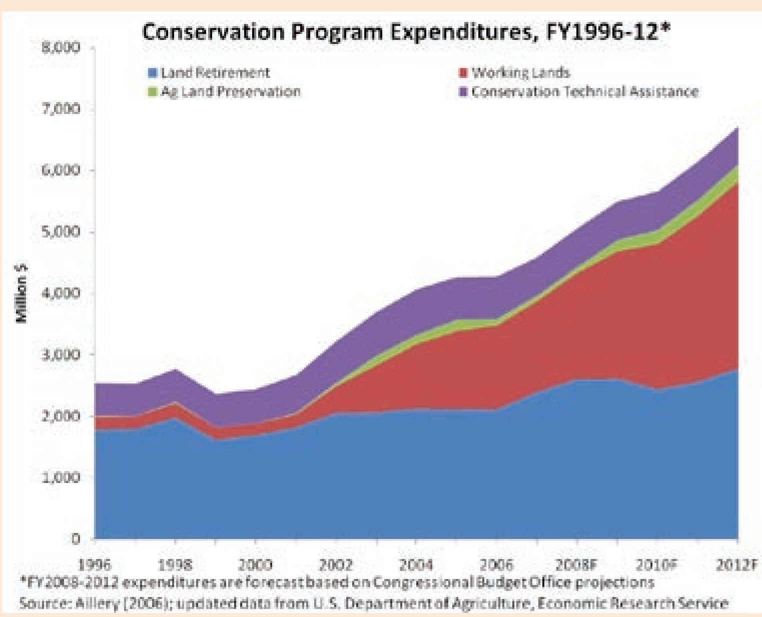
- Most conservation programs have program–specific payment limits, and a blanket income limitation prohibits conservation payments to persons or entities with average adjusted gross income greater than $1 million unless at least two–thirds of adjusted gross income is farm income.
- Direct attribution to a person is required for conservation program payments.
- Cooperative conservation projects at the community, ecosystem or watershed scale will receive 6% of all conservation program funds.
- USDA is to develop technical guidelines for measuring and reporting environmental services provided by farm, ranch, and forest lands, with priority directed to emerging carbon markets.

Opportunities and Challenges for the FCE 2008

On its surface, the Food, Conservation, and Energy Act appears to be a logical extension of past trends—an increase in funding for virtually all programs without dramatic program revisions. However, FCE 2008 and the 2002 Farm Bill can be viewed as "two steps forward, one step back" for conservation. On one hand, program funding and focus have expanded rapidly, while on the other, political distaste continues for targeting conservation programs to the most critical environmental problems such as impaired waters rather than allocating funds "equitably" among states (Claassen, 2007). Increased emphasis on working lands programs promises better environmental results per program dollar, but USDA is prohibited from selecting contract proposals on the basis of lowest cost. Although conservation funding increases in FCE, conservation costs have risen even faster during the commodity boom, both in terms of cash investments and of producer income foregone. Moreover, it seems unlikely that FCE spending will meet the levels outlined in the Act. Federal budget deficits are rising rapidly and U.S. economic conditions are worsening. It is likely that Congress will take action to restrict nondefense spending, and "mandatory" conservation spending is likely to be a target.

Viewed from an alternative perspective, FCE 2008 signals the maturation of the conservation program portfolio in a new era. What issues and questions will be most critical in the next era? First, conservation programs now constitute a central element of farm policy—no future farm bill will be passed without a significant, possibly predominant role for conservation programs. Second, the 2008 bill appears to both broaden and strengthen the political commitment of all stakeholders to conservation programs. The political economy of programs that meet the interests of farmers, environmental activists, and the general public suggests the emergence of a stable social and political trade–off between increased agricultural production and improved environmental quality. As a consequence, all farm bills in the foreseeable future will probably have prominent working lands programs addressing a wide range of environmental issues. Third, as the emphasis on technical assistance–intensive conservation practices on working lands grows, the issue of human capital resources in NRCS must come to the fore. Simply said, an agency whose funding for technical assistance has stagnated during rapid growth of conservation program funding cannot be expected to adequately deliver and monitor programs. Some have referred to staffing issues at federal agencies as having reached "crisis" levels (Liebowitz, 2004). Questions requiring closer scrutiny in the near future include whether such a situation exists at NRCS, and what human capital investments are necessary to deal with the problem. Fourth, as conservation and agricultural policy develop, the issue of policy consistency will become more acute. Social and political questions to be addressed include: To what degree is a U.S. biofuels–driven energy policy consistent with conservation goals and policy? To what degree should income support or risk management policies be merged with working lands conservation policies, and what policy tools and procedures will be needed to achieve multiple policy targets (Lubowski, Bucholtz, Claassen, Roberts, Cooper et al., 2006; Batie and Schweikhardt, 2007)? In all likelihood, the next era of conservation policy will be dominated by these questions.

Figure 1. Actual and Forecast Conservation Program Expenditures, FY1996–12



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Appreciation is expressed to Roger Claassen, U.S. Department of Agriculture, Economic Research Service for his assistance in providing program funding data.

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The U.S. 2008 Farm Bill: Title X and Related Support for the U.S. Specialty Crop Sector

Mechel S. Paggi and Jay E. Noel

JEL Classification: H100

The Food, Conservation and Energy Act of 2008 (FCEA), provided a landmark in U.S. agricultural policy by including for the first time a separate title dealing specifically with issues related to the fruit, vegetable tree nut, floriculture and nursery sectors of agricultural economy (specialty crops). The bill dedicates almost $3 billion in funding over five years to areas of importance to the sector including nutrition, research, pest and disease, trade, conservation and block grant funding for individual State initiatives. In addition, specialty crops continue to receive direct and indirect benefits from other sections of the legislation related planting restrictions associated with programs for crops such as wheat, corn, soybeans and cotton, crop insurance and general nutrition programs. This article summarizes key provisions of Title X of the 2008 Food, Conservation and Energy Act and related support for U.S. specialty crop agriculture and discusses their potential benefit to the U.S. specialty crop agriculture.

There were approximately 304.3 million acres of harvested cropland in the United States in 2006. Specialty crops harvested acreage was 11.2 million harvested acres or approximately 3.7% of the 2006 total harvested cropland. This percentage has remained relatively constant over the past five years.

Specialty crops are produced throughout the United States. The Upper Midwest and Northwest have the largest vegetable acreage for processing, while California, Florida and Texas harvest the largest share of fresh vegetable and melon acreage. California is the largest producer of grapes, strawberries, peaches, nectarines, avocadoes, and kiwifruit. It also leads in fresh–market orange production and tree nut production. Florida is the largest citrus producer, while Washington is the largest apple producer for both fresh and processing. Midwest and Northeastern states are important producers of processed fruit products while Florida leads in the production of citrus juices. Floriculture production takes place in 40 different states. The Southern states are the largest producers of floricultural products followed by the Western states, then Midwest states and the Northeastern states. Nursery crops are produced in 17 states. Leading producing states, in order of size of production (acres) are Oregon, Pennsylvania, Michigan, North Carolina, Tennessee, Florida, and California.

The 2006 value of total U.S. cropland production was approximately $122.8 billion dollars excluding the production value of nursery and floriculture. If nursery and floriculture production value is included, the total cropland value of production becomes approximately $139.7 billion dollars. Specialty crop production accounts for $51.4 billion of that figure or 36.8% of the total crop land production value. The average 2003–2006 percentage of production value is approximately 37%. The fact that specialty crops are grown on a relative small amount of cropland acreage and yet account for a substantial share of the cropland production value was used extensively by specialty crop stakeholders in their arguments for greater federal government support in the 2008 Farm Bill debate.

U.S. Government Support to Fruits and Vegetables: Pre–FCEA

As noted, the major component of the 2008 Farm Bill of importance for this paper was the creation of a separate title and expanding existing program benefits for the fruit, vegetable and nut sector of the U.S. agricultural economy. It is useful to review briefly some of the major ways government programs affected specialty crops in the past to have a basis for determining the potential impact the changes resulting from passage of the FCEA may have for the U.S. specialty crop industry. Before turning to long–standing programs contained in previous farm bills, a review of some ad hoc support for specialty crops is in order.

Ad Hoc Legislation

Areas of federal support for specialty crops outside of specific farm bills include legislation to provide funding for states to administer programs on behalf of the industry. For example, the Emergency Agricultural Assistance Act (EAAC) of 2001 provided states with block grants to promote specialty crops. The act provided almost $160 million to all 50 states and Puerto Rico. The funds allocated to the states were used to fund a variety of programs and the decision on what programs to fund was left almost entirely to the individual states, with the provision that the programs funded improve the competitiveness of U.S. specialty crops.

The specialty crop block grant program continued with the passage of Specialty Crop Competitiveness Act (SCCA) of 2004 (PL 108–465). SCCA block grants are used to support programs in research, marketing, education, pest and disease management, production, and food safety. The initial legislation (HR 3242) called for an annual appropriation of $470 million in mandatory funds from the Commodity Credit Fund to support the block grant program. The final bill authorized the program subject to annual appropriations, and limited funding to $44.5 million per year; $7 million was actually appropriated in FY 2006.

Crop Insurance and Disaster Assistance

Federally subsidized crop insurance programs are available for many crops, including specialty crops. Under the federal crop insurance program, USDA authorizes private insurance companies to sell and service insurance policies, while the government provides subsidized reinsurance and compensates them for administrative costs. Besides paying costs and covering losses for insurance companies, the government pays much of the premium.

Marketing Orders and Agreements

Marketing orders and agreements allow collective action among industry participants for product definitions, promotion, and research. Federal marketing orders and agreements for fruits, vegetables, melons, and tree nuts were first authorized in the Agricultural Marketing Agreement Act of 1937(AMAA). There are currently 32 authorized federal marketing orders in place for fruits, vegetables and tree nuts, covering many of the major crops and production locations.

Generic Promotion, Research, and Information Programs (Check–off Programs)

Federally regulated but industry funded generic promotion, research, and information programs have also been used in the marketing of specialty crops. The origin of check–off programs dates back to the 1954 promotion program for wool. Currently specialty crops with free standing promotion, research and information programs include mangos, cultivated blueberries, popcorn, potatoes, watermelons, and Hass avocados.

Export Promotion

The federal government also provides direct support for the international marketing of many specialty crops. The USDA Foreign Agricultural Service Market Access Program (MAP) provides federal matching funds to assist in the overseas marketing of U.S. agricultural commodities. Funding is provided in annual allocation of USDA Commodity Credit Corporation funds on a competitive grant basis. In 2007 MAP allocated almost $200 million to promote a variety of U.S. commodities. Specialty crops accounted for 35% of MAP fund allocations, with about $56 million going to promote export marketing efforts of 30 commodity groups and related organizations.

Food Assistance and Nutrition/ Food Purchases

Nutrition assistance programs play a role in federal support for the fruit and vegetable sector through direct commodity purchases and increased demand for food. The USDA operates 20 nutrition assistance programs with expenditures of about $54 billion in FY2006, accounting for 55% of USDA total spending. These programs are operated by the USDA's Food and Nutrition Service (FNS). In addition, USDA's Agricultural Marketing Service (AMS), Farm Service Agency (FSA), and Commodity Credit Corporation (CCC) play roles in the procurement and distribution of food commodities for some programs.

An important component of these programs for the fruit and vegetable sector is the purchases made possible from "Section 32" allocations. The Section 32 funds are a permanent appropriation that has been part of federal support programs since 1935. The program sets aside the equivalent of 30% of annual customs receipts to support the farm programs. Most of that appropriation is transferred to the U.S.D.A. to fund general child nutrition programs. A certain amount of Section 32 money is set aside each year to purchase commodities that are not supported by other federal programs and make them available to schools and other food distribution programs. Purchases of these commodities by the AMS currently exceed $750 million per year. A five year average of $308 million has been spent to purchase fruits and vegetables from these funds.

Research and Extension

USDA conducts research, extension and economics projects for programs related to the specialty crop industry through four USDA agencies: the Agricultural Research Service (ARS), Cooperative State Research, Education and Extension Service

(CSREES), and Economic Research Service (ERS) and the National Agricultural Statistics Service. The total FY 2007 research budget of these agencies was approximately $2.6 billion: about 2.1 percent of USDA's FY 2007 budget.

A recent review of research efforts on the part of ARS, CSREES, NASS, and ERS provides a perspective on the level of federal research expenditures relative to specialty crops. The total ARS budget for research on crops in FY 2005 was $476.1 million, with 33.7% allocated to fruits, nuts, and vegetables and 6.3% to trees, shrubs, flowers, potted plants, bedding and ornamental turf. In FY 2003, CSREES invested approximately $79.6 million to support research, extension, and education focused on specialty crops, representing about 7.2% of a total budget of $1.1 billion.

Plant Health and Safety

The USDA Animal and Plant Health Inspection Service (APHIS), is the agency responsible for dealing with issues related to invasive pests, harmful insects such as the Mediterranean fruit fly, dealing with foreign countries' import requirements, and negotiating science–based standards to protect U.S. agricultural exports from unjustified barriers to trade. The total APHIS budget for FY 2007 was about $1.2 billion. However the amount going to deal specifically with fruit and vegetable issues is difficult to isolate. The one program that is uniquely related to fruits and vegetables is the fruit fly exclusion and detection program, with an annual appropriation of $59 million.

Fruit and Vegetable Planting Restrictions

Beginning with the 1990 Farm Bill, producers who were participating in government commodity programs were allowed to plant other program crops on a portion of their program crop base acres but were generally prohibited from planting fruits, tree nuts, melons crops, wild rice or vegetables, including dry edible beans and potatoes. The amount of benefits gained by the fruit and vegetable sector from these restrictions is not directly measurable. Recent attempts to measure the benefits have provided a wide range of estimates. The results of studies providing quantitative estimates of the loss to the industry of removal of the restrictions range from $1.7 to $4.0 billion in the first year following removal.

The 2008 Farm Bill changed the fruit and vegetable planting restrictions by creating a CY 2009–12 pilot program to allow production of cucumbers, green peas, lima beans, pumpkins, snap beans, sweet corn, and tomatoes for processing on limited amounts of base acreage in Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin.

Provisions of the Food, Conservation and Energy Act of 2008

The difference in policy development in this farm bill can be traced to the organized efforts on the part of the industry to identify specific programs and policies, link the positive attributes of increased consumption of fruits and vegetables with human health and nutrition and to highlight equity issues surrounding a potential removal of planting restrictions on program crop subsidy beneficiaries. In large part this was accomplish by the formal coalition of over 120 organizations representing growers of fruits, vegetables, dried fruit, tree nuts, nursery plants and other products, The Specialty Crop Farm Bill Alliance. The alliance worked for almost three years to have their issues addressed explicitly in the 2008 farm bill. The following provides a review of the subtitles of Title X.

Subtitle A—Horticultural Marketing and Information

The programs included in Subtitle A cover a variety of issues including authorization for funding of initiatives for food safety education ($1 million); promotion of farmers markets ($3 million increasing to $10 million annually in 2011 and 2012); increasing the coverage of specialty crop market news reporting ($9 million annually); and perhaps most importantly the State Specialty Crop Block Grant program that allocates $10 million increasing to $55 million annually across all 50 States, Puerto Rico, Guam, American Samoa, the U.S. Virgin Islands and the Commonwealth of the Northern Mariana Islands, with each entity receiving a minimum of $100,000 with the balance allocated according to their value of specialty crop production.

Subtitle B—Pest and Disease Management

As the name implies, Subtitle B provides procedures and programs to better coordinate the work of federal and state agencies in their roles related to early plant pest detection, management and surveillance. The major components include funding for the various initiatives from the Commodity Credit Corporation and begin in 2009 at $12 million, increasing to $50 million annually in 2012 and each fiscal year afterwards. In addition, $5 million annually is provided for the establishment of a National Clean Plant Network to establish centers for diagnosis and elimination of plant pathogens in planting stock.

Subtitle C—Organic Agriculture

Highlights of Subtitle C include increases in funding for the U.S.D.A. national organic certification cost–share program from $5 million to $22 million along with $5 million to enhance the collection and reporting of data related to the production and marketing of organic products. In addition, funding is authorized to carry out the activities of the national organic program that regulates the harvesting and handling of organic products in the amount of $5 million annually, increasing to $11 million for fiscal year 2012.

Subtitle D—Miscellaneous

In Subtitle D, a matching grant program of an undetermined amount is established to address issues related to specialty crop transportation and a market loss assistance program for asparagus producers of fresh market and for-processing product to compensate growers for injury from imports during the 2004 to 2007 crop years. In addition, there are provisions for the transition of the National Honey Board that is composed of producers and packers to two boards: a Packer–Importer Honey Board and a U.S. Producer Honey Board, along with requirements that honey labels which bear any official certificate of quality or grade mark or statement must also show the country or countries of origin near the grade mark.

Other Farm Bill Support for Specialty Crops

As in previous bills support for specialty crops also exists within the programs and provisions of other Titles. Among the more important in non–Title X provisions are:

- Section 7311 — The Specialty Crop Research Initiative – provides CCC funds in support of matching grants on research topics related to the development and dissemination of science–based tools to address the needs of specific crops and their regions. ($30 million in 2008; $50 million each year 2009–2012.
- Section 3102 — Maintains the Market Access Program funding at $200 million annually
- Section 3203 — Technical Assistance for Specialty Crop – Creates a Technical Assistance for Specialty Crop (TASC) fund of $19 million over 10 years to report on and address issues related to significant sanitary and phytosanitary issues and/or barriers to trade facing U.S. producers of specialty crops.
- Section 4304 — Expands the Fresh Fruit & Vegetable Snack Program to all 50 states. Funding provided $40 million in 2008 expanding to $150 million in 2012.
- Section 4404 — Expands purchases of fruits and vegetables under Section 32 program. Increases the minimum threshold (currently at $200 million per year) of funding levels: $390 million in FY08; $393 million in FY09; $399 million in FY10; $403 million in FY 11; and $406 million FY12.
- Section 1107 — Fails to repeal the planting restrictions provisions associated with program crops; establishes a pilot project limited to production of vegetables for processing in limited quantities in selected states.

Concluding Observations

Perhaps the most notable accomplishment of U.S. specialty crop agriculture as the 2008 Farm Bill negotiations took place was the building an alliance of disparate specialty crop organizations that had the overall goal of getting the U.S. specialty crop specifically included in Farm Bill legislation.

That goal was achieved with the inclusion of Title X in the 2008 Farm Bill. The direct inclusion of U.S. specialty crops into the 2008 Farm Bill allowed two issues of importance to U.S. specialty crop agriculture to be addressed. These issues are: 1) increase domestic and international demand for U.S. specialty crops; and 2) expand research, technical, economic, market, and product development funding for U.S. specialty crop agriculture.

The above review of Title X and other sections of the 2008 Farm Bill that relate to U.S. specialty crops indicate that those issues were addressed with some success. It is difficult to determine at this point what the economic impact of U.S. specialty crop agriculture inclusion in the 2008 Farm Bill will be. Will the increase in nutrition and food assistance funding directed at U.S. specialty crop agriculture increase profitability? If so, what specialty crop sectors will benefit the most? Will the research sustain or increase U.S. specialty crop agriculture's domestic and international competitiveness?

Perhaps the most intriguing question that will be addressed by U.S. specialty crop agriculture over the course of time that the 2008 Farm Bill is in place is whether U.S. specialty crop agriculture can maintain and build on its success.

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The WTO and U.S. Domestic Support in the Food, Conservation, and Energy Act of 2008

Eric Wailes and C. Parr Rosson III

JEL Classifications: F13, Q18

Changes in the Food, Conservation, and Energy Act of 2008 have the potential to push domestic support for United States farmers above current and proposed commitments in the WTO. This article explores one of the inevitable questions that arise with the enactment of the Food, Conservation and Energy Act of 2008 regarding how the domestic agricultural support provisions in this legislation will affect United States commitments under the Uruguay Round Agreement on Agriculture (URAA). And further, how will the domestic supports fit with the proposals and negotiations in the Doha Development Agenda?

Much of the discussion going into the development of the 2008 Act identified four main pressures that would bear on its development, namely: federal budget issues, changing demographics, evolving structure of interest groups, and implications for WTO agreements and dispute panel findings (Mercier and Smith, 2006).

In the end, with the enactment of the Food, Conservation and Energy Act (FCEA) of 2008 on May 2, 2008 it appears that at least the first three pressures did generate reforms in the 2008 Act compared to the previous Farm Security and Rural Investment Act of 2002. This is reflected in new titles such as Horticulture and Organic Agriculture, Livestock, Commodity Futures, and Crop Insurance and Disaster Assistance. The act also provides reforms in payment eligibility and limits. However, with respect to domestic farm support, nearly all of the basic farm safety net that accounts for the notification by the United States on domestic support commitments with the WTO remains intact, including price supports for dairy and sugar, loan deficiency payments, direct payments and counter-cyclical payments. Changes in the dairy support program include shifting support to product prices rather than the milk price. This will affect how the program is notified under the U.S. Aggregate Measure of Support (AMS), although it will not greatly affect program operation. The 2008 Act provides few reforms that address in any substantive way U.S. obligations under the WTO. In fact it may be argued that the 2008 farm bill potentially creates more payment exposure to meeting WTO obligations than its predecessor.

U.S. Commitments on Domestic Support under the Agreement on Agriculture

The United States and some thirty other countries agreed in the Uruguay Round Agreement on Agriculture to a scheduled reduction of trade-distorting domestic support. As part of this agreement, the members agreed to notify the WTO annually regarding the payments made under several categories of domestic support, including Green Box (minimally trade-distorting), Blue Box (trade-distorting but subject to supply control) and Amber Box (trade distorting). Amber Box includes the Aggregate Measure of Support (AMS) which is subject to the scheduled reduction, and the *de minimus* support that is not. Both the AMS and *de minimus* payments are further divided into non-product specific and product specific. (Under the de minimus provision if product specific or the non-product specific payment totals are not larger than 5% of their respective total market value of production, then the support does not have to be included in the total AMS.)

At the end of the scheduled reduction period of the Uruguay Round Agreement on Agriculture in 2000, the annual spending constraint on U.S. AMS was U.S. $19.1 billion. It will remain at this level until a new agreement is negotiated and ratified by member nations. Domestic support payments subject to constraints are monitored and implemented by the Agriculture Committee of the WTO. "Notifications" of support payments are submitted by members. Notifications however have been slow. Only within the past year has the U.S. submitted notification of domestic support commitments for the marketing years 2002, 2003, 2004 and 2005, as shown in Table 1. (WTO document G/AG/N/USA/60 of 9 October 2007)

Programs that count toward the U.S. AMS commitment based on current U.S. notification include: loan deficiency payments, marketing loan gains, other product specific support including storage payments and commodity loan interest subsidies, market price supports for dairy and sugar, and non-product specific supports including irrigation programs, grazing programs and federal crop insurance (indemnities less premiums paid notified as non-product-specific amber box *de minimus*). (See CRS Report RS20840, Agriculture in the WTO: Limits on Domestic Support, by Randy Schnepf, listed in For More Information section)

Table 1. U.S. Notification of Domestic Agricultural Support Payments to the WTO

ITEM	2002	2003	2004	2005
	U.S. $ Billion			
Amber Box	$9.6	$6.9	$11.6	$12.9
Amber Box Limit (WTO Ceiling)	$19.1	$19.1	$19.1	$19.1
Green Box – No Limit	$58.3	$64.1	$67.4	$71.8

Source: USDA, News Release No. 0278.07, October 4, 2007.

Key Changes in the 2008 Act Likely to Affect AMS Notification

Minor changes are authorized in the 2008 Act for the marketing loan program, direct payment program and the price-based counter-cyclical program The direct payment program (notified by the U.S. as Green Box) and the counter-cyclical program (notified as non-product-specific Amber Box *de minimus*) are mentioned here because in the recent Brazilian cotton dispute panel finding and appeal. The panel found that U.S. payments under the Production Flexibility Contract and Direct Payment programs do not qualify for WTO's Green Box category of domestic spending because of their prohibition on planting fruits, vegetables, and wild rice on covered program acreage. While the counter-cyclical program was not considered in the dispute, it also is subject to prohibition on planting specialty crops. Even though in the Doha July 2004 Framework, the U.S. succeeded in obtaining agreement on counter-cyclical payments as Blue Box, without a Doha Round agreement, this Blue Box notification would be also likely subject to dispute. See Mercier (2004) and Schnepf (2007) for information on the Brazilian dispute. More significant is the introduction of the Average Revenue Crop Election (ACRE) program. This program is offered to program commodity producers as an alternative to the counter-cyclical payment (CCP) program beginning in 2009.

The CCP program, enacted as part of the 2002 farm bill, is triggered by low commodity prices relative to fixed target prices; ACRE provides a risk management tool to address either or both low yields and low prices. Two triggers must be met before an ACRE payment occurs. First, state-level ACRE guarantee revenue per acre must exceed the actual state revenue per acre and second, the farm ACRE benchmark revenue per acre must exceed the actual farm revenue per acre. The state ACRE guarantee is the 5-year Olympic average state yield times the average of the past two years' national price times 90% for the specified crop. The actual state revenue will be the state yield per planted acre times the national average market price or 70% of the national loan rate. The farm ACRE benchmark is the farm's 5-year Olympic yield per planted acre times the average of the past two years' national price plus the per acre insurance premium on the crop. The state ACRE guarantee revenue cannot increase or decrease more than 10% during 2010-2012 from the previous year's state ACRE guarantee revenue level. Because the payments are triggered or coupled to current production, market prices and yields, payments under this program will likely be Amber Box and count against the AMS constraint. See the accompanying article by Zulauf, Dicks and Vitale in this issue for more details on the ACRE program.

The commodity title also increases the loan rate for sugar a quarter cent per year for 3 years and changes the overall allotment quota to be a minimum of 85% of domestic consumption. The Act extends the Milk Income Loss Contract program until 2012, increases the payment rate and eligible poundage and provides price supports for cheddar cheese, butter, and nonfat dry milk.

Notification of 2008 Payments Under Existing Commitments

Projections of market prices for most program crops supported by the 2008 Act will imply that the notification values on loan deficiency payments and marketing loan gains will help keep AMS product specific payment levels well below $19.1 billion. (See USDA Long-Term Projections to 2017 at http://www.usda.gov/oce/commodity/ag_baseline.htm and FAPRI 2008 U.S. and World Agricultural Outlook at http://www.fapri.iastate.edu/outlook2008/) The primary concern will focus on the payments that are likely to flow from expected high participation on the ACRE program by corn, wheat and soybean producers. This program will not go into effect until the 2009 marketing year but exceptionally high market prices in 2007 and 2008 provide the potential for large payments in the 2009 and possibly 2010 marketing years should market prices decline.

Potential for Changes in WTO AMS Commitments

A successful conclusion to the Doha Round negotiations remains elusive as reflected by the July 2008 mini-ministerial collapse. The U.S. offered to reduce overall trade distorting support (Blue Box + Amber Box + non-product-specific *de minimus* + product-specific *de minimus* limits) from $48 billion to $15 billion contingent on matching market access offers by other WTO member nations. It also agreed under the same contingency to reduce the AMS trade-distorting commitment of $19.1 billion down to $7.64 billion. Again, with sustained high crop prices, market price supports for sugar and milk will account for most of the payments against this proposed new limit. However, as suggested above, the potential payment exposure from the ACRE program could easily strain the ability of the U.S. to remain below the proposed $7.64 billion limit. Not until and unless a new round is completed will this become a real concern. Even then, how the U.S. Congress may address the potential of exceeding the AMS remains unclear.

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The authors would like to thank two anonymous referees for helpful comments.

CHOICES
The magazine of food, farm, and resource issues

A publication of the Agricultural & Applied Economics Association

Offsetting Behavior: Consumers' Response to Food Safety Policies

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JEL Classifications: Q18, I18

Offsetting behavior occurs when policies implemented to reduce risk exposure of potential victims change consumers' behavior in such a manner that they become lax and increase the likelihood of an accident. Literature on offsetting behavior has dealt primarily with policies relating to improved transportation safety and a resulting increase in automobile accidents (Peltzman 1975). A more general theoretical framework of offsetting behavior applicable to a variety of industries was developed by Hause (2006).

Food safety policies are designed to reduce/minimize the amount of foodborne pathogens in the food supply chain. Consumers' response to these food safety policy measures points to the presence of offsetting behavior in food consumption (Miljkovic, Nganje and Onyango 2008).

Food safety uncertainties are present at all levels of the food supply chain and in food consumption, sometimes leading to foodborne diseases caused by bacteria, viruses, parasites, toxins, and heavy metals. These food safety uncertainties and events influence consumers' perception and are the main reason for the development and implementation of various food safety policies.

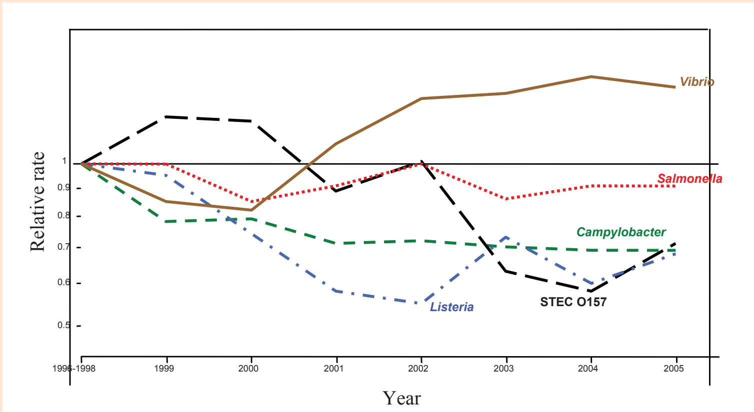
Due to *E. coli* O157:H7 and *Salmonella* outbreaks witnessed in the U.S food supply chain, the Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA) in 1996 introduced mandatory food safety regulations in the meat and poultry sectors. Named the Pathogen Reduction/ Hazard Analysis and Critical Control Points (PR/HACCP), the act was intended to ensure the safety and well–being of consumers in the meat and poultry sectors. Increases in contamination linked to the consumption of domestic and imported fresh fruits and vegetables and the government's effort to develop nationwide safety measures for fresh fruits and vegetables, led the Food and Drug Administration (FDA) to develop guidelines addressing food–safety hazards and good agricultural practices common to the growing, harvesting, packing, and transportation of the majority of fresh fruits and vegetables which are characteristically sold and consumed in a minimally processed manner.

Despite these measures which are mandatory in some sectors (such as meat and poultry), and voluntary in other sectors (such as fruits and vegetables), the Centers for Disease Control (CDC) recorded an increase of foodborne disease outbreaks from 1983 to 2004, with a sharp increase in the years following the implementation of PR/HACCP. Figure 1 represents a general trend in foodborne disease outbreaks for this period observed by the CDC. CDC data should be treated with caution. Although it is clear from the graph there was an increase in foodborne disease over time, the implementation of PR/HACCP at the processing level saw a significant decrease in the level of certain foodborne pathogens. Figure 2 shows this trend as documented by CDC. The difference between pathogen mitigation as a result of instituted policies and the increase in the number of foodborne disease outbreaks observed, suggest the possible presence of offsetting behavior by consumers regarding food–safety.

Figure 1. Trends: Foodborne Disease Outbreak Surveillance System

Source: Centers for Disease Control FoodNet (2006).

Figure 2. Trends: Relative rates compared with 1996–1998 baseline period of laboratory–diagnosed cases with *Campylobacter,* STEC O157, *Listeria, Salmonella* and *Vibrio*, by year.



Source: Centers for Disease Control FoodNet, (2006).

Hence the expected effect of food safety policy implementation in terms of reduced foodborne illness, mortality, and food–associated disease, may be less than expected due to the change in consumers' risk attitude and behavior. Consumers may exhibit riskier behavior in the face of implemented food safety policies.

Recent research using experimental economics found that offsetting behaviors exist in food safety (Miljkovic, Nganje and Onyango 2008). Their experimental design involved a representative sample of more than 2,556 individuals nation–wide. Food safety related questions associated with consumers' perception of risk and consumption preferences for hamburgers were asked and analyzed. Consumers had a strong preference for rare over well done hamburgers before any information on food safety, potential presence of E. coli O157:H7 in meat, and its impact on human health was provided. Once negative information on the impact of E. coli O157:H7 on human health was supplied, these same consumers switched their preferences towards well done burgers. Finally, when consumers were presented with information on the positive impact of PR/HACCP, their risk perception for the safety of the meat changed in such a way that they dropped their guard and increased their preference for rare meat to a level even higher than before any food safety information was provided. To them, the implementation of PR/HACCP nullified the food–safety risk due to E. coli O157: H7 in their beef burgers.

Given recent food safety outbreaks, regulators may come under pressure to introduce mandatory food–safety measures such as the one in the meat and poultry sector for fresh fruits and vegetables. The hypothetical scenario of introducing mandatory PR/HACCP in the fruit and vegetable sector and its impact on consumer behavior was experimentally tested. Vegetables were preferred because of certain attributes they possess. These include health benefits associated with regular consumption, consumption in minimally processed form, and increased food safety outbreaks in recent years. Outbreaks include the 2003 green onion Hepatitis A outbreak, 2006 spinach and lettuce *E. coli* O157:H7 and *Salmonella* outbreaks. Results indicate consumers exhibit offsetting behavior when positive information is provided to them about the potential impact PR/HACCP would have in the vegetable sector.

Thus, offsetting behavior was found to be exhibited by consumers both in consumption and preparation of vegetables, and in consumption of burgers. In both cases, positive information from food safety policies altered consumers' perception of risk in such a way that they developed a false sense of safety, which might increase the possibility of a food contamination event occurring. Lui, Huang and Brown (1998) illustrated a relationship between trust, risk, and food safety concerns given media and other associated information. The risk perceived by consumers is based on information about the quality and safety of a product that can be acquired from a variety of sources. It is therefore likely consumers can acquire new information and change their perception of risk. For example, information about a contamination incident causes consumers' perceived risk R^p to increase relative to their original risk perception. New and favorable information about food safety provisions help consumers slowly adjust their risk perception back toward a more objective level.

Consumers' perception of foodborne risk can be affected by several factors. These include measures taken to reduce the risk of contamination from production to consumption, experience an individual has with a foodborne poisoning event in the past, fear of the unknown, and demographic characteristics such as age, sex, income, race, and educational background. Following the 2006 nationwide spinach recall, research found trust in private and public institutions in charge of ensuring food safety have a substantial influence on consumers' food safety perception (Onyango et al. 2007). This influence is exhibited by consumers' trust of regulatory agencies such as the U.S. Department of Agriculture (USDA), Centers for Disease Control (CDC), and the Food and Drug Administration (FDA). Consumers' implied trust can reduce their concern in response to positive information about the impact of potential polices aimed at alleviating the risk of a foodborne incident.

Potential Rationale for the Existence of Offsetting Behavior in Food Safety

The absence of a mandatory policy approach at farm and retail levels hampers the mitigating effect for which the food safety strategy is implemented. Food undergoes different forms of processing and handling from the time it is harvested to when it is consumed. Some food substances are delicate and perishable and need to be processed and distributed rapidly. However, the mere fact that different agencies are responsible for different aspects of food safety in the food production chain opens the situation to ongoing inconsistencies and inefficiencies. Hence, food might be contaminated along the production chain due to these nontransparent and nonuniform regulations.

There exists a dichotomy between pathogen levels at the farm, processing, and retail levels, including the consumption level. For example, cross contamination occurring at the kitchen level and restaurants during food preparation, might undermine the impact and effectiveness of food safety risk reduction strategies. *Salmonell*a and *E. coli O157: H7* are known to thrive at all levels of the food supply chain. A significant number of foodborne disease outbreaks have been witnessed at the processing level although PR/HACCP in the United States is mandatory. Given the optional nature of the PR/HACCP at the farm and retail levels, and the voluntary nature of regulations in the fruit and vegetable sectors, the state of California, from where the 2006 nationwide spinach outbreak started, is pushing for regulations to upgrade existing policies which have been found deficient in protecting the wellbeing of consumers. Some authorities have suggested present agricultural practices in the produce industry have not been effective in providing the necessary protection against pathogen contamination.

The mix of food safety strategies undertaken by firms in the different food sectors is complex and cumbersome. For example, it is known that some firms employ voluntary PR/HACCP while others employ a different blend of testing involving standard operating procedures (SOP), good agricultural practices (GAP), third party checks, and varying degrees of testing by the U.S. Department of Agriculture. The mix of strategies utilized might confuse consumers and cause them to not fully understand the nature of the actions employed to improve food–safety standards. Therefore, consumers might develop a false sense of security or trust in food–safety regulations and become negligent (reduction in avoidance expenditure) about their preparation and consumption behaviors. The expected outcomes of these food safety actions can be mitigated due to the reduction in consumers' preventive actions. A common example that can be advanced here is consumers' consumption of ground beef. Even though it is generally recognized that undercooked ground beef has a higher risk of contamination from a lethal bacteria like *E. coli O157: H7*, beef burgers not cooked to recommended levels are still one of the more widely consumed foods in the United States.

Further Reflection

Given the rationale for offsetting behavior in food safety, consumers' food expenditure decisions can be affected by the availability of food safety information, the nature of the supply chain to produce a final product, and consumers' timing of decision making. The motivation behind implementing food safety policies in the food sector is to guarantee the well–being of consumers. These food safety regulations (PR/HACCP in meat processing) are structured and implemented at points where the probability of adulteration is high, such as critical control points (CCPs).

The effectiveness of these food safety policies is evaluated at these points, though each might be a single control in the network from farm to fork. In the case of meat, meat at the processing plant might be free of contamination, but that does not guarantee meat is safe for final consumption since it could have been contaminated in transport or at retail stores or restaurants. Therefore, when food safety information about processing plants is given to the public, consumers could assume this safety level is relevant to what they buy at the retail outlet. Assuming information is fully transmitted, consumers may exhibit offsetting behavior and the net benefit of food safety policies would be overstated.

Positive food safety information following policy implementation was found to affect consumers' attitude and behavior to the point where they become lax and negligent about the way they prepare and consume food. In the case of meat, they increased the likelihood of contamination due to the consumption of undercooked meat. In the case of vegetables, the likelihood of contamination increases due to consumers' diminished effort to wash vegetables well. The welfare consequence of offsetting behavior depends on the reduction in potential victims' accident avoidance expenditure.

Offsetting behaviors should be taken into account to correctly state the net benefits of proposed food safety regulations. These include possible mandatory regulations in the fresh fruit and vegetable sector and better and more efficient food safety regulations in the meat and poultry sector as well as seafood and fruit juice sectors. Failure in this regard may lead to overstating food safety policy's positive impact, which may in turn mislead consumers, potentially further jeopardizing their health.

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