A Stochastic Analysis of Proposals for the New US Farm Bill

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Most of the large scale modeling systems used in the analysis of agricultural policies produce deterministic projections. In reality, however, the agricultural sector is subject to a high degree of uncertainty as a result of fluctuations in exogenous factors such as the weather or macroeconomic variation. A stochastic approach can provide additional information to policy makers regarding the implications of this uncertainty, through the use of stochastically generated projections. This paper also shows how deterministic analysis may result in systematic errors in the projection of some variables. As an applied example, the FAPRI model of the US agricultural sector is simulated stochastically to analyse the impact of proposals for the new US farm bill.

Key Words: Stochastic simulation, US Farm Bill, policy analysis.

The Food and Agricultural Policy Research Institute (FAPRI), a joint institute of the University of Missouri and Iowa State University, provides quantitative analysis of issues related to food, agriculture, and natural resources. For 20 years FAPRI has used it's modeling system to produce projections of world agricultural commodity markets and analysis of agricultural policy. The models encompass all major commodities including wheat, maize, soybeans, rice, cotton, barley, sorghum, sugar, meats, and dairy products. The modeling system produces global projections, as well as routinely producing analysis of US policy. The models have also been used to examine global policy change, such as the Uruguay Round Agreement on Agriculture, and policy changes in other regions, such as reform of the CAP (Babcock et al, 1999; Westhoff and Young, 1999).

Each year, the FAPRI modeling system is used to generate ten-year baseline projections for world agricultural commodity markets (the latest baseline is presented in FAPRI, 2001a). For purposes of the baseline projections, current or already approved agricultural and trade policies are assumed to remain in place indefinitely. Assumptions regarding income growth, inflation, exchange rates, and other macroeconomic variables are primarily taken from DRI-WEFA (Eddystone, Pennsylvania). The objective is to develop a baseline that is a plausible outlook for the world agricultural economy, given the conditioning assumptions. Once the baseline is developed, alternative scenarios are analysed by changing one or more exogenous assumptions (usually some policy variable), solving the model, and comparing the results to the baseline.

In recent years the models have been refined to allow their simulation stochastically, in order to capture some of the uncertainty inherent in agricultural production systems. Distributions around certain exogenous variables and error terms in the equations are produced and models are simulated hundreds of times under the resulting stochastic draws. In this paper the basic structure

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of the FAPRI models is outlined, and the stochastic simulation approach is discussed. The methodology is then discussed in the context of the results of the simulation of the model to analyse the House of Representatives proposal for the new Farm Bill.

Basic Model Structure

The models that have been developed by FAPRI are multi-market, structural, dynamic, non-spatial, partial equilibrium models of agricultural markets. The focus of the models is the correct incorporation of economics, policy, and biology. The models incorporate integrated analysis of multiple agricultural markets, with, for example, wheat and barley as substitutes in both production and in livestock rations. Particular attention is made with regard to the correct incorporation of policy levers, and the biological constraints of the system through the appropriate lag structure. The resulting structure of the models reflects their primary purpose of policy analysis, rather than for forecasting.

The models are based on time series data, with the parameters estimated econometrically where possible and appropriate. In some cases, however, data limitations or structural change make econometric estimation of model parameters impractical or inappropriate. In these cases, model parameters are selected based on the literature, estimated parameters from similar markets, and analyst judgment. Most equations in the model are either linear or linear in logarithms.

i) Crop sector model specification

Although a common methodology is used to construct the models, the details of the equations in individual countries will differ in order to reflect country specific factors, either in markets, production methods or policy. In general, the model for a typical crop (e.g., wheat) for a particular country generally would include the following equations:

Area harvested = f(Lagged area, real expected prices or returns for the crop, real expected prices or returns for competing crops, government subsidy and set-aside programs) (1)

Yield per harvested hectare = f(Trend, area harvested, real expected prices) (2)

Production = Area harvested x yield (3)

Feed use = f(Real price of the crop, real price of other feedstuffs, index of livestock numbers or meat and dairy production) (4)

Other domestic uses per capita = f(Real price of the crop, real price of competing crops, real per capita income) (5)

Ending stocks = f(Real price of the crop, production, beginning stocks, policy variables) (6)

Net exports = Production + beginning stocks - feed use - other domestic uses - waste - ending stocks (7)

Sum of net exports across all countries and regions = 0 (8)

Prices are determined in different ways in the model. In cases where prices are determined solely by domestic policies, these can be treated exogenously. Alternatively, where there are no barriers to trade, prices can be determined simply through a direct conversion of a representative world price at the appropriate exchange rate taking into account quality differentials and transport costs. Where appropriate, tariffs can be incorporated into the conversion. Quantitative restrictions to trade are included in the models where appropriate, that then solve for prices.

ii) Livestock sector model specification

In the livestock sector, care is taken to correctly model the biological constraints of the production systems through the appropriate use of lags and inventory tracking. For example, the production of beef will be related to the number of animals available for slaughter, with calf numbers sourced from both dairy and beef herds. As with the crop sector model, the differences in policies and production systems in various regions will be reflected in different model specifications. In general, a model will include the following equations:

Breeding herd = f(Lagged breeding herd, livestock prices, feed and other input prices, government subsidies and other policies) (9)

Animals born = f(Breeding herd, trend) (10)

Slaughter = f(Lagged animal inventories, livestock and input prices) (11)

Ending animal inventories = Lagged inventories + animals born + net imports of live animals – slaughter – other death loss (12)

Slaughter weight per animal = f(Trend, mix of breeding and market animals slaughtered, livestock and input prices) (13)

Meat production = Slaughter x slaughter weight per animal (14)

Domestic consumption per capita = f(Real price of the meat, real price of competing meats, real per capita income) (15)

Ending stocks = f(Real price of the meat, production, beginning stocks, policy variables) (16)

Net trade = f(Price of domestically produced meat/price in international markets) (17)

Production + beginning stocks = Domestic consumption + ending stocks + net trade + waste (18)

In the case of poultry, production is estimated directly rather than as a function of animal inventories. For the dairy sector, behavioral equations determine both dairy cow numbers and milk production per cow. Milk is allocated to the various products based on relative prices or returns. Prices in these models are determined in the same way as for the crops sectors outlined above.

Stochastic methodology

FAPRI has undergone a major change in its approach to policy analysis over the last two years. The request to examine a variety of ‘safety-net’ programs, has prompted the unit to adopt a stochastic analysis methodology for examining policy options. The stochastic methodology uses the same set of core linked economic models of the agricultural sector described in the previous section.

Previously in commodity policy analysis, an essentially deterministic, or single value, approach has been taken. The FAPRI baseline has been developed each year to give the ‘most likely’ view for world markets over the coming ten years. It assumes constant policy, but more importantly, it also assumes trend yields or ‘normal weather’ both domestically and abroad. Further, the baseline assumes that world macroeconomic conditions are also fairly well behaved, with stable exchange rates and modest general economic growth. The baseline then serves as a yardstick against which all policy requests are evaluated. While this ‘most likely’ view of world agriculture is carefully reviewed, it does not give an indication of future variability.

Recently, much attention has focused on the ‘safety net’ or ‘counter-cyclical’ features of various programs. These programs are designed to provide additional support when market prices or revenue decline, without the need to resort to the type of *ad hoc* government assistance programs that have been operated over the last several years. By design, the counter-cyclical programs are intended to provide support contingent on market conditions. An analysis of these programs must therefore take into account the varying market conditions that define the agricultural economy.

The nature of agricultural production systems means that the sector is particularly exposed to uncertainty (Hardaker et al, 1997). The most obvious source of uncertainty and variability in agriculture is weather, both domestic and foreign. To incorporate yield variability in the United States, distributions of the percentage deviations from trend yields over the 1980-2000 period were examined (Figure 1). An empirical distribution was used to provide a basis for generating yield paths that served as an input into the model. However, since the model includes multiple crops, it is necessary to generate yield distributions that account for the correlations between crops (Richardson et al, 2000a). For example, the correlation between maize and soybean yields is 0.88, while the correlation between maize and wheat yields is only 0.13. Figure 2 shows a comparison of the underlying deviations that define the empirical deviations. Also, as these yields were examined on a departure from trend basis, the absolute levels of departure from trend increases over time as the baseline yields increase.

Figure 1. Deviations in U.S. Maize Yields

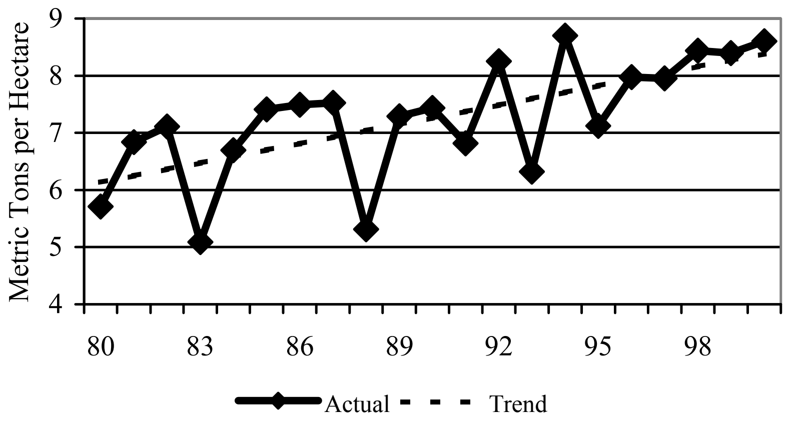
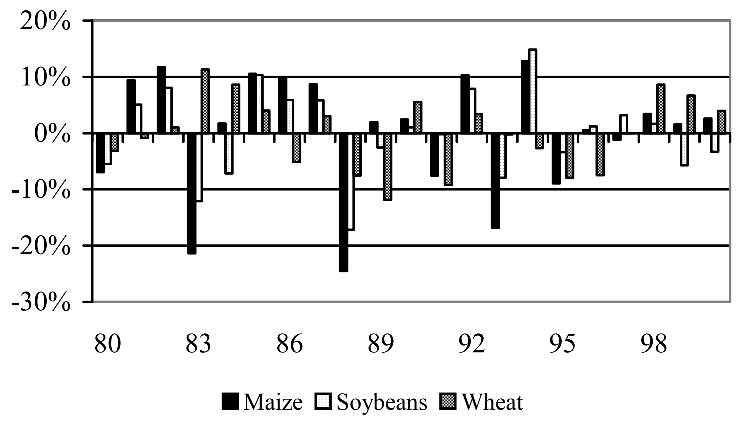


Figure 2. Deviations in U.S. Crop Yields



Developments in global weather conditions are among several factors that have an impact on exports of agricultural commodities from the U.S. Changes in policies and macroeconomic conditions also affect production and consumption in other countries, thus shifting their net trade positions. As, discussed earlier FAPRI maintains models for the major importing and exporting countries and regions around the world, and these models are structured to capture these different influences. Ideally, shocks to the yields, policy, macro-economic and other variables in all of these respective countries would be conducted. However, this would be an extremely involved undertaking. As an alternative, equations for U.S. exports have been developed that mimic the behavior of the FAPRI global model to changing commodity prices. As with yields, the error terms, or deviations, from the equations are used to develop distributions that determine the potential range of shocks to U.S. exports. As in yields, correlations across commodities are also imposed. Further, correlations across time are derived from the historical data and imposed on the set of draws for the export equations.

Prices of inputs, such as fuel and fertilizer, can also be highly variable. In the FAPRI modeling system, these input prices help to drive production costs, which influence production and area decisions, but also help to determine the total production costs in the farm income accounts. The baseline projects these cost of production components for the major crops. Given the underlying macroeconomic assumptions, these projections of input costs generally increase smoothly based on general price inflation. History suggests that here as well, year-to-year fluctuations have also been significant. As with yields and exports, historical deviations have been used to introduce variability around production costs.

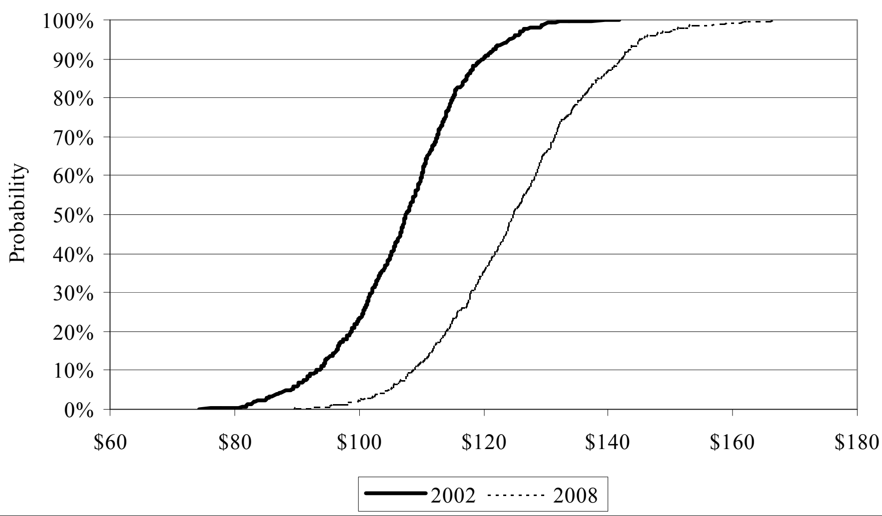
In any economic model, the equations contain unexplained errors. Models are, necessarily, simplifications of reality and as such factors that are not incorporated can cause even the best of models to display some error. This represents an additional area of uncertainty around the deterministic projections. To incorporate these errors, distributions around the error terms of selected equations have been developed and used to generate stochastic draws. These equations include ending stocks for the major crops and slaughter weights, breeding inventories and per-capita domestic consumption for the livestock side.

With the distributions and appropriate correlations in place for the identified sources of variability, 500 multi-year draws are made from the various distributions in order to generate the stochastic input data. Each draw of data serves as input into the FAPRI modeling system, with the solution to the system giving output for variables such as production, consumption, prices and trade of the major crop and livestock commodities. In addition, estimates for farm income and government outlays under the various program designs are calculated for each of the 500 draws. The models are simulated using SAS and Excel, with stochastic draws generated using Simitar (Richardson et al, 2000b).

The approach allows both the cross commodity and the inter-temporal relationships between stochastic variables to be incorporated. Given the structure of the modeling system, shocks from whatever source will affect stock-holding behaviour, future planting decisions, and certainly the path of the livestock sector. Rather than a single year 500 times then, the system generates 500 ten-year paths for these exogenous variables. That way the recovery period from a drought or a sustained boost to milk yields are represented as well as possible.

As shown in Figure 3, the results generated by passing the weather, macroeconomic and export shocks through the system suggest significant commodity price variability. From a government cost standpoint however, the results suggest that the deterministic estimate of government costs is well below the average suggested by the 500 draws. In less than one-third of the draws, government outlays fell below the baseline expenditure estimate. In other words over two-thirds of the time government outlays exceeded those suggested by the deterministic baseline results. The reasons for this are the subject of the following section. Farm income distribution looks much less skewed than government outlays.

Figure 3. CDF of U.S. Wheat Farm Price, Dollars per MT



It is important to note that the stochastic analysis is based on the distributions described for a set of selected input variables. The distributions are derived from observed deviations during the historical period. It is the goal of this analytical approach to capture the major sources of variability in the sector and to reflect the impact of that variability on key variables in the system. By no means, however, have all possible sources of variability been captured. It would be a mistake to conclude that the extreme values achieved in this analysis represent the absolute extremes that are possible in the future.

U.S. Farm Legislation and the Need for Stochastic Analysis

It is clear from the discussion above that there are several features of U.S. farm legislation that make stochastic analysis essential. A number of policies make payments to farmers only under defined adverse circumstances. Deterministic analysis may systematically underestimate the impact of such programs on production, prices, and the federal budget, particularly if those parameters were selected based on those same projections. Jagger and Hull (1997) provide a discussion of how this applied to the development of the 1996 Farm Bill.

Consider, for example, the cereal, oilseed, and cotton marketing loan program. Under the program, the federal government makes payments that are tied to market price levels. Producers have several options under the program.

1. The producer can obtain a loan for an amount equal to the loan rate multiplied by the quantity of harvested production the producer chooses to place under loan.
    a. Producers can repay the loan principal and interest and will generally choose to do so if market prices are sufficiently high.

    b. When prices are sufficiently low, producers have the option of repaying their loan at a repayment rate that moves with (and is generally slightly lower than) market prices.
    c. Producers have the option of forfeiting to the government the commodity placed under loan in lieu of repaying the loan. Given the availability of options (a) and (b), this option is rarely exercised.
2. In lieu of obtaining a loan, the producer can choose to receive a "loan deficiency payment" (LDP) for an amount equal to the quantity harvested that could have been placed under loan multiplied by the difference between the loan rate and the loan repayment rate.

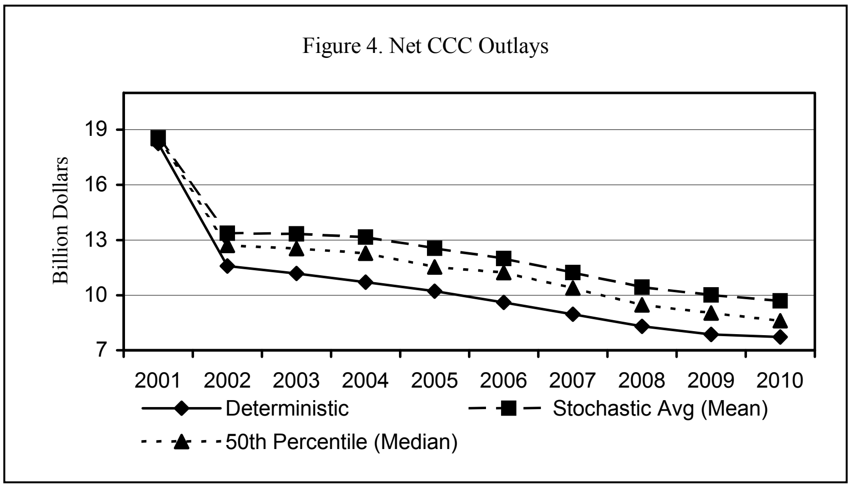
When market prices are well above the established loan rates, few producers use the marketing loan program, and those that do generally repay their loans with interest. Thus when prices are sufficiently high, the program does not entail significant government expenditures and direct effects on producer revenue are likewise limited. When prices are well below loan rates, on the other hand, government expenditures can be very large, and the impacts on producer revenue can drive production decisions.

For example, the national average loan rate for soybeans during the 2001/2002 marketing year is $193 per tonne. If the loan repayment rate on a given day is $147 per tonne, producers can receive an LDP of $46 per tonne on all the soybeans they harvest. Alternatively, under (1)(b), the producer can take out a loan for $193 per tonne and repay it at $147 per tonne, and once again pocket the $46 per tonne difference. In either case, the producer is then free to sell the soybeans in the market at the prevailing market price, which generally will be slightly higher than the loan repayment rate. In essence, the loan rate program means that total producer revenue per unit of production will generally exceed, but should not be less than, the announced loan rate, regardless of market prices.

When expected market prices are low, rational producers will make production decisions based on established loan rates, as the loan rate effectively truncates the price distribution by placing a floor on per-unit returns. If, for example, the loan rate for soybeans is set much higher than expected market prices while the loan rates for cereals are more in line with expected market prices, the marketing loan program will encourage more production of soybeans and less production of cereals than would take place in the absence of the program.

However, loan rates can have real effects on production even when producers are risk neutral and the mean of the distribution of expected market prices exceeds the loan rate for each commodity. If there is a non-zero probability that market prices will fall to a level that triggers marketing loan benefits, then producers should include the expected value of those benefits in their estimates of expected returns from production.

Deterministic analysis would tend to underestimate the market and budgetary impact of the marketing loan program when projected market prices are above the loan rate. The point can be illustrated by a comparison of deterministic and stochastic projections of U.S. government expenditures under the agricultural legislation in place in early 2001 (Figure 4). The mean of the stochastic estimates exceed the deterministic estimates by an average of $2.2 billion per year, primarily because of differences in estimates of the cost of the marketing loan program.



In the deterministic analysis, cereal prices generally exceed loan rates during most of the projection period, and cereal loan expenditures fall to zero. Even if the distribution of market prices were identical in the stochastic analysis, the non-zero probability that market prices will fall below the level necessary to trigger marketing loan expenditures in any given year means that the mean value of cereal loan expenditures never falls to zero. The non-normal distribution of government expenditures is illustrated by the difference between median and mean levels. Very low prices can trigger very large expenditures on marketing loans, but once market prices exceed loan rates by a comfortable margin, further increases in market prices do little or nothing to reduce government expenditures, as LDPs and other marketing loan costs cannot generally be negative.

Proposed U.S. Farm Legislation, H.R. 2646

FAPRI is continually involved in the process of the drafting of agricultural policy in the US by providing analysis of proposals to interested parties. In 2001 and 2002 the unit has produced numerous analyses of proposals in relation to a new Farm Bill. In this paper, the analysis of the Farm Security Act of 2001, H.R. 2646, issued by the House Committee on Agriculture is presented. An analysis of the Agriculture, Conservation, and Rural Enhancement Act of 2001, S. 1731, is also available (FAPRI, 2001b). H.R. 2646 was chosen on the basis that at time of writing this had been passed by the House of Representatives. The analysis includes the provisions directly related to cereals, oilseeds, cotton, and the Conservation Reserve Program. It does not address features or provisions of the legislation related to other commodities or conservation (other than the CRP), trade programs, research, nutrition, and rural development. In this paper, the focus is the implications of the stochastic analysis for the budgetary consequences of H.R. 2646, with a more detailed analysis presented in FAPRI (2001c).

H.R. 2646 would extend a number of provisions of current legislation, such as the marketing loan program and would continue to make additional fixed payments (under the Agricultural Market Transition Act (AMTA)) to producers. These fixed payments are not affected by either market prices or current production decisions. H.R. 2646 would also make a number of important changes to U.S. farm legislation, including the introduction of a new counter-cyclical payment (CCP) program. Producers would qualify for payments under this program when market prices are lower than "target prices" established in the bill. These target prices are substantially higher than current loan rates; e.g., the target price for wheat is $148 per tonne, while the loan rate is $95 per tonne. In contrast to the loan program, however, CCPs would not be tied to current production levels. Rather, they would be made on a fixed portion of historical production on the farm. Because the payments would not be made on a marginal unit of production, arguably a dollar spent on the CCP program would have a smaller effect on production and market prices than would a dollar spent on the marketing loan program. The relevant loan rates, fixed payments, and target prices are presented in Table 1.

Table 1. Loan Rates, Fixed Payment Rates, and Target Prices Used in the Analysis, $/MT

Crop	Loan Rates		Fixed Payments		Target Prices
	2002 Baseline	H.R. 2646	2002 Baseline	H.R. 2646	H.R. 2646
Wheat	95	95	17	19	148
Maize	74	74	10	12	109
Sorghum	67	74	12	14	104
Barley	79	76	9	11	110
Oats	79	83	1	2	101
Upland cotton	1,145	1,145	123	147	1,623
Rice	143	143	45	52	239
Soybeans	193	181	NA	15	215
Minor oilseeds	205	192	NA	16	228

Source: Baseline loan rates are from FAPRI's January 2001 baseline.
* Barley and oats loan rates continue to be determined based on relative price relationships with corn with levels in the table representing legislated maximums.

Under H.R.2646 producers face a choice in the base area eligible for fixed and counter-cyclical payments. Producers can choose to use their AMTA contract area for all crops on a farm or an average of 1998-2001 planted area for all crops on a farm. In other words, the decision is on a farm-by-farm basis and not a crop-by-crop basis. This implies that if producers wish to receive fixed and counter-cyclical payments for oilseeds, they must choose to use 1998-2001 plantings because there is no AMTA payment base for oilseeds. Fixed and counter-cyclical payments are made on 85 percent of the base area. Current planting flexibility rules apply, so current plantings have no effect on fixed or counter-cyclical payments, provided the producer does not grow fruits or vegetables on the base area.

To develop a precise estimate of base area under the legislation, it would be necessary to have information about current payment bases and 1998-2001 plantings on a farm-by-farm basis. Given time and data constraints, base areas were estimated by examining data on a county basis. In general, producers in a given county were assumed to choose to update their payment base if they would get larger payments by using 1998-2001 plantings than they would by maintaining their AMTA contract area. Note in Table 2 that the oilseed base area is less than 1998-2001 average oilseed plantings as it is assumed some producers choose to maintain their historical AMTA contract area to maximize expected payments. The optimal decision for one producer in a county will often be different from the optimal decision for other producers, so the approach used in this analysis should be considered an approximation.

Table 2. Base Area for Fixed and Counter-cyclical Payments

Crop	2002 AMT	H.R. 2646	Difference
		million hectares	
Wheat	31.7	28.7	-3.0
Maize	32.9	31.8	-1.1
Sorghum	5.5	4.2	-1.2
Barley	4.5	3.5	-1.0
Oats	2.7	1.9	-0.8
Upland cotton	6.7	6.8	0.2
Rice	1.7	1.7	0.0
Soybeans	n.a.	28.0	28.0
Sunflowers	n.a.	0.6	0.6
Sum of above	85.7	107.4	21.8

Source: 2002 AMTA contract area is from FAPRI's January 2001 baseline. H.R. 2646 figures are estimates based on county information, as described in the text.

Grain and cotton payment yields are set at the same levels used to calculate AMTA payments. Oilseed payment yields are to be established based on average yields for the 1981-85 crops. It has been assumed that this would result in a national average soybean payment yield of 2 tonnes per hectare. In addition to these commodity program provisions, the analysis incorporates the proposed increase in the area that can be enrolled in the CRP. It is assumed that this will result in actual 2007 CRP area of 15.6 million hectares compared to the baseline level of 14.6 million hectares.

Results of Analysis

The impact of H.R. 2646 is evaluated through a comparison with a "business as usual" baseline outlined in the discussion above. The scenario generally has only modest impacts on commodity supply and demand. For nine major crops, total planted area increases relative to the baseline by approximately 0.6 million hectares (0.6%) in 2002 and by less in subsequent years. Soybean area falls slightly, while the area planted to other crops expands. These relatively small effects can be explained by the influence of several offsetting factors.

i. The additional payments relative to the baseline tend to increase crop area. The fact that the fixed and counter-cyclical payments do not depend on current planting decisions suggests that the area effect is smaller than if the same amount of payments were provided through more coupled programs.
ii. Allowing producers to update program bases is also likely to contribute to an increase in planted area. Even though payments under this program are not tied to current planted area, producers might anticipate that a future program may again allow them to update their payment base.
iii. Conversely, the reduction in oilseed loan rates tends to reduce area planted, especially the area planted to oilseeds.
iv. The increased size of the CRP also tends to reduce the area planted to major crops. Slippage effects and other factors mean that a one-hectare increase in CRP enrollment reduces the area planted to major program crops by much less than one hectare.

The modest changes in area drive the relatively small effects of the scenario on prices, use, and exports. Grain and cotton prices fall slightly in response to increased production, while soybean prices increase slightly in response to reduced production. Given small changes in feed prices, impacts of these crop policy reforms on the livestock sector would be minor. A summary of the simulation results for crop area, prices and returns is given in Table 3.

Table 3. Impacts of H.R. 2646 on Crop Area, Prices, and Returns, Average 2002-2010.

	Area (million hectares)		Price (dollars/mt)		Net Returns (dollars/hectare)	
	Baseline	**H.R. 2646**	**Baseline**	**H.R. 2646**	**Baseline**	**H.R. 2646**
Wheat	25.54	25.73	119.42	118.31	212.51	239.69
Maize	32.46	32.66	90.55	89.37	442.31	506.56
Sorghum	3.72	3.83	76.06	74.59	163.09	207.56
Barley	2.32	2.33	110.23	108.85	180.38	200.15
Oats	1.61	1.63	91.63	89.56	76.60	93.90
Soybeans	30.28	30.04	191.07	192.54	368.18	392.89
Cotton	6.16	6.22	1263.25	1254.43	365.71	491.73
Rice	1.36	1.37	164.24	162.70	605.40	736.36

Source: Simulation of FAPRI model, 2001.

Under the legislation, returns for all crops increase relative to the baseline due primarily to the additional counter-cyclical payments. For example, the contribution of government payments to overall wheat returns increases from an average of 10 percent to 17 percent over the period of analysis. The increase in soybean net returns averages $3.6 per hectare with a portion of the additional fixed and counter-cyclical payments being offset by the lower loan rate. The increased government payments reduce the relationships between variable costs and total returns. In the case of cotton, variable expenses average 65% of total returns under the baseline. The provisions of H.R. 2646 reduce the percentage to 58%. Similar declines are seen in other crops as well.

The Budgetary Impact of H.R. 2646

As with a continuation of current policies, stochastic analysis of H.R. 2646 yields substantially higher estimates of government expenditures than result from deterministic analysis. For the 2002-2010 period, stochastic analysis of H.R. 2646 results in estimated government expenditures of $144.1 billion, compared to $123.4 billion in a deterministic analysis (Table 4). Once again, marketing loan expenditures are substantially higher under stochastic analysis, given the non-zero probability that marketing loan expenditures will result even when the mean of the distribution of expected prices exceeds the loan rate.

Table 4. Estimated U.S. Government Expenditures on Farm Programs (billion dollars)

	Deterministic analysis				Stochastic analysis means		
Fiscal year	Baseline	H.R. 2646	Difference		Baseline	H.R. 2646	Difference
2002	11.58	12.87	1.29		13.37	14.44	1.07
2003	11.18	16.26	5.08		13.33	17.96	4.63
2004	10.71	17.25	6.54		13.16	19.24	6.08
2005	10.21	16.09	5.88		12.55	18.27	5.72
2006	9.61	14.70	5.09		11.99	17.25	5.26
2007	8.96	13.18	4.22		11.24	15.88	4.64
2008	8.31	11.90	3.59		10.44	14.46	4.02
2009	7.86	11.01	3.15		10.01	13.67	3.66
2010	7.72	10.18	2.46		9.70	12.94	3.24
Total	86.14	123.44	37.30		105.79	144.11	38.32

Source: Simulation of FAPRI model, 2001.

While the level of expenditures is significantly higher in the stochastic analysis, the difference in outlays between the baseline (current law) and H.R. 2646 is approximately the same over the 2002-2010 period under either the deterministic or the stochastic analysis. H.R. 2646 increases farm commodity program outlays by $37.3 billion in the deterministic analysis and by $38.3 billion in the stochastic analysis.

The estimates of changes in expenditure are similar because of offsetting effects. Late in the analysis period, the estimated differences are larger in the stochastic analysis for reasons analogous to the causes underlying marketing loan expenditures being greater in the stochastic analysis. Payments under the new CCP program decline over time as projected prices increase. In the deterministic analysis, the CCP payments become very small or even zero for some commodities, but in the stochastic analysis, there remains at least some probability of significant CCP payments.

By contrast, early in the projection period, the difference in outlays is actually smaller in the stochastic analysis than in the deterministic case. Projected market prices are lower and projected CCP payments are larger. With substantial CCP expenditures even in the deterministic analysis, the mean of the distribution of CCP expenditures in the stochastic analysis is actually slightly lower. This occurs because there is some probability that prices will be high enough that no CCP payments result, and because rules of the CCP program set a maximum CCP payment rate. Thus, CCP expenditures are effectively capped even when market prices fall to a very low level in stochastic analysis.

The WTO Perspective: Implications for AMS Expenditures

The EU Commission has been quick to point out the apparent contradiction between the provisions contained in H.R. 2646 and the stance of the US Administration in the ongoing WTO negotiations. H.R. 2646 involves the introduction of payments that can potentially be viewed as "coupled" and therefore distorting.

Determining the WTO implications of the additional spending under H.R. 2646 is ultimately dependent on the classification of the payments. For this analysis, the counter-cyclical payments are assumed to be non-product-specific amber box spending because they are triggered by current prices but do not require producers to produce the payment crop. While other interpretations are certainly possible, this assumption follows the classification of the market loss assistance payments by the USDA. The fixed payments for soybeans are classified as green box spending, following the classification of AMTA payments under the current program. Aggregate measures of support (AMS) are assumed for dairy ($4.3 billion), sugar ($1.1 billion), peanuts ($0.3 billion), and other non-product-specific spending ($0.4 billion).

Under the Uruguay Round Agreement on Agriculture, the United States agreed to limit spending on domestic support programs that are considered trade distorting to $19.1 billion per year. Given the structure of the proposed policy changes, the stochastic analysis suggests a 36.5 percent chance that the U.S. will exceed this limit in the 2002 marketing year. As prices increase over the projection period, the probability of exceeding the spending limit decreases.[2]

Conclusions

The ability to generate a large number of stochastic simulations of the FAPRI models has enabled the projections that it produces to mirror some of the uncertainty that is inherent in the agricultural system. In addition to this simulations such as that outlined above have shown that deterministic simulation of these models makes systematic errors for some variables. In particular it has been shown that this is important for the budgetary expenditures related to US agricultural policy. The introduction of new measures, such as the proposed counter-cyclical payments, further linking expenditure to market conditions increases the additional information that this type of approach can provide.

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[2] It should be pointed out that such an approach has yet to be applied by FAPRI to the analysis of the CAP, or policies in any other country. With any payments tied to prices or production, however, there will be at least some chance of significant outlays and thus a likelihood of exceeding domestic support limits.

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