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Project 8131.102

ABARE conference
paper 91.10

35th Annual Conference of the
Australian Agricultural Economics Society
University of New England, Armidale, 11–14 February 1991

Effects of Policy Change in World Wheat and Coarse Grains Markets

An Evaluation Using the FAPRI Grains Model

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In this paper the grains model of the Food and Agricultural Policy Research Institute (FAFPRI) is used to evaluate the implications that certain public policy changes in major grain exporting and importing countries or regions may have for Australian grain exporters. The model is used to examine the implications of 'planting flexibility', which is an option available under the 1990 US farm bill, and of some policy options contingent on the GATT (Uruguay Round) negotiating proposals. Specifically, a reduction in US and EC support, which comprises a 50 per cent reduction in export subsidies plus 33 per cent reductions in import barriers and in internal support, is considered.

In the latter case, the results demonstrate that a degree of success in the GATT negotiations which would guarantee reductions in agricultural support would benefit Australia through increased exports of grains and, more importantly, through world price increases for these commodities. On the other hand, the type of US planting flexibility examined in the paper has mixed effects for Australia. Prices for wheat and soybeans decline and export competition by the United States for these commodities increases, thus imposing some costs on Australian wheat and soybean producers. Prices and export prospects for feedgrains, however, improve, benefiting corn, barley and sorghum producers.

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Introduction

The international wheat and coarse grains export markets are dominated by the United States, Canada, the European Community, Australia and Argentina. These countries account for around 90 per cent of the world wheat and coarse grains exports.

In the 1980s, Australia's share of world wheat exports fluctuated between 10 per cent and 18 per cent, while its share of world coarse grains exports was about 6 per cent. The value of wheat and coarse grains exports constitutes approximately 20 per cent of Australia's total export earnings from rural sources. In 1989-90 the gross value of Australian grain crops was nearly $A4 billion, about 17 per cent of the total value of Australian farm production.

Prices received by Australian grain farmers are largely determined on world markets, the proportion of the crop being exported ranging from just under half for coarse grains to around three-quarters for wheat. Australia's ability to compete in the world market with other major grain exporters — in particular, with those exporters that adopt distortionary trade policies — largely determines the long-term prospects for Australian grain producers. US government policies which affect American grain production and sales (including 'loan rate' supports, land diversion programs and the Export Enhancement Program) and the European Community's Common Agricultural Policy (CAP), have both affected returns to Australia's grain producers.

In this paper the effects on grain trade and prices of selected policy changes in major grain exporting countries are assessed using a model of world grain trade developed by the Food and Agricultural Policy Research Institute, Iowa. Two experiments have been conducted, involving simulation of the following:

- more flexible planting arrangements recently introduced for grain crops in the United States under the 1990 Food and Agricultural Resources Act; and

- possible broad reductions in trade and internal support for grains consistent with GATT negotiating proposals.

The World Grains Market

World wheat production rose by about 50 per cent between 1975-76 and 1989-90 (Table 1). Over the same period, however, world population rose by 30 per cent, from 4 billion to 5.2 billion, so that production of wheat per head increased by only 15 per cent. (Bumper crops in the United States, the Soviet Union and China have boosted world wheat production in 1990-91 to a record 595 Mt. However, this is likely to be well above the long term trend.)

TABLE 1

World Production, Consumption and Stocks of Wheat and Coarse Grains

Year	Production		Consumption		Stocks			
	Wheat	Coarse grains	Wheat	Coarse grains	Wheat (a)		Coarse grains (b)	
	Mt	Mt	Mt	Mt	Mt		Mt	
1975-76	359	649	362	645	80	(38)	95	(24)
1976-77	425	704	384	684	121	(56)	115	(37)
1977-78	386	700	409	690	98	(53)	126	(50)
1978-79	451	755	429	742	120	(56)	139	(58)
1979-80	429	745	448	742	101	(49)	142	(64)
1980-81	445	732	449	748	97	(47)	126	(44)
1981-82	454	767	447	742	104	(54)	151	(78)
1982-83	482	784	465	753	121	(66)	182	(109)
1983-84	494	688	483	759	132	(64)	111	(40)
1984-85	518	816	503	783	147	(72)	144	(58)
1985-86	505	843	495	779	157	(85)	208	(127)
1986-87	538	832	534	806	161	(84)	234	(153)
1987-88	511	793	538	814	134	(61)	213	(134)
1988-89	504	730	532	798	106	(40)	146	(66)
1989-90	538	800	538	826	106	(39)	119	(46)

(a) Wheat stocks held by the United States, European Community, Australia and Argentina in parentheses. (b) US figures in parentheses.
Source: ABARE (1990).

Production of coarse grains has risen more slowly than production of wheat. World coarse grains production has been as high as 843 Mt (in 1985-86), and is forecast to be 822 Mt in 1990-91.

Production of wheat and coarse grains is quite variable from year to year (for example, the 1990-91 wheat crop will be up more than 10 per cent on the year before). Consumption of grains is less variable, and stocks are generally built up in bumper years and drawn on in years of low production. The level of grain stocks, however, may depend as much on government price support policies as on expectations of future consumption requirements.

World grain stocks grew dramatically over the first half of the 1980s, most of this increase occurring in the United States. Stocks peaked in the mid-1980s and then declined (Figures 1 and 2). World wheat stocks as a percentage of consumption became quite low in 1988-89 and 1989-90. The record 1990 world wheat crop has drawn attention away from the low stock situation, and will allow some rebuilding of stocks. Wheat stocks in particular, however, will still be at levels well below that of the early 1980s.

Grain stocks also serve to indicate situations of surplus or shortage. Figures 1 and 2 illustrate how, as such, stocks tend to be inversely associated with grain price movements.

FIGURE 1 - Wheat stocks as a percentage of consumption, and world wheat prices

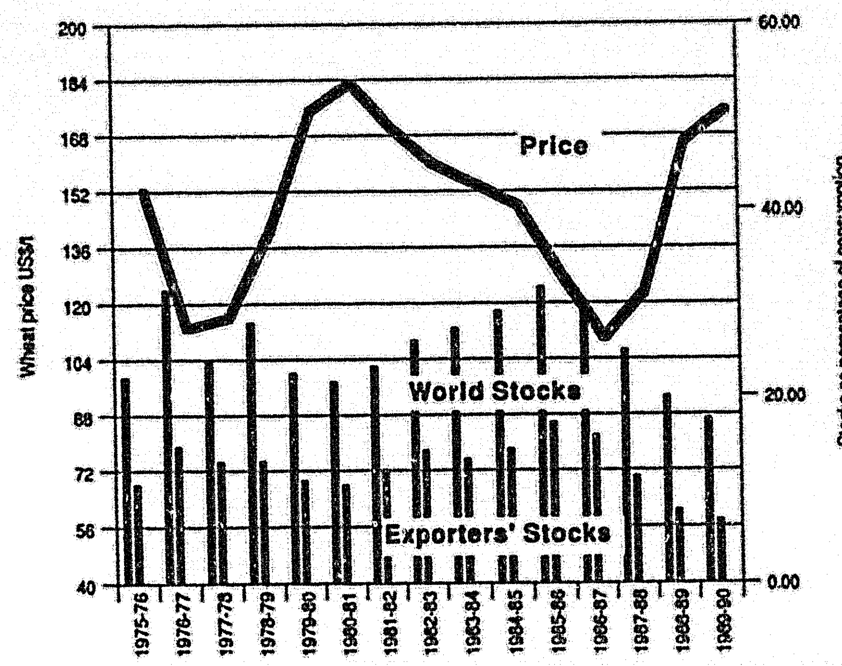


FIGURE 2 - Coarse grains stocks as a percentage of consumption, and world corn prices

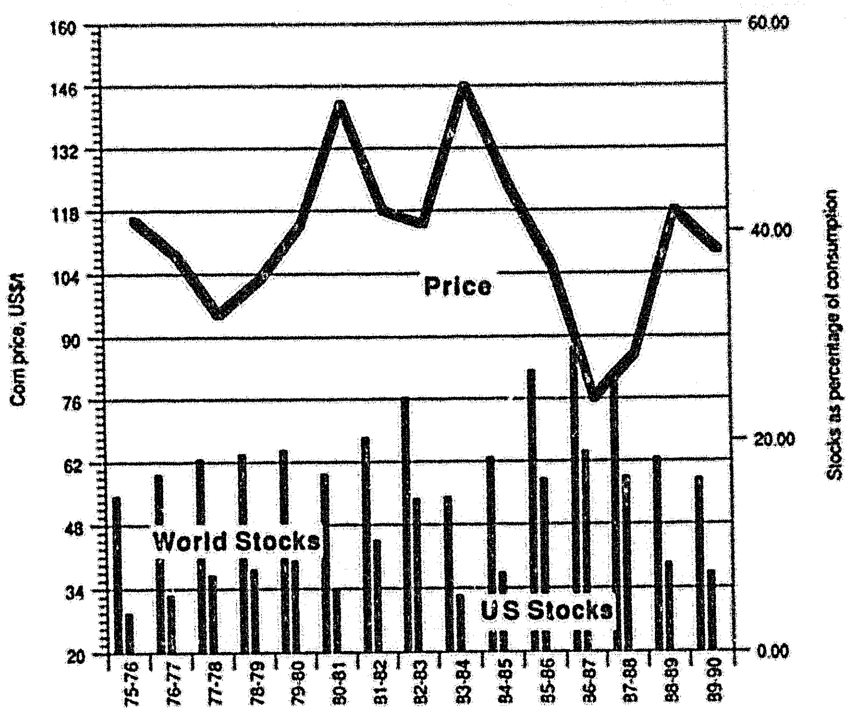


TABLE 2

Wheat and Coarse Grains Trade – Major Exporting and Importing Countries

Country	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
	Mt	Mt	Mt	Mt	Mt	Mt	Mt	Mt
Wheat exports								
European Community	14.1	15.1	17.3	14.3	15.3	14.7	19.4	18.5
United States	39.3	38.3	36.7	23.5	27.3	44.4	39.2	34.5
Canada	21.1	21.2	19.1	16.8	20.9	23.7	13.8	17.0
Soviet Union	0.5	0.4	0.6	0.7	0.3	0.3	0.5	0.4
Argentina	7.5	9.7	8.0	6.2	4.4	3.8	3.4	5.2
Australia	8.3	10.6	15.7	16.2	14.9	12.4	10.6	12.0
World total	96.1	100.4	102.6	82.0	88.8	105.8	96.5	94.6
Wheat imports								
European Community	3.4	3.4	2.1	2.7	2.8	2.4	2.4	2.1
Soviet Union	20.1	20.6	28.2	16.5	15.9	22.0	14.8	14.5
China	13.0	9.8	7.4	6.9	8.9	15.4	15.9	13.3
Japan	5.6	5.9	5.7	5.6	5.6	5.7	5.4	5.7
Egypt	6.2	7.3	6.6	6.4	7.3	7.1	7.2	7.2
Coarse grains exports								
European Community	4.3	4.3	8.5	8.1	6.7	9.5	10.8	10.3
United States	52.6	56.1	56.1	36.1	45.9	52.1	61.2	68.9
China	0.1	0.3	5.7	7.1	4.1	4.2	4.9	2.8
Canada	7.1	5.5	3.3	5.8	6.6	4.3	4.4	5.1
Argentina	11.6	10.9	10.6	9.7	5.0	5.3	3.5	4.0
Australia	1.8	4.5	6.3	5.9	3.3	2.5	2.6	3.2
World total	89.9	93.1	100.7	83.2	83.3	83.2	94.5	109.8
Coarse grains imports								
European Community	14.0	12.2	9.6	5.5	3.4	5.0	3.4	3.8
Soviet Union	11.0	11.9	27.3	13.6	10.8	10.4	23.5	22.9
China	2.5	0.2	0.1	0.7	2.1	0.6	0.3	1.0
Japan	18.7	20.7	20.7	21.5	22.1	22.4	21.5	21.7
Egypt	1.5	1.5	1.7	1.9	2.4	1.4	1.2	1.2

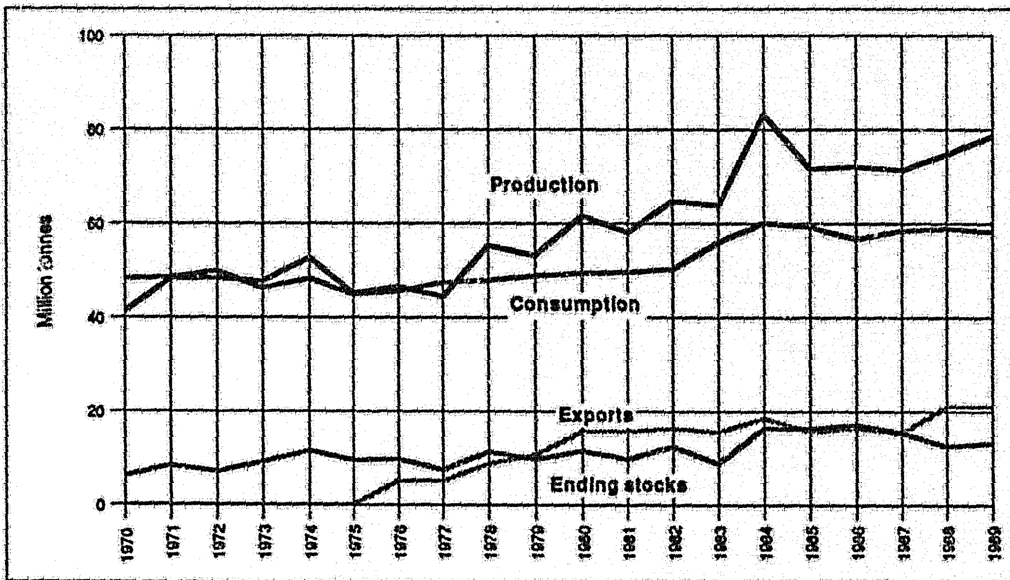
Source: ABARE (1990).

Around 90 per cent of the wheat traded on the world market is produced in the 'five exporting countries' — the United States, the European Community, Canada, Australia and Argentina. (The existence of the EC Common Agricultural Policy makes it realistic to regard the Community as a single 'country' when discussing world grain trade.) These five countries also produce around 85 per cent of coarse grains entering trade (Table 2).

During the late 1970s and the 1980s, European Community wheat production has increased steadily and markedly, but domestic Community wheat consumption has risen only slightly

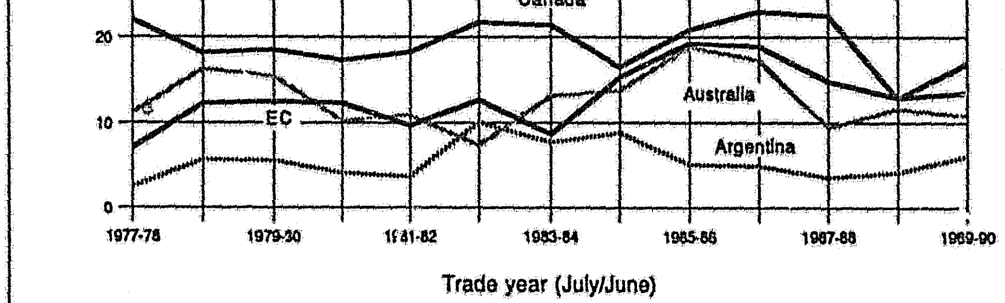
(Figure 3). As a result, the Community has emerged as a major wheat exporter. Over the period mentioned the Community increased its market share noticeably, from 7 per cent to nearly 20 per cent in 1985-86 and 1986-87, although its market share has declined to around 14 per cent in more recent years (Figure 4).

FIGURE 3 - EC wheat production, consumption, exports and ending stocks



*Excludes intra-EC trade

FIGURE 4 - World wheat trade shares



This increase in grain exports from the Community became all the more noticeable when world grain import demand levelled off in the 1980s. World trade in grains had expanded strongly in the 1970s as many developing and centrally-planned countries increased their demand for imported grains. In the 1980s, however, many of these former importers experienced difficulties in finding foreign exchange for grain purchases. Some countries, such as China and Brazil, also successfully increased domestic grain production.

The effect of domestic agricultural policies on the world grain market

World prices, production and use of grains are influenced heavily by the domestic agricultural policies of a number of key grain marketing countries: more specifically, by policies aimed at supporting the incomes of grain growers at levels in excess of those obtainable generally from the market. To achieve this income support, domestic grain producer and consumer prices are divorced from world levels using a variety of mechanisms.

In the United States, producer prices are supplemented by deficiency payments. Producers who participate in government commodity programs receive the market price plus a fixed payment per bushel intended to cover the gap between the market price and an administratively set 'target price', generally well above market levels (Roberts, Love, Field and Klijn 1989, pp. 20-21). For example, in 1990-91, the target price for wheat in the United States is US$4/bus, while the market price is expected to be around US$2.60/bus. This leaves a gap of around US$1.40/bus to be covered by deficiency payments. To be eligible for these deficiency payments, growers had to agree not to plant 5 per cent of their wheat 'base acreage' to wheat. The amount of a crop which is eligible for deficiency payments is calculated from the farm's 'base acreage' of that crop, less the specified percentage reduction, and a 'program yield'. In previous years this required 'acreage reduction program percentage' has been higher. It is limited, however, by the fact that the income forgone by growers in not planting the specified percentage of their 'base acreage' must not generally exceed the additional income from deficiency payments, or growers will not participate in the programs. (In 1990, 83 per cent of growers participated in the wheat program, and 78 per cent in the corn program.)

The US government also intervenes in the domestic grain market in two further ways. First, it acts as a buyer of last resort for grain when domestic grain prices fall below specified 'loan' levels. This provides a floor to domestic grain prices (at least for program participants), and further indirect support to growers. Second, the United States provides subsidies to grain exporters who sell US wheat in specific 'targeted' markets. Such subsidised grain is not available to domestic consumers.

In the European Community, domestic producer and consumer prices for grain are separated from world prices, and maintained above them, by the use of variable import levies and export subsidies. Domestic grain prices are set administratively each year. Competition from foreign grains is discouraged by a variable levy which adds to the price of imported grain, bringing it up to levels which are meant to be comparable with internal Community prices but which are in most instances higher. Community grain production (in response to these internal prices) exceeds domestic consumption, and the surplus is disposed of on world markets with the use of export 'restitutions'. These are subsidies which compensate Community grain exporters for grain sales to the lower-priced world market.

As well as these major grain exporters, major grain importers such as the Soviet Union, China and Japan also maintain domestic agricultural policies which insulate domestic grain production and use from the world market. The net result of this widespread insulation is to force most of the adjustment to annual supply and demand shocks on to those countries such as Australia where grain producers and consumers are subject to world market prices.

Policy developments in the United States and the GATT round

In 1990 the United States adopted a new farm act, the Food and Agricultural Resources Act, to run for the five crop years 1991-92 to 1995-96. This act replaced the 1985 Food Security Act, which operated from 1986-87 to 1990-91. Although most policy instruments from the 1985 act were retained. the new act introduced several significant changes. One of the changes was to allow increased planting flexibility, by reducing the amount of the base acreage of a given crop on which deficiency payments are paid for that crop, but allowing other crops to be planted on a part of the remainder. The latter area, on which deficiency payments are not paid, is referred to as the 'triple base'. In general, farmers' decisions as to which crops to plant on this 'triple base' area are determined by market, rather than target, prices. Target prices themselves were frozen at 1990 levels. Finally, large amounts continued to be allocated for export subsidies.

Internationally, in the forum of the Uruguay Round of GATT, the United States has advocated the phased elimination of export subsidies and domestic agricultural price supports. The United States has been supported in this stance by the 'Cairns Group' of agricultural exporters. Resistance by the European Community to the scope of the proposed changes and the timetable for them resulted in a breakdown of the talks in mid-December 1990. Talks are expected to reconvene this year, although the outcome remains uncertain.

Both the United States and the Community have proposed some reduction in the level of support for agriculture. The EC proposal, however, does not specifically distinguish between the support provided by domestic price arrangements and that provided by export subsidies.

The scenario explored in this paper is an attempt to isolate the economic effects of the type of compromise solution which eventually may be adopted in these multilateral negotiations.

A Crops Trade Model

The crops trade model used in the analysis of this paper is one component of the integrated crops and livestock modelling system developed by the Food and Agricultural Policy Research Institute (FAPRI) and the Meat Export Research Centre, both at the Center for Agriculture and Rural Development, Iowa (Bahrenian, Devadoss and Meyers 1986; Devadoss, Helmar and Meyers 1986; Center for Agriculture and Rural Development 1988; Westhoff, Baur, Stephens and Meyers 1989). A brief description of the FAPRI crops trade model is given later in this section.

Other world grains trade models

The FAPRI model is one of a number of recent efforts in modelling world agriculture. Other relevant models from the econometric literature include the MTM model, the GFOR model, the World Bank models, the US Department of Agriculture's Swopsim model, the Tyers and Anderson model and the EMABA model. Brief descriptions of the characteristics of most of these models can be found in OECD (1989).

The MTM model (OECD 1988) and the Swopsim model (Roningen 1986) are reduced-form 'elasticities' models — that is, the variables in these models are linked in assumed static relationships by a matrix of elasticities which have been gathered from other studies or assumed. Unlike the FAPRI model, they cannot be employed to generate forecasts (projection simulations). They do, however, constitute useful tools for policy analysis. The GFOR model (OECD 1987) is an econometric specification of production, utilisation, stocks, trade and price determination for wheat and coarse grains. Emphasis is given in the specification to the policy and institutional detail of these markets. The country coverage of the model is more detailed for the OECD countries, especially large OECD countries. The rest of the world is grouped into eastern Europe, OPEC countries, and high income and low income developing countries. Although this model has many similarities with the FAPRI model, it is limited in the explicit coverage of countries and regions compared to FAPRI; moreover, there exists only a limited documentation of it.

A series of models for different commodities has been constructed in the World Bank. A notable example is the 'world grain and soybeans model' (Mitchell 1985). This is an annual partial-equilibrium structural model that covers in some detail fifteen individual countries, and in less detail nine regions comprising the rest of the world. This model appears to have major similarities to the FAPRI model in its structure and specification. However, it is limited in the detail of specification of the policy instruments used by the United States in support programs for the crop sector. Tyers and Anderson (1988) have developed over recent years a dynamic, stochastic, multi-commodity model of world food markets to analyse the effects of liberalising agricultural policies in industrial countries. Finally, the EMABA model (Dewbre, Shaw, Corra and Harris 1985) is a detailed forecasting and simulation model for major Australian livestock and crops industries. Concern with non-Australian production, consumption and trade is largely confined to beef, intensive livestock and wool in major Pacific Rim countries.

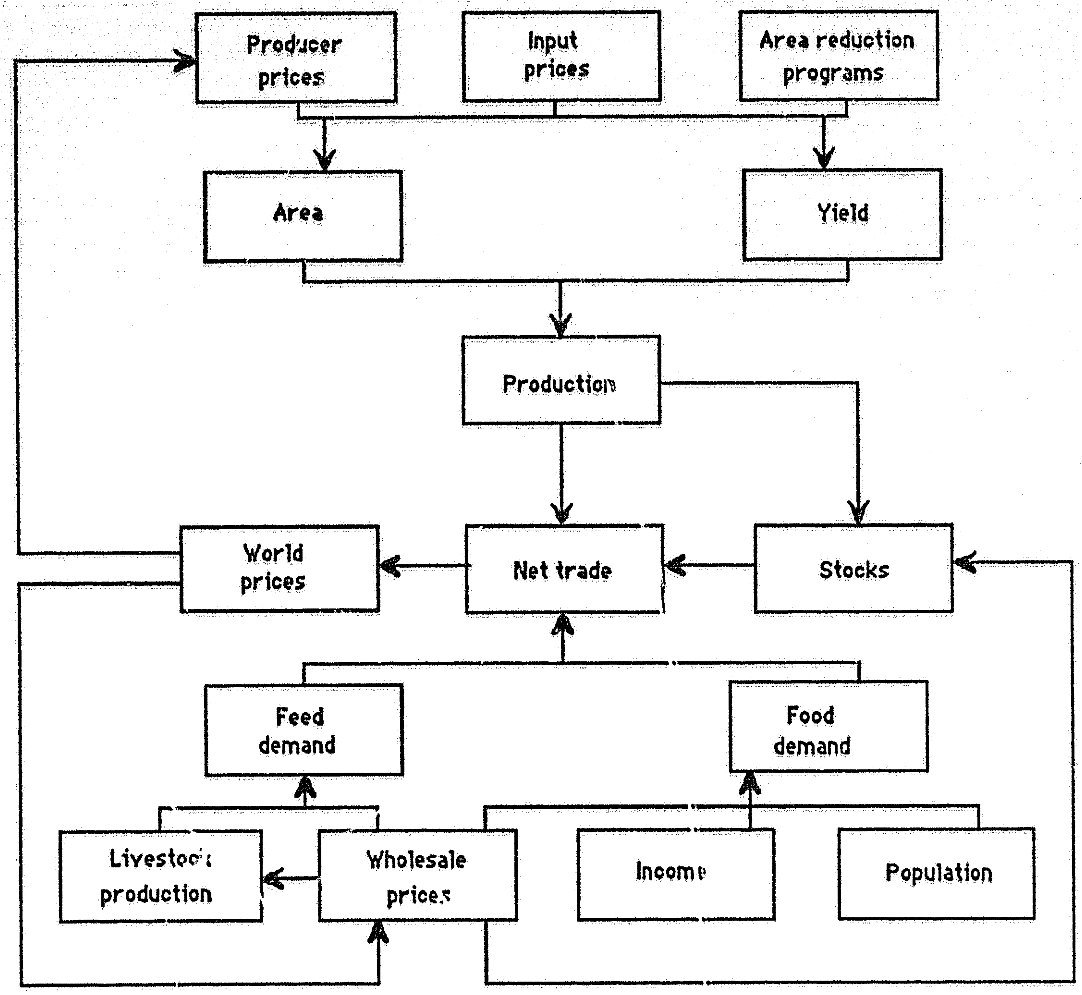
General description of the FAPRI model

The FAPRI crops trade model is an annual econometric representation of the world grains and oilseeds markets. It is a nonspatial, partial equilibrium model: partial equilibrium because only one sector and not the whole economy is modelled, and non-spatial because it does not account for transport costs and in consequence cannot be used to identify trade flows between specific regions; commodities are also assumed to be homogeneous, with no differentiation according to origin or destination.

The country/region coverage of the model varies in the degree of detail for different commodities. The emphasis is very much on the United States. A fairly detailed model structure is included for the United States which explicitly incorporates relevant policy instruments of US support programs. The rest of the world is modelled in varying degrees of detail, from structural modelling of production, utilisation and prices for major trading countries (such as Canada, Australia, European Community, Argentina, Japan) through to simple net trade equations and assumptions of exogeneity for a variety of smaller market participants. The US crops module determines domestic supply, utilisation, and prices for wheat, corn, sorghum, oats, barley, soybeans, soybean meal, soybean oil, rice and cotton. Crops modules for other importing and exporting countries contain supply and demand specifications for major grains and oilseeds. Each country module generates an export supply or import demand function, and these taken together determine the traded quantities and equilibrium world price. The world reference prices obtained are also the US prices, the United States being seen as a residual supplier.

A schematic diagram of the US module is presented in Figure 5. Basically, there are four commodity trade models in the system: the wheat model, the feedgrains model, the sorghum model and the soybean complex model. The four models are linked through cross-price linkages in their supply and demand components to facilitate simultaneous solutions. The feedgrains model spans three main feedgrains namely corn, barley and oats. Separate models

FIGURE 5 – Structure of the FAPRI grains model



are specified for each of these three commodities for some of the major market participants, while an aggregate 'feedgrain commodity' (that is the sum of corn, barley and oats) is specified for other countries. An aggregate feedgrains market is cleared, and hence world reference prices for corn, barley and oats are determined.

The countries or regions included in the wheat section of the model are the United States, Canada, Australia, Argentina, European Community (EC-12), India, Japan, China, the Soviet Union, eastern Europe, Africa and Middle East, other Asia, high income east Asia, other western Europe and an aggregate of all other countries. The feedgrain model contains 20 country/regional sub-models. Feedgrain exporters modelled are the United States, Canada, the European Community (EC-12), Argentina, Australia, Thailand, China and South Africa. Importers modelled are the Soviet Union, Japan, eastern Europe, Brazil, Mexico, Egypt, Saudi

Arabia, other Latin America, other Africa and Middle East, high income east Asia, other Asia and, again, an aggregate of the rest of the world. The countries/regions included in the sorghum model are the United States, Australia, Argentina, South Africa, Japan, Mexico, India, Nigeria, and an aggregate. Finally, the soybean trade model includes the United States, Brazil, Argentina, EC-10, Spain, Japan, eastern Europe, and an aggregate.

An ABARE version of the FAPRI grains trade model has now been constructed as a result of an exchange program between ABARE and the Center for Agriculture and Rural Development. This model comprises the wheat, feedgrains and sorghum sub-models. Updated parameter estimates of all the behavioural relationships in the grains model have been obtained and a simulation structure is available to perform forecasts (projections) and policy analyses related to developments in the world grains market. A detailed documentation of the updated estimation and validation of the ABARE version of the model is currently being undertaken. The ABARE version of the FAPRI grains model is highly complementary to EMABA (mentioned above), and hence there may be great value in future in joining the two models together to create a grains–beef–wool structural model. Such a model would facilitate forecasting and policy analysis of these important agricultural commodity markets and their main interactions.

Model specification

The FAPRI model uses linear functional forms that link endogenous variables to a set of pre-determined and exogenous variables. There are four types of equations: supply, demand, price linkage and market clearing. Where detailed modelling of supply is undertaken, grain producers in a country or region are represented by a system of area and yield equations. In the case of the United States, and to a lesser degree Canada and the European Community, the model contains equations which describe policy and institutional detail of agricultural price support and area reduction programs (Westhoff et al. 1989). Where less detailed modelling is undertaken, area equations are specified and yields are taken to be exogenous.

On the demand side, food demand and feed demand equations are specified for most of the countries/regions included in the model. Stock demand in each country is the aggregate of free and government stocks. Free stocks are determined endogenously for most commodities, while government stocks are assumed exogenous. Price linkage equations are used to represent differences between traded prices and those realised by producers and consumers. These differences may include exchange rate effects, processing margins, tariffs and export taxes. Market clearing equations determine prices.

The general forms of the domestic supply and demand blocks for the *i*th country (whether exporting or importing) and *j*th commodity are as follows:

Domestic supply block

Area harvested:

$$A^j_{it} = Aj\ (pp^j_{it-1},\ pp^k_{it-1},\ gp^j_{it},\ Z^j_{it})$$

Production:

$$Q^j_{it} = A^j_{it}\ .\ Yld^j_{it}$$

Supply:

$$S^j_{it} = Qp^j_{it} + M^j_{it} + OS^j_{it}$$

That is, area harvested (A^j_{it}) for the *j*th commodity is a function of: its lagged producer price (pp^j_{it-1}); the lagged domestic prices of competing crops k (ps^k_{it-1}); a government policy variable (gp^j_{it}); and a vector of other variables that affect acreage planted (Z^j_{it}). Production (Q^j_{it}) is equal to acreage harvested times yield (Yld^j_{it}). Finally, supply is equal to production plus imports (M^j_{it}) plus opening stocks (OS^j_{it}).

Domestic demand block

Food demand:

$$FOD^j_{it} = FODj\ (pc^j_{it},\ pc^k_{it},\ Y_{it},\ POP_{it})$$

Feed demand:

$$FED^j_{it} = FED_j\ (pw^j_{it},\ pw^k_{it},\ LPI_{it},\ LN_{it})$$

Closing stocks:

$$CS^j_{it} = CSj\ (pd^j_{it},\ Q^j_{it},\ GS^j_{it})$$

Domestic demand:

$$DD^j_{it} = FOD^j_{it} + FED^j_{it} + CS^j_{it}$$

where FOD^j_{it} is domestic consumer food demand for the *j*th commodity; pc^j_{it} is the consumer price; pc^k_{it} is the price of substitutes; Y_{it} is per capita consumer income per person; POP_{it} is domestic population; FED^j_{it} is feed demand; pw^j_{it} is the wholesale price; LPI_{it} is a livestock price index; LN_{it} is the number of livestock; CS^j_{it} is closing stocks; pd^j_{it} is stock demand price; GS^j_{it} is government stocks; and DD^j_{it} is total domestic demand.

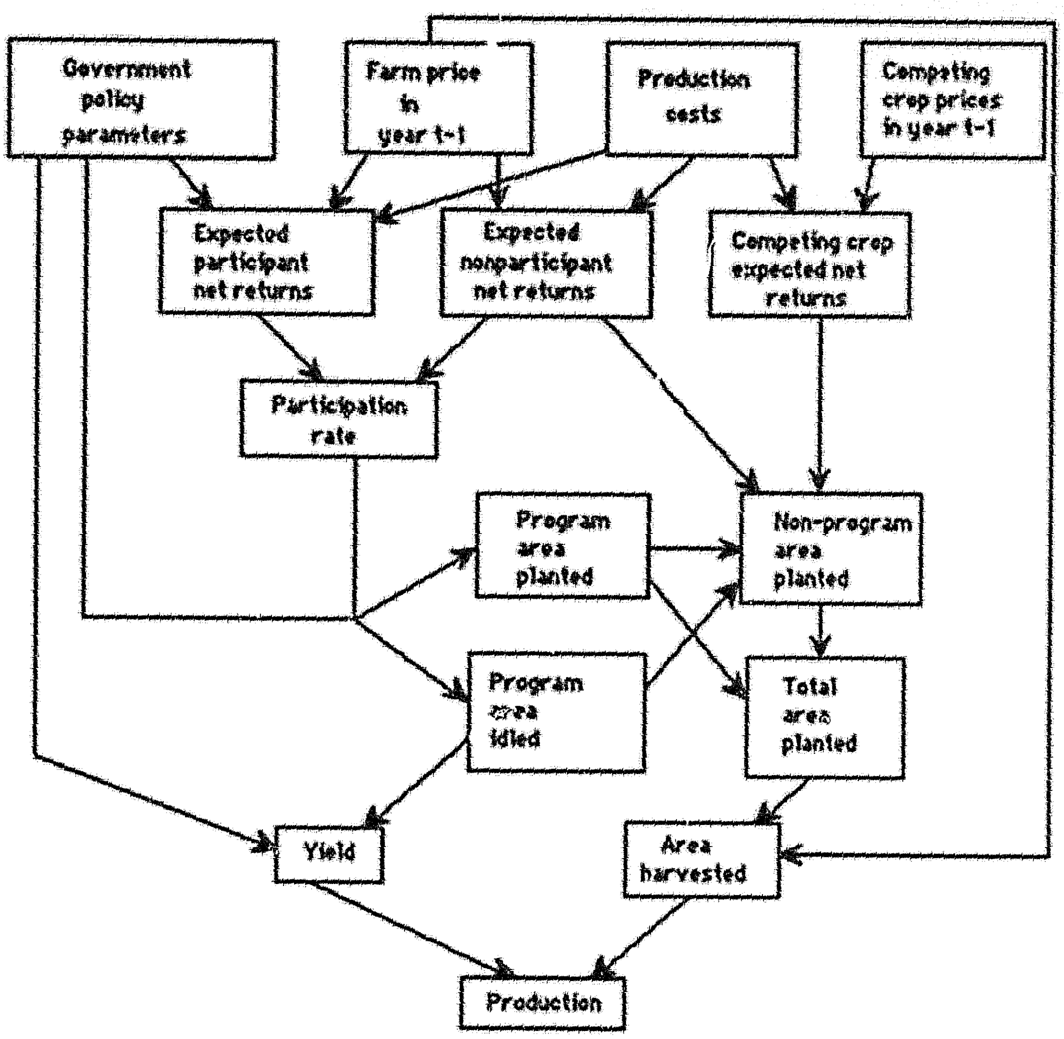
Exports (Imports)

Exports of the jth commodity are determined as a residual:

$$X^j_{it} = S^j_{it} - DD^j_{it}$$

The specifications for US grain production are much more complex than the general form presented above. Figure 6 illustrates the production determination of a typical US grain crop.

FIGURE 6 – Production determination of a US grain crop



Also, the demand specification presented above, which is based on price theory, may not be applicable to the centrally-planned economics of the Soviet Union, eastern Europe and China, or indeed to most developing countries. For these regions, total demand is postulated to depend on income and the available supplies, which are mainly from production.

Estimated supply and demand elasticities

The estimated equations for the various sub-models together with the obtained parameter estimates and other statistical measures of performance are not presented in this paper. A full account of these results and a set of validation results for the FAPRI model can be found in Center for Agriculture and Rural Development (1988) and Westhoff et al. (1989). However, selected supply and demand elasticities estimated using the model are presented in Tables 3 and 4. The selected countries/regions include five major producers and exporters of grains, namely: the United States, Canada, Australia, the European Community and Argentina. A summary of wheat supply and demand elasticities obtained from the literature in a recent study of the world wheat market by Bailey (1989) is presented for comparison in Table 5.

The estimated wheat supply elasticities (with respect to domestic prices) from the FAPRI model for these five countries indicate that wheat supply is most price-elastic in Canada, with an elasticity of 0.54, followed by Argentina with a supply elasticity of 0.38. The European Community is the other end of the spectrum, with a very price inelastic wheat supply (0.05). Australia and the United States fall between these estimates, with supply elasticities of 0.12 and 0.24 respectively.

Comparing these FAPRI model elasticities · ith other estimates found in the literature (Table 5) it is observed that: the elasticity estimated for Canada is at the top of the range of estimates from previous studies; the estimate for Argentina lies within that range; and the estimates for the other three countries are below the previous estimates. For Australia, some older studies have estimated much higher supply elasticities (Table 5), though more recently Bailey (1989) has reported an elasticity of 0.13. (For the United States, the FAPRI model specification of US wheat supply makes comparison with other elasticities in the literature difficult.)

Supply elasticities of similar magnitude to those for wheat are estimated for coarse grains in Argentina (corn and sorghum) and in the European Community (corn and barley). In the United States, barley and oats supply, and in Australia barley supply, are estimated to be much more price-elastic than wheat production. In Canada, however, coarse grains (barley and corn) are estimated to be less supply elastic than wheat. As would be expected, barley is found in most cases to compete strongly for land with wheat.

On the demand side (Tables 3, 4 and 5), food wheat is estimated (as expected) to be relatively price-inelastic. Estimates of feed wheat demand elasticity, on the other hand, range from relatively high in the FAPRI model to very high in some previous studies. Coarse grain feed demand is also estimated to be relatively price-elastic in most cases. A price elasticity of -1.27 is estimated for barley demand in Australia. Feedgrain demand elasticities estimated by the FAPRI model are mostly found at the lower end of the spectrum of such elasticities estimated by previous studies. For example, the estimated feed wheat demand elasticity for the European Community is -0.675, while Bailey (1989) has reported an elasticity for EC-10 of -1.92. Barley, sorghum and sometimes corn are found to be demand substitutes for feed wheat. In Australia, feed wheat is estimated as a relatively strong substitute for barley, with a cross-price elasticity of 0.66. In the United States, corn is estimated to substitute for sorghum with a cross price elasticity of 0.89.

TABLE 3

Estimated Supply and Demand Elasticities: United States

	Elasticities with respect to:					
	Wheat	Corn	Sorghum	Barley	Oats	Soybeans
	price	price	price	price	price	price
Wheat production	0.24		-0.06	-0.08		
Corn production		0.08				-0.02
Sorghum production	-0.04		0.27			
Barley production	-0.33			0.53	-0.32	
Oats production		-0.25		-0.31	1.05	-0.21
Wheat feed demand	-0.62	0.19				
Corn feed demand	-0.01	-0.26	0.08	0.01	0.02	
Sorghum feed demand	0.39	0.89	-1.54			
Barley feed demand	0.05	0.31		-0.6		
Oats feed demand		0.5			-1.83	
Wheat food demand	-0.02					
Corn food demand	0.04	-0.09				
Sorghum other demand		0.22	-0.67	0.42		
Barley other demand				-0.02		
Oats other demand		-0.03		-0.02	0.01	-0.02
Corn gasohol demand		-0.12				
Wheat stock demand	-3.89		0.45	0.59		
Corn stock demand		-0.67				0.02
Sorghum stock demand			-2.35			
Barley stock demand						
Oats stock demand				-0.91		
					-1.36	

TABLE 4

Summary of Estimated Domestic Supply and Demand Elasticities for Selected Countries other than the United States

	Elasticities with respect to:					
	Wheat	Corn	Sorghum	Barley	Oats	Income
	price	price	price	price	price	
Canada						
Wheat production	0.543			-0.369		
Wheat feed demand	-0.851			0.299		
Wheat food demand	-0.027					0.36
Wheat stock demand	-0.511					
Corn production		0.19				
Corn domestic use		-0.56		0.37		
Corn stock demand		-0.14				
Barley production				0.47		
Barley domestic use				-0.12		
Australia						
Wheat production	0.123		-0.068			
Barley production	-0.46			0.6		
Barley domestic use	0.66			-1.27		0.38
Barley stock demand				-1.85		
Sorghum production	-0.35		0.5	-0.4		
Argentina						
Wheat production	0.377		-0.211			
Corn production		0.36				
Corn domestic use		-0.31	0.44			
Corn stock demand		-2.94				
Sorghum production	-0.67		9.15			
Sorghum domestic use		1.79	-2.56			
Sorghum stock demand			-1.3			
European Community						
Wheat production	0.051					
Wheat feed demand	-0.675	0.62				
Wheat food demand	-0.051					0.057
Barley production				0.08		
Barley feed use				-0.27		0.75
Barley food use				-0.17		
Corn production		0.14				
Corn domestic use		-0.27				
Corn stock demand		-0.77				

TABLE 5

Summary of Wheat Supply and Demand Elasticities from Previous Studies

Supply elasticities, with respect to:

Study	United States		Canada		Australia			EC-10		Argentina	
	Expected program net returns, program acreage	Expected market net returns, non-program acreage	Wheat price	Barley price	Wheat price	Barley price	Wool price	Wheat price	Barley price	Wheat price	Sunflower price
Bailey (1989)	0.58	1.23	0.25	-0.28	0.13		-0.07	0.77	-0.85	0.32	-0.50
Barncroft (1981)	0.47			-0.06							
Krakar and Paddock (1985)			0.46								
Devadoss et al. (1986)			0.38								
Meilke (1976)			0.53	-0.69							
Dewbre et al. (1985)					0.39	-0.12	-0.1				
Vincent et al. (1980)					0.77	-0.08	-0.25				
Powell and Gruen (1967)					0.18		-0.11				
Gardiner (1986)								0.25 (EC-9)			
Meilke and deGorter (1986)								0.34	-0.75		
Waunio (1983)										0.48	-0.47

Demand elasticities, with respect to:

Study	United States			Canada		Australia			EC-10		
	Feed wheat price (a)	Corn price	Sorghum price	Feed wheat price (a)	Barley price	Feed wheat price (a)	Barley price	Pork price	Feed wheat price (a)	Barley price	Corn price
Bailey (1989)	-0.97			-1.03	0.61	-2.24	2.24	1.27	-1.92	1.98	
Gardiner (1986)	-3.22 (-0.02)	1.47							-0.84 (-0.27)		0.65
Devadoss et al. (1986)	-0.35 (-0.14)		0.87	-0.12					-3.11 (EC-9)	6.04 (EC-9)	
Gallagher et al. (1981)	-3.29		1.62								
Krakar (1985)				-0.59	0.23						
Spriggs (1981)				-0.6 (-0.03)	0.14						
Ryan (1981)						-2.76 (-0.4)	1.26	0.71			
Meyers (1982)						-2.37 (-0.17)	1.58 (b)				
Spriggs (1978)						-0.73 (-0.47)	0.73				
Meilke and deGorter (1986)									-1.37 (-0.09)	1.13	

(a) Figures in parentheses are food wheat own price demand elasticities. (b) Other feedgrains price.
Source: Bailey (1989).

An Application of the FAPRI Crops Model: Estimating the Effects of Policy Changes

The FAPRI model was used to perform a number of experiments in which a range of possible policy options were simulated. The experiments reported here were designed to capture the effects on the grains and oilseeds industries of a policy change stipulated by the 1990 US farm bill and of changes which might result from the Uruguay Round GATT negotiations.

Baseline assumptions

The FAPRI model baseline projections are based on a series of assumptions about the general economy, agricultural policies, the weather and technological change. The baseline assumptions are intended to reflect a 'most likely' set of circumstances.

After a slowdown in 1990, both US and other economies are assumed to grow at a modest pace. Inflation and interest rates remain in check, and the US dollar declines slightly in value against most major currencies. The US budget deficit also falls over time, but the US current account deficit remains large.

Major trading nations are assumed to continue their current agricultural policies. In the United States, target prices and 'program yields' (used in calculating the output eligible for price support) are frozen at 1990 levels, and current formulas determining loan rates (effective floor prices) and dairy support prices remain in effect. Intervention prices are assumed to remain steady in the European Community, and government procurement prices are frozen in Japan.

Average weather and crop growing conditions are assumed to persist throughout the five-year projection period. Past trends in technological change are assumed to continue: for example, crop yields increase according to historical trends, with some adjustment for changes in prices and planted areas. Major changes in productivity due to biotechnology or other developments are not incorporated.

More flexible US grain planting arrangements

The 1990 US farm bill (as was discussed earlier) has provisions which increase US farmers' planting flexibility. Essentially, this will allow farmers to shift a portion of their crop bases for a given crop to specified other crops (US Department of Agriculture 1990). The effectiveness of the planting flexibility options, however, will greatly depend on the incentives created by the target prices of the program crops. A producer's decision to utilise these provisions will depend on the market price of a possible 'flexed' crop relative to the target price of a program crop. To maximise the effects of planting flexibility and to align farmers' actions more closely with market signals, the incentives created by deficiency payments would need to be reduced.

To demonstrate the simulation capabilities of the FAPRI model, with its detailed specification of the US crops sector, it was used to estimate the extent to which planting flexibility options will affect grain and oilseed production, trade and prices in the United States. This simulation experiment was designed and performed at FAPRI, and its detailed description and results are reported by Westhoff and Stephens (1990). The five-year period affected by the farm bill was simulated with the provision that farmers may plant any program crop or oilseed within their total program crop area, instead of areas being specific to particular crops as in the past. Although not exact, the design of the experiment approximately models the 1990 farm bill 'flexibility' provisions.

Table 6 summarises the assumptions of the alternative policy strategies in comparison with the baseline simulation. For each farm, a 'normal crop acreage' is established, based on the historical plantings of program crops and oilseeds. Farmers may plant any program crop or oilseed within this acreage. Deficiency payments are still based on specific crop bases, but irrespective of the crop now actually planted. Acreage reduction programs remain in effect. Farmers may plant a program crop on part of their 'acreage conservation reserve' (ACR), but in that case they forgo deficiency payments on an acre-for-acre basis. Target prices are frozen at 1990 levels. Required acreage reduction percentages and all other program provisions also remain at baseline levels.

The estimates obtained are presented in Tables 7, 8 and 9. Planting flexibility options A and B lead to about a 2 per cent increase (from the baseline) in wheat area planted and about a 3 per cent increase in soybean area planted, while the areas planted to corn and sorghum are estimated to decline by 2 per cent each. Differences between option A and option B in areas planted to these crops are very small (see Table 7).

Wheat and soybean farm prices (Table 8) decline by about 3 per cent and 12 per cent, respectively. Corn, sorghum, barley and oats farm prices, on the other hand, increase by about 6 per cent, 3 per cent, 4 per cent and 1 per cent, respectively. Finally as is indicated in Table 9, planting flexibility as modelled leads to increases in US exports of wheat and soybeans by about 2 per cent and 6 per cent, respectively, and a decline in corn exports of about 4 per cent.

TABLE 6

Assumptions for Alternative US Policy Strategies Modelled

Policy instrument	Baseline	Option A	Option B
US program settings			
Base acreage	Continuation of current base acreage system: crop-specific bases determined by planting history	'Normal crop acreage' system: total farm acreage base, with crop-specific bases maintained only for determining payments and idling under area reduction program (ARP)	Same as Option A
Permitted flexibility	Continuation of current 0.25 program for oilseeds, but no additional flexibility	Farmers may plant any program crop or oilseed within their 'normal crop acreage'; payments determined by historical bases	Same as Option A
Acreage reduction programs	Continuation of current programs	Farmers may plant program crops on 'acreage conservation reserve' and forgo deficiency payments on an acre-for-acre basis; ARP percentages set at baseline levels	Same as Option A
Target prices	Frozen at 1990 levels	Same as baseline	Reduced 1.5 per cent from baseline levels
Loan rates	Continuation of current formulas	Same as baseline	Same as baseline
Government stock management	Continuation of current rules and management	Same as baseline	Same as baseline
Conservation reserve enrolment	40 million acres by 1991	Same as baseline	Same as baseline
Non-US agricultural policies	Continuation of current policies	Same as baseline	Same as baseline

TABLE 7

Evaluation of Planting Flexibility Options: Simulation Results for Area Planted in the United States

	1991 -92	1992 -93	1993 -94	1994 -95	1995 -96	Average 1991-92 to 1995-96	Change from baseline	
	Million acres					Million acres	Million acres	%
Wheat								
Baseline	77.5	77.9	79.0	78.4	78.7	78.3		
Option A	79.2	79.1	80.2	79.5	80.2	79.7	1.4	1.8
Option B	79.4	79.2	80.3	79.9	80.2	79.8	1.5	1.9
Corn								
Baseline	73.9	74.2	73.6	73.3	73.4	73.7		
Option A	72.1	73.2	72.2	71.9	71.4	72.2	-1.5	-2.1
Option B	72.2	73.2	72.3	72.0	71.5	72.2	-1.5	-2.0
Sorghum								
Baseline	12.3	12.5	12.2	12.0	11.9	12.2		
Option A	12.1	12.2	11.8	11.7	11.6	11.9	-0.3	-2.2
Option B	12.2	12.2	11.8	11.7	11.6	11.9	-0.2	-2.0
Soybean								
Baseline	55.4	56.5	58.0	57.7	58.4	57.2		
Option A	57.5	57.9	58.8	59.5	60.8	58.9	1.7	2.9
Option B	57.5	58.0	58.9	59.6	60.9	59.0	1.8	3.1

TABLE 8

Evaluation of Planting Flexibility Options: Simulation Results for US Farm Prices

	1991–92	1992–93	1993–94	1994–95	1995–96	Average 1991–92 to 1995–96	Change from baseline	
	US$ /bus	US$ /bus	US$ /bus	US$ /bus	US$ /bus	US$ /bus	US$ /bus	%
Wheat								
Baseline	3.18	3.35	3.27	3.36	3.53	3.34		
Option A	3.06	3.23	3.19	3.28	3.43	3.24	–0.10	–3.0
Option B	3.05	3.21	3.18	3.26	3.41	3.23	–0.11	–3.4
Corn								
Baseline	2.12	2.04	1.99	2.02	2.07	2.05		
Option A	2.26	2.13	2.10	2.12	2.26	2.17	0.13	6.2
Option B	2.25	2.12	2.09	2.11	2.25	2.16	0.11	5.5
Sorghum								
Baseline	1.95	1.92	1.91	1.94	1.99	1.94		
Option A	2.02	1.96	1.98	1.99	2.10	2.01	0.07	3.5
Option B	2.00	1.96	1.97	1.99	2.09	2.00	0.06	3.0
Barley								
Baseline	2.04	2.03	2.03	2.07	2.12	2.06		
Option A	2.10	2.10	2.11	2.15	2.24	2.14	0.08	3.9
Option B	2.08	2.09	2.10	2.13	2.25	2.13	0.07	3.3
Oats								
Baseline	1.63	1.66	1.66	1.66	1.69	1.66		
Option A	1.65	1.66	1.66	1.67	1.72	1.67	0.01	0.6
Option B								
Soybeans								
Baseline	5.82	6.03	5.45	5.70	6.01	5.80		
Option A	5.17	5.26	4.96	5.02	5.09	5.10	–0.70	–12.1
Option B	5.16	5.22	4.92	5.00	5.06	5.07	–0.73	–12.6

TABLE 9

Evaluation of Planting Flexibility Options: Simulation Results for US Wheat, Corn and Soybean Exports

	1991-92	1992-93	1993-94	1994-95	1995-96	Average 1991-92 to 1995-96	Change from baseline	
	Million bushels					Million bushels	Million bushels	%
Wheat								
Baseline	1483	1508	1562	1581	1605	1548		
Option A	1504	1536	1592	1619	1636	1578	30	1.9
Option B	1505	1538	1593	1621	1642	1580	32	2.1
Corn								
Baseline	2155	2259	2384	2497	2622	2383		
Option A	2108	2189	2287	2394	2497	2295	-88	-3.7
Option B	2111	2193	2291	2399	2501	2299	-85	-3.5
Soybean								
Baseline	672	681	697	720	742	702		
Option A	702	720	729	759	793	741	38	5.4
Option B	702	722	731	760	794	742	40	5.6

Qualifications and sensitivity of US flexibility experiment

The above results must be interpreted with caution. The estimates of many of the important variables are very sensitive to particular assumptions made in preparing the baseline projections or in analysing the flexibility options. The following are among the qualifications presented by Westhoff and Stephens (1990):

- Planting on the acreage conservation reserve (ACR)
  It is difficult to estimate how many farmers would choose to plant their ACR and thus forgo some deficiency payments. If more were to do so, market prices would be lower. If the program were changed so that planting on ACR was not permitted, participation rates would be lower, market prices would be higher and government costs would be lower.

- Acreage reduction percentages
  The analysis assumes that the acreage reduction percentages are the same under the flexibility options as in the baseline. If the percentages were increased to offset the effect of

producers planting on their ACR, market prices would be higher and government costs would be lower.

- Export demand
  Results are sensitive to both the level and price responsiveness of export demand. For example, suppose soybean export demand were stronger than is here assumed, as a result of increased soybean crushings and soybean meal demand in the Soviet Union and reduced rapeseed production in the European Community. In the baseline situation the increase in US soybean exports would be limited, since large price increases are needed to bring about an increase in US soybean production. Under the flexibility options the United States would pick up a larger share of the increase in world soybean demand than in the baseline case, because in this case the increase in soybean prices would be smaller.

- Variability
  The FAPRI baseline assumptions include average weather in every year of the projection period, and there are no other factors built into the baseline case that would result in wide swings in supply, demand, or prices from one year to the next. In the real world, of course, markets will show more variation. Variations can be expected to be especially large at present, when levels of stocks stand sharply reduced from levels of the mid-1980s. The flexibility options make US commodity supplies more responsive to changes in market conditions, and make it more difficult for policy makers to control supplies.

- Other policy assumptions
  For the purposes of this analysis, all program assumptions not related to planting flexibility were held at baseline levels. Changing stock management policies, loan rate formulas, conservation reserve enrolment or a variety of other policies would not only change the levels of key variables reported here for the two flexibility options, but also could change the differences between them.

Multilateral reduction in export subsidies, import barriers and internal support

The aim of this simulation experiment — also performed at FAPRI — was to determine the extent to which world grain prices and trade will be affected if certain GATT (Uruguay Round) negotiating proposals are accepted. The policy changes assumed for this experiment as a hypothetical example are as follows: simultaneous reduction in expenditures on EC export 'restitutions' and US 'export enhancement' subsidies by 50 per cent (10 per cent each year) between 1992 and 1996; and, worldwide, increased import access through tariffication of import barriers and reduction in tariffs by 33 per cent (6.6 per cent each year) between 1992

TABLE 10
World Wheat and Feedgrains Trade and Prices, assuming Multilateral Trade Reforms

	Units	1991-92 Baseline (level)	1996-97 Baseline (level)	1996-97 Reforms (change)	Average 1997-98 to 2000-01 Baseline (level)	Average 1997-98 to 2000-01 Reforms (change)
Wheat net exports						
United States	kt	39 240	43 940	670	48 420	640
EC-12	kt	18 540	19 710	–440	21 370	–590
Japan	kt	–5 490	–6 070	–480	–6 420	–680
Canada	kt	19 100	21 830	180	23 320	–240
Australia	kt	11 720	13 330	60	14 120	210
Developing	kt	–73 560	–84 980	140	–93 520	400
Centrally-planned	kt	–16 430	–15 770	110	–15 670	60
Feedgrains net exports						
United States	kt	63 383	72 165	2 727	81 766	3 463
EC-12	kt	1 088	4 333	–3 889	6 056	–4 767
Japan	kt	–21 896	–23 401	–239	–24 278	–272
Canada	kt	4 337	4 471	209	4184	332
Australia	kt	2 314	2 730	64	2713	279
Developing	kt	–37 625	–48 610	645	–56 722	794
Centrally-planned	kt	–22 574	–23 615	136	–24 978	91
World prices						
Wheat	$/t	135.85	159.25	8.53	168.51	6.48
Corn	$/t	97.65	107.28	9.62	107.34	8.00
Barley	$/t	111.9	129.35	7.49	126.41	5.66
Sorghum	$/t	95.81	104.19	5.37	102.83	3.20
Rice	$/t	284.62	322.76	29.10	349.54	23.92

and 1996. The internal support was reduced by at least 33 per cent; it was allowed to be overriden by the (larger) decrease in export subsidies, so that the reduction was usually greater than 33 per cent.

In this '50-33-33' simulation, 1986–88 average world prices and 1988 EC internal prices were used as starting points. Levels of subsidy or tariff equivalents were calculated, and were reduced at the above rates. The simulation results obtained are presented in Table 10.

The '50-33-33' plan of multilateral reduction in support is estimated — relative to the 1996-97 values in the baseline case — to lead to a 5 per cent increase in the world prices for wheat and sorghum, a 6 per cent increase in barley price and a 9 per cent increase in the price of corn.

Net wheat exports by the United States and Australia to 1996-97 are estimated to increase by about 1.5 per cent (670 kt) and 0.5 per cent (60 kt) respectively. Net exports of wheat by the European Community and Canada are estimated to decline by just over 2 per cent (440 kt) and by 0.8 per cent (180 kt) respectively. Japan's wheat imports are estimated to increase by about 8 per cent (480 kt), while imports by developing and centrally planned countries are estimated to decline slightly.

Net feedgrain exports by the United States to 1996–97 are estimated to increase by just under 4 per cent (2727 kt), those of Canada by almost 5 per cent (209 kt) and Australia's by about 2 per cent (64 kt). Exports of feedgrains by the European Community are estimated to decline by 90 per cent (3889 kt). Japan's feedgrain imports are also estimated to increase, by 1 per cent (239 kt) while imports by developing and centrally-planned countries taken together are estimated to decline by 1 per cent (781 kt).

Summary and Conclusions

In this paper the FAPRI crops trade model has been outlined and has been used to examine the implications of the planting flexibility options contained in the 1990 US farm bill and some policy options contingent on the GATT Uruguay Round negotiating proposals. Brief summaries of the trade environment and of the major policy influences surrounding the world grains market were first presented. The ABARE version of the FAPRI grains model was also introduced. The ABARE version of the grains model can be used to expand the EMABA structural model to include the world grains sector, and also can be used independently to perform projection exercises and policy analyses.

World trade and prices of grains are heavily influenced by the agricultural policies of a number of key grain trading countries and groups. The net result of the widespread use of internal support policies which lead to distortionary trade policies is to force a disproportionate share of market adjustment on to countries such as Australia where grain producers and consumers are subject to world market prices.

As regards the flexibility provisions contained in the 1990 US farm bill, the particular version examined here gives producers wide flexibility in making planting decisions, and is close to the rules actually applying. Results indicate that planting flexibility results in increased competitiveness in world markets for US wheat exports. On the other hand, it also results in either reduced producer net returns, increased government costs, or both.

The analysis has highlighted a number of the programs provisions that are particularly influential. Wider planting flexibility within 'normal crop acreage' results in larger average shifts between crops from year to year. Allowing planting of the conservation reserve further increases flexibility, but it is also a major factor encouraging program participation and hence increasing government costs. Finally, the level of target prices is a key factor in determining both government costs and producer net returns.

The extent to which world grain prices and trade will be affected if certain Uruguay Round negotiating proposals are accepted was also examined. A multilateral reduction in support comprising reductions of 50 per cent in export subsidies, 33 per cent in import barriers and 33 per cent in internal support was considered as an illustrative example. The results indicate that this reduction in support would lead to increases in world grain prices of between 5 per cent (for wheat) and 9 per cent (for corn).

The results also include some interesting estimated changes in trade flows. Wheat exports are estimated to increase for the United States by about 1.5 per cent. Australian wheat exports also increase, but only by 0.5 per cent. Canadian wheat exports, in contrast, decline by 0.8 per cent. As would be expected, EC wheat exports decline, by just over 2 per cent, while Japan's imports increase (by about 8 per cent). A slight decline in imports is shown for the developing and centrally planned countries.

Larger changes are observed in feedgrain trade flows. The United States, Canada and Australia are estimated to increase their exports of feed grains by 4 per cent, 5 per cent and 2 per cent, respectively, and there is a dramatic 90 per cent decline in EC exports. While Japanese imports are estimated to increase slightly, here too a small decline is shown for feedgrain imports by developing and centrally planned countries.

It should be noted that these changes are the differences between the experimental simulation and the levels of the baseline simulation in 1996-67. There are two key points to be made here. The results refer to the fifth year after the start of reduction in support, allowing for considerable adjustment to have taken place; and they depend critically on the assumptions about levels of support that are embodied in the baseline simulation.

Overall, the results demonstrate that some success in the GATT negotiations which would guarantee reductions in agricultural support would benefit Australia through increased exports for grains and more importantly through world price increases for these commodities. On the other hand, the type of US planting flexibility examined in the paper would have mixed effects for Australia. Prices for wheat and soybeans are estimated to decline and export competition by the United States for these commodities to increase and thus impose some costs to the Australian wheat and soybean producers. Prices and export prospects for feed grains, however, are estimated to improve and thus benefit corn, barley and sorghum producers.

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