Agricultural Protectionism and Multilateral Trade Negotiations in the GATT

by

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Abstract

The 7 year long GATT Uruguay Round (UR) of trade negotiations saw the first concerted attempt to reform world trade in agricultural products which was badly distorted by government policies to support domestic farmers. From the outset agriculture was the single most divisive issue on the 15 point agenda, with conflicts between the USA and the EC severely hampering the reform process. This study provides a review, and analysis, of the alternative strategies proposed by the main participants in the UR, and the final UR settlement, agreed in December 1993; it also provides an examination of the policy options open to governments wishing to support farm incomes with minimal distortions to world markets. The main participants accepted relatively early in the Round that an Aggregate Measure of Support (AMS) would be needed to quantify the existing level of internal support and then monitor reductions in it. Differences of opinion as to the calculation of such an AMS existed until 1990 when the main participants proposed that the AMS be based on the OECD Producer Subsidy Equivalent (PSE), but adjusted for differing policy coverage and the method of measuring market price support. Therefore, the PSE and the changes to the PSE suggested by the major participants in the UR are examined, giving the unsurprising conclusion that by 1990 the USA and Cairns Group (CG) of exporting countries were calling for a far greater reduction in agricultural support than the EC. In addition, the USA and CG required that there be separate reductions in border protection and export subsidisation while the EC contended that an AMS should capture all agricultural policies so that separate commitments would not be required. A partial equilibrium, dynamic, stochastic simulation model, covering 7 main trading areas, for wheat is developed to examine this contention; using the EC's 1990 proposals for reform, it is found that a reduction in the AMS does lead to a commensurate fall in import tariffs, but not in export subsidisation. The final UR agreement is analysed, using the model developed previously to determine whether the commitments in each of the 3 areas (internal support, border protection and export subsidisation) are compatible, in the sense that the different targets can be met simultaneously. The conclusions of this analysis are that the EC and USA are likely to have considerable difficulty in meeting the commitment to reduce the quantity of subsidised exports if the current agricultural policies are continued. Finally, it is acknowledged that although a significant aim of the agreed UR programme is raising world prices above what they would otherwise have been, it also has the effect of limiting the policy options of governments wishing to provide income support to farmers. The analysis suggests that the need to meet the UR commitment on export subsidisation will force the USA to cut expenditure on the Export Enhancement Program, and the EC to reduce intervention prices further and increase the amount of effective set aside. In addition, the cost of the compensatory payments policy is likely to result in continued budgetary crises after 1996.

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Chapter 1

Introduction

For several decades agricultural trade has been considered a problem area in the international arena. The development of increasingly complex systems of policies to support domestic farmers has had a lasting impact on the global structure of production, consumption and trade, thereby generating acute conflicts between the main trading economies, the USA and the EC, and smaller exporters such as Australia, New Zealand and Argentina. The primary concern of agricultural policy makers in many of the industrialised countries is the welfare of *domestic* farmers, with little consideration for the world market, except with regard to protecting domestic producers from competition by lower-priced imports or disposing of surplus stocks. These domestic agricultural support policies have led to a distortion of the location of world production, and of the extent and direction of trade flows[1]. In addition, while trade in industrial products has been covered by the General Agreement on Tariffs and Trade (GATT) since 1947, agriculture has received several derogations from the liberal trade principles embodied in it; for example, Article XI forbids import restrictions other than tariffs but exempts agricultural products from its provisions under certain conditions; the now infamous 'Section 22 Waiver', introduced to allow the US to impose import restrictions on dairy products even though there were no domestic supply control measures, has been used as a precedent for imposing import quotas in several countries; primary product export refunds were excluded from the general prohibition on export refunds in 1955 (Article XVI).

There have been several attempts to reduce the distortions to agricultural trade under the auspices of GATT; in 1958 the Harbeler Report set out detailed recommendations for reforming the principles of the GATT in relation to farm trade, calling for a free market with the difference between world and domestic prices in those countries supporting their farmers being eroded over a period of adjustment; in the Kennedy Round (1964-67), the USA argued for a return to the original GATT notion of a market-oriented trading system for both industrial and agricultural products while the Tokyo Round (1973-79) again saw agriculture on the agenda with a suggestion that negotiations should be oriented towards liberalisation of agricultural trade while taking account of the special characteristics and problems of the farm sector. Disagreements on fundamental issues, principally between

1 Rayner, Ingersent & Hine (1993) p62.

the EC and the US, have meant that the results from all of these attempts at a liberalisation of agricultural trade were disappointing.

The Uruguay Round (1986-93) was launched against a background of increasing agricultural protectionism and saw the first concentrated attempt to reform world trade in agricultural products. Its inclusion in the 15 point agenda was a reflection of US concerns about the effects of the EC's Common Agricultural Policy and the rising costs of farm policies in the USA. From the outset, agriculture emerged as the single most divisive issue on the agenda with conflicts between the USA, CG and the EC severely hampering the reform process. The UR, timetabled to finish in December 1990, took three more years to complete largely due to the very slow progress in the agricultural section. The crux of the disagreements in agriculture was the EC's insistence that agricultural trade could be liberalised (though not completely 'free', a concept that the USA took 3 years to accept) if the diverse farm income support polices were included in an Aggregate Measure of Support, while the USA and CG insisted that liberalisation could only take place if specific commitments were made in each of 3 areas - internal support, border protection and export subsidisation.

Various studies of the effects of liberalising agricultural trade have been carried out since the inception of the UR in September 1986. A useful review on the models and what they say about the impacts of trade liberalisation can be found in Goldin and Knudsen (1990); briefly, however, two of the most well known of the studies carried out since 1986 are those of Tyers and Anderson and of Roningen and Dixit (SWOPSIM) (the models used in these studies, along with other models, are reviewed in chapter 5). The studies by Tyers and Anderson have shown that a phased, complete liberalisation of agricultural policies by the OECD countries would have resulted in a 22 percent increase in agricultural prices by 1995 (weighted average of wheat, coarse grain, rice, meat, dairy products and sugar)[2], while the Roningen and Dixit (1989) study estimated that a complete liberalisation in 1986 would have lead to a wheat price some 36.7 percent above the level which did occur in that year. On the other hand, results from the OECD's Ministerial Trade Mandate model have shown that a 10% reduction in support by industrialised countries, from a 1982-85 base period, would lead to a fall in grain prices of around 0.3%. If developing countries are included in the liberalisation, the price increases predicted by the Tyers and Anderson model and the SWOPSIM model are significantly muted.

These studies have concentrated on assessing the overall effects of varying degrees of

2 Tyers & Anderson (1991), table 2.

liberalisation on the state of the world market. This study is an attempt to examine the details of the process of the UR negotiations as they developed, emphasising the key elements, and to analyse the final outcome with respect to the effects it is likely to have on the behaviour of the EC and USA; after all, one of the main reasons for the inclusion of agriculture in the UR was a desire to moderate the protectionist policies of these two.

Given this general background, the specific aims of this research are:

(i) to review the reform processes proposed in the Uruguay Round of GATT negotiations (UR);

(ii) to examine the reform processes for trade-distorting effects;

(iii) to analyse the alternative strategies proposed by the main participants during the UR, and examine the final agreement;

(iv) to suggest the policy options open to governments wishing to support farm incomes with minimal distortions to world markets.

The study takes the form of 7 chapters, each of which deal with a different aspect of the negotiations and the remainder of this chapter provides a route-map of the way in which the specific aims are met.

Chapter 2 gives an introduction to the domestic agricultural support policies of the USA and Western Europe, concentrating on those for the cereals sector, from the 1930's to the present day. For Western Europe this involves a discussion of the formation of the EC and the Common Agricultural Policy (CAP). In addition this chapter provides a discussion of how the internal support policies led to external conflicts as the volumes traded on world markets grew after the Second World War. The conflicts that occurred were usually dealt with at a bilateral level, or under the auspices of the GATT. Thus the history of the GATT and the treatment of agricultural trade by the contracting parties are also discussed, with a brief discussion of the attempts to reform agricultural trade in the GATT rounds prior to the UR.

Chapter 3 provides an overview of the agricultural negotiations in the UR. The negotiating positions of the leading participants, the USA, the EC and the Cairns Group, are summarised and commented upon along with the major contributions of the GATT Secretariat (the Geneva Accord (April 1989), the De Zeeuw Framework (June 1990) and the Dunkel Compromise (December 1991)). The chapter ends at the final agreement (December 1993).

In chapter 4, it is acknowledged that the main participants accepted relatively early in the Round that an Aggregate Measures of Support (AMS) would be needed to quantify the existing level of internal support and then monitor reductions in it. Differences of opinion as to the calculation of such an AMS within a programme to reform agricultural policies existed until 1990, when the main participants proposed that the AMS be based on the OECD Producer Subsidy Equivalent (PSE) but adjusted for differing policy coverage and the method of measuring market price support. In the fourth chapter, therefore, the use of AMSs in the UR is examined. This chapter begins with an examination of the PSE and the problems associated with it as a measure of trade distortions. A commentary on the changes to the PSE suggested by the major participants in the UR as solutions (the Canadian 'Trade Distortion Equivalent'(TDE), the EC's 'Support Measurement Unit'(SMU) and the CG/US 'Adjusted PSE'(APSE)) to these problems follows; the ways in which they take account of supply control policies, the choice of external reference price, and the differing distortive effects of various domestic policies are discussed. An illustration of the use of proposed AMSs in the reform processes follows. This shows that for the EC's cereals sector, the EC's offer (autumn 1990) would have resulted in a significantly higher level of support to cereal producers in 1995 than the US or CG offers. The final section of this chapter contains a comparison of the amended AMSs and the PSE. This involves estimation of a 'world' cereals price in 1995 by combining a forecast of real international wheat prices with an assumed inflation rate of 3 per cent and an assumed $/ECU exchange rate (mean rate for mid-1987 to mid-1991). The forecast is generated from an ARIMA (1,1,2) process with the degree of differencing being determined, before the Box-Jenkins procedure was initiated, using unit root tests. The rather unsurprising conclusion of this analysis is that by 1990 the USA and Cairns Group (CG) of exporting countries were calling for a far greater reduction in agricultural support than the EC. In addition, the USA and CG required that there be separate reductions in border protection and export subsidisation, while the EC contended that an AMS would capture all agricultural policies so that separate commitments would not be required. Chapter 5, therefore, is an attempt to examine the EC's expectations about the effectiveness of reductions in an AMS.

The analysis in chapter 5 is carried out using a partial equilibrium, dynamic, stochastic simulation model, covering 7 main trading areas, for wheat. A review of the modelling procedures used in other studies precedes a presentation of the simulation modelling procedure which makes up the majority of this chapter. Following the review, it was decided to construct a partial equilibrium simulation model for two reasons. Firstly, even the simplest model is very information-intensive, and, given the time constraint of a Ph.D. thesis, a partial equilibrium model was thought to be more appropriate. Secondly, and more importantly, as pointed out by Winters (1990), partial equilibrium modelling is more appropriate for a detailed examination of a particular problem or sector, in this case whether reform targets can be met simultaneously in the wheat market, especially when linkages between sectors and countries are specified. The world market is not modelled using a formal oligopolistic structure as suggested by some commentators, although the USA and EC are assumed to have some market power such that their stock decisions influence the quantity supplied to the world market and hence the market price, however, this influence is limited by domestic concerns over stock levels and world market share. The stochastic nature of the model is introduced via yield estimations for individual areas.

The EC's contention about the effectiveness of reductions in an AMS is analysed, using the EC's 1990 proposals for reform, for the EC wheat sector, under the assumption that policies remain unchanged from those in existence at the time of the UR agreement (including the policy changes embodied in the CAP reform and the 1990 FACT). Finally, it is assumed that the policies in place at the time of the EC's proposal are continued (i.e. no CAP reform) and the results examined.

In chapter 6 the actual UR agreement is analysed, using the model developed in chapter 5, to determine if the commitments in each of the 3 areas are compatible, in the sense that the different targets can be met simultaneously. The conclusions of this analysis are that the EC and USA are likely to have considerable difficulty in meeting the commitment to reduce the quantity of subsidised exports unless changes are made to their policies. In the second section of this chapter, therefore, it is acknowledged that although the agreed UR programme is aimed at increasing import demand (via the market access agreement) and reducing the quantities of subsidised exports, thereby raising world prices above what they would otherwise have been, it also has the effect of limiting the policy options of governments wishing to provide income support to farmers. The policy options open to the USA and EC at the time of the the 1995 Farm Bill and 1996 review of the CAP respectively are therefore examined. The current policies are assumed to apply until these dates, after which changes can be made to (i) the percentage of required set-aside in EC; (ii) the administered prices (e.g. the intervention price); (iii) the compensatory payments in the EC; and (iv) the Export Enhancement Programme. Although compensatory and deficiency payments do not feature in the AMS calculation, making it easy for both the USA and EC to meet the internal support commitment, the results suggest that the need to meet the UR commitment on export subsidisation will force the EC to reduce intervention prices further and increase the amount of effective set-aside. In addition, the cost of the compensatory payments policy is likely to result in continued budgetary crises after 1996.

The conclusion to this study is presented in chapter 7. The chapter begins with a summary of the results presented in chapter 4 to 6, and a discussion of the significance of these results in relation to the questions posed in the course of the analysis. The results presented in this study are, of course, dependent upon the the effectiveness of the model used to generate them. A discussion of the limitations of the simulation model, and hence the results presented in chapters 5 and 6, forms the next section of this chapter. Finally, as with most research, the analysis of one set of questions throws up another, perhaps more interesting, set and this thesis is no exception. As a consequence, the concluding chapter includes some suggestions for further research into this area.

Chapter 2

Agriculture and the GATT

2.1 Agricultural Protectionism: A Historical Perspective

For political reasons ranging from national food security to the preservation of rural life (and winning elections), farmers have, for over a century, been granted special status by the governments of industrial economies. They have been the recipients of government and consumer transfers aimed at stabilizing and supporting farm incomes, and providing a regular, sufficient supply of food to domestic markets. The systems of policies now used by the economies providing comprehensive support (mainly those in Western Europe, the USA and Japan) are complex, mainly to correct the imbalances caused by the principal policy measures, which have had a lasting impact on the structure of production, the patterns of consumption and international trade, domestic income distribution and welfare. This section gives an overview of the different methods of agricultural support chosen by the two main trading developed economies for the cereals sector[1] (the USA, and the countries now forming the European Communities[2] (EC)), together with some insight into the rationale behind these choices and examines how the domestic policy objectives have led to the growth of protectionism and the GATT conflicts observed between the main trading nations.

2.1.1 The Development of Agricultural Support Policies

The United States

Although there had been sporadic depressions in the agricultural sector of the US economy since the late nineteenth century, and the question of agricultural income support had been discussed extensively throughout the 1920s, the depression of the 1930s brought the first actual government intervention in agricultural markets. The Agricultural Adjustment Act (AAA) of 1933 was part of Roosevelt's 'New Deal' and was made politically necessary by

1 The USA and EC are not the only significant exporting countries but emphasis is placed on these two because of their prominent role in the Uruguay Round and hence the remainder of the thesis.

2 Encompassing the European Economic Community (EEC), the European Steel and Coal Community (ESCC), and the European Atomic Energy Community (EAEC), which were merged in 1967. At the time of writing the EEC has become one facet of the European Union, brought into being by the Maastricht Treaty.

the chronically low incomes of farmers relative to the rest of the population and by the increasing number of farm failures. It authorised the Federal government to control the flow of agricultural produce onto the market in an attempt to raise prices to farmers. Permissible measures included the setting up of voluntary agreements among processors and distributors of agricultural produce to eliminate 'unfair' practices (the Marketing Orders), payments to producers for land 'idled' (i.e. supply control) and for production on an 'allotment' acreage, and the 'non-recourse' loan system. The latter became the cornerstone of US agricultural policy and operates as follows. The government sets a 'loan rate' (effectively a floor price) at the start of each marketing year. Farmers can borrow at that rate before the harvest, using their expected crop as security. If, after the harvest, the market price is above the loan rate the farmer can sell on the open market and repay the loan. If the loan rate is above the market price the farmer forfeits his commodity as full payment of the loan to the Commodity Credit Corporation (CCC), a government financed corporation created in October 1933. A notable exception to the loan rate system was the sugar sector which continued to be supported via import controls (e.g. the Smoot - Hawley Tariff of 1930); however, in 1934, production and import quotas were introduced along with set-aside payments. The 1933 AAA also allowed for the use of 'benefit payments' to boost the income of farmers who agreed to participate in a programme to reduce production, paid for by a special excise tax on processors. The latter was declared unconstitutional by the Supreme Court in 1936 and by 1938 a new AAA was passed which emphasised conservation as the prime reason for the production controls and the supply management programmes contained in the original Act. The payments to farmers for the 'conservation' measures they implemented were to be appropriated from the Treasury. The 1938 Act also implemented import quotas for processed dairy products to defend the support prices set under the loan rate/ Marketing Order system. Whether the price and income supporting measures contained within the AAA would have solved the long standing depression in farm incomes was never to be determined, as the shortages in Europe caused by the Second World War (WW2) pushed prices high enough to make the measures inoperative from 1940 until 1951 (with the exception of 1949). After this time prices fell sharply as foreign demand was reduced following the end of the Korean war and the phasing out of post WW2 relief in Europe .

After WW2 the farm policy debate began in earnest with interested parties polarizing into two groups; those advocating a reduction in the extent of government intervention with a substantial lowering of the level of price support ('Republican party leaders, businessmen from the agribusiness complex, and most economists' (Cochrane p144)) , and those advocating the maintenance of high prices as a means of supporting farm incomes ('Democratic party leaders from the South and the Plains, the farm organisation leaders who had led the battle for the agricultural adjustment legislation .... some government economists, and form time to time some union leaders' (*ibid*). In addition technological developments within the agricultural sector (improvements in the efficiency of machinery, in yields, in the disease and drought resistance of crops, and the increased use of commercial fertilizer) led to extensive restructuring of the industry and, perhaps more importantly, an increase in the level of supply - 25 per cent in the 1940s[3] Faced with an inelastic domestic demand and slack exports, a situation of excess capacity and chronic oversupply persisted throughout the 1950s and 1960s. The US government refused to face the consequences for farm incomes of tackling the excess capacity question by dismantling the support system (or even reforming it substantially), so that it was effectively rolled over from year to year with the level of price and income support in any one year being determined by the relative strength of the two lobbies. Although three major attempts were made to break the stalemate (the Brannan Plan (1949) and efforts by E. Benson (1952-60) and D. Freeman (1961-63)), a compromise was not found until 1964.

For cereals the 1964 Agricultural Act has formed the basis of American agricultural policy to the present day[4] - adjustments have been made, but essentially the mechanisms embodied in the original Act remain. The Act redefined the role of the market price support mechanism as price stabilisation rather than income support. Thus levels of price support (via the loan rate) for each commodity were reduced towards the world market rate. Support of farm income, when needed, was in the form of direct income payments which, in keeping with the 1936 AAA, would only be made if farmers participated in authorised production control programmes when the over-supply situation became too burdensome. In addition, the application of the direct payment was limited to the proportion of output sold domestically; production destined for the export market was not covered until 1973. The storage and surplus disposal schemes which had been a feature of US farm policy since the 1938 AAA were retained to deal with any surpluses which occurred and any possible short term shortages domestically and abroad.

Generally favourable world market conditions allowed farm income support policies to continue in the same vein during the 1970s with only minor adjustments; if anything, farm lobbies succeeded in increasing the amount of support potentially available to producers as

3 Cochrane (1989) p137.

4 The sugar, dairy, tobacco and peanut programmes were not changed by the 1964 Act.

relatively high world market prices kept government costs low. Two significant developments did occur, however, in the 1973 Agriculture and Consumer Protection Act. One was the introduction of the 'Target Price', which assured producers a set price for their allowed production, including exports, through a deficiency payment representing the difference between the Target price and market prices (or the loan rate, whichever was the higher). A deficiency payments ceiling of $20,000 per producer of wheat, feed grains or cotton was introduced to limit budgetary expenditure. The second was the considerable discretion which the Secretary of Agriculture had in setting loan rates and target prices - previously loan rates had been rigorously set according to a 'parity' formula.[5] (Note that due to the high levels of world market prices, the measures in the 1973 Act did not become operational in the 1974-76 period. The expected effects of the deficiency payments ceiling (discrimination against larger farmers which would encourage them the grow larger to maintain total returns) could therefore not be analysed). In 1977 an alternative to forfeiture to the CCC was introduced into the loan rate system for cereals. Previously participants had either to repay loans or forfeit crops to the CCC after 9 months. The new alternative was to place grain in a Farmer Owned Reserve (FOR) for up to 3-5 years (depending on the programme), in the expectation of improved market prices, with the government paying the storage costs and farmers receiving a payment (a FOR loan) for storing the grain. The FOR loan rate was higher than the CCC loan rate. Note that for sugar the 1977 Food and Agriculture Act introduced payments to producers without production controls, and significantly increased import duties.

The 1980s began in optimistic mood. The 1981 Agriculture and Food Act (AFA) was drawn up in the expectation of continuing high market prices, high inflation and a belief by many in the government that the the key agricultural issue of the 1980s was going to be how to produce enough food for the world's hungry rather than curbing surpluses. Hence, for those participating in production control programmes, high minimum target prices and loan rates were set with a continuation of deficiency payments to make up any gap between the market price (or the loan rate, whichever was the higher) and the target price. Production control could take the form of the traditional set-aside or one of the crop-specific acreage reduction programmes (ARP) introduced as part of the AFA. However, market conditions were rather different from those expected in the early 1980s (mainly due to changes in the macro economy and the dollar exchange rate). A situation of global surplus necessarily changed the emphasis of US farm income support policies away from

5 The 'Parity Price' was defined as that price which kept the ratio of farm prices received to the index of prices paid by farmers equal to that which prevailed in the base period (1910-1914).

encouraging surplus production, and towards curbing the excess supplies which were having adverse effects on the levels of world market prices, stock-holdings and the US budget. Adjustments to the AFA included the introduction of an export promotion policy in 1982 to complement the measures already operated by the CCC[6]; the establishment of a 'Payment In Kind' programme in order to ease the budget in 1983 under which farmers were paid not to produce with payments being made in the form of government held commodities rather than cash; and in 1984 the introduction of triggers for ARPs to limit production further.

By the time the 1985 AFA was to be discussed, market conditions had not significantly improved and the high budgetary outlays on agricultural policies prompted the Reagan Administration (who wanted to reduce government intervention in all sectors of the economy) to propose a change in US farm policy. It proposed an income 'safety-net' for farmers rather than support through market intervention. Extensive discussions in the House and Senate agricultural committees produced a less radical compromise which nevertheless was aimed at encouraging a more market-oriented approach in the agricultural sector. For cereals, cotton and rice loan rates were tied to a five-year moving average of market prices, but were also subject to discretionary reductions of up to 20 per cent if the previous season's prices were low or if the formula-determined rate was likely to affect market competitiveness. Target prices were frozen for the first two years of the Act with the provision for reductions in the subsequent three. The production control measures (especially ARPs) were tied to trigger stock levels and an Acreage Conservation Reserve was introduced to reduce soil erosion (which effectively restrained production further as harvesting and grazing were not allowed on the affected land). As before, deficiency payments were only to be paid to those participating in supply control. In the dairy sector a 'herd - buyout' scheme was introduced which, over a three year period, 'resulted in the slaughter of about 1 million dairy cows (about 8 per cent of the total dairy cow population)' (Gardner (1990)). In addition, provision was made to cut support prices if CCC stocks of butter or skimmed milk powder rose to unacceptable levels (an accumulation of more than 5 billion pounds). For sugar deficiency payments were ended so that price support relied solely on import quotas. One significant extension of government intervention, however, was in the international market. In response to what the US saw as 'unfair' trade practices by other countries (principally the EC,) the Act introduced two new forms of export assistance; the Export Enhancement Program (EEP) and the Targeted Export Assistance

6 A revolving export credit facility for importing nations; funds provided by the Secretary to provide export subsidies to match those of foreign governments if required; and various food aid programmes (e.g. PL 480).

Program (TEA). Under the EEP, trading firms which successfully tendered to export specific commodities to specific markets were provided with bonuses from CCC stocks to help reduce the price of such exports. Essentially it is a discriminatory export policy aimed at winning back markets gained by other countries through 'unfair' trading. For similar reasons, the TEA provided cash on CCC commodities to help US exporters expand their foreign sales.

The effects of the 1985 Farm Bill were, initially at least, favorable to the agricultural sector while the costs of the programmes reached record levels. Despite high world market prices in 1989 (due mainly to the US drought of 1988) the programme costs remained high and discussions for the 1990 Farm Bill centered on reducing government expenditure on agriculture. The most important feature of the 1990 Bill was the introduction of the 'triple base' scheme. Incorporated under the ARP, it is compulsory for all participants in the US cereals scheme, and aims to reduce the amount of deficiency payments a farmer may receive through a 15 per cent reduction in the crop area eligible for a deficiency payment. The farmer may, however, grow another crop on the 15 per cent 'triple base' area, which is not itself eligible for deficiency payments. Note also that the TEA was renamed as the Marketing Promotion Program (MPP) and was expanded.

Western Europe[7]

Government intervention in agriculture has a longer history in the countries of Western Europe than in the USA. Brief interludes of market orientation have occurred, for example in the mid-nineteenth century, but essentially the countries which now form the EC and the European Free Trade Association (EFTA) have protected farmers from the vagaries of agricultural markets for over a century[8].

As in the US, the depression of the late 1920s and early 1930s prompted extensive government intervention in the agricultural sector, although the preferred method of support in most Western European states was tariff protection rather than the loan rate and deficiency payments policies favoured by the US. Tariffs had been used by France, Germany, Switzerland, Austria and Belgium prior to the depression to protect their farmers from import competition and allow the agricultural sector to develop. As world prices of agricultural produce fell, tariffs were raised to protect domestic farm incomes and

7 This section draws primarily on Tracy (1990).

8 The governments of Britain, Denmark and the Netherlands have been less enthusiastic about market interventions than those of the other European countries but have nevertheless resorted to them when circumstances dictated.

production. Liepmann[9] has estimated that 'average potential tariff' levels for foodstuffs (an unweighted average of 38 important foodstuffs) as a percentage of export prices for these countries were around 2 to 2.5 times higher in 1931 than in the previous depression (pre the First World War); in some countries the 'average potential tariff' level reached over 100 per cent of export prices. The sustained fall in world market prices also prompted the UK to impose tariffs on agricultural imports in the autumn of 1931. This was a significant development given Britain's previous commitment to universal free trade.

Despite their high levels, tariffs alone did not prove to be an effective means of protection as world prices were so low that exporters (primarily the US for cereals) were prepared to sell at almost any price. A series of non-tariff barriers was thus introduced. The first of these was the 'milling ratio', introduced by Norway in 1927, under which millers were obliged to use a minimum percentage of domestically-produced wheat and/or rye. The ratio of home-produced to imported grain was variable and could be set to reflect the market situation. France and Germany adopted this measure in 1929, with much of the rest of Europe following suit during the early 1930s. In almost all of the countries operating the milling ratio scheme, the proportion of home-produced grain to be incorporated rose as the crisis deepened, reaching almost 100 per cent in France, Germany, Italy and Sweden. In addition, the general idea of what Tracy calls 'linked-utilisation' policies caught the imagination of the policy makers such that similar measures were applied widely to feed grains, to margarine in Sweden, the Netherlands and Denmark (where a minimum proportion of domestic butter or lard had to be included), and to several non-agricultural products. The second form of non-tariff barrier to be implemented was the import quota. The French government applied import quotas to provide emergency cover for a few products in 1931. France, Germany, Belgium, Italy, the Netherlands and the UK later adopted import quotas as an integral part of their agricultural policies.

As the 1930s progressed it became clear that the protectionist measures were not a panacea for the problems of the agricultural sector. In France wheat surpluses and falling farm incomes induced the government to introduce, firstly, fixed minimum prices and then, when the costs of dealing with the resulting surpluses became too great, guaranteed prices supported by government purchasing of part of the crop. The guaranteed prices were set significantly above world market prices which encouraged increased production while suppressing domestic demand. As the surpluses continued to rise, France became a net exporter of wheat for the first time. In Britain, a 10% ad valorem tariff was imposed on

9 Referenced in Tracy (1990) pages 22 and 123.

most goods (although wheat, maize, meat, livestock and wool were exempted). However, pressure from the Empire countries, whose exports were mainly agricultural, led to an agreement to exempt all goods from the Empire from duties. This weakened the UK's efforts to protect agriculture form import competition. The British solution to the farm income problem involved commodity by commodity measures rather than the less commodity specific solution pursued by other Western European countries[10]. Individual products were supported through various combinations of subsidies, import restrictions and marketing schemes. The latter were established in the 1931 and 1933 Marketing Acts, and allowed a 'substantial' majority of producers of any one commodity to adopt a marketing scheme regulating minimum and sometimes maximum prices and other aspects of the production process. The marketing scheme, if approved by Parliament, was to be binding on all producers of that commodity. Marketing schemes were set up for milk, potatoes, hops and pigs. For wheat, a deficiency payments scheme was enacted with a guaranteed price set above the market price and a subsidy equal to the gap between them paid to farmers. The payment was initially limited by a production ceiling to discourage excessive expansion of production; it did not, and wheat production rose at the expense of oats and barley such that by 1937 guaranteed prices were introduced for these products also. Under the centrally-planned fascist economies of Germany and Italy, agriculture was treated as any other industry. The agricultural sector was organised, in accordance with government plans, such that all aspects of food production, distribution, trade and prices were regulated by state marketing boards. The aim of the government plans was self-sufficiency (i.e. increased production). Even the more liberalised exporting economies (Denmark, Switzerland and the Netherlands) were forced to intervene in agricultural markets as their exports were threatened by the protectionist policies of their neighbours. As in the other European countries, the policies implemented included minimum prices coupled with state subsidies, marketing arrangements and milling ratios although the emphasis of the policies was not import control but was necessarily more export-oriented.

During, and for sometime after the end of, the Second World War the overriding aim of agricultural policy in most of Western Europe was to increase domestic production. The income support policies developed in the 1930s, but abandoned during WW2, were reinstated and expanded. For example, in Britain the deficiency payments scheme and the Marketing Boards were reintroduced; in France the guaranteed prices and government purchasing programmes were joined by a policy to promote the mechanisation of agriculture, thereby releasing labour for industry. Western Germany particularly needed to

10 ibid p152.

increase food production as it was cut off from its traditional sources of supply in East Germany. Imports provided the bulk of the food supply, financed partly by the Marshall Plan from 1948, while the domestic sector developed. The support policies implemented by West Germany were similar to those of France, with 'stable' prices being maintained by the State Import and Storage Boards purchasing and selling commodities at the appropriate time, and controlling imports.

The various support policies successfully stimulated production so that by 1951 crop production had reached pre-war levels in most Western European countries. Production continued to rise mainly due to the considerable technical progress in agricultural inputs (especially in machinery) which occurred throughout the 1950's, and the continuation of policies to encourage production. However, food consumption grew relatively slowly after the initial post war shortages had been overcome. The governments of Western Europe were therefore faced with large and increasing surpluses in many products. In addition, incomes per head in agriculture were still well below those in other sectors in most countries[11]. The emphasis of the support policies thus moved away from a general increase in production towards selective expansion and improved efficiency. However, the same basic mechanisms of income support were retained; these tended to stimulate production, so an increasingly complex set of policies evolved to try to curb production while at the same time dealing with the problem of low farm incomes.

The Common Agricultural Policy

The six founding countries of the European Economic Community (EEC) - France, Germany, Belgium, Luxembourg, the Netherlands and Italy - agreed in the Treaty of Rome[12] that a 'common market' should be established in all sectors including agriculture. The common market would allow free trade across the borders of the Member States but have a common level of protection against goods originating elsewhere, in the form of a common external tariff. Article 39.1 of the Treaty sets out the objectives of the Common Agricultural Policy (CAP). These are to provide adequate supplies of food to consumers, at reasonable prices, from a stable market, while at the same time ensuring a 'fair' standard of living for the agricultural community and increasing agricultural productivity through the promotion of technical progress and the rational development of the factors of production. It proved difficult (and somewhat acrimonious) to establish a common market in

11 ibid p219.

12 The treaty establishing the EEC and its organisations (the Commission, the Parliamentary Assembly (now the European Parliament), and the Court of Justice), and the EAEC, 1957.

agricultural products because of the variation in the national policies of the Six, which were well-established and which the governments were loath to give up without a fight. The final package of measures which formed the CAP was not agreed for all products until 1970, even though the basic system was agreed in 1962. The support system envisaged in 1962 rested on the management of surplus stocks to maintain high internal market prices and protection against the lower prices on world markets through a variable import levy (VIL). The Commission was to establish, annually, a 'Target' price for the internal market which in turn determined the price at which intervention buying (by the various national Intervention Boards acting under EEC legislation) would occur. Any chronic surpluses could be disposed of in 'Third countries' (those not belonging to the EEC) with the aid of 'export restitutions'. In theory, the latter were to represent the difference between internal EEC and world market prices; in practice they were sometimes subject to political tinkering. The VIL was to be equal to the difference between the fluctuating, lower world price and a fixed minimum import price, the 'Threshold' price, which was also set annually by the Commission. The import levies applied initially to intra-EEC trade, but were progressively removed as internal prices were harmonised. All common prices were expressed in Agricultural Units of Account in the absence of a common European currency[13]. The common polices were to be financed by national contributions to the European Agricultural Guidance and Guarantee Fund; the guidance section was to deal with 'structural' spending, and the guarantee section with expenditure on export restitutions and intervention.

The support system finally agreed by the Six was essentially the 1962 system, i.e. an amalgamation and extension of the traditional support measures in the major countries (France and Germany). It was agreed that any country wishing to join the common market would have to accept the CAP as it stood, subject only to transitional derogations (the *acquis communautaire* principle).

This was the position in January 1973 when Denmark, Ireland and the UK became members of the EC[14]. The new Member States had a six year period to progressively adjust their internal support prices to Community levels. The UK needed additional derogations from the CAP to allow the continued operation of the marketing boards and give some preference to imports from Commonwealth countries (mainly through bilateral agreements on import quotas or 'voluntary' export restraints). Its deficiency payments

13 The Unit of Account was replaced by the European Currency Unit (ECU) in 1979.

14 Recall that the three communities had become one by this stage.

scheme had become costly and the government had already begun replacing it with other measures. The EC was again enlarged in 1981 with the accession of Greece and in 1986 when Spain and Portugal joined; the same principle of *acquis communautaire* applied.

The CAP framework did little to relieve the problem of excess supply within the EC, indeed it moved from being a net importer to a net exporter in a relatively short period of time. Neither did it satisfactorily improve the structure of the farm sector. Expenditure on agricultural support grew throughout the 1970s reaching crisis point by the mid 1980s.

The Commission introduced a series of measures aimed at curbing the growth of the agricultural budget. In the cereals sector, the over-supply situation was particularly bad (along with that in the dairy sector where production quotas were introduced in 1984). Guarantee thresholds were introduced in 1982 to reduce the price incentives to over-production[15]. Although these were intended to penalise farmers when the production thresholds were exceeded the policy was not very effective as the penalties were not automatic and the agriculture ministers of the Member States, under pressure from the farm lobbies, found several ways of mitigating the effects of the penalties, e.g. by raising prices. In 1986 the co-responsibility levy was introduced; this effectively made producers themselves pay towards the storage costs of intervention. The situation did not improve and in 1988 the EC introduced the 'stabiliser mechanism'. Under this mechanism a total maximum guaranteed quantity (MGQ) for all cereals of 160 million tonnes was set. Production above the MGQ induced a 3 per cent cut in the intervention price for the following year. In addition, the unit co-responsibility levy would be 6 per cent of the intervention price rather than 3 per cent if the MGQ was not exceeded. A land retirement scheme ('set-aside') was also introduced as part of the stabliser package, with farmers being paid to set-aside land from crop production and put it to some other use e.g. grass. Farmers who set aside at least 30 per cent of their arable land were exempted from any co-responsibility levy on the first 20 tonnes of their sales.

The stabiliser mechanism did not control the over-supply situation within the EC. In 1991 budgetary crises again forced a review of the policies. In the cereals sector the basic co-responsibility levy was increased from 3 per cent to 5 per cent of the intervention price, and a special one year set-aside scheme was introduced. Under this scheme farmers set-aside a minimum of 15 per cent of their land given to all supported crops, in return for a reimbursement of the 5 per cent co-responsibility levy. However, the policy of supporting

15 Durum wheat and rice were not covered by the guarantee thresholds.

farm incomes by maintaining internal prices significantly above world prices remained central to the CAP.

In July 1991 major modifications to the CAP were proposed in what became known as the MacSharry Plan. The proposals were aimed at solving the CAP's major problem - that of over-production. The plan essentially involved various combinations of support price reductions and quantity restrictions in each of the important agricultural sectors. In the cereals sector, a cut in the intervention prices of 42% by 1995/96 was proposed. 'Compensatory payments' for the price reduction would be paid if farmers agreed to set-aside 15% of their arable crop land (although set-aside compensation would only be payable on the first 7.5 ha of this land). The compensatory payments would be made on the basis of a fixed, average EC yield thereby disadvantaging more efficient producers, while the limit on the set-aside payments would have disadvantaged larger producers[16]. The MacSharry Plan proved too radical for many of the Member States. Britain in particular was unhappy with the proposals to limit the area on which set-aside payments would be made because of the higher proportion of larger producers in the UK. Adjustments were under the Portuguese Presidency of the Council in 1992.

The final reform package, known as the 'Cunha Reforms'[17], was most radical in the cereals market but even here price reductions were limited to 29% of the intervention price during the 1992/3 to 1996/7 period, a figure which itself was only arrived at after it was decided to remove co-responsibility levies for the following four marketing years (this was thought by commentators to be a concession to Germany in order that the reforms could be sold to her farmers without too much resistance) In addition, as a concession to the British (with the largest proportion of farms too big to qualify for the MacSharry compensations in the Community) and the French, the acreage limit on the compensatory payments was not included in the agreement and the decision on whether the payments would be degressive or fixed was postponed until the review in 1996/97.

Concerns over the budgetary costs of the reform plan were voiced from the start. However, although the Commission acknowledged that the new scheme would cost more, it argued that the fundamental oversupply problem would be tackled with the area to be set aside in the first year of operation set at 15% of the base area. Special concessions for

16 A farmer with 1000 ha of arable land would have been required to set aside 150 ha but would only have received compensation on 7.5 ha, leaving 142.5 ha uncompensated. (Agra Europe no. 1448 pE/2).

17 A comprehensive summary of the Cuhna Reforms can be found in Agra Europe no. 1492 (May 22 1992) ppP/3-P/11.

small farms and some slippage meant that the actual area set aside was much lower than this (around 9% of the base area). At the time of writing the final effects remain to be seen.

2.1.2 Domestic Farm Income Support and External Conflict

From the discussion above we can deduce that the primary concern of agricultural policy makers is the welfare of *domestic* farmers. The support policies of the industrial countries were not developed with any significant consideration for the world market, except with regard to protecting domestic producers from competition by lower-priced imports, and from excessive variations in world market prices, or disposing of surplus stocks. With the small volumes of cereals traded globally during the 1930s and the general trend towards protectionism in the developed nations, the effects of domestic income support policies on other countries were of no great concern. However, after WW2 the reconstruction programmes in Europe (and to some extent Japan) induced an extended period of economic boom in the industrialised countries (Warnock (1988), ch.15) and an expansion of trade in all commodities. As the volumes of farm products traded grew, the effects of domestic agricultural policies began to be felt on the world market, and with them the potential for conflicts between trading countries increased.

To summarise, the agricultural policies of the industrialised countries had the effect of expanding output, depressing domestic demand, reducing world market prices for agricultural products and distorting the relative prices of agricultural and manufactured goods (World Bank (1986), p124). In more detail, during the period following WW2 the US emerged as the dominant economic and trading power. However, as Europe and Japan recovered and began to export again, a situation of excess capacity emerged. US agriculture faced new and increasing competition on world markets. The potential for conflict arose mainly from the diversity of the policies operated by the major exporting countries. In the cereals sector the US was (and still is) a major cereals exporter; its policies were thus oriented towards maintaining farmers' incomes through internal measures with no need for import protection. Potential distortions to a 'free' international market by the US stemmed from the effects of its domestic policies on production, and hence the volumes to be exported, and the export promotion policies needed to dispose of the surpluses - both of which put downward pressure on world market prices. The EC, on the other hand, was initially a net importer of cereals and import restrictions were used as an integral part of the CAP. However, as in the USA, the high internal prices stimulated production. This was in addition to the increased production due to technical improvements, and the EC became a net exporter; these exports, like those of the US, enjoyed government support (albeit in a different form from the US export support). The US and the EC thus became competitors (see figure 2.1) and the differing domestic policies of the two, which had in effect caused the situation, took on a new significance. While the US argued that the VIL and export restitution systems hindered the free movement of (American) agricultural products on international markets, the EC could similarly point to the US import quotas for sugar and dairy products. Conflicts have, perhaps understandably, arisen periodically between these two since the 1960s.

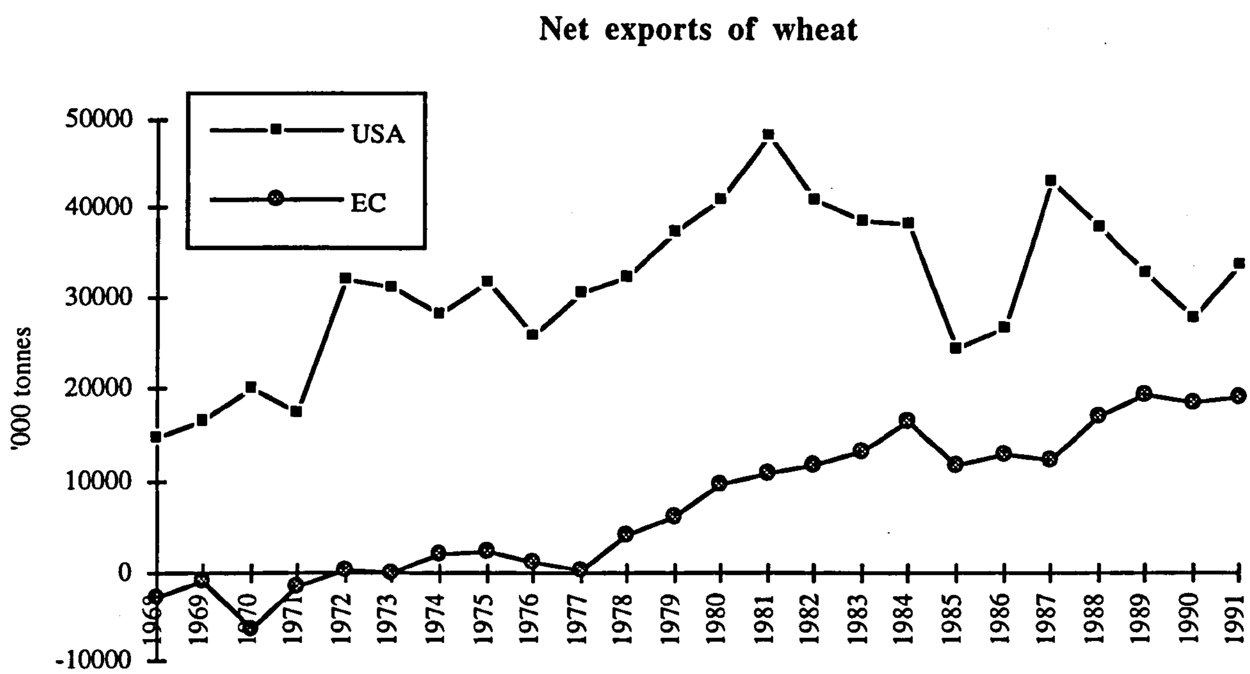

Figure 2.1

(Note: EC includes 6 member states up to 1972, 9 up to December 1980, 10 to December 1985, and 12 thereafter.)

In addition to the more general trade distortion arguments above, the EC's import restrictions in particular have drawn criticism from countries who also claim to have been adversely affected, for example, New Zealand, Australia, and the ACP (African, Carribean and Pacific) states. Conflicts have often arisen over the amount of imports allowed into the EC under concessions granted to the ACP countries and over the special treatment of Commonwealth countries when the UK joined the Community. Particular problems have been the preferential treatment given to butter imported from New Zealand when the EC has been the preferential treatment given to butter imported from New Zealand when the EC has an excess supply of butter, and the arrangements with the sugar producing ACP countries which gave no concessions to Australia (which had been the largest sugar supplier to Britain prior to its joining the EC).

The conflicts that have occurred have usually been dealt with either at a bilateral level or under the auspices of the GATT - the General Agreement on Tariffs and Trade.

2.2 The History of the GATT[18]

The history of the GATT (the General Agreement on Tariffs and Trade) is intertwined with that of the preparation of the charter for the International Trade Organisation (ITO) - an institution of the Bretton Woods international system which was never ratified.

The 1944 Bretton Woods conference, which laid the foundations of the current international financial system, recognised the need for an international organisation with the aim of reducing the level of protection within the world trading system (although the exact nature of such an organisation was not detailed). Discussions on the charter of the ITO continued over the three years following the Bretton Woods meeting with the main conference being held in Geneva in 1947. This conference was divided into three main parts (often referred to as a 'three-ring circus'); one section dealt with continuing preparations for the ITO charter; a second was devoted to a multilateral agreement to reciprocally reduce tariffs; and a third to the development of 'general clauses of obligations' (rules) relating to the tariff commitments. Together, the second and third sections constitute the GATT. The GATT was not intended to be an organisation *per se*, but a multilateral treaty, similar to the bilateral treaties which existed at the time, under the umbrella of ITO when it came into being; indeed many of the clauses of the GATT were written on the understanding that they would be revised at a later date to bring them into line with those of the ITO charter. However, the ITO never came into being, principally because the US Congress refused to approve it, and the GATT was left as the main method by which international trade was to be liberalised.

The story does not end there however. Although the GATT is today the principal method of reforming international trade, the treaty as such never came into force. The GATT was

18 The following sections draw upon Catholic Institute (1989), Curzon (1965), Dam (1970), F.A.O (1983), Jackson (1989) and Witzke *et al* (1989).

concluded at the 1947 Gevena conference while the charter for the ITO was not to be completed until 1948. Many negotiators in Geneva felt that the GATT should be brought into force much earlier. As a result, a 'Protocol of Provisional Application' (PPA) was agreed, under which eight nations would *provisionally* implement the GATT on 1 January 1948 while other contracting parties would follow suit soon afterward. The PPA called for contracting parties to implement Part II of the GATT 'to the fullest extent not inconsistent with existing legislation', while Parts I and III were to be fully implemented without exception. Part I of the GATT contains the 'Most Favoured Nation' clause which obliges contracting parties to provide all other contracting parties with the most favourable trading conditions that it grants to any one country. This clause is in many ways the cornerstone of the Agreement. Part II of the GATT contains most of the substantive measures relating to tariffs, quotas, subsidies, anti-dumping policies, national treatment and so on. Part III is mainly procedural. The PPA in effect granted countries the right to retain legislation which contravened Part II of the GATT (these were called 'grandfather rights'). After the collapse of the 1948 talks on the ITO charter no definitive implementation of the GATT took place, so that 'grandfather rights' still apply to protective legislation which was in force prior to 1 January 1948!

Despite its rather chequered origins, obligations made under the auspices of the GATT by the contracting parties are binding under international law.

2.2.1 The GATT Structure and Decision Making Process

As the GATT was not to have been the main body for dealing with problems in international trade, its drafters did not provide for a structured organisation (the present GATT Secretariat is *de jure* not the GATT secretariat but is leased from the Interim Commission of the ITO set up in 1948). All decisions are made by the CONTRACTING PARTIES (written in capitals to indicate the contracting parties acting jointly). Over time the CONTRACTING PARTIES have used Article XXV[19] to devise procedures and working methods such that the GATT has now evolved to act *as though* it were an organisation. Briefly, the GATT operates as follows. Annual 'sessions' are arranged for the purpose of taking joint action on matters affecting the implementation or administration of the Agreement. The need for the major trading nations to discuss trade questions more frequently lead to the creation of the Council of Representatives (the Council). It meets to

19 Article XXV: 1 'Representatives of the contracting parties shall meet from time to time for the purpose of giving effect to those provisions of this Agreement which involve joint action and, generally, with a view to facilitating the operation and furthering the objectives of this Agreement.'

deal with any urgent matters which may arise and can establish subsidiary bodies such as Committees or Working Groups to deal with particular problems (the latter working in greater detail). Membership of the Council is open to all those contracting parties who wish to be represented and special rules exist to allow contracting parties who are not members representation when discussions concern them. Recommendations by the Council have to be approved by the CONTRACTING PARTIES at a council session (or in a postal ballot if necessary). Generally, there is no voting and a consensus of opinion is taken by the Chairman of the CONTRACTING PARTIES; only when the consensus is not conclusive, or in doubt, or when a decision is required about a 'waiver', or if specially requested, will a vote be taken. Each contracting party has one vote and most decisions require a simple majority. The trade liberalisation aim of the GATT has been fulfilled by a series of 'Rounds' which have provided countries with opportunities to negotiate significant tariff reductions, principally in industrial products (see section 2.2.3). Disputes between contracting parties, usually regarding the legal rights and obligations of trading partners, or the legality of certain non-tariff measures, are not handled as legal matters per se but are referred to the relevant working parties or panels of experts for preliminary discussion and then to the CONTRACTING PARTIES for a final decision. The decision is thus more a political rather than a judicial matter, so that the disputees may have all relevant factors taken into account, not just the legal ones. If CONTRACTING PARTIES rule against a member then the latter should make the necessary corrections.

2.2.2 The GATT Rules for Agriculture

The original GATT had little to say about agriculture, and drew no conceptual difference between trade in farm and industrial products; protectionist measures in the agricultural sector were therefore covered by the general obligations of the Agreement and the 'free' trade principle was to be applied except where special commodity agreements regulated trade. However, US negotiators obtained special dispensations for agricultural trade in order that the GATT would be ratified by the Senate. These were designed to provide as full an accommodation as possible for US farm policy, such that, for agriculture, the GATT became a *de facto* extension of US farm legislation, based on interventionist principles. The safeguard for US agricultural policy came in Article XI which forbids import restrictions other than tariffs but exempts agricultural products from its provisions under certain conditions. The US could effectively impose import restrictions on agricultural products if the imports potentially threatened government farm income support in the form of production restriction policies.

Subsequent amendments to the GATT rules only served to further incorporate the protectionist policies pursued in agriculture, for example the now infamous 'Section 22 Waiver'. This was introduced to allow the US to impose import restrictions on dairy products even though there were no domestic supply control measures. The waiver was also applied to cereals, cotton and peanuts. In addition, although other countries were *not* covered by this waiver, they have tended to use it as a precedent for imposing import quotas on their own agricultural imports. On the same day the 'hard-core' waiver was passed, allowing countries to continue with some of the import restrictions imposed under the balance of payments criteria (Article XII), for a transitional period, while industries adapted to a free market situation. Agricultural restrictions formed the vast majority of measures continued under this waiver. When the general prohibition on export refunds was introduced into the GATT in 1955 (Article XVI), primary product export refunds were explicitly excluded if the subsidy did not result in the exporter having more than an 'equitable share of the contracting parties in such trade in the product'. Article XVI has, however, proved to be particularly weak in limiting export subsidies as the 'equitable' market share condition imposed on their use was never quantified, and several challenges under the Article (particularly against the EC) have not been successful due to differing interpretations of what constitutes an 'equitable' market share. Article XVII was introduced in 1955 to deal with the quantities marketed by governments, and stated that commercial considerations should govern such trade - no derogations or waivers were applied to this Article. The formation of the EEC brought into being Article XXIV (as part of the Dillon Round) which recognised the right of contracting parties to enter into customs unions on the condition that duty levels did not exceed those already existing in the individual countries. Although the US secured some significant concessions in the form of zero tariff bindings on soya and protein meal (i.e. free entry to the EC market for these goods), the EC believed that the CAP policy instruments had been accepted under the GATT. This belief has since been challenged, principally by the US, who argued that the CAP should be liable to reform under the GATT. Of some concern is the legality of the variable import levy (VIL); Article XXIV provides for a common external tariff which is not 'on the whole higher or more restrictive than the general incidence of the duties' of the members of the customs union. The VIL could mean duties greater than those provided for under this Article. Indeed Orville Freeman (US Agricultural Secretary during the Dillon Round) likened the VIL to 'moving the high jump bar to disqualify even the most proficient competitor'.

The treatment of agriculture under the GATT has been called into question on more than one occasion. In 1958, the Harbeler Report set out detailed recommendations for reforming the principles of the GATT in relation to farm trade. It called for a free market with the difference between world and domestic prices in those countries supporting their farmers being eroded over a period of adjustment. The report 'succeeded in seriously offending several European contracting parties,...[but it] had a limited policy impact largely because of US ambivalence towards its recommendations'[20]. The GATT Programme of Action Directed Towards an Expansion of International Trade, Committee 11, although simply a fact finding body popularized the idea of a liberalised market for agricultural products. Its third report in 1962 argued that the proliferation of non-tariff barriers seriously impeded the ability of the GATT to deal with farm trade problems and advocated a rapid adjustment to a free market system. The conclusions of the report highlighted the real problem of dealing with agricultural protectionism within the GATT structure.

The GATT, as its name suggests, was primarily concerned in its early years with reducing tariff protection. This it has done with some success in the industrial sectors which relied more heavily on tariffs as forms of support, but the diversity of the measures used in the agricultural sector necessarily called for a different approach. The approach of the CONTRACTING PARTIES was to virtually ignore the protectionist measures in the agricultural sector except to change the rules to fit in with the various national policies; in other sectors domestic policies were developed to fit in with the GATT rules[21].

In general three possible approaches to solving the problem of resolving conflicts in international trade in agricultural products can be identified.

(i) *Change the GATT rules* applying to agriculture to make the treatment of export subsidies and the non-tariff barriers used in the sector consistent with the treatment of other sectors, thus committing contracting parties to reducing these methods of protection. This would allow countries to continue with internal farm income support policies with the ensuing problem of over-supply, but without border protection and export subsidisation downward pressure would be exerted on internal support prices.

(ii) *Organise trade* through a series of commodity agreements such that either each contracting party had an equitable share of the market or prices could be maintained at a higher level. The latter was proposed by the EC in the Pisani-Baumgeitner paper (1961) as a way of reducing the level of domestic protection, not by price cutting

20 Catholic Institute (1989) p4.

21 Hathaway (1987) p104.

(which could have proved politically difficult for both the US and the EC) but by raising world prices.

(iii) *Reduce the level of overall support,* including border measures, export subsidies and domestic price support, either through a series of commitments to reduce individual support measures for a particular commodity, or reducing an aggregate measure of support (AMS) which would account for all of the support policies used in a particular sector

The latest GATT Round - the Uruguay Round - has attempted to deal with the problem of agricultural trade in a way that previous rounds have not. The following section examines the attempts made within the GATT rounds prior to the Uruguay Round to reform agricultural trade in the light of the three approaches outlined above, while chapter 3 will examine the UR itself in the same way.

2.2.3 The Early Rounds

Seven rounds of trade negotiations had taken place prior to the Uruguay Round. The initial conference was held in Geneva in 1947; the GATT itself was drafted to embody the results of the tariff negotiations of this round. Further conferences were held in Annecy (1949) and Torquay (1951), primarily to facilitate the accession of those countries who had not participated in the Geneva round, although some tariff reductions were negotiated at Torquay. Another set of conferences held in Geneva (1955-56) mainly dealt with the accession of Japan and minor rule changes (e.g. the Section 22 waiver which, in the context of the GATTs total coverage, was a minor change). The more well-known, and perhaps more significant, rounds began with the Dillon Round (1960-62), which was followed by the Kennedy Round (1964-67) and the Tokyo Round (1973-79).

The Dillon Round

The Dillon round was primarily concerned with the inclusion of the embryonic EEC within the GATT framework, which necessitated rule changes. As has already been stated, the result of discussions was the addition of Article XXIV to the GATT to allow for customs unions. The tariff discussions of the round were split into two parts; the first decided on the levels of the common external tariffs of the Six. At the insistence of the other contracting parties, the common tariffs were established such that losses in any one non-EEC member country were balanced by gains. The process took nine months. The second part of the Round was aimed at a product-by-product tariff reduction (including the new EEC tariffs). Although progress was made in industrial sectors, the reductions were less than the 20 per cent expected. In agriculture, the new Article was taken by the EEC to mean an acceptance of the CAP with very little adjustment (concessions on access to EEC markets). However, soon after the Dillon Round agreement the US position changed; concerns about the CAP's effects on US agricultural exports became the dominant feature of US attitudes to agricultural trade.

The Kennedy Round

As in earlier rounds the emphasis of the Kennedy Round was on the reduction of tariffs. The US proposed a change in the method of tariff reduction from a product-by-product approach to some form of linear tariff reduction (i.e. a set percentage reduction in all tariffs). For industrial products this was implemented with an average tariff reduction of 35 per cent (table 2.1). In agriculture, growing US hostility towards the CAP lead to a remarkable U-turn by US negotiators. They argued for a return to the original GATT notion of a market-oriented trading system for both industrial and agricultural products. This was essentially an attack on the VIL system of the CAP. Having spent most of the Dillon Round negotiating the necessary changes in member states duties on imports from third countries, the Community was understandably unwilling to dismantle the CAP, and indeed advocated the extension of the CAP's principles to the world market. The central elements of the Community's position were the setting up of 'world commodity agreements' and the binding of support levels (as measured by the difference between domestic prices and an external reference price which would take into account realistic production costs and the price-depressing effects of subsidised exports). Contracting parties would agree a reference level below which exporters would not sell; thus the cost of domestic support would be reduced by raising world prices rather than cutting domestic support prices.

The approaches of the EEC and the US were fundamentally different. The US essentially proposed a change in the GATT rules for agriculture to bring them into line with those for other sectors, while the EEC proposed organising trade to reduce the need for subsidised exports and import levies (mainly as a cost-cutting exercise). Both positions were understandable given the trading positions of the two - the EEC being a high-cost producer and the US facing what it believed was as unfair competition. As a result of these differences, little progress was made on agriculture in the Kennedy Round, although some limited, temporary success was achieved in the cereals working group in the form of the

International Grains Arrangement (IGA) which was aimed at price stabilisation. The IGA had a short life, however, as surplus grain production pushed prices below the established minimum and countries proved unwilling to restrain output.

The Tokyo Round

Agriculture was again on the agenda in the Tokyo Round (1973-1979) during which negotiations were to be oriented towards liberalisation of agricultural trade while taking account of the special characteristics and problems of the farm sector. Disagreements on fundamental issues, principally between the EC and the US, persisted throughout the Round, so that while industrial tariffs were cut by on average a third, tariff reductions in the agricultural sector were restricted almost entirely to tropical products. As in the Kennedy Round, the EC stated that the principles and mechanisms of the CAP were not a matter for negotiation. The Community saw the appropriate GATT action to be commodity arrangements aimed at market stabilisation rather than liberalisation. The US on the other hand stuck steadfastly to the free market ethos. Fundamental questions were raised about the US commitment to this by, for example, Canada and France, who argued that deficiency payments in support of loan rates set below production costs represented export subsidies rather than the 'decoupled' (not related to or affecting production) income payment claimed by the US. The Tokyo Round did produce two commodity agreements (for dairy products and for meat), but neither had the strength to stabilise world markets for those products.

Overall, the GATT has been successful in reducing tariff levels among the contracting parties for industrial products (see table 2.1). The question of non-tariff barriers, particularly in agriculture and in the service sector, has not been addressed so successfully. The diverse measures used to support farm incomes in the industrialised countries, and perhaps more importantly, the differing ideologies of the EC and US with respect to free trade in agricultural products, have made it difficult for any progress to be made within the GATT framework.

Table 2.1

The extent of the GATT

	No. of countries	Value of trade covered ($ billion)	Average tariff cut (%)
Geneva (1947)	23	10	35
Annecy (1949)	33	n/a	n/a
Torquay (1950)	34	n/a	n/a
Geneva (1955/56)	22	2.5	n/a
Dillon (1960/62)	45	4.9	n/a
Kennedy (1964/67)	48	40	35
Tokyo (1973/79)	99	155	34

Notes: n/a not available
Source: Jackson (1990) p53

2.3 Conclusion

The original GATT made no distinction between trade in agricultural products and industrial products - both were to be liberalised. The US, however, using its very powerful position in the international arena after the Second World War, managed to gain derogations from the GATT rules for its agricultural sector, such that the GATT rules for agriculture became *de facto* an extension of US farm policy and allowed trade restrictions to be imposed if imports threatened the effectiveness of domestic farm-income support policies. The development of the EC's Common Agricultural Policy (CAP) challenged US dominance in the world cereals market and prompted them to attack the mechanisms of the CAP on several occasions. Initially the main bone of contention was the EC's variable import levy, but as the EC became a net exporter the export subsidy system was also attacked. Attempts to reduce the level of protectionism within the framework of GATT rounds have not on the whole been successful. The methods of reform suggested have included changing the GATT rules such that agricultural trade was treated in the same way as trade in other products, and organising agricultural trade to stabilise and raise prices on the world market, thereby reducing the need for domestic price support. An additional possible approach, reducing the overall level of support, has been introduced in the Uruguay Round of GATT negotiations. In the next chapter, the proposals of the main participants in the Uruguay Round on agricultural trade reform will be discussed in the light of the three possible methods highlighted in section 2.2.2 (namely changing the GATT rules, organising trade and reducing the overall level of support).

Chapter 3

The Uruguay Round

3.1 Towards Another Round

The success of the GATT in liberalising trade in manufactured goods led to a steady increase in the volumes traded on the world market in the post-war period. However, a recession in the developed countries in 1974-75 heralded the beginning of what has been called the 'new protectionism', based on increased use of 'voluntary' export restraints and 'orderly marketing arrangements'. By the early 1980s, the world trading system was characterised by a general slowdown in the growth of volumes traded, a significant debt-induced reduction in developing country imports, a widespread disregard for the established GATT rules, and a widening of trade imbalances, especially in the US and Japan. A GATT ministerial meeting was called in 1982 to reaffirm the commitment of contracting parties to the free trade principle. In the event, disagreements emerged as to which rules should govern trade. In 1983 a new major round of trade negotiations was proposed which would bring areas of trade not previously covered under the auspices of GATT and, where necessary, amend the rules, in addition to reducing the level of trade restrictions. Although Japan made the first formal proposal for a negotiating round, the US was the principal instigator of the round, possibly because the Reagan administration saw trade talks as a way of easing domestic protectionist pressures. The agenda for the negotiations largely reflected American concerns. These included agreements on liberalising trade in services (possibly through a General Agreement on Trade in Services - GATS) and high in technology goods, the liberalisation of import controls in the newly industrialising countries, establishing international rules on 'intellectual property', and, perhaps most importantly, the reduction of protection in agricultural markets.

The problems in agricultural trade stem partly from underlying structural factors[1]. but have been exacerbated by government intervention in support of domestic agriculture by the industrialised countries - largely the US, the EC and Japan. These agricultural policies

1 The structural problems are summarized by Hine et al (1989a p1) as follows

'in the rich countries, the two main factors increasing demand - population growth and rising incomes - operate only weakly for foodstuffs. In the poor countries, demand for food and feed is strong but is constrained by shortages of foreign exchange.'

have caused considerable damage to the economies of smaller agricultural exporters, for example Australia and New Zealand, and developing countries. In addition, the policies are very costly to consumers and taxpayers in the industrial countries and concerns about large transfers were also growing. The US had some strong allies in its call for agricultural trade liberalisation (especially Australia and New Zealand), although the EC made it clear that the principal mechanisms of the CAP were not negotiable, this being a (justifiable) response to suspicions that the US would mount an attack on the Community's export refund and variable levy systems as it had in earlier rounds. The scene was thus set for the Uruguay Round (UR) negotiations to become yet another forum for the US and the EC to air their differences over agricultural policy. After much haggling, during which agriculture emerged as the single most divisive issue when setting the 15 point agenda, the UR was finally launched in September 1986.

3.2 The Early Stages

3.2.1 The Punta del Este Declaration

In the Punta del Este Declaration, which set the framework for the UR, all of the participants recognised that world trade in agricultural products was badly distorted by government policies to support domestic farmers. The Declaration called for 'greater liberalisation of trade in agriculture' and 'more operationally effective GATT rules and disciplines' regarding 'all measures affecting import access and export competition'. However, substantial differences of opinion between the US and EC as to how far agricultural support should be reduced resulted in a non-specific commitment to a) improve 'the competitive environment by increasing discipline on the use of all direct and indirect subsidies and other measures affecting directly or indirectly agricultural trade, including the phased reduction of their negative effects and dealing with their causes', and b) reduce import barriers including those relating to animal health (sanitary) and plant (phytosanitary) regulations. With hindsight, although this represented a significant departure from earlier rounds where internal policies were regarded as non-negotiable, the lack of methodological direction in the early stages of the UR inevitably meant that the negotiations would become dominated by the ideologically opposed positions of the US and EC rather than a forum for real discussion. The initial proposals for the implementation of the Punta del Este Declaration mainly dealt with methodological issues, such as how support was to be reduced, and indeed, what the final aim should be; the magnitude of the reductions in agricultural support was not quantified. The proposals offered various ways of reducing the overall level of support to agriculture (individual commitments to cut export subsidisation, import protection and domestic income support, the latter largely being through reductions in an aggregate measure of support (AMS)), with some changes to the GATT rules to facilitate this.

3.2.2 The Initial Negotiating Positions

Negotiations began in February 1987 and by the end of 1988 seven proposals for the implementation of the Punta del Este Declaration had been tabled.

The USA presented the first proposal in July 1987; it contained a call for the *elimination* of all policies which distorted agricultural trade, including sanitary and phytosanitary regulations, by the year 2000 - the now infamous 'zero option'. More specifically the negotiating framework in the US proposal had four main elements:

(a) agreement on a measure of agricultural support (such as the OECD Producer Subsidy Equivalent (PSE)) and a schedule for reducing it to zero over a ten-year period;
(b) agreement on comprehensive commodity coverage;
(c) the drafting of country programmes for the phasing out of support in the context of binding GATT arrangements;
(d) agreement on the monitoring arrangements.

The US paper distinguished between agricultural support payments which affect production and pricing decisions and direct 'decoupled' income support: the latter would not be within the scope of the negotiations. Policies singled out for exclusion from the reform process were restricted to *ad hoc* emergency payments and foreign and domestic aid programmes while market-price support policies, income support and infrastructure supports (e.g. research) were covered by the proposal. It was clear from the outset that the EC and Japan would not accept these proposals as they stood and that they therefore represented an extreme position which the US would have to tone down during the negotiations.

The proposal submitted in October 1987 by the Cairns Group (CG)[2] - a group of fourteen countries with an interest in agricultural trade expansion, which are, in general, countries 'with a comparative advantage in agriculture whose export interests have increasingly been frustrated by the export subsidy battle between the US and EC' (Hine *et*

2 The members of the Cairns Group are Argentina, Australia, Brazil, Canada, Chile, Columbia, Fiji, Hungary, Indonesia, Malaysia, New Zealand, the Philippines, Thailand and Uruguay.

al. ,1989a, p20) - fell in the middle ground, but was philosophically closer to the US position in its concern to liberalise agricultural trade, differing from it with regard to the method of achieving freer trade. The long-term aims of the CG were the binding of all levies on all agricultural produce at zero or near zero levels, and special GATT disciplines for all other support measures relating to agriculture. In the shorter-term, however, the CG proposed 'early relief measures' committing exporters to the non-disruptive release of stocks, a *freeze* on existing trade barriers and subsidies affecting trade, increased access levels and the introduction of phased reductions in export and production subsidies. An 'intermediate reform programme', operating over a ten-year period, was proposed to provide the basis of the long-term reform. It was envisaged that the intermediate programme would require additional specific commitments to reduce support to agreed levels (as measured by the PSE or a variant of it), with special emphasis on the most trade-distorting policies. Like the US, the CG also proposed the exclusion of 'decoupled' income support from the negotiations.

The EC position (October 1987) represented a political and philosophical framework for implementing the Punta del Este Declaration which was far removed from that of the US and CG. Although the EC had conceded to the US demand that agriculture should be on the Uruguay Round agenda, it sought to restrict the parameters of the reform debate, insisting that all of the CAP mechanisms be retained. Thus the EC stressed the need for long-term *liberalisation* of agricultural trade as opposed to the shorter-term *full liberalisation* stance taken by the US and CG. The emphasis of the EC proposal was on raising world prices, through market intervention, in order to reduce the costs of farm income support, whilst the US and CG view was that market instability (including price cuts) was a necessary short-term cost of achieving higher equilibrium market prices in the longer term. The EC did, however, accept the need for a significant long-term reduction (not elimination) of support spending and was prepared to consider levels of protection being bound under the GATT. Originally the EC advocated a phased, commodity-specific approach using a measure of support based broadly on the OECD's Producer Subsidy Equivalent (PSE). The chosen measure would, the EC argued, need to give credit for production restraints as they put upward pressure on prices and hence reduced the amount of farm income support. In a later proposal (October 1988), the EC suggested that the support cuts be made over a five-year period beginning in 1984 to give the EC credit for the introduction of milk quotas in the 1984/85 marketing year. In the important cereals, sugar and dairy sectors, the EC proposed short-term actions to induce market stability in order to reduce subsidy levels - for cereals and cereal substitutes the Community proposed minimum export prices and one-year renewable market sharing arrangements; for sugar it supported a reduction in world exports but not a redistribution of market shares or the renegotiation of the International Sugar Arrangement (the latter being important to developing country exporters). More controversially, the EC proposed that the GATT should allow 'more balanced protection': in other words the EC should be allowed to 'rebalance' its support. In practice, this would have meant the withdrawal of the GATT zero bindings of import restrictions on soyabeans and cereal substitutes in order to reduce the budgetary cost of support to the oilseed sector and stimulate the use of domestic cereals for animal feed.

The Japanese proposal (December 1987) was the most conservative. While conceding that some degree of liberalisation in its import policy could be discussed, this was to be subordinated to social issues such as food security, rural development, regional employment and environmental protection. Japan argued for the elimination of export subsidies (hardly a significant concession for a major importer!), and on the issue of improved market access proposed that tariffs could be reduced using traditional GATT 'request-and-offer' procedures while quantitative restrictions would, in principle, be gradually eliminated. Japan proposed the clarification (but retention) of the rules covering the use of waivers contained in Article XI:2 which permitted the retention of import quotas to buttress food security. The use of aggregate measures of protection and support such as the PSE was considered to be unnecessary.

The Nordic Countries position (December 1987) was somewhere between that of the EC and the CG. The paper called for a reduction in the overall level of agricultural support and protection to be achieved through a removal of internal subsidies, price reductions, a reduction on subsidised exports and special measures for supply management.

While the major input of the developing nations in the Uruguay Round was through the Cairns Group, other contributions came from food-importing developing countries. A proposal in September 1988 by Egypt, Jamaica, Mexico, Morocco and Peru, supported by a number of other developing countries, envisaged a formula reduction of tariffs to zero or very low levels and changing the GATT rules to improve the competitive environment. It stressed, however, that the new rules would have to take account of the special circumstances of developing countries with respect to their dependence on agricultural trade. Korea (October 1988) also stressed the need for developing countries to be treated differently especially with regard to developing agricultural infrastructure and security of supply in basic foodstuffs. It proposed strengthening the GATT rules and the progressive reduction of trade-distorting subsidies (over a longer time frame for the developing countries).

3.3 The Mid-Term Review

Held in December 1988 in Montreal, the Mid-Term Review was to have marked the beginning of serious negotiations. The objective was to reach agreement on the broad parameters of multilateral trade reform in all of the 15 negotiating areas. In the event, progress was only made in 11, with intellectual property rights, textiles, safeguards and agriculture proving to be the sticking points. As in other rounds, the US and the EC were the main protagonists with the Cairns Group representing the middle ground.

Before the meeting, the prospects of an agreement of sorts seemed possible. In preliminary meetings in Washington and Brussels, the US had indicated a willingness to move towards the CG plan for a schedule of short-term scaling-down of agricultural support - something the EC was prepared to negotiate upon - although it still maintained its insistence that commitments on the long-term *elimination* of support were a prerequisite to any discussions on *lowering* it in the short-term. In Montreal, when negotiators were asked to determine whether the aim of the Round was 'the elimination or the substantial reduction of trade-distortive support and protection', the US refused to budge from its position while the EC refused to consider any undertaking which would effectively dismantle the CAP. Indeed the EC maintained that the long-term goal of the round should be the lowering of support. The CG, in an attempt to overcome the difficulties, urged the US to drop its 'zero option' in return for a 10 per cent cut in farm support before December 1990. While not agreeing with figures in the CG plan, the EC had shown itself willing to use it as a basis for negotiation. The US, on the other hand, feared (with considerable justification) that the EC would offer only modest cuts and insist that the reductions made in support since 1984 be taken into consideration. If this were the case then the gain to the US in terms of reduced competition for US farm exports would have been small.

With the main participants remaining at opposite ends of the reform spectrum, the Montreal talks ended in an impasse. The only achievement in the Trade Negotiating Group (TNG) for agriculture, albeit an important one, was the freeing of markets in developed countries for developing countries' products.

A decision was made to adjourn the talks until April 1989, and the Director General of the GATT, Arthur Dunkel was charged with resolving the impasse on agriculture, a difficult task given the seemingly unbridgeable differences between the US and the EC. However, Dunkel was able to reconvene the TNG for agriculture in April 1989 to discuss a text which was based on the Chairman's report from Montreal.

3.4 The Geneva Accord

The Dunkel paper emphasised the short-term aspects of the negotiations and, perhaps more significantly, did *not* call for the elimination of all trade-distorting agricultural support, but rather 'substantial, progressive reductions of agricultural support and protection sustained over an agreed period of time'. It included a recommendation for a *freeze* on support and production control measures at the levels seen in 1988/89 for the remaining twenty months of the UR (by implication criticising the United States' relaxation of their set-aside programme in early 1989). The paper also took the realistic view that, unless some recognition were given for CAP modifications made since 1984, the negotiations would remain in stalemate (Agra Europe no. 1331, p E/1). A compromise starting date of September 1986 was thus suggested to give credit for measures implemented since the Punta del Este Declaration in 1986 which contributed to the reform process. It suggested that the GATT rules and disciplines should be strengthened and made more operationally effective, with any new rules applying to all countries. In addition, a timetable for the final stages of the negotiations was agreed; participants were to submit proposals by December 1989 on 'all aspects of long-term reform ... including terms and use of AMS, decoupled income support and other ways to adapt support and protection'; and a final ministerial meeting to agree the reform process was set for December 1990. On the issue of export subsidies, the paper recommended a freeze at the average level in the two most recent fiscal years followed by progressive reductions.

At the Geneva meeting an accord was reached with relatively few adjustments to the Dunkel text with the US abandoning the 'zero option'. The Accord should have provided the impetus for a move away from methodological discussions towards negotiations on the magnitude of support cuts. However, the papers presented to the GATT after Geneva were again methodological.

3.5 The Post Geneva Accord Proposals - Autumn 1989

3.5.1 US

Although the US had officially abandoned the 'zero option' at Geneva, its October 1989 paper did not depart entirely from it. It contained proposals for the elimination of export subsidies and export taxes (except food aid) over a five-year period beginning in January 1991; the elimination of domestic support affecting production and pricing decisions over a ten-year period; and the reduction of all import protection to zero (or very low) tariffs over a ten-year period. In order to achieve this, all bilateral deals, such as voluntary export restraints (VERs) and minimum import price arrangements, would be banned and all other border measures would be converted to tariff-equivalents or tariff-quotas, which would also be phased out over the ten-year reform period. After ten years, the final bound tariff would be the only permitted form of import protection. This became known as the tariffication proposal. In addition, the US proposal also contained a recommendation that all GATT derogations, including the US 1955 waiver, be eliminated.

On internal support, the US proposed a three-tier approach to reform. Existing domestic farm support would be divided into three categories: those which were very trade-distorting ('red' policies) and would therefore be phased out over the ten-year period; those which were harmful to trade (but less so than those in the first category) which would require 'GATT discipline' ('amber' policies); and those which were deemed not to be trade-distorting ('green' policies). Measures falling into the first category would include administered price policies, income support policies linked to production or marketing (including deficiency payments), input or investment subsidies not provided to producers or processors of agricultural produce on an equal basis, and certain marketing programmes (for example transport subsidies). On the other hand, the following policies would be permitted: income support measures not linked to production or marketing, environmental and conservation programmes, bona fide disaster and domestic food aid, general services (including certain marketing services such as inspection and grading), resource retirement programmes (for example, set-aside) and certain stockpiling of food which did not directly affect price or income support. All other policies would be allowed only under strict GATT disciplines and these too would be reduced during the reform period using an AMS such as the OECD PSE.

3.5.2 CG

The CG proposals followed the liberalising objectives of the US proposal, but took into account considerations such as food security and the maintenance of modest support in the farm sectors of less developed countries. The paper stated that the long-term aim of the Uruguay Round should be 'the establishment of a fair and market-oriented agricultural trading system'. The CG envisaged a reform process over a ten-year period which provided no scope for raising protection of any product except under 'carefully circumscribed safeguard provisions'. On border protection, the CG also proposed the tariffication of all non-tariff barriers with the resulting tariffs, and existing tariffs being reduced to zero (or very low levels) by the end of the reform period. As in the US proposal, all GATT waivers, protocols or other derogations and exceptions would be eliminated. It also proposed minimum access levels into markets where protection had the effect of prohibiting imports of agricultural produce (for example the Japanese rice market). Export subsidies would be phased out over the ten years, new export subsidies would be prohibited, and measures to prevent subsidised exports being disguised as food aid would be introduced. In the short term, the level of export subsidies would be frozen in accordance with the Geneva Accord. Internal support would be reduced on the basis of agreed percentage cuts in an AMS which would be calculated using the average support levels in 1986-1988. Like the US, the CG also made a three tier classification of support policies but the emphasis of the reduction process in the CG proposal was on market price support policies and direct payments so that the effective price farmers received for their output, and the quantities subsidised, would be lowered.

3.5.3 EC

The EC paper, submitted after those of the US and CG, stressed that the aim of the Round could *only* be to progressively reduce support 'to the extent necessary to re-establish balanced markets and a more market oriented agricultural trading system' and that the setting of a final absolute level of support was not an objective. The EC proposal rested on the reduction of internal support with the commitments being made on the basis of the Community's chosen AMS, the Support Measurement Unit (SMU), using 1986 as a base year (as agreed in the Geneva Accord). The reductions would be agreed as percentage reductions in the SMU, which would not necessarily be of the same magnitude for all products or groups of products, over an initial five-year period. Further reductions would be negotiated in the fourth year of the initial period. The EC paper made it clear that it found the US tariffication proposal unacceptable, arguing that protection based exclusively on tariffs which would then be reduced to zero would lead to instability in world markets, which would in turn be imported into domestic markets and lead to 'consequences for production and trade which are not the result of normal competition'. However, the EC recommended 'partial tariffication' of some border protection measures and deficiency payments, subject to the 'rebalancing' of protection. This controversial proposal would have allowed the EC to increase support for oilseeds and cereal substitutes in return for reducing support on other products. The partial-tariffication proposal involved replacing variable levies and non-tariff barriers with a tariff consisting of two elements - a fixed tariff which would be reduced in line with reductions in the SMU, and a variable element (the corrective factor) which would be used to offset world price and exchange rate fluctuations beyond certain limits. The EC did not make explicit proposals for the reduction of export subsidies, except to say that they would be reduced as a result of the reductions in the SMU.

The meeting of the TNG on agriculture in December 1989 to discuss progress in the Round produced positive reactions from the US and CG given the EC's willingness to consider some form of tariffication (although this was dissipated somewhat by the EC's insistence that the Community's dual pricing system would remain intact). However, at meetings early in 1990, the main protagonists seemed as far apart as ever. The EC's proposals were condemned by the CG for 'coming from the minimalist end of the reform scale' while the CG, EC and Japan called into question US motives in the Round. The proposals for the 1990 Farm Bill did not confirm the US's commitment to the long-term (theoretical) rhetoric of their GATT proposals; they were essentially a continuation of the support policies with a few refinements and an increased export enhancement programme to help US exporters regain markets lost by the 'unfair' trading practices of other countries (i.e. the EC). Attempts by Aart de Zeeuw, chairman of the GATT agricultural committee, to assemble a document outlining and refining the negotiating positions of the participants in order that the Round could progress were hampered by the attitudes of the EC and Japan, while the US restated that it would not settle for modest reforms in agriculture simply to achieve overall accord in the Round.

3.6 The De Zeeuw Framework

The final draft text from the GATT Secretariat was issued in June 1990 to provide a framework for agreement at the July meeting of the agriculture TNC. The text highlighted the major issues which would have to be resolved at the ministerial meeting in December 1990 and aimed to direct the negotiations away from methodological argument and towards discussions on the magnitude of cut in agricultural protection by offering possible solutions in four broad, but interrelated, areas.

(a) Import Protection

- conversion of all border measures other than normal customs duties into tariff-equivalents, irrespective of the level of existing tariffs;
- upward movement of these tariff equivalents to be prohibited while downward movements were negotiated;
- maintenance of current access opportunities through the use of, amongst other things, tariff quotas;
- where only minimal imports existed, the establishment of a minimum level of access from 1991/92 using tariff quotas ;
- all existing tariff rates to be frozen in the short-term at current levels.

Tariffs and tariff equivalents would then be reduced from 1991/92 levels at an average rate over a number of years; both to be agreed. Provision would be made for temporary tariff increases in *exceptional* circumstances.

(b) Export subsidies

The paper suggested that participants agree that all budgetary assistance for exports be effectively reduced more than other forms of support and protection (this proved to be a major sticking point for the EC), and that the basis for negotiating a reduction in export assistance should be the three most recent marketing/financial years.

(c) Internal support measures

Policy coverage would include market price support measures (i.e. those which maintained 'producer prices at levels above those prevailing in international trade'), direct payments to producers (including deficiency payments), and measures to reduce the costs of agricultural inputs and marketing. Policies which did not distort markets would be excluded from 'progressive and substantial reduction'. An AMS would be used to measure support levels and the cuts. This would be calculated for each commodity, using a base year of 1988 and a fixed reference price based on 1986 - 1988 data. The latter could be re-assessed periodically.

(d) Sanitary and Phytosanitary Regulations and Barriers

A GATT Working Group[3] would complete the text to form the basis of negotiations

3 A Working Group consists of a number of specialists who are assembled to deal with particular discussions or disputes.

in this area.

The paper was a political compromise incorporating ideas from each of the major proposals, and was intended to enhance the chance of a final agreement in December. The July meeting of the TNG agreed that the paper should be 'used as a means to intensify the negotiations' - in other words it was not to form the basis of a final agreement. The meeting did, however, agree a strict timetable for the remaining fifteen working weeks of the Round.

1 October 1990	-	Countries to submit detailed lists of their current farm support measures.
15 October 1990	-	Offers to be tabled on reducing support to farmers.
23 November 1990	-	Documents for the final December meeting to be ready.

Mr Dunkel, Director General of the GATT, stated that the final documents would have to reduce to the barest minimum the number of policy decisions that ministers would have to take in December, and stressed the need to adhere to the timetable if the Round were to produce any agreement.

3.7 The 'Final' Negotiating Positions of the Major Players (December 1990)

In accordance with the timetable agreed at the July meeting of the TNC for agriculture, the US and CG submitted detailed proposals for the long-term reform of agricultural trade in October 1990. Both proposals reflected the compromise paper put forward by De Zeeuw (although the American paper contained some significant amendments). Disagreements within the EC, firstly between Commissioners and then between ministers in the Agriculture Council, meant that the EC did not submit its text until November. The EC's paper followed the format of its earlier proposals in calling for a reduction in the SMU as the main method of reform rather than accepting the three area programme of the De Zeeuw framework. The papers offered some numerical indication of the reductions each of the participants was prepared to make in agricultural support, and as such represented a move forward. However, the EC, as expected, offered a far lower reduction than either the US or CG.

3.7.1 Import Protection

There appeared to be a consensus among the protagonists about the need to deal with both tariff and non-tariff barriers to agricultural imports independently of any commitment on other support policies. The US retained the 'tariffication' proposal of earlier papers under which all non-tariff barriers would be converted to percentage *ad valorem* tariff equivalents 'based on the average gap between external and internal prices during the 1986-1988 base period'[4]. These newly converted tariffs would be reduced by an average 75 per cent over ten years with the maximum permissible *ad valorem* tariff allowed by 2000 being 50 per cent. Where products are currently subject to an effective import ban (for example in the Japanese rice market), a minimum access level of 3 per cent of domestic consumption would be established, using tariff-quotas, and subsequently expanded over ten years (in other cases, a minimum access level of 3 per cent of imports would be provided through tariff-quotas). The US proposed that farmers should be shielded from abrupt swings in world market prices or exchange rates. To prevent trade causing severe disruption to domestic market prices, a "tariff snapback" was written into the paper to allow for increases in protection of a particular commodity if imports exceeded 120 per cent of the previous year's level or if import prices fell below 75 per cent of the average price in the 3 preceding years. This represented a more generous safeguard than in the 1989 paper, where imports would have had to exceed 120-160 per cent of year-earlier levels to qualify for protection, and was probably a response to pressure from the EC and Canada.

The CG proposed a 75 per cent 'trade weighted' reduction in border protection over the ten-year reform period (1991 to 2000) with a minimum reduction of 50 per cent on each agricultural tariff line. This would be achieved through cuts in tariffs and in non-tariff barriers which would be converted to tariff-equivalents (i.e. tariffication). These conversions would be subject to the maintenance of current access opportunities through tariff-quotas; where prohibitive measures existed a minimum access level of 5 per cent of domestic consumption would be provided in 1991/92 through tariff-quotas. In both cases, the tariff-quotas would be expanded at the same rate as the tariffs are reduced over the reform period. Any tariffs which remained higher than 50 per cent at the end of the reform period would be reduced to that level.

The EC's partial-tariffication plan was elaborated upon with the fixed element of the tariff-equivalent being reduced over the five-year period to 1995/96 by an annual amount reflecting the SMU reduction for that year. For the purpose of calculation, the fixed

4 US Agriculture Proposal presented to the GATT 15 October 1990.

element would be defined as the difference between a *representative* price, based on the average world market or import price for the years 1986-1988, and the average Community support price (in most cases the intervention price), increased by 10 per cent to maintain 'Community preference', for the same period; in most cases, this would give lower effective import protection than under the current variable levy system. The EC did not, however, indicate the extent of the reduction in the fixed element; Commission proposals for a 30 per cent cut were rejected by the Council in favour of a less specific commitment to reduce tariffs 'once a year by an absolute amount which reflects the incidence of the SMU reduction' (Agra Europe no.1414 p P/3). A 9 per cent uncounted franchise on the 'variable element' (the gap between world market prices and the external representative price) would mean that any world price fluctuation (in either direction) of less than this magnitude would be borne by domestic exporters rather than the EC budget. In a move away from the December 1989 proposal, however, compensatory payments (deficiency payments and other direct producer subsidies) would be only partially converted to tariff-equivalents to avoid 'unacceptable' consumer price increases. The Community view remained that tariffication would only be acceptable 'to the extent that it will be possible to remedy serious imbalances noted in support and protection measures'. In practice, this 'rebalancing' would mean the imposition of fixed tariffs on oilseeds, protein crops, maize gluten and non-grain feeding stuffs (NGF) plus the introduction of tariff-quotas on oilseeds and NGF's. The size of these tariff-quotas would be based on average imports for the period 1986-1988. The fixed tariff would be 6 per cent for oilseeds and NGF's and 12 per cent for other products on the list. The EC's rebalancing proposal was, however, not accepted by either the US or the CG.

3.7.2 Export Competition

This area proved to be one of the major stumbling blocks at the abortive December 1990 meeting, as the EC was alone in insisting that export subsidies should *not* be singled out for special treatment (as had been suggested by De Zeeuw) because they would automatically be reduced as the overall level of support was reduced. Indeed the EC paper maintained the Community view that agreement could be reached to maintain the levels of export refunds such that 'insofar as world market prices remain stable' they would not exceed the difference between internal prices and some agreed world reference price and would not be greater than any import levy for the same product. In addition, the subsidy granted on processed products would be limited to that for the basic agricultural product content. The paper called for a formal GATT statement concerning the *control* of export credits (such as those under the US Export Enhancement Program) and an improvement of the rules on food aid and preferential sales. On the other hand, the US and CG proposed separate reduction targets for export subsidisation. The US called for a 90 per cent reduction in export subsidies on primary agricultural products over ten years; for processed products export subsidies would be phased out over six years. Using the annual average for 1986-1988 as a base period, these reductions in export subsidies would be on the basis of both the total budget outlay on such programmes and the physical quantities exported with the aid of subsidies. The CG also proposed that total budgetary outlays on export assistance, including deficiency payments and per unit export subsidies, and the quantities of subsidised exports, be reduced by no less than 90 per cent from the average annual level in the years 1987-89. In addition, the extension of export subsidy schemes to products or markets which did not qualify for export assistance in 1987-1989, would not be allowed. Special rules would apply for food aid.

3.7.3 Internal Support

The US plan called for a reduction of 75 per cent in trade-distorting internal support, between 1991 and 2000, on the basis of a commodity-specific AMS, expressed as the total monetary value of support, using the average of 1986-1988 as a base. The 75 per cent cut would apply to 'the most trade-distorting' domestic subsidies while a cut of 30 per cent would apply to a single-sector wide AMS applied to policies that were 'generally available to all commodities'[5]. The so-called 'green light' policies (income safety-net policies, environmental protection, domestic food aid, marketing and research services) would not be liable for any reductions under the US proposal; however, they would have to be implemented in such a way as to have a minimal impact on trade. Under the CG proposal, trade-distorting internal support would be reduced by no less than 75 per cent over a ten-year period starting in 1991/92, using (where possible) commodity-specific AMSs as reference tools, expressed in total monetary value. The base year for the AMS would be 1988, with reductions being subject to a cut-off level of 5 per cent of the value of production, below which further reductions would not be required. The EC's paper contained an offer to reduce support and protection for the Community's major products by 30 per cent between 1986 and 1995/96. The level of support would be measured by the Community's preferred AMS, the SMU, expressed in total monetary value for the following groups of products; cereals and rice, sugar, oilseeds and protein pulses, olive oil and animal products. Budget-induced reforms of the CAP which had taken place since

5 ibid.

1986 would reduce the required cuts in support from 1991/92 to 1995/96.

3.8 The 'Final' Meeting

Although the December 1990 meeting was to have produced a final agreement in all of the 15 areas identified in the Punta del Este declaration, in the event the agricultural discussions dominated the proceedings, and ultimately it was the EC's rejection of separate commitments to reduce export refunds which caused the breakdown of the entire negotiations. The other participants appeared to be prepared to negotiate on the depth and timing of the cuts, but were not prepared to concede to the EC's argument that reductions in the SMU would automatically lead to commensurate cuts in export subsidisation and border protection, so that specific commitments in these areas would not be necessary. In addition, the US and CG remained adamantly opposed to the EC's rebalancing proposal.

An attempt at compromise by the Swedish farm minister, Mats Hellstrom, who chaired the agriculture TNG in Brussels, was swiftly rejected by the EC. The Hellstrom 'non-paper' was based on a 30% reduction in subsidies over a 5-year period, beginning on 1st January 1991, using support levels in 1990 as a base. Internal support would be reduced in equal instalments on a commodity -by-commodity basis. The policies which had had the most distorting effects on the world market would bear the brunt of the cuts, but the use of an AMS was not specified. On import protection, the Hellstrom paper called for a 30% cut in border protection over the 5-year period but did not specify the method to be employed, thus requiring ministers to agree the principles of 'tariffication' or 'partial tariffication'. Commitments on export subsidies would be on the basis of reductions in budgetary outlays, per-unit export subsidies or the quantity of a product receiving export assistance. Food aid would be excluded. The approach deprived the EC of its claimed 'credit' for support reforms since 1986[6], and would have represented an effective doubling of its commitment to liberalisation. In addition, the rebalancing mechanism was ignored and specific reductions in export subsidies included. It is hardly surprising therefore that the EC representatives took less than an hour to reject it.

Although the EC did make some minor concessions during the dying hours of the meeting, they were not enough to prevent the CG and the US from leaving the negotiating table, and

6 In fairness to the EC it is unlikely that the US would have accepted 1990 as the base year for the liberalisation process as it too was effectively claiming credit for policy reform since 1986 by proposing a base of 1986-1988.

the talks ended in disarray.

3.9 Developments After December 1990

The Uruguay Round negotiations were restarted by Mr Dunkel in February 1991 as officials from all of the contracting parties (including the EC) undertook to reach 'specific and binding commitments to reduce farm income support in each of three areas; internal assistance, border protection, and export subsidies' (FT 22/2/91)[7]. However, the EC did not abandon its rebalancing proposal and continued to insist that the base year for any GATT agreement should be 1986. It also maintained that it could not improve on the commitment to reduce support by 30 per cent over a ten-year reform period. The US and CG maintained their more liberalizing positions. By May 1991 it was clear to all observers that the GATT officials and the other participating countries were tired of the battle between the US and EC in the agricultural negotiations; the US and EC were reprimanded by Mr. Dunkel for having spent the whole of the Round dealing in rhetoric. He warned that 'the days of passing the buck all around the globe as a means of avoiding the crucial political challenges in trade policies are long gone' (Agra Europe no.1440 p P/3). However, in mid-1991 the prospects for an agreement improved slightly. In June Congress extended the US 'fast track' negotiating authority for two years. This ensured that any agreement reached in the GATT negotiations could not be altered by Congress, but had to be ratified, or rejected, in its entirety; without this safeguard it is unlikely that the other contracting parties would have continued with the Round. In addition, internal pressures for an agreement in the agricultural negotiations as a prelude to agreements in the important areas of services and intellectual property grew in the US such that a compromise on agriculture could be envisaged. Perhaps the most encouraging development, however, was the continued budgetary crisis in the EC, which prompted the Commission to suggest substantial revisions of the CAP. The Community insisted that these proposed reforms were independent from the GATT, and that they in no way changed their negotiating position, but the extent of the proposed cuts in support prices, especially in the cereals sector (35 per cent over 3 years), indicated to the US and CG that the EC was serious about agricultural policy reform (see chapter 2, section 2.1.1 for an exposition of the 'MacSharry Plan' for EC agricultural policy reform).

Despite the optimistic signs there was a worrying lull in the serious negotiations during the

7 Some pundits argue that the EC 'did not object' to the formula rather than actually supporting it.

summer of 1991. What can only be called 'bickering' took over. Occasionally, significant persons made general commitments to reach an agreement, for example, the leaders of the seven leading economies (G-7) in July, and a tentative proposal by the EC Commission to improve its offer to the UR in September (this effectively amounted to abandoning the 1986 base year; however, as EC spending on agriculture had risen so much in 1990/91 as to virtually wipe out any 'gains' made since 1986 anyway, this was not such a significant move as it might first appear), but no progress was actually made. The US was accused of losing interest in the UR in favour of the negotiations on a 'North American Free Trade Area' (between Canada, Mexico and the US). The EC was accused by the US and CG of employing rhetoric rather than 'putting flesh on the bones' of its "new" proposals. Australia and Canada blamed the EC/US export subsidy 'war' for the plight of their cereal farmers; Canada threatened unspecified retaliatory steps against the EC if progress was not made by the end of the year towards ending the subsidy war' (FT 8.10.91). Meanwhile Japan, which had remained in the background at the Brussels meeting, re-stated that it would not accept UR proposals which included the tariffication, and subsequent liberalisation of Japanese rice imports. In early June, Carla Hills, the US Trade Representative, declared that the Round would be finished by Christmas 1991, but later, more pessimistically, stated that March 1992 would be a more realistic date. (Given that the US Presidential election campaign would have been underway by then, March 1992 was probably the last possible date for an agreement in order to give the US time to ratify it.) In the autumn of 1991, however, the prospects for an agreement began to improve. At an EC-US summit in The Hague on November 9, President Bush scaled down US targets for reductions in export subsidies from the original 90 per cent over 10 years to 30-35 per cent over 5 or 6 years. This represented a considerable narrowing of the gap between the US and EC and prompted a tentative resumption of negotiations, albeit with several difficult methodological issues to be solved. Firstly, agreement was needed on whether the commitment on export subsidisation should be in terms of budgetary expenditure or volumes exported, the EC favouring the former while the US stated that this would not result in as significant a reduction in subsidised EC cereals exports as it envisaged. Secondly, although all protagonists agreed that tariffication should be adopted, the technical details of how this should occur, and whether a mechanism allowing adjustments to the resulting tariffs for currency and world price fluctuations should be incorporated, still had to be decided. Thirdly, the USA maintained that the EC rebalancing proposal was unacceptable while the EC insisted that it could not reach an agreement without it; in December, however, the EC scaled down its rebalancing proposal such that import protection would only apply to certain cereal substitutes rather than all oilseeds (Agra

Europe 1470, pE3). Finally, while the USA conceded that its deficiency payments scheme was 'amber box' (i.e. production positive), the EC wished to classify compensatory payments proposed as part of the MacSharry plan as 'green box' (i.e. non-distorting). It is clear that the MacSharry compensatory payments cannot be classified as 'production neutral'; they are conditional on land being set aside, and adjustments can be made to the amount received in each marketing year if land is bought or sold.

The Dunkel Compromise Paper

On December 20 Arthur Dunkel issued a 'Compromise Paper' which was intended to have been a 'take it or leave it' document aimed at inducing a satisfactory end to the negotiations in all areas in as short a time as possible. The agricultural section was split into 3 main sections: agreement was to be reached on sanitary and phytosanitary measures, the differential treatment of less developed countries and on the reduction of support to farmers. The latter was to be a three point programme with the now familiar reductions in import protection, export subsidies and internal support. All non-tarrif import protection would be converted to tariff-equivalents (full 'tarrification'). Adjustments to the tariffs would only be allowed if either imports reached 125 per cent of average imports in the previous three years or prices fell below a trigger price equal to the average reference price in 1986-1988. These newly converted tariffs and all existing tariffs would be subject to a 36 per cent reduction over the 6-year reform period (1993-1999), with a minimum reduction on 15 per cent on each product. A minimum-access requirement of 3 per cent of domestic consumption in 1993, rising to 5 per cent in 1999, would also be established. The rebalancing proposal of the EC was left out of the Dunkel paper. On export subsidies, Dunkel proposed a 36 per cent reduction in budgetary outlays *and* a 24 per cent reduction in the quantities exported with export subsidies over the reform period using 1986-1990 as the base period. Internal support would be reduced by 20 per cent by 1999, on the basis of an agreed AMS, using 1986-1988 data to form the base figure. Criteria for determining internal support policies which would not be subject to control, set out in an annex to the agreement, effectively precluded the EC from including the MacSharry compensatory payments in the 'green box'. Reaction to the paper was mixed. Predictably it was the CG who largely accepted the Compromise paper while the US and EC (along with Canada, Japan, Norway, Switzerland and Korea) stated that it would provide a basis for further negotiation. The EC in particular identified three main objections; (i) too large a concession on import protection, (ii) the lack of any consideration of rebalancing and (iii) the classification of compensatory payments as production positive. Moreover the continued (and sometime acrimonious) domestic debate over the CAP reform proposed by MacSharry meant that the Agriculture Council was in no mood to have any external constraints put on their decision-making process.

The negotiations had seemingly reached stalemate until, after a prolonged debate, the EC Council finally accepted a CAP reform package in May 1992. Adoption of the 'Cunha Reforms' (a weakened version of the MacSharry plan described in section 2.1.1) cleared the way for a resumption of at least US-EC negotiations. The breakthrough came in November 1992, six years into the Round, with a bilateral agreement between the EC and the USA which became known as the 'Blair House' Accord.

The Blair House Accord

Also known as the Washington Accord, the Blair House Accord amended the Dunkel Compromise in several key areas. On border protection, the Accord called for a 36% reduction in tariffs (after tariffication) over 6 years. For the Community, the initial tariff would be the difference between the world market price and the intervention price, increased by 10%, equivalent to a permanent 10% Community Preference. In other words, even if the EC's internal price fell to the external reference price level, a 10% *ad valorem* tariff would still remain (Rayner *et al.* 1993, p1520). On internal support, a reduction of 20% in a global AMS from a 1986-88 base was agreed, but direct aids (per hectare and headage payments) adopted under the CAP reform programme were explicitly excluded provided the aids were paid as part of a production limiting scheme. The classification of these payments as 'green box' also meant that the deficiency payments paid under the American programs would be exempted. On export subsidisation, the EC agreed to comply with the Dunkel text except in the area of the quantitative reduction in subsidised exports, where the commitment would be to a 21% reduction from base period exports (compared to 24% in the Dunkel draft). This concession was viewed as potentially very important; Guyomard *et al.* (1992) estimated that of the three areas for reduction, the export subsidy reduction was the only one which could be binding on the EC (especially with respect to grains and beef) and the USA (due to the Export Enhancement Programme).

Following the Blair House agreement, the emphasis of the UR negotiations moved away from agriculture to other areas of contention (services, the MFA, market access). December 1993 was set for the final meeting, at which the heads of government were to sign the agreement.

3.10 The Uruguay Round Agreement for Agriculture

After 7 years of negotiation, the UR agreement was finally signed on 15th December 1993, the last day of the US President's 'fast track' authority. Subject to ratification by the government of each contracting party, the Agreement will run from July 1st 1995 to June 30th 2001. For agriculture the agreement was essentially the same as that agreed bilaterally by the USA and EC in Washington. The detail of the agreement is given below under the three recognised headings of import protection, internal support and export subsidisation.

Import Protection

It was agreed that all border protection measures are to be changed into *ad valorem* customs duties (i.e. "tariffication"). Once established, the tariffs are to be reduced by 36% over the 6 year period, from a base level calculated using average 1986-1988 data (note that for developing countries the requirement is reduced to a 24% cut in tariffs over 10 years (1995-2005), but the base period remains the same). The 36% reduction is of a simple, unweighted, mathematical average of all tariffs. To prevent strategic manipulation of the system (such that a single tariff remains unchanged, or is increased while another is reduced by more than 36% for example), each individual tariff must be reduced by a minimum of 15% over 6 years.

In principle, the duties calculated under the tariffication scheme should be the difference between the average cif price over the reference period and the average domestic wholesale price. However, the EC's tariff schedules (which were accepted by the other CONTRACTING PARTIES) were firstly calculated as the difference between the fob world market price and the intervention price, increased by 10% to maintain Community Preference, and secondly calculated using the 'market ECU' (defined as the 'green' ECU multiplied by the switchover coefficient). The latter implies that the levels of protection afforded to EC farmers by the end of the reform period could be around 20% lower than it would appear from the EC's tarrif schedules; "Assuming that the green ECU is still in existence in 1995, the Commission will have to take each of its monetary commitments agreed under the GATT and divide them by the current switchover coefficient ...in order to render these amounts in green ECU" (Agra Europe no.1578 pE10). The current (March 1994) switchover coefficient is 1.207509.

Included in the agreement are several 'safeguard clauses' which allow countries to increase tariffs on certain goods in order to prevent domestic markets being damaged by a surge of imports, provided that a set of specific conditions are met. The conditions are essentially a high trigger level of imports or a low trigger level of world market prices.

The agreement also requires each country to make 'minimum access' provisions in all sectors; import opportunities must be opened at least to the equivalent of 3% of internal consumption, rising to 5% by 2001. In order to achieve these minimum access targets, tariff-quotas will be established with the tariff fixed at 32% below the basic tariff, whatever its level (i.e. these tariffs will also be subject to an average 36% reduction). In cases where market access is already guaranteed by an import quota (for example, the butter access agreement between the EC and New Zealand), the existing opportunities for access must be maintained, at least at the average 1986-88 level.

Internal Support

Domestic agricultural subsidies are to be included in a global AMS, which is then to be reduced by 20% over the 6-year period (13.3% in the developing countries). The AMS is to expressed in monetary terms, for each product, using the 1986-88 base period. Countries in which the current *total* AMS does not exceed 5% of *total* agricultural production need not reduce domestic support further (for developing countries this *de minimis* percentage is 10%).

Certain policies are exempt from the reduction - the GATT text states that "direct payments under production-limiting programmes shall not be subject to commitment to reduce domestic support." This is on the condition that: (i) the payments are based on fixed areas and yields; (ii) they are made on 85% or less of the base level of production; (iii) livestock payments are on a fixed number per head. The compensatory payments introduced in the 'Cunha' reform of the CAP do not strictly meet these criteria but were exempted from AMS reduction in a political move to reach an agreement.

In addition to the direct payments, other types of subsidy are placed in the 'green box'. These policies must not have the effect of providing price support and must be provided via a publicly-funded government programme, for example research into pest control. Public stockholdings for food security purposes and domestic food aid are also exempt.

Export Subsidisation

On export subsidies, the agreement is for the dual commitment of reducing budgetary expenditure on export subsidies by 36% over 6 years and reducing the volume of subsidised exports by 21% over 6 years (for developing countries 24% and 14% respectively)[8]. Both commitments are based on a 1986-90 reference period, although there is some flexibility in the phasing of the reductions. The agreement states that where 1991/92 subsidised export levels exceed those of the base period, the former may be used as the starting point for the reductions. However, by the end of the reform period, the resulting reduction must be the same, namely a 21% reduction in the volume of subsidised exports from the average 1986-90 level. This concession was won by the EC to avoid having to make drastic cuts in subsidised exports of beef and cheese in the first year of the reform period; however, it also allows the EC (and any other qualifying country) to export more of the product covered by this clause, in absolute terms, over the reform period than would otherwise have been permissible. For example, the Commission has calculated that it will be able to export an additional 8.1 million tonnes of cereals while the USA will be able to export an extra 7.453 million tonnes of wheat than would have been possible under the Blair House formulation of the export subsidy reduction[9].

The Peace Clause

An important element in the final agreement as far as the EC and USA are concerned is the so-called 'Peace Clause'. This states that agricultural policy measures are not subject to challenge through the GATT (or its successor the World Trade Organisation (WTO)) as long as they do not contravene the provisions of the UR. In effect this clause formally recognises the right of contracting parties to pursue income-supporting agricultural policies; in the EC it was seen as giving legitimacy to the CAP while ensuring that any future CAP reform would not be forced on the Community by the WTO. Note that the Peace Clause is to run from 1995 to 2003, three years longer than the rest of the UR Agreement (this was seen as a major victory for the EC).

3.11 Conclusion

The UR was the longest and most wide-ranging of all of the GATT Rounds to date. It

8 Food aid exports are excluded from the agreement

9 Agra Europe Supplement, December 1993, p16.

produced an agreement in many difficult sectors, including agriculture. The agricultural deal was essentially designed by the EC and the USA (this was not unexpected given their dominant positions in the agricultural trading system); however, the other contracting parties saw the deal as a way to end the US/EC export subsidy 'war', thus allowing them to benefit from envisaged increases in world market prices. The agriculture agreement concentrated on reducing the trade-distorting elements of domestic farm income support policies, with cuts in import protection and export subsidisation being larger than those in internal support. However, a major element of both the USA's and EC's domestic farm income support policy was excluded from any reduction; namely deficiency payments (compensatory payments in the EC). The conditions placed on such payments were designed to ensure that excess production was not encouraged even though the payments are not strictly 'de-coupled'. That said, the agreement provides a starting point for the review negotiations in 1999, which should mean that the years of ideological battling by the EC and United States seen in the UR can be avoided.

Chapter 4

The Use of Aggregate Measures of Support in the Uruguay Round

4.1 Introduction

From chapter 3 it is clear that the main participants in the UR accepted that an AMS would be needed to quantify the existing level of internal support and then monitor reductions in it relatively early on in the Round. Differences of opinion as to the role of such an AMS within a programme to reform agricultural policies continued to exist in the proposals tabled by the US, Cairns Group (CG) and the EC[1], but in the papers submitted before the abortive 'final' meeting in December 1990 there appeared to be a remarkable degree of agreement on the form that the AMS should take. It was proposed that it be based on the principles of the OECD Producer Subsidy Equivalent (PSE). Thus it would contain elements to capture market price support, direct payments to producers plus other input, investment and marketing cost reduction measures only available to agriculture, but with adjustments to the policy coverage and the method of measuring market price support. This chapter examines the PSE and the problems associated with it as a measure of trade distortion, the changes to the PSE suggested by the major participants in the UR as solutions to the problems, and an illustration of the use of the 'new' AMSs in the reform process proposed in autumn 1990. Finally, a comparison is made between the proposed AMSs and the PSE.

4.2 The Producer Subsidy Equivalent[2]

The use of PSEs to measure assistance to agriculture was developed by Josling in the early 1970s (although the theoretical basis of the PSE may be found in the work of Corden). The method was adopted by the OECD in 1982 and PSEs are now calculated annually for certain key agricultural products for the OECD countries.

The PSE calculation is based on the principle that policies to assist farmers do so by

1 Only in the Blair House Accord of 1992 did the EC accept separate reductions in each of the three Areas (internal support, import protection & export subsidisation) as a principle.

2 This section is based largely on Cahill & Legg (1989).

transferring income from consumers and taxpayers. It is an aggregate measure of the total monetary value of assistance to agricultural inputs and outputs, on a commodity basis, associated with a set of policies given the policies of other countries, and represents the value of consumer and taxpayer transfers[3].

The PSE framework rests on 'a downward-sloping demand curve and an upward-sloping supply curve which determine equilibrium prices that reflect the private and social benefits and costs' (Cahill & Legg p 20), within a *partial equilibrium* framework (so that, by assumption, prices and quantities in the rest of the economy are not affected by changes in agricultural markets), using *observed* levels of commodity production and domestic and 'world' prices[4]. In addition, the partial equilibrium assumption means that *zero substitutability* is also assumed so that 'no cross-commodity effects are incorporated in the calculations based on observed prices and quantities' (Cahill & Legg p 21) and homogeneity is assumed for a commodity produced and consumed within a country (whether or not the latter is domestically produced or imported). Finally, the PSE calculation assumes the *small country* case. In other words, the potential effects of any country's policies on the levels of trading prices are ignored. The problems associated with this assumption are well recognised by the OECD and are discussed in section 4.2.1.

PSEs can be expressed in three ways: (1) the total PSE which measures the total value of transfers to the commodity; (2) the per unit PSE which measures the total value of transfers to each unit of the commodity; and (3) the percentage PSE which measures the total value of transfers as a percentage of the total value of production (including transfers). Figure 4.1 gives an illustration of the PSE concepts in the case of (a) a perpetual net importer and (b) a perpetual net exporter, where the government policies are aimed at market price support.

In each case the supported domestic price is P^d and the world market price is P^w. The perpetual importer produces at QSm while consumers within that country demand QDm, imports are thus QDm-QSm. The total PSE in this case is the rectangular area $P^d abP^w$[5].

3 These should not be confused with the transfers measured in the Consumer Subsidy Equivalent (CSE) which captures only the effects on consumers of agricultural support policies rather than capturing all policies that affect consumption. See Cahill & Legg (1989 p 17).

4 The 'world' price being an approximation of an 'unassisted' price against which to measure the effects of the policies employed on internal prices.

5 The area acdb represents the total (negative) CSE resulting from the higher prices paid by consumers for the imported good.

In the case of the perpetual exporter production is at QSx, domestic demand is QDx and exports are equal to QSx-QDx. The total PSE is the area $P^{d}efP^{w}$. The unit PSE in both cases is $P^{d}-P^{w}$. Now assume that both countries employ a deficiency payments scheme. The levels of production would not change in either country, however, new levels of consumption would arise - QDm' in (a) and QDx' in (b). The unit PSE would be unchanged at Pd-Pw as would the total PSE in both (a) and (b)[6].

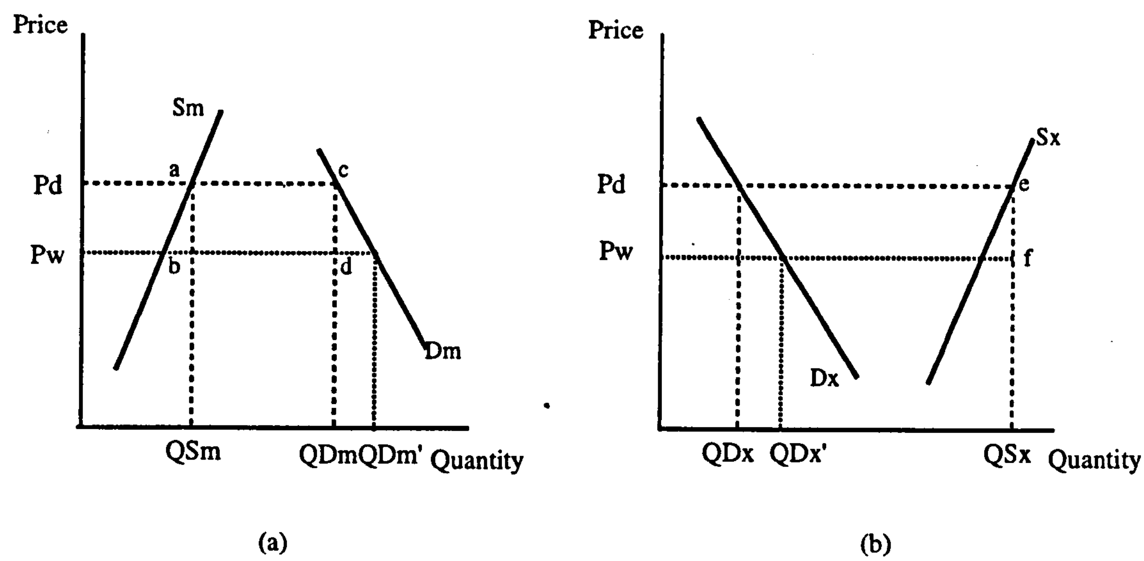

Figure 4.1

Algebraically the three PSE measures can be expressed, in general, as follows

$$PSE = Q(P^{d} - P^{w}) + D + B - L \qquad (4\text{-}1)$$

$$\text{Unit PSE} = PSE / Q \qquad (4\text{-}2)$$

$$\%\ PSE = PSE / [Q(P^{d}) + D - L] \qquad (4\text{-}3)$$

where Q is the domestic production level, P^{d} is the domestic producer price, P^{w} is the 'world' price, D are direct payments, B are all other budgetary financed support and L are producer levies. Note that the PSE could also be expressed as a percentage of domestic production valued at world prices. The resulting percentage PSE would then be comparable with an *ad valorem* tariff as such a tariff is also expressed as a percentage of world prices (Tangermann *et al.*, 1987).

The OECD PSE calculations aim to incorporate all agricultural policy measures which directly or indirectly influence production, consumption and trade and which would not be

6 In the case of deficiency payments there are no CSEs.

captured if only trade barriers were measured. More specifically, five categories of agricultural policies are included:

(i) market price support policies;
(ii) direct payments to producers which do not necessarily raise consumer prices;
(iii) policies to reduce input costs, with no distinction being made between subsidies to capital and those to other inputs;
(iv) the provision of general services which reduce long-term costs but are not directly received by producers;
(v) other indirect support policies including regionally funded subsidies and taxation concessions.

Included under (i) are government storage costs and export subsidies - 'The unit price gap multiplied by the relevant level of production results in the total PSE due to market price support and this includes both quantities exported and taken into government stocks.' (Cahill & Legg p22). This of course becomes significant when considering the EC's position in the UR (see chapter 3). In each of the other categories only those policies specific to agriculture are included - policies which are also applied to other sectors are excluded. For example, a global transport subsidy, such as that operated in the US, would not be included while a targeted subsidy, such as that to grain producers in western Canada, would (*ibid*).

The PSEs are calculated for the OECD countries (the EC counting as one country) for commodities which account 'for at least one per cent of the value of agricultural production as measured at the farm gate' (*ibid*). Adjustments are made in the livestock sectors to compensate for the effects of market support policies applied to products that are used in animal feed; support of cereals, soybeans and skimmed milk powder, for example, raises the cost of animal feed above what it would otherwise have been. These are calculated using fixed input-output coefficients for feed.

4.2.1 Drawbacks of the PSE Measure

The prominence of the PSE in the UR negotiations has prompted a number of papers pointing out the limitations of it in assessing the effects (distorting or otherwise) of domestic support policies on world markets (for example Harvey (1990), McClatchy (1987), Peters (1988), Tangermann *et al* (1987) and others). In defence of the PSE, the OECD has stated that it was not developed to measure anything other than 'the gross costs to consumers and taxpayers which are transferred as benefits to the agricultural sector.' (Cahill & Legg p38). Nevertheless the criticisms of the use of the PSE in the UR to measure the distorting effects of domestic policies are still valid. These are discussed below and the solutions proposed in the UR are presented in section 4.3.

The PSE has the advantage of encompassing the wide range of agricultural support policies which the measures of support used previously[7] did not; however, despite their use in assessing the costs of transfers to the agricultural sectors within the OECD countries, the OECD has freely acknowledged that PSEs have some drawbacks. The first of these is the 'small country' assumption. The world markets for agricultural products are in reality dominated by the large OECD countries (mainly the US and EC) 'which subsidise exports using the world market as a residual recipient of surplus production' (*ibid* p24) so that their domestic support policies have an effects on the level of world market prices; the observed price levels are lower than they would otherwise have been. Thus for small, relatively unprotected, price-taking countries the price gap (and hence the PSE) would be larger than would otherwise have been the case. The OECD, however, defends the small country assumption by stating that 'in so far as changes in world prices for a commodity affect all countries for which calculations are made, this maintains the correct relative level of assistance' and 'the PSEs and CSEs measure the transfers to the agricultural sector from the rest of the economy arising from agricultural policies with a given set of prices and making adjustments for a '"policy-free" world price would lead to incorrect transfer calculations.' (*ibid* p21).

In addition to the theoretical considerations, technical problems of measurement also exist. The world price level is a very important element of the PSE calculation and the choice of the appropriate price is a contentious issue. Some argue that the appropriate price is some estimate of a 'free market' equilibrium price, while others argue that the estimation of this latter price is in itself contentious so that observed prices should be used despite the 'small country' problems. In so far as is possible, own-country border prices are used in an attempt to net out some of the distorting effects of other countries' support policies, using c.i.f. prices for net importers and f.o.b. prices for net exporters[8]. However, even after following these guidelines, technical problems (such as accounting for quality differences) are still to be resolved for some products.

7 Nominal and effective rates of protection for example.

8 Within the UR the issue of the external reference price has been raised several times in the search for an AMS. This will be discussed further in later sections.

Another of the drawbacks of the PSE is the partial equilibrium framework. Black and Bowers (1984) state that on balance the use of such a framework results in an under-estimation of the overall level of assistance afforded to agricultural producers. This results from the fact that 'neither macro-economic polices affecting the agricultural sector (in particular the effect of changes in exchange rates) nor the effects of assistance to agriculture on the rest of the economy are measured' (*ibid* p20). In addition, as has been mentioned previously, no cross-commodity effects are considered other than the somewhat ad hoc animal feed adjustment. McClatchy & Cahill (1988) point out that the cross-commodity effects 'may have considerable impacts on the volumes of that product produced, consumed and traded' (p3). The areas most affected are the cereals sector, for example where production of one crop is suppressed by support for a substitute, and the livestock sector with support for animal products tending to increase the demand for feedgrains, thus offsetting the price reducing effects of feed subsidies. They conclude that in the UR the cross-commodity effects could be taken into account by a 'balanced' reduction of an AMS between commodities which they suggest could take the form of varying rates of policy reform in different commodity areas. The problems caused by the partial equilibrium framework are again recognised by the OECD.

4.2.2 The PSE as a Measure of Trade Distortion

The major criticism of the PSE has been its usefulness as a measure of trade distortion, which stems from its inability to distinguish between the diverse distortionary effects of the differing policies employed by the industrial countries. For example, Hathaway (1987, p26) argues that while the US deficiency payments programme provides a significant degree of income support to producers and hence an incentive to produce, consumption of the commodities concerned is not reduced, either in the domestic market or on the world market. On the other hand, a set of policies which raise the domestic market price as well as the price received by producers provides an output incentive (as with deficiency payments) *and* changes the pattern of consumption on both the domestic and world markets (given that the world market is the residual market for disposing of any surplus product on the domestic market). To clarify this, consider figure 4.2.

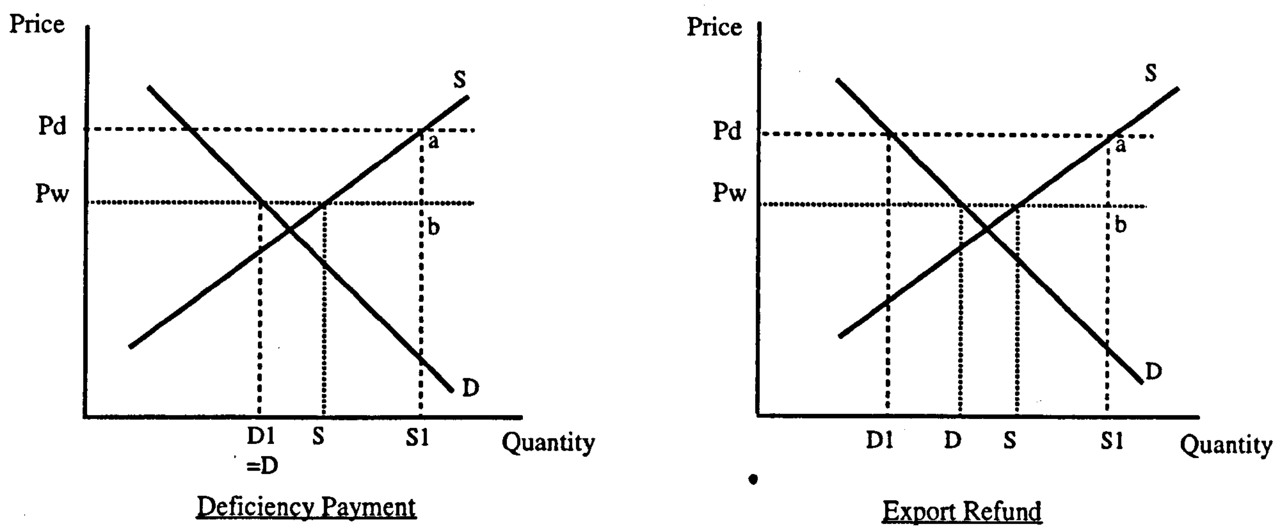

Figure 4.2

In both cases, the total PSE is equal to the area $P^{d}abP^{w}$ and the unit PSE is $P^{d}-P^{w}$. D and S represent the quantities which would be demanded and supplied on the domestic market if the market price were equal to the world market price P^{w} while D1 and S1 represent the quantities demanded and supplied at the supported price P^{d}. It is clear from the figure that the distortion caused by the export refund policy is greater than that caused by the deficiency payment; the latter results in a smaller change in the traded volume - [(S1-D1)-(S-D)] - than the former because the deficiency payment does not distort the demand side of the market.

Harvey (1990) suggests that given that the UR had as its primary objective the reduction of trade distortions and of the domestic pressures for continued support in the agricultural sector, there was a need to 'separate agricultural support from agricultural trade distortion and, in so doing, clarify the meaning of protection' (p17). The PSE cannot do this as 'there is no unique relationship between levels of protection and distortion' (p4). A better method, he suggested, would be to use a 'real' rate of distortion, based on the change in the quantities traded, signed by the differences in the observed levels of domestic and world prices and a post-reform market price. However, Harvey's measure relies upon an a priori estimate of what the levels of trade and world prices would be following a multilateral reform of agricultural policy to determine the real rate of distortion before the reforms occur. Clearly this would be subject to all the usual problems associated with forecasting and one of the main advantages of using a PSE-based measure in the UR negotiations was that the required data were readily accessible (for the OECD countries the data are already collected). Tangermann *et al.* (1987) suggested that rather than abandoning the PSE altogether, the GATT negotiators could agree to classify all support measures such that policies which were not trade distorting would not be included in any reform programme while other measures would be included in the new 'PSE'.

If the PSE is adjusted to account for the differing distortionary effects of the support polices, one problem remains, that of the choice of world (external reference) price. The main concern of the policy makers was that changes in world market prices may be due to factors outside of the agricultural sphere, for example exchange rate movements. It was suggested by the EC that the external reference price should not be allowed to fluctuate but should be fixed. The logic behind this can be seen with reference to figure 4.3.

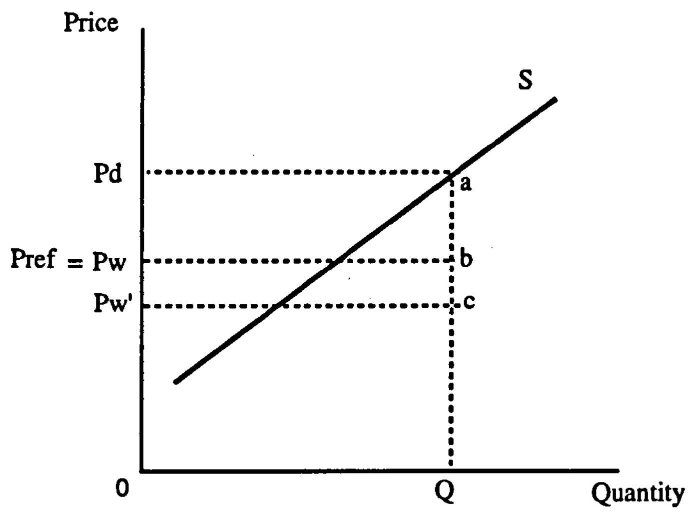

Figure 4.3

If the world market price, expressed in domestic currency, in the base year t were P^w the total PSE be equal to the area $P^d abP^w$, where P^d is the domestic support price . If the world price fell in year t+1 to $P^{w'}$ due either to a change in the market price or the exchange rate or a combination of the two, with the level of P^d unchanged, the total PSE would be increased to $P^d acP^{w'}$. On the other hand, the use of the fixed reference price, P^{ref} (=P^w), would leave the measure unchanged. If the world price fluctuates for reasons beyond the control of governments, for example a drought or exchange rate movements caused by changing circumstances in other economies, reductions in the level of support cannot be measured consistently. One only need examine the PSEs for the EC cereals sector in 1989 compared to earlier years and 1990 (table 4.7) to see how unexpected shocks (a US drought) can drastically affect this measure[9]. If the aim of the proposed

9 The OECD in it annual publication 'Agricultural Policies, Markets and Trade' pursues a decomposition

reductions in support is to narrow the gap between domestic and 'world' prices, and the success of the reduction policy is to be measured by an AMS, then it would seem essential to have a stable benchmark against which to measure progress. The best solution to this stable benchmark question would be to compare real domestic prices with a real external price. However, given the political difficulties likely to be involved in choosing the appropriate deflators, the comparison of current domestic prices with a fixed reference price could offer a second best solution. Tangermann *et al* (1987) suggest that it is desirable for domestic market prices to have some degree of responsiveness to changes in world market prices and some account would have to be taken of inflation over a UR reform period, thus adjustments would need to be made to the fixed reference price.

It must be noted, however, that the use of a fixed external reference price based on recent levels of world market prices does not resolve the problem of the effects of large country distortions to market prices on small countries. Even if prices are fixed, the smaller, price-taking countries (mainly the developing countries) still face a base level price gap which is larger than would be the case if estimated free market world prices were used.

4.3 Adjustments to the PSE Proposed in the Uruguay Round

Discussions about the form of the AMS in any UR agreement centred on adjustments to the PSE in the areas of policy coverage and the choice of external reference price. Suggestions were first tabled by Canada (the Trade Distortion Equivalent) and the EC (the Support Measurement Unit) and eventually by the US and CG.

4.3.1 The Trade Distortion Equivalent

The Canadian government proposed this alternative to the PSE/CSE framework on the grounds that in the context of the UR negotiations only trade-distorting agricultural support polices needed to be addressed. As has been noted before, one of the problems with the PSE is that it does not distinguish between policies for their trade-distorting effects. The Trade Distortion Equivalent (TDE) weights the various policy elements of the PSE or CSE according to the extent to which they have distorting effects on world markets. Algebraically, the TDE which measures transfers from consumers and government to

analysis of PSEs and CSEs, by country and by product to assess the relative importance of the various components of these measures. In 1989 the OECD found that had there been no changes in the other components of the PSE for wheat, the changes in the world price would have induced a 46 per cent fall in the total PSE from the base year as opposed to the 40 per cent fall that actually occurred.

farmers (i.e. analogous to the PSE) can be expressed as

$$TDE = \omega_1 Q(P^d - P^w) + \omega_2 D + \omega_3 B - \omega_4 L \qquad (4\text{-}4)$$

ω_i, i=1,..4 are the weights to be attached to the individual policy elements in PSE measure as defined in equation 4-1. The weights would be set such that the policies which greatly affected world trade would be emphasised while those that had essentially internal effects would not be counted. According to McCorriston (1993) 'no explicit guidance on the value of the weights has been given', though Cahill and Legg (1990) suggest that they will vary between 1 (for the most trade-distorting policies) and 0 (for the least trade-distorting policies)' (p419); this, of course, gives a rather wide range of possibilities!. In addition, it is worth noting that the TDE (like the PSE) suffers from the use of the small country assumption, and the partial equilibrium framework.

4.3.2 The Support Measurement Unit

The EC's preferred AMS, the SMU, is again similar to the PSE but differs from it in three significant ways. Firstly, in defining the SMU, the EC suggested that market price support should be calculated as the difference between internal prices (in most cases the intervention price), and a *fixed external reference price*, P^{ref} (rather than the current world price in the PSE calculation), expressed in national currency, multiplied by production. The aim of the fixed external price was to introduce stability into the SMU over time by eliminating the effects of short-term exchange rate and world price movements, thereby allowing 'a party to enter into commitments knowing precisely to what it is committing itself' (EC Commission (1989a)). However, it makes the SMU sensitive to the chosen reference price; if a high level of external prices is chosen then the price gap (and hence the SMU) would be smaller than if a lower level were chosen. In the latter case, an agreed percentage reduction in the SMU would leave producers with a higher level of protection at the end of the reform period than in the former. It is therefore in the interests of farmers to press for a lower base external reference price. The EC suggested an average of the world market prices in 1986-1988 as a base for P^{ref}.

Secondly, the SMU gives credit for government-imposed *supply control* programmes (e.g. quotas) by estimating a shadow price associated with the limited production level; the shadow price is the minimum price necessary to induce the controlled volume of production and is necessarily less than or equal to the domestic price. The SMU takes account of the difference between the shadow price and the reference price rather than the difference between the domestic price and the reference price. The credit for supply control is illustrated in figure 4.4. P^d is the internal support price, at which farmers wish to produce Q. If P^{ref} is the external reference price, then at Q the unit SMU is P^dP^{ref}. If a production control (e.g. a quota such as in the EC dairy sector) is imposed and limits production to Qs, then the unit SMU is as P^s-P^{ref} where P^s is the estimated shadow price associated with Qs. The total SMU is Qs(P^s-P^{ref}), whereas the total PSE is Q(P^d-P^{ref}) and the unit PSE is P^d-P^{ref} (if P^{ref} is also the actual world market price). Rayner *et al.* (1990) note that if P^d is adjusted upwards whilst the supply control is maintained at Qs, then both the unit and total SMU are unchanged but the unit and total PSE are affected. In addition they state that 'if production is limited by an area reduction programme as in the USA, then (P^s) becomes an adjusted producer price being approximately equal to (Pp + d(1-x)) where Pp is the internal market price, d is the unit deficiency payment and x is the percentage of area set aside. Similar considerations apply, adjusting producer prices downwards, for the set-aside and extensification programmes in the EC.' (p10).

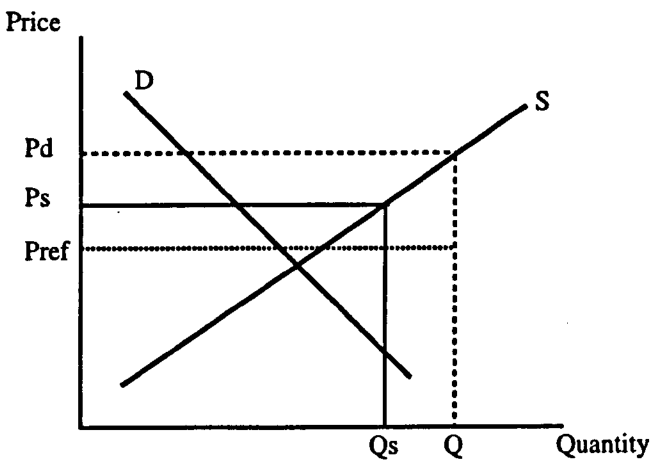

Figure 4.4

It is also clear from figure 4.4 that the shadow price is dependent on the point elasticity of supply (given that in reality only Qs is known). The determination of the appropriate supply elasticities for countries and products with production controls is likely to be politically difficult.

Finally, the SMU differs from the PSE in its *policy content*. It purports to take account of only those policies which have a significant impact on the farmer's decision to produce and hence on trade. To this end, the SMU embraces market-price-support policies, input-cost-reduction schemes, general services and certain direct payments, but not 'disaster payments' which do not, according to the EC, affect the farmer's decision to produce, and 'diversion payments' (e.g. set-aside and retirement programmes) which represent 'a direct and immediate compensation for the reduction of production factors' (EC Commission (1989a) p3).

In the absence of supply controls the SMU can be represented algebraically as

$$SMU = Q(P^d - P^{ref}) + (D - DIV - DIS) + B - L \tag{4-5}$$

while the presence of supply control policies would alter the SMU to

$$SMU = Qs(P^s - P^{ref}) + (D - DIV - DIS) + B - L \tag{4-6}$$

where DIV are diversion payments and DIS are disaster payments.

4.3.3 US and CG Proposed AMSs - Autumn 1990[10]

While the EC continued to forward the SMU as the AMS to be used in the reform process, both the US and the CG offered more detailed descriptions of the form that an AMS would take under their respective reform proposals in the autumn of 1990. They proposed changes to the PSE in three areas which were similar to those proposed by the EC and are presented below.

External Reference Price

In their papers of October 1990 the CG and US appear to concur with the EC on the reference price question. All three suggest the use of a fixed reference price based on 1986-1988 data, in the calculation of market price support. The CG and US also proposed periodic reviews of the reference price (the first being in 1995/96 under the CG proposal) to take account of inflation, world price trends and exchange rate adjustments. Under the CG proposal, the reform process would be halted once the percentage AMS reached less than 5 per cent of the value of production. If, however, this was the case but P^d was still significantly above the world price (even though the gap between P^d and P^{ref} had narrowed) a downward revision of the reference price would be necessary to complete

10 This section is taken largely from O'Connor *et al* (1991b) and has not been updated since then, hence it should be read bearing in mind that only data available at that time are used in any examples.

the reform process[11]. In addition, the CG proposed that the fixed reference price would apply only in the 'early years of the implementation period'. If any country's agricultural sector became market-oriented to the extent that movements in world market prices directly influence producer prices, the current world price would become the reference price. The papers do not make it clear whether the gap between the fixed reference price and the domestic support price would be measured in real or nominal terms, so the illustration of the proposals in section 4.4.2 is in terms of nominal prices to conform with the PSE procedure.

Credit for Supply Controls

An important feature of the Community SMU is that it gives credit for government imposed production controls. The AMSs proposed by the US and CG do not explicitly give credit for supply control. However, the US proposed that only the quantity of the production eligible to receive the support price be used to calculate the AMS, which could potentially give some credit for some forms of supply controls. The effects of taking account of supply controls rather than a limited eligibility for price support can be seen by considering figure 4.5. Firstly, assume production is at Q but only Qe is eligible to receive support. The total US 'PSE' in this case is P^ddcP^{ref} as opposed to the larger P^dabP^{ref} without the restriction. If we now assume that Qe represents a production quota it can clearly be seen that some credit is given for the supply restriction in the *total* 'PSE' calculation, $(P^d - P^{ref})$Qe, the area P^ddcP^{ref}, but not in measuring the unit 'PSE' $(P^d - P^{ref})$. The unit SMU, on the other hand, is calculated as $P^s - P^{ref}$ while the total SMU is limited to $(P^s - P^{ref})$Qe, the area P^secP^{ref}. The CG proposed no such adjustment of production, neither did it propose the use of shadow prices to give credit for supply control.

11 Consider again figure 4.3. If the reform process occurs such that P^d equals P^{ref} at some stage, any further reduction of P^d towards $P^{w'}$ would require a lowering of P^{ref}.

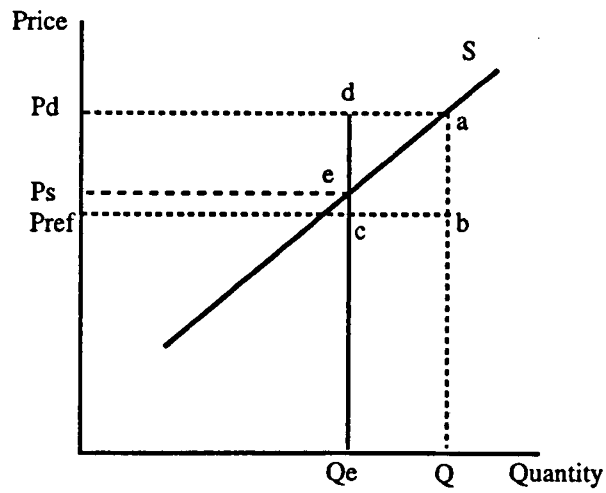

Figure 4.5

It is possible that the US incorporated the Qe principle into their GATT proposals to make them consistent with the so-called 'triple base' feature of the 1990 Farm Bill, under which commodity programme participants suffered a 15 per cent cut in the area eligible for direct payments as a means of limiting the budget, but it would also take account of the fact that participation in the US deficiency payments scheme is voluntary, with the production of non-participants being excluded from Qe. The Qe feature of the US proposal could have resulted in an inconsistent treatment of the EC's supply control policies. For example, in the dairy sector all of the EC's production is eligible for intervention support, even if the quota is exceeded. The penalties are in the form of producer levies rather than any commitment not to support the excess production[12]. In this case, the US AMS calculation would not explicitly take account of the supply control (Qe would be Q and the 'PSE' would be $P^{d}abP^{ref}$ as opposed to a SMU of $P^{s}ecP^{ref}$). In the sugar sector, on the other hand, the EC operates a three-tier quota system, within which there is a proportion of EC sugar production which does not qualify for any internal support and cannot be sold on the domestic market. This production would be excluded from the US AMS calculation, thus giving some credit for the supply control.

Policy Coverage

There was general agreement among the participants that the AMS should only take into account policies which distort trade. As with the EC's SMU, the US and CG also excluded 'disaster' payments such as food aid or 'decoupled' income safety-net policies

12 It is recognised that as producer levies are excluded from the US AMS calculation, some 'credit' would be given to the EC for milk quotas.

from the AMS calculation, along with 'resource retirement' policies (e.g. set-aside) and general services 'of a beneficial nature to the rural community' (US 1990). The US also proposed that for the base period, the AMS should be augmented to take account of resource set-aside policies, although no comment was made on how this would be achieved.

Essentially then, in the initial reform period the CG proposed a measure similar to the SMU (but excluding the possibility of credit being given for supply controls), while the US proposed an 'adjusted PSE' (APSE), which can be written algebraically as

$$APSE = Qe(P^{d} - P^{ref}) + (D - DIV - DIS) + B - L \qquad (4\text{-}7)$$

where Qe is the quantity of production eligible for support.

Comparison of the SMU in equation 4-5 with the APSE indicates that, ceteris paribus, there is little to chose between them unless there is a large difference between Q and Qe (of course if supply controls exist then the difference is more fundamental).

4.4 A Numerical Illustration of the AMS Proposals

4.4.1 Supply Control and the EC Dairy Sector

The effects of the differing treatment of supply control policies by the EC, US and CG can be seen if the APSEs and SMUs for the EC dairy sector are compared. As stated in section 4.3, an APSE for the EC dairy sector would not give the EC any explicit credit for the introduction of milk quotas and as such can be calculated from OECD data, adjusting the PSEs to include a fixed external reference price (1986-88 average), and exclude the costs of resource retirement programmes (in this case the ECs milk 'outgoers' scheme). Calculation of the SMU, on the other hand, requires the determination of a shadow price for milk quotas. In order to calculate this, a medium-term supply elasticity of 0.75 was used. The Ministry of Agriculture, Fisheries and Food suggested a supply elasticity of around 0.7-0.8 had been used by the Commission in their SMU calculations[13] but the true value is unknown. It is worth noting at this point that the OECD in its Ministerial Trade Mandate model employed a supply elasticity of 1.0, which was attributed to a Commission source in 1979, but this could be a longer-run estimate. The importance of choosing the most appropriate supply elasticity can be seen by referring to table 4.1. In each case the elasticity

13 Private correspondence October 1991.

was used to calculate the shadow price associated with the Guaranteed Quantity for each calendar year (including the Deliveries Quota and national reserves, net of adjustments for quantities suspended). Using these shadow prices and guaranteed quantities while taking other data from the OECD, an elasticity of 1.0 results in a 1986 SMU some 0.4 per cent above the level calculated with an elasticity of 0.75, and 0.9 per cent below that calculated using an elasticity of 0.7; by 1990 the figures are 0.6 per cent below and 6.5 per cent above respectively. This analysis shows that the precise elasticity used in the calculation of the dairy SMU has only a slight effect on its measured value.

Table 4.1

SMUs in the EC Dairy Sector: The Effect of the Elasticity of Supply

(Million ECU)

	Supply Elasticity				
	0.5	0.7	0.75	0.8	1.0
1986	14,362	14,750	14,566	14,586	14,622
1987	11,552	12,467	12,232	12,334	12,800
1988	10,051	11,295	11,692	11,826	11,930
1989	10,160	11,354	12,507	12,172	11,245
1990	11,848	11,983	12,886	12,978	12,813

Table 4.2 shows a comparison between the PSE, APSE and SMU, calculated as described above, for the EC dairy sector, 1986-1990. Two things are evident from this. Firstly, the use of shadow prices in calculating the SMU results in a considerably lower level of aggregate support than when it is measured in terms of either the PSE or APSE. Secondly, the fixed reference price used to calculate the APSE means that in 1989, and to some extent 1990, when international prices of dairy products were at historically high levels, the PSE measure was considerably lower than the APSE.

Table 4.2

Comparison of the PSE, APSE and SMU Measures for the EC Dairy Sector, 1986-1990
(million ECU)

	PSE	APSE	SMU (εs=0.75)
1986	25,213	22,758	14,566
1987	22,333	21,527	12,232
1988	20,375	22,995	11,692
1989	20,691	25,186	12,507
1990	24,960	27,266	12,886

4.4.2 Proposed Reforms in the EC Cereals Sector[14]

Calculations made by the EC in the autumn of 1990 to illustrate their offer to reduce cereals support provide a total SMU for the base year of 1986 and for 1995 (the 1986 level reduced by 30 per cent). For the CG and the US who did not provide numerical illustrations of their offers, an AMS can be calculated using data collected by the OECD for their PSE calculations.

For the SMU calculation, the quantity of EC cereals production eligible for support for 1986 was taken as the actual level of production, as the intervention mechanism was not restricted by quantitative ceilings or limited buying-in periods. Thus Q was the same as Qe (note that as supply controls were not operated the SMU is calculated as in equation (4-5)). The difference between the APSE and the SMU in 1986 concerned the reference price. All three participants proposed that the reference price be based on 1986-1988 levels and it therefore seemed reasonable for the purposes of this analysis to assume that P^{ref} is the same under both measures. However, although the EC stated that OECD data could be used in the SMU calculation (EC Commission (1989a)), the P^{ref} used by them was not the same as the P^{ref} calculated as a production weighted average of the cereals reference prices quoted by the OECD for 1986, 1987 and 1988 (OECD 1991); the latter was used to calculate the APSEs for the CG and US while for the EC an APSE equivalent of the

14 This section is again taken from O'Connor *et al* (1991b), the same advice applies.

SMU[15] was calculated to take account of the differing reference prices[16]. For 1995 the APSE equivalent of the SMU was calculated under the assumption that all of the EC's cereal production for that year became eligible for market price support. Production is assumed under a 'best' scenario to be such that the all-cereals Maximum Guaranteed Quantity (MGQ) of 160 million tonnes is not exceeded in 1995. This would be achieved through an increase in the area 'set-aside' and stabiliser-induced price reductions in previous years. In addition, it was assumed that there would be no disaster payments or food aid payments in 1995, then the durum wheat subsidy would be reduced by 4 per cent per annum (the yearly reduction in the SMU suggested by the EC, over the reform period, for all cereals) and that the coresponsibility levy would be 2.39 ecu per tonne (derived from the 1987 levy when the MGQ was not operational so that the supplementary levy did not apply)[17]. Under a 'pessimistic' scenario, EC production is assumed to over-shoot the MGQ by 5 million tonnes.

The reader is reminded of the offers on the long-term reduction of 'internal' agricultural support tabled by the EC, US and CG up to December 1990:

EC - 30 per cent reduction in the SMU between 1986 and 1995;
US - 75 per cent reduction in support between 1991 and 2000, using the average level of support in 1986-1988 as the reference;
CG - 75 per cent reduction in an AMS between 1991 and 2000, using the 1988 level as the reference.

Note that the policies singled out for the lesser (30 per cent) reduction under the US proposal are assumed not to be included in the commodity-specific APSEs (this simplifies the analysis somewhat).

The results of this exercise are shown in table 4.3. The expected conclusion can be drawn from this table, namely that the EC's offer would have resulted in a significantly higher level of support to cereal producers in 1995 than the US or CG offers when measured in APSE terms. Even under the extremely optimistic assumption that EC cereal production could have been restrained to 160 million tonnes by 1995, the costs of supporting that production under the EC's plan would have been around 4.5 billion ECU more than if the

15 Essentially substituting the P^{ref} proposed by the EC with that calculated for the APSE.

16 The reference prices were, for the SMU 90.33 ECU ,and for the APSE 84.94 ECU.

17 The coresponsibility levy is paid annually regardless of whether production is above or below the MGQ. The supplementary levy is paid only if production is above the MGQ.

CG or US plans had been implemented. Not surprisingly, the CG proposal emerged as the most reforming in terms of reducing aggregate support.

The total costs of support in table 4.3 can be translated into levels of support to individual producers over and above P^{ref} by defining a percentage APSE as that part of the producer's revenue (or the value of output) accounted for by governmental assistance. Note that a percentage APSE would also have the advantage of being comparable between sectors and across countries. Relying on the definitions given by the OECD for the percentage PSE in equation 4-3, the percentage APSE would become

$$\%APSE = [\text{Total APSE}/(Qe(P^d)+D-DIS-L)]\cdot 100 \qquad (4\text{-}8)$$

Table 4.3

Comparing the 1990 Uruguay Round Proposals: EC Cereals Sector
(million ECU; APSE measure)

	Base period	Proposed reduction over reform period	Level in 1995	Level in 2000
US proposal	15,968 (a)	11,976	7,986 (b)	3,992
CG proposal	15,504 (c)	11,623	7,754 (b)	3,876
EC proposal (SMU)	15,621 (d)	4,686	10,935	-
APSE equivalent of the SMU -				
Best	16,910	4,531	12,379	-
Worst	16,910	4,488	12,422	-

(a) Average 1986-1988 APSE

(b) 75 per cent reduction by 2000 implies an approximate annual, compound decrease of 12.94 per cent; this has been applied to the US and CG proposals to gain a 1995 value.

(c) 1988 APSE

(d) 1986 SMU. Source: EC Commission (1990)

Table 4.4 shows the 1990 Uruguay Round proposals in terms of percentage APSEs. Again under the best scenario cereal production is assumed to be 160 million tonnes while under the worst scenario production is 165 million tonnes. The percentage APSEs illustrate a number of points; firstly, although the US and EC identified roughly the same level of support in the base period, by 1995 the EC proposal would result in a significantly higher level of support to producers (percentage APSE): this follows logically from the total support costs presented in table 4.3 Secondly, producers receive a lower level of income support when production is higher although the total monetary cost of this support is larger - in percentage APSE terms the extent of support received by EC cereals farmers would be 48.55 per cent of the value of production under the EC proposal 'worst' scenario by 1995 and 49.28 per cent under the 'best' scenario, whereas the costs of this support (table 4.3) would be 43 million ECU higher under the 'worst 'scenario.

Table 4.4

Comparing the 1990 Uruguay Round Proposals
(% APSE)[(a)]

		1995	
	Base period	Best	Worst
US proposal	57.19	38.53	37.76
CG proposal	55.27	37.83	37.07
EC proposal	57.63	49.28	48.55

(a) Derived from the information used to calculate table 4.3, using equation (4.8)

The levels of P^d derived for 1995 as part of the percentage APSE calculation[18] can be taken as an indication of what might loosely be called the cereals 'producer price' implied by the three proposed reform programmes (given the assumptions about production and coresponsibility levies stated above). Table 4.5 shows a comparison of the 1995 'producer price' with a production-weighted average of the cereals producer prices published by the OECD for 1986 to 1990. Under the EC proposal, cereals farmers within the Community are unlikely to suffer as large a cut in 'producer prices' as under either the CG or US proposal. Under the former, cuts of around 5 to 6 per cent would be likely to occur while under the latter two the cuts would probably be around 20-23 per cent.

18 Given the assumptions about production, coresponsibility levies etc. and the fact that P^{ref} is known, the only unknown in the APSE calculation is P^d, hence it can be easily derived by simple mathematics.

Table 4.5

Producer Prices for EC Cereals Farmers
(ECU per tonne)

1986	1987	1988	1989	1990		1995 US	1995 CG	1995 EC
184.64	179.82	172.66	174.03	176.12	Opt.	139.64	138.06	167.24
					Pess.	138.00	136.47	164.95

4.4.3 Comparison of the SMU and APSE with the PSE.

In order to compare the projected levels of support with those experienced recently, percentage PSE equivalents of the proposed SMU and the APSEs for 1995 are computed. The main difficulty in the calculations is the determination of an appropriate, current, 'world' market price to replace the fixed reference price in equations (4-5) and (4-6) in 1995. As a backcloth to the calculations, it is noteworthy that there is a long-run downward trend in the real cereals price (a declining trend is the dominant feature of the time series data of real food commodity prices presented by Tyers (1990)) and that agricultural support policies in most OECD countries have served to retard the rate of transmission of this decline to domestic prices. The 'world' price was estimated by combining a forecast of real international wheat prices[19] with an assumed inflation rate of 3 per cent and a view of the nominal \$/ECU exchange rate (mean rate for mid-1987 to mid-1991). The levels of P^w thus obtained are baseline figures for comparison. They are generated from a model dominated by a downward trend and based on data from a period when the agricultural support policies of the industrial nations affected the world market. If a serious reform process is initiated, real wheat prices may fall less quickly over the reform period[20]. Consequently, the PSEs calculated below for 1995 may overestimate support levels relative to the probable level in 1995. However, the possible importance of policy intervention should not be exaggerated in respect of calculations for 1995, given the short time scale involved and the presence of offsetting supply and demand policy interventions in the cereals markets.

19 US Hard Winter no.2, ordinary protein, f.o.b. Gulf; deflated using the index of US wholesale prices (all products), 1980 = 100.

20 A structural simulation model would be required in order to assess the effects of reform on the trend in world prices; such a model isdeveloped chapter 5

4.4.3.1 The Model: Simply a Long Run Time Trend ?

A visual examination of the real international wheat price series in figure 4.6 suggests that although it is extremely volatile, there exists a slight downward trend over time. A time trend is often included as an independent variable in many time series analyses to capture the effects of technological progress or quality changes which, if not accounted for, could cause the residual errors to be 'badly behaved' and invalidate the usual test statistics. In order to establish whether a simple time trend could be used to forecast world wheat prices (or indeed to establish whether a deterministic time trend should be included in a more general model), the international wheat price series was tested to see if it had a 'unit root'. If a unit root can be established then the series follows a 'random walk' and does not in general return to any long term trend (although it may drift towards its long term mean) - in this case the series is said to be *difference stationary*. More formally, a stochastic process Y_t is said to be (covariance) stationary if its mean, variance, and autocovariances are independent of time

.

(i) $E[Y_t] = \mu$

(ii) $E[(Y_t - \mu)^2] = \chi(0)$

(iii) $E[(Y_t - \mu)(Y_{t-T} - \mu)] = \chi(T) \qquad T = 1,2,...$

The last condition ensures that the covariance between any two values depends only on their distance apart, not on time t.

The importance of the stationarity concept in time series analysis cannot be understated. If variables within a regression relationship are non-stationary, the conventional test statistics do not hold. In particular, R^2 tends towards 1; the t-statistics do not obey the usual distribution[21]; and the Durbin-Watson statistic is low. (These are the characteristics of spurious regressions, resulting from time series data which are trended, identified by Granger and Newbold (1974)). Thus even intrinsically unrelated variables can appear to be highly correlated, albeit in a relationship with serially correlated errors. If a deterministic regression model is to have any validity then the dependent and independent variables must be stationary before any inferences can be made about the relationship.

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21 The Phillips-Durlauf result shows that t and F statistics diverge asymptotically hence the regression coefficients do not converge on their 'true' values.

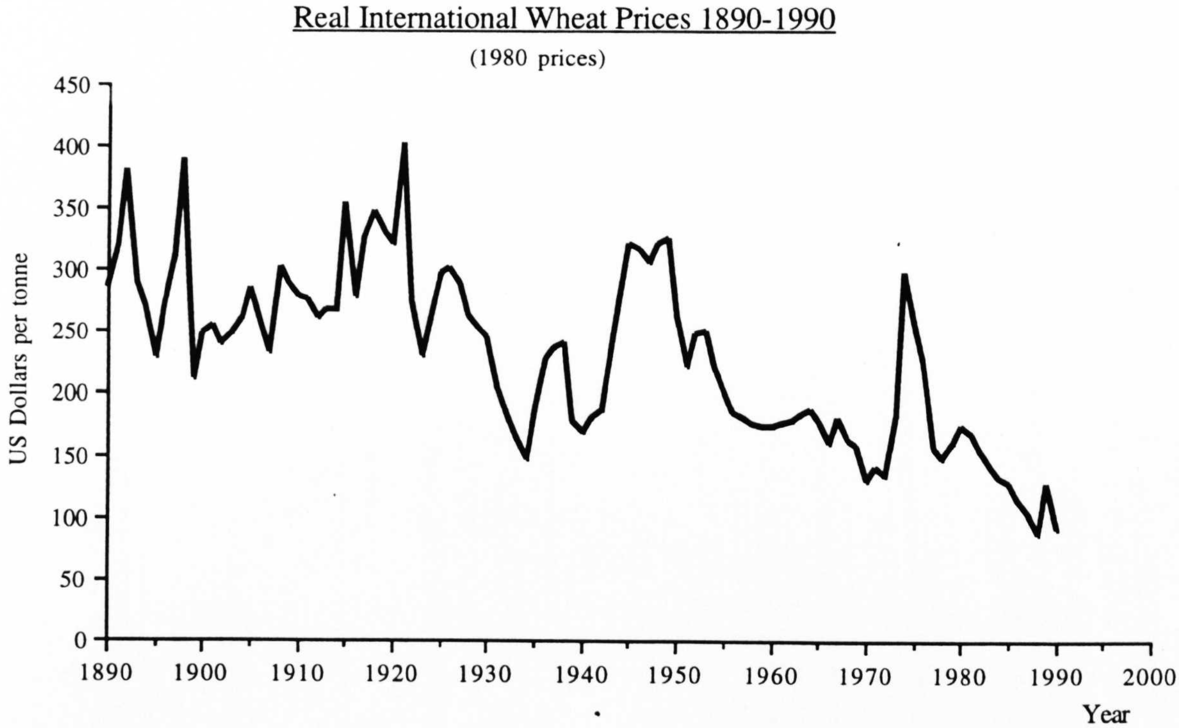


Figure 4.6

Testing for Stationarity

A growing literature has emerged about the concept of stationarity and testing for it. The formal tests rely on the existence of a non-time dependent variance; therefore a constant variance should be established before any formal stationarity (or unit root) tests are carried out.

a) Constant Variance - A range - median plot can be used to establish whether a series has a constant variance. The data is sliced into sections containing 3 to 12 observations and their median values are plotted against their ranges. If a non-constant variance is found data transformations may be used to induce stationarity. The type of transformation necessary can also be inferred from the range - median plot.

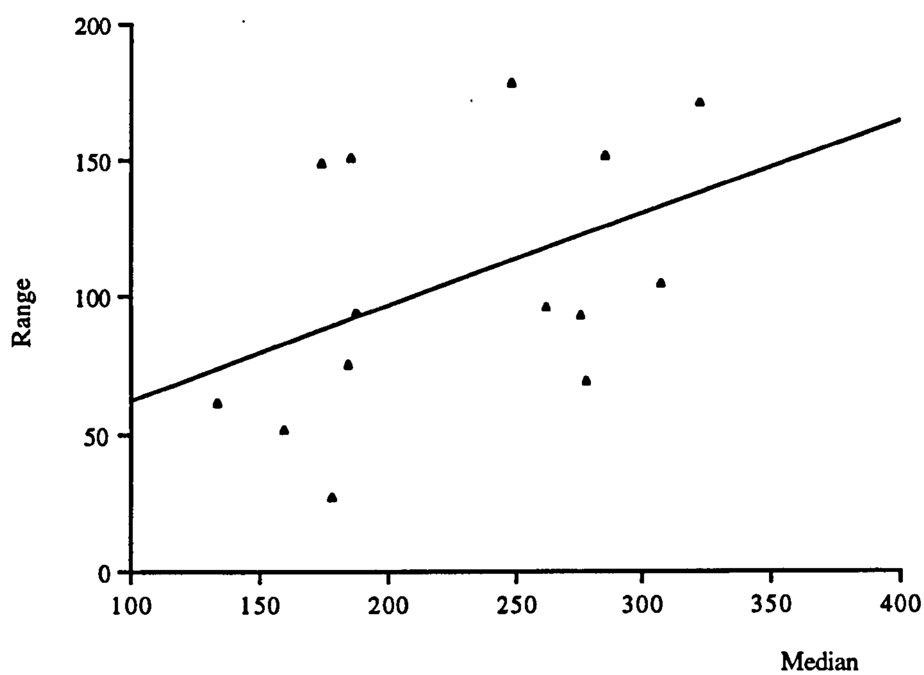
Figure 4.7 shows range - median plots for the real international wheat price data series (1890 - 1990)[22]. For a series to have a constant variance a line fitted through the points should be horizontal; from the range - median plots of the international wheat price series it

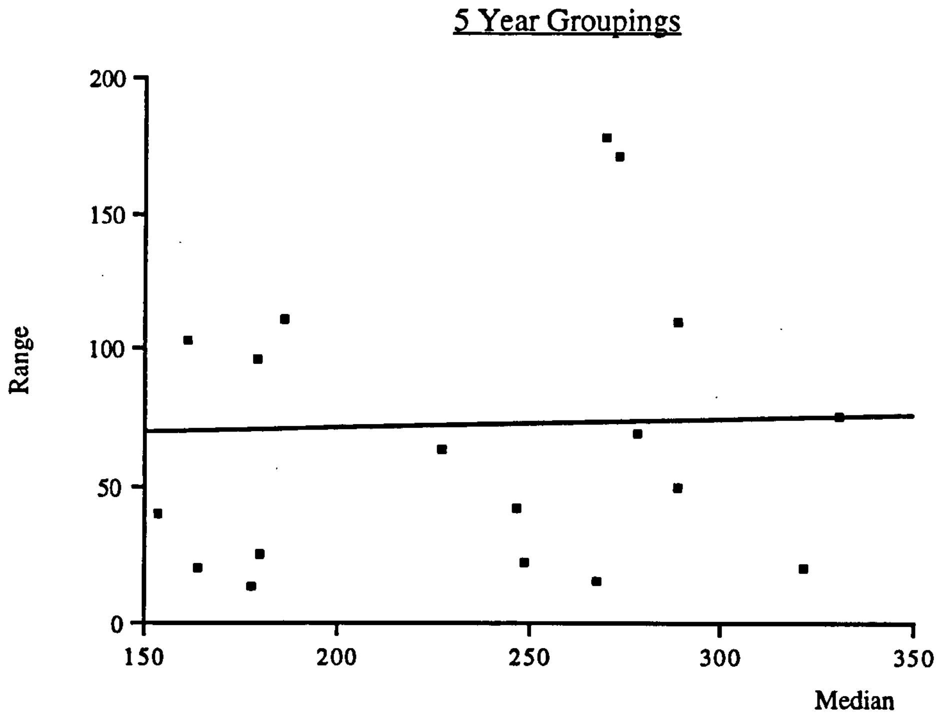
22 This model was developed in 1991 and later data were not available.

is evident that its variance is not constant. The upward slope of the fitted line suggests that a log transformation would be appropriate (Mills (1990) p41). Figure 4.8 shows the range - median plots for the logged series. When 7 year groupings are used the log transformation appears to satisfy the constant variance condition of stationarity. However, the 5 year grouping presents a slight problem. It is possible that the results are being distorted by suspected outlying values in 1898, 1921, 1945 and 1973, although it is more likely that the presence of two world wars during the period and the change in agricultural support policies in the aftermath of the 1930s depression lead to a series of 'structural breaks'.

Original Data

7 Year Groupings




5 Year Groupings
Range
Median
200
150
100
50
0
150
200
250
300
350

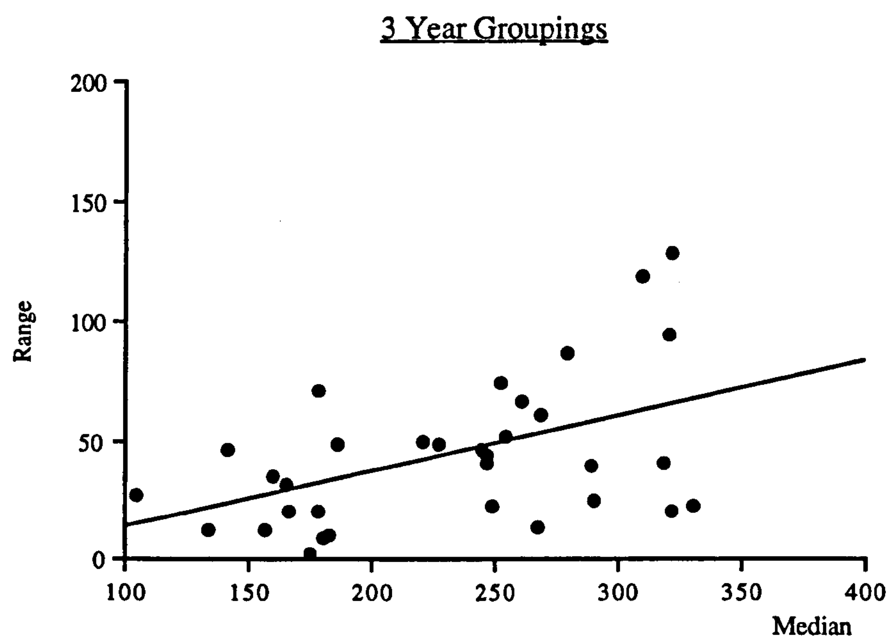
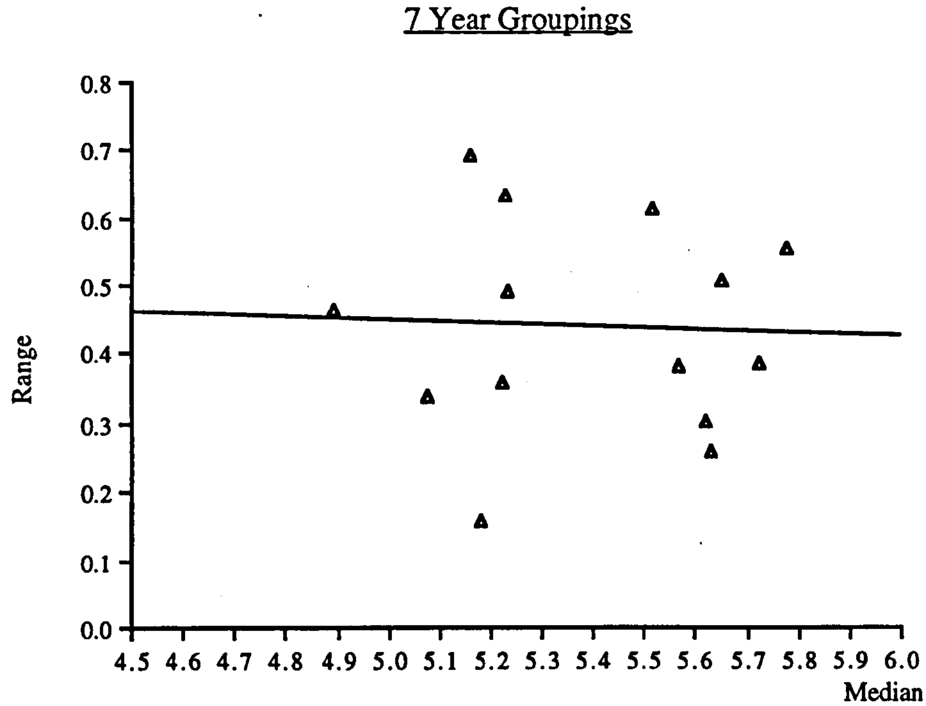
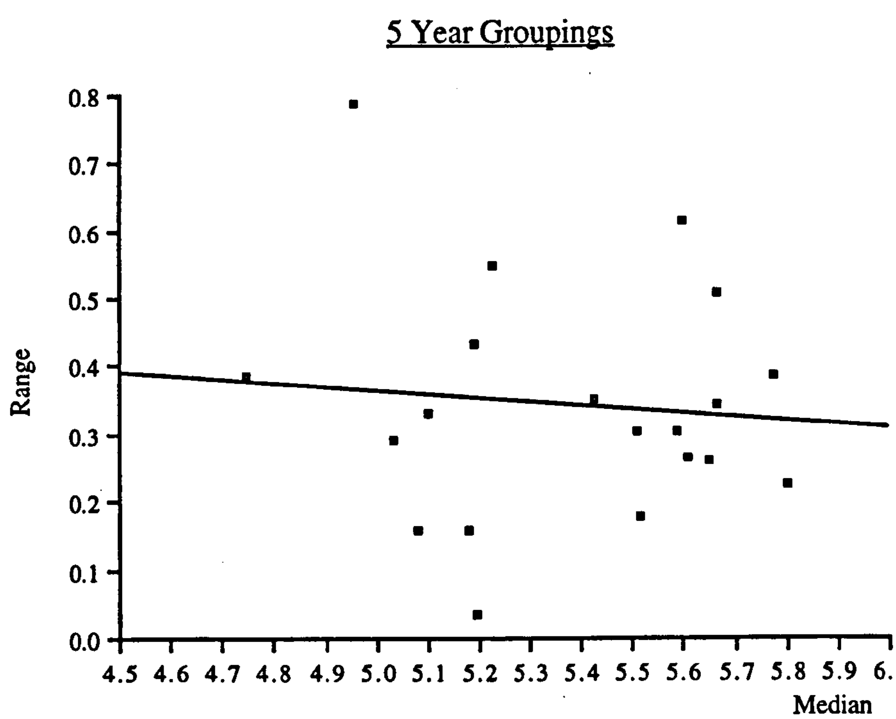

3 Year Groupings
Range
Median
200
150
100
50
0
100
150
200
250
300
350
400

Figure 4.7

Data in natural logs





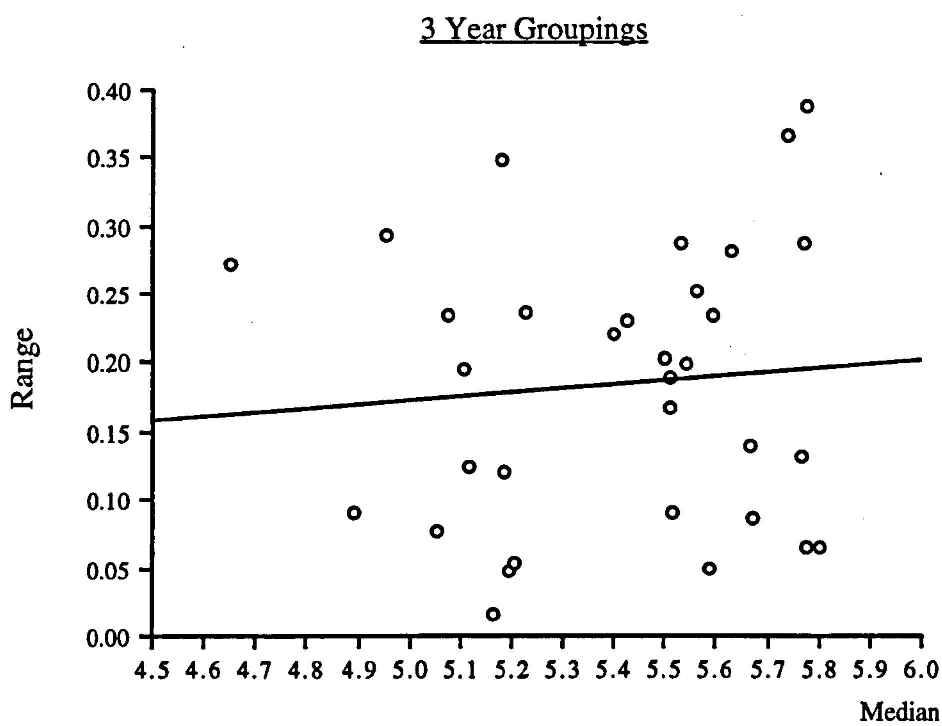


Figure 4.8

Chow tests were carried out to test whether the series exhibited structural stability[23] in the following time trend model

$$\ln WP = c_0 + \beta_0 t + u_t \qquad u_t \sim NID(0,\sigma^2) \qquad (4\text{-}9)$$

where lnWP is the logged international wheat price series. After correcting for autocorrelation in the error term, the results indicated that the changing policies in the 1930s did not lead to a change in the trend. However, two breaks were indicated; both after the wars - one in 1920 and the other in 1945. Bleaney and Greenaway (1990) found that there was no evidence to suggest that general commodity prices suffered from a structural break in 1920 and that the significant Chow statistic was more likely to have been caused by 'the influence of one or two extreme observations in the period of considerable prices instability' (p21). Indeed, incorporating a dummy variable into the model to remove the

23 Bleaney (1990) suggested that when testing for structural breaks in any model only one of the possible test procedures should be followed and showed the Chow test to be reasonably robust when the time of such a change is unknown.

effects of the extreme values resulted in an insignificant test statistic and the conclusion that no structural break occurred. If a similar dummy is incorporated to remove the effects of extreme values in the 1945 test, the test statistic is still significant (at the 1% level) - a further indication of a break in the series at this time.

b) Unit Root Tests - As has already been stated, the presence of a unit root can be taken as an indication that a series is 'difference stationary'. In order to understand the concept of a unit root consider the following autoregressive model

$$Y_t = \rho Y_{t-1} + \varepsilon_t \qquad t = 1,2 \ldots. \qquad (4\text{-}10)$$

ρ is a real number

$\varepsilon_t \sim NID(0, \sigma^2)$

Y_t is stationary only when the autoregressive coefficient $|\rho| < 1$. The series will thus be non-stationary for all other values of ρ. If $\rho = 1$ then Y_t follows a random walk, and is said to have a unit root; ΔY_t will be stationary in $Y_t - Y_{t-1} = \varepsilon_t$. In this case the series is known as a 'difference stationary process' and is integrated of order 1 (written as I(1)). Note that if $|\rho| > 1$ then an explosive series is implied with the variance growing exponentially over time. In general the explosive case is not plausible in terms of economic theory so that the hypothesis testing procedures concentrate on whether a series is a 'difference' stationary process. The hypothesis $\rho = 1$ can be tested by estimating the above model or, more usually the reparameterized model, $\Delta Y_t = \rho Y_{t-1} + \varepsilon_t$ (in this case we test the equivalent hypothesis $\rho = 0$).

Fuller and Dickey and Fuller (DF)[24] have demonstrated that the usual t and F tests are inappropriate for testing the hypotheses and have produced corrected tables for the asymptotic distributions of the t and F statistics. The DF test is based on a regression of the form

$$\Delta Y_t = c_1 + c_2 t + \rho Y_{t-1} + \varepsilon_t \qquad (4\text{-}11)$$

Three hypotheses can be tested using this maintained model; (i) that Y_t has a unit root ($\rho=0$); (ii) that the series follows a random walk with a drift towards a mean value ($c_2=\rho=0$); and (iii) that the series follows a random walk without drift ($c_1=c_2=\rho=0$)[25].

24 Fuller W.A. (1976) *Introduction to Statistical Time Series* Wiley, New York.
Dickey D.A. & Fuller W.A. (1979) 'Distortions of the Estimators for Autoregressive Time Series with a Unit Root' *Journal of the American Statistical Association* vol.74 pp427-431.

Note that if c_2 cannot be restricted to zero then the series contains a deterministic time trend which must be isolated prior to any modeling.

The DF maintained model only allows for the testing of the simple AR(1) case; a more general form of the equation, known as the augmented Dickey-Fuller (ADF), is usually used to allow a more rigorous testing of the nature of the integration of a series

$$\Delta Y_t = c_1 + c_2 t + \rho Y_{t-1} + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \varepsilon_t \qquad (4\text{-}12)$$

where m is chosen so as to eliminate any autocorrelations, leaving the error term ε_t as white noise and permitting efficient OLS estimation. Testing of the augmented model is carried using the same null hypotheses as for the DF model above.

Applying the ADF method to the lnWP series for the 1945 to 1990 period[26] yields the following results. (All autocorrelation and heteroscedasticity problems were eliminated with m=3)

$$\ln WP_t = 2.005 - 0.005t - 0.366 \ln WP_{t-1} + 0.249 \Delta \ln WP_{t-1} + 0.193 \Delta \ln WP_{t-2} - 0.226 \Delta \ln wp_{t-3} \qquad (4\text{-}13)$$

The hypotheses tested were as follows

(i) H0: $\rho=0$ The DF $\tau_{\hat{\tau}}$ statistic (DF(1979)), given by the t-ratio on the estimated coefficient on Y_{t-1} ($\hat{\rho}$), is used to test the hypothesis. In this case the t-ratio of -2.3606 is larger than the critical $\tau_{\hat{\tau}}$ value (at the 5% significance level) and the null hypothesis cannot be rejected. LnWP thus has a unit root over the 1945-1989 period.

Even accepting that the series has a unit root does not guarantee a difference stationary process if c_2 is non-zero (the first difference will depend upon time and the series will not be I(1)); in addition, the test statistic $\tau_{\hat{\tau}}$ is dependent on c_2 being zero. Thus the second ADF hypothesis was tested.

(ii) H0: $c_2=\rho=0$ An F statistic is calculated using the residual sum of squares from the original ADF and a regression with the joint restriction of $c_2=0$ and $\rho=0$. It is then

25 Perman R. (1989).

26 In the presence of structural breaks a different unit root test is needed for the full period. See section c).

compared to the critical values of the DF ϕ_3 statistic[27]. In this case F(4,34) is 1.3945 which is not significant at the 5% level, and H0 cannot be rejected.

For the period after the Second World War, therefore, it would appear that there was a trend in world wheat prices which can be eliminated (and a stationary process established) by taking logs and then first differencing. But what of the full sample period?.

c) Testing for Unit Roots in the Presence of Structural Breaks - Perron (1989) showed that when a time series contains a structural change (characterized by a change in the mean level at a known date) the standard unit root tests are biased towards the non-rejection of the null hypothesis of a unit root; the problem being caused by misspecification of the tested equation. He suggested alternative processes to distinguish a series with a unit root from a stationary series with a single, permanent (exogenous) change in the mean value, all of which were 'asymptotically equivalent'. He noted, however, that the method could not explain the exogenous change, nor could it provide a descriptive stochastic structure; it simply removed the effects of it from the error term. The simplest procedure suggested by Perron effectively subtracted the mean from the original series by allowing a change in it at the time of the break. If Y_t is the original series, then the unit root test can be carried out as follows

$$R_t = \alpha R_{t-1} + \varepsilon_t \qquad (t=1,2,\ldots..T) \qquad (4\text{-}14)$$
$$\varepsilon_t \sim NID(0,\sigma^2)$$

where R_t are the residuals from an OLS regression of Y_t on a constant and a dummy variable DU_t which is equal to 0 up to and including the year of the mean change (T_B) and 1 thereafter. Testing for a unit root under the null hypothesis that $\alpha=1$ is done using the t-statistic on the estimated value of α, $\hat{\alpha}$, $t_{\hat{\alpha}}$. As with the DF tests the usual t distribution cannot be used, nor indeed can the DF $\tau_{\hat{\tau}}$ distribution; Perron thus derived an asymptotic distribution of $t_{\hat{\alpha}}$. The values are however only valid when the error term in the first regression is not autocorrelated.

Carrying out this Perron process using the lnWP series for the full sample period, 1890-1990, revealed autocorrelation of the error term in $Y_t = \psi + \eta DU_t + \varepsilon_t$ thus further testing was required. In formulating the further tests, Perron distinguished between 'additive

27 Dickey D.A. & Fuller W.A.(1981) 'Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root' *Econometrica* vol 55 pp251-276.

outliers' and 'innovative outliers'. The former refers to a once and for all change in the mean, while the latter refers to changes in the mean which do not occur instantaneously with the effect on Y_t depending on a dynamic process. The 'additive outlier' test is based on the ADF equation and as with the simple test requires an OLS estimation of R_t

$$R_t = aR_{t-1} + \sum_{i=1}^{k} c_i \Delta R_{t-i} + \upsilon_t \qquad (t = k+1, \cdots T) \qquad (4\text{-}15)$$

where k is chosen to eliminate any autocorrelations in the error term. The null hypothesis of $\alpha=1$ is again tested using the t statistic on $\hat{\alpha}$ with the critical value being $t_{\hat{\alpha}}$.

Testing the null hypothesis of a unit root in the case of an 'innovative outlier' is achieved by OLS estimation of equation 4-16 and with the t-statistic associated with $\hat{\alpha}$ being used to test $\alpha=1$ against critical values of $t_{\hat{\alpha}}$.

$$Y_t = \gamma DU_t + \partial D(T_B)_t + \alpha Y_{t-1} + \sum_{i=1}^{k} c_i \Delta Y_{t-i} + v_t \quad (t = k+1, \cdots T) \qquad (4\text{-}16)$$

where $D(T_B)_t$ is equal to 1 if $t=T_B+1$ and 0 otherwise.

Although it is known that there is a structural break in 1945, it is not known whether the form is 'additive' or 'innovative'; therefore both tests were carried out on the lnWP series. The results were as follows.

	$t_{\hat{\alpha}}$
Additive outlier method	-3.27
Innovative outlier method	-3.28

In each case the critical value of $t_{\hat{\alpha}}$ was -3.38 so that the null hypothesis of a unit root could not be rejected.

From the DF and Perron tests it would appear that the international wheat prices cannot be accurately forecast using a simple time trend. This is hardly surprising given the volatility of the original series (figure 4.6) and the change in the parameters after 1945. The data did, however, display a downward trend (which can be eliminated by differencing), suggesting that while a simple time trend may not be appropriate, a more sophisticated approach to time series analysis, the Box - Jenkins approach, could be used.

4.4.3.2 The Box-Jenkins Approach

In essence the Box-Jenkins (BJ) approach to forecasting involves building an 'Autoregressive, Integrated, Moving Average' (ARIMA) model to represent the data. Suppose Y is the variable to be forecast. The BJ analysis begins by transforming Y to ensure that it is stationary (usually by differencing), thereby creating a new variable Y* which becomes the variable used in the ARIMA model. The general model for Y* can be written as

$$Y^*_t = a_1 Y^*_{t-1} + a_2 Y^*_{t-2} + \cdots a_p Y^*_{t-p} + \varepsilon_t + b_1 \varepsilon_{t-1} + b_2 \varepsilon_{t-2} + \cdots b_q \varepsilon_{t-q} \qquad (4\text{-}17)$$

where a_i and b_j ($i=1,2,\cdots p, j=1,2,\cdots q$) are unknown parameters and the ε are independent and identically distributed normal errors. The model is denoted ARIMA(p,d,q) where p is the number of lagged values of Y* representing the autoregressive part of the model, d is the degree of differencing required to produce the stationary series Y*, and q is the number of lags of the error term representing the moving average part of the model. Obtaining the specific ARIMA model for a particular series involves three steps

(a) *identification* - the choice of p, d and q which seem appropriate for further consideration;
(b) *estimation* - the estimation of the unknown parameters a_i and b_j from the data;
(c) *diagnostic checking* - the resulting model is tested to see if it adequately fits the data, or if any further models should be tested.

The BJ approach was applied to the lnWP series as follows:

(a) **Identification** - the unit root tests performed above showed that the lnWP series is first-difference stationary hence the magnitude of d was already known to be 1. The data period used for model estimation was taken as 1946-1990 because of the presence of the change in mean in 1945. An ARIMA model estimated over the full period was of the same form as the 1946-1990 model, but the parameters differed. A visual examination of the differenced series, however, revealed potential outlying values which may have biased any attempts to estimate an ARIMA model. International wheat prices in the early 1970s were subject to several abnormal shocks, the most important of these being the emergence of the

USSR as a significant buyer on the world market, and it was therefore decided to remove the effects of these shocks from the data points concerned. Estimates of what the lnWP values would have been in 1974 and 1975 in the absence of any shock were made as follows. Using data from 1946 to 1973 the model

$$\ln WP_t = c + \alpha_1 \ln WP_{t-1} + \alpha_2 \ln WP_{t-2} + \varepsilon_t \qquad \varepsilon_t \sim NID(0, \sigma^2) \qquad (4\text{-}18)$$

was estimated, by OLS, and then used to forecast a 1974 value. The model was then re-estimated using the newly created data 1946 to 1974. This second model was used to forecast a 1975 value. The resulting series, lnWP2, was found to be difference stationary under the ADF criterion and could therefore be used in the ARIMA procedure.

With d for the new series known to be 1, the identification stage simply entailed determining p and q. Although this is the most crucial step in ARIMA model building, it is subject to personal judgement as it requires a visual inspection of the autocorrelation function (ACF), or the correlogram, and the partial autocorrelation function (PACF), and an 'educated guess' at the appropriate orders of p and q. In practice the actual autocorrelations are not known and must be estimated from the data. From the ACF and the PACF it was deduced that the appropriate model was a mixed ARIMA(p,q) process rather than a simple MA(q) or AR(p); however the orders of p or q were not obvious. The BJ approach in this case would be to choose a few likely forms for the ARIMA model, estimate them ,and use diagnostic tests to select the one which best fits the data.

(b) **Estimation** - Under the BJ 'parsimonious parametrization' principle, it is generally thought preferable to have a simple model rather than a more complicated one. This does not imply a belief that the world is necessarily simple, but that if a model with fewer parameters can be shown to represent the variables under consideration, then this is better to use this rather than a more complicated one. The forms chosen for comparison were ARIMA(1,1,1), ARIMA(2,1,1), ARIMA(1,1,2).and ARIMA(2,1,2); note that in this case the possibility of p=0 or q=0 has already been discounted by the identification stage. Estimation showed that the ARIMA(2,1,2) model was non-stationary in the AR term and therefore an unacceptable form. In order to choose between the remaining models, it was necessary to examine some model selection criteria. The Akaike (AIC) and Schwarz (SC) criteria (Akaike (1974) and Schwarz (1978), as reported in Mills (1990)) are perhaps the most well known of these, and are presented for the lnWP2 series in table 1 below. For both criteria, it is assumed that the degree of differencing is known so that the objective of the procedures is to determine the most appropriate values of p and q. The calculated AIC and SC criteria are examined in the following way. Upper bounds, P and Q, are chosen so as to be sufficiently large to encompass the true model, with pbar = {0,1,····P} and qbar = {0,1,····Q}; p* and q*, the most appropriate value of p and q, are selected such that

AIC(p*,q*) = min AIC(p,q) where, p is an element of{pbar}, and q is an element of{qbar}

and similarly for the SC criterion.

Table 4.6

Akaike and Schwarz criteria for LnWP2

		Akaike p = 1	Akaike p = 2			Schwarz p = 1	Schwarz p = 2
q	1	-3.6185	-3.5730	q	1	-3.4956	-3.4092
	2	-3.5696	NS		2	-3.4058	NS

(NS = non-stationary)

The ARIMA(1,1,2) model performed best under both the AIC and the SC criteria and was thus selected as the most appropriate model.

$$\ln WP2_t = -0.0847 + 0.6046 \ln WP2_{t-1} + 0.7753\varepsilon_{t-1} + 0.1550\varepsilon_{t-2}$$

Figure 4.9 shows the actual and estimated values of the lnWP2 series using this model.

(c) **Diagnostic checking** - the best way to investigate whether a model satisfactorily fits the data is to see how well it performs outside of the sample period. However, frequently, and indeed in this case, the amount of data available is insufficient for this approach to be used, so that models are identified, estimated and checked over the same data set; the diagnostic tests thus performed are less powerful than if they had been carried out on data outside the sample period, but nevertheless are an important stage of model building. The usual test is to check whether the calculated residuals of a model mimic to a reasonable degree a white noise process. If this is the case then the residuals would have a mean close to zero, an approximately constant variance and negligible autocorrelations. The validity of the latter point can be checked by comparing the calculated autocorrelations with the standard errors. The autocorrelations of the residuals of the ARIMA(1,1,2) model calculated from the lnWP2 series are within the standard error bands for all values of k except k=14 and k=23. It was suspected that the volatility of the later data points as compared to the 1946-1970 period may have accounted for this and so it was decided not to reject the model at this stage, but perform further diagnostic tests.

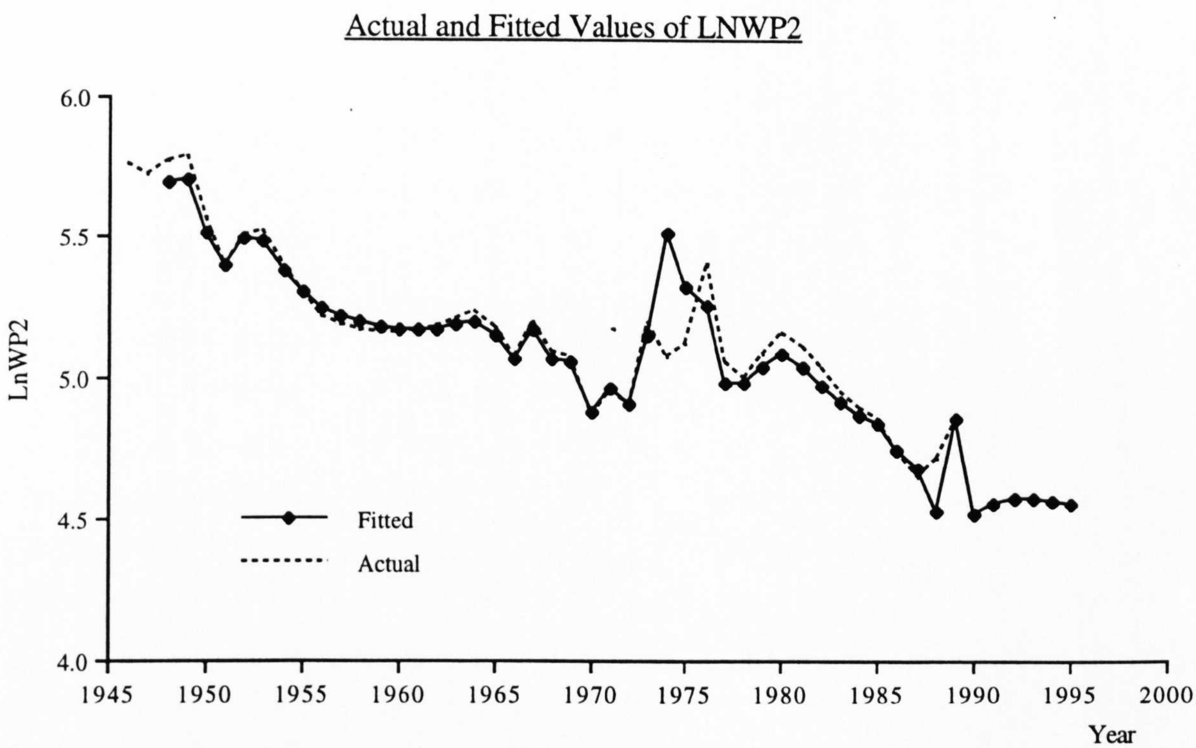


Figure 4.9

More formal diagnostic checks are the 'portmanteau' tests of Box and Pierce and Ljung and Box (Q* and Q respectively). Box and Pierce (1970)[28] showed that if the stationary process was correctly generated by the ARMA(p,q) process then Q* would be asymptotically distributed as χ^2 with (m-p-q) degrees of freedom, where $m=T^{1/2}$ and T is the length of the time series[29]. Ljung and Box (1978)[30] modified the Q* statistic (and called it Q) and showed that it also would have a χ^2 (m-p-q) distribution if the model is correctly specified. If the calculated value of Q exceeds the tabulated χ^2 (m-p-q) value then

28 As reported in Mills (1990) p145.

29 Note that if a constant term is included in the model, as with lnWP2, the degrees of freedom are reduced by one.

30 As reported in Mills (1990) p145.

the adequacy of the model would be questioned. The ARIMA(1,1,2) model estimated from the lnWP2 series did not fail the Box-Pierce-Ljung portmanteau tests and can thus be regarded as adequately fitting the data.

4.4.3.3 The Comparison

After applying an annual inflation rate of 3 per cent to the forecast values of LnWP2 for 1991-1995 and converting from US dollars to ECU at the exchange rate of 1ECU=$1.1934, a 'world price' of 120.82 ECU per tonne was estimated. Table 4.5 gives the OECD PSEs for 1986-1990 and estimates of the percentage PSEs in 1995 (PSE equivalents of the APSE and SMU) which would occur under each proposal, based on two scenarios concerning EC cereals production. Also presented are 'wheat PSEs' for those years calculated by replacing the OECD wheat reference prices with those used in the forecasting procedure.

Production is assumed to be 160 and 165 million tonnes in scenarios A and B respectively, but in addition production of oats, rye and sorghum is assumed to be 10 million tonnes so that 'wheat' production (effectively wheat and barley production) is 150 and 155 million tonnes respectively. The assumptions made about co-responsibility levies and other expenditure in section 4.4.2 are assumed to hold in this case, but in addition set-aside payments are assumed to be increased by 4 per cent per annum between 1990 and 1995.

Table 4.7 indicates that there would have been a very considerable reduction in the proportion of farmers' receipts made up of governmental support if any of the reform processes had been initiated, since internal farm support in 1995 would have been considerably lower than 1990 levels in percentage PSE terms. However, it should be re-emphasised that these projections are based on trend dollar prices for wheat and a view of the mean $/ECU exchange rate. Actual world prices in ECUs, and hence PSEs, in 1995 could be quite different from those used in the projections as a result of factors causing short-run instability in the world cereals market and/or exchange rate variability. For example, if the value of the ECU against the $ were 10 per cent higher (lower) than that used in the projections then the 1995 PSEs would be considerably higher at 20 per cent under the US proposal and 34 per cent under the EC proposal (considerably lower at 2 per cent under the US proposal and 20 per cent under the EC proposal).

Table 4.7

Percentage PSEs for the EC Cereal Sector 1986-1990 and Percentage PSE Equivalents 1995

	1986	1987	1988	1989	1990	Scenario	1995 Projections (a) US	CG	EC
Cereals	54.02	55.86	44.55	24.61	45.15	A.	12.0	11.6	27.9
						B.	11.5	10.5	26.8
Wheat	45.75	43.24	39.51	39.86	41.82				

(a) PSE equivalents of the SMU, in the case of the EC, and of the APSE in the case of the US and CG.

4.5 Conclusions

The Autumn 1990 proposals of the major participants in the UR showed some convergence on the definition of the AMS which was to be used in the reform of internal agricultural support. Based on the PSE, the AMS incorporated the notion of a fixed reference price and made some allowance for supply control, although the US and the EC methods for achieving this were still very different. However, evaluating the offers tabled for the EC cereals sector, on a comparable basis, indicates that there was still a considerable gap between the EC and the US and CG proposals. Under the EC proposal, the costs of supporting the EC cereal sector, as measured by the APSE, would have been around 4.5 billion ECU higher in 1995 than under either the US or CG proposals; EC cereal farmers could thus have been receiving a 1995 'producer price' some 20 per cent higher if the EC's 1990 Uruguay Round proposals, rather than those of the USA or CG, had been implemented. In addition, a comparison of the APSE with the PSEs calculated by the OECD indicated that while there would have been a very considerable reduction in the proportion of farmers' receipts made up of governmental support if any of the reform processes had been initiated (since internal farm support in 1995 would have been considerably lower than 1990 levels in percentage PSE terms), the EC's reform proposal would have resulted in a 1995 value some 15 percentage points above that if either the USA's or CG's had been implemented. Given these divergent positions, it is perhaps understandable that the USA and CG left the negotiating table in December 1990.

Appendix A4.1[1]

Other Measures of Government Intervention

1. Nominal Rate of Protection
2. Effective Rate of Protection
3. Nominal Rate of Assistance
4. Effective Rate of Assistance

The first two are traditional measures of government intervention while the latter two were developed in Australia to increase the policy coverage of the former without using a PSE format.

The *nominal rate of protection* measures how domestic prices for traded goods change in response to changes in government policy. It is defined as the percentage difference between the producer price[2] and the border price of a commodity. In algebraic terms

$$
\begin{aligned}
NRP_i &= [(P^d{}_i - P^w{}_i) / P^w{}_i].100 \\
&= [(P^d{}_i / P^w{}_i) - 1].100 \qquad \text{A4-1}
\end{aligned}
$$

where NRP is the nominal rate of protection for the ith good, P^d is the producer price and P^w is the world price.

The NRP measure covers mainly border policies which cause the domestic and world market prices to differ.

The *effective rate of protection* incorporates the effects of government intervention on the prices of both the final output and intermediate input prices. It is defined as the percentage difference in the value-added of a good with and without border distortions. Algebraically it can be written as

$$ERP_i = [(V^d{}_i - V^w{}_i) / V^w{}_i].100 \qquad \text{A4-2}$$

where ERP_i is the effective rate of protection in good i, V^d is the value added measured at domestic prices and V^w is value added at world prices. Also

1 The information in this appendix is drawn largely from ABARE (1990).

2 Consumer rates of protection can also be calculated using consumer prices rather than producer prices.

$$V^w_i = P^w_i - a_{ji}P^w_j \qquad \text{A4-3}$$

and

$$V^d_i = P^d_i - a_{ji}P^d_j \qquad \text{A4-4}$$

where j are an intermediate input, a_{ji} is an input-output coefficient, P^w_j is the price of the input measured at world prices and P^d_j the price of the input in domestic currency.

The *nominal rate of assistance* for any commodity is defined by the Australian Industries Assistance Commission as the percentage difference between the unit gross returns to domestic producers (R^d) and the world price. It therefore covers the effects of both border measures and all other forms of assistance which directly affect the producers' unit gross returns. It may be defined algebraically as;

$$NRA_i = [(R^d_i - P^w_i) / P^w].100 \qquad \text{A4.5}$$

Finally the Australian *effective rate of assistance* is defined as the percentage difference between the value-added per unit of output with and without government interventions. It can be written as;

$$ERA_i = [(AV_i - UV_i) / UV_i].100 \qquad \text{A4-6}$$

where ERA_i is the effective rate of assistance to commodity i, AV is the assisted value-added and UA is the unassisted value added, both of which are measured at world prices. The ERA takes into account policies which are aimed at intermediate factors (e.g. fertilisers), value-adding factors (e.g. land and capital) and those which directly affect the domestic price of the final commodity.

Appendix A4.2: World Wheat price Data

Year	Nominal Price Unit Values (a) (calendar year) ($/bushel)	($/tonne)	(crop year) (b) ($/tonne)	Market price (c) (crop year) ($/tonne)	Calculated price (d) (crop year) ($/tonne)	Deflator (e) (1980=100)	Real Price (Calculated, crop year) ($/tonne)
1890	0.83	30.50	30.50		30.66	10.763	284.818
1891	0.93	34.18	34.18		34.35	10.726	320.242
1892	1.03	37.85	37.85		38.04	10.019	379.728
1893	0.80	29.40	29.40		29.55	10.242	288.499
1894	0.67	24.62	24.62		24.75	9.199	269.008
1895	0.58	21.32	21.32		21.42	9.385	228.252
1896	0.65	23.89	23.89		24.01	8.901	269.714
1897	0.75	27.56	27.56		27.70	8.938	309.911
1898	0.98	36.02	36.02		36.20	9.311	388.753
1899	0.57	20.95	20.95		21.05	10.019	210.141
1900	0.72	26.46	26.46		26.59	10.763	247.071
1901	0.73	26.83	26.83		26.96	10.614	254.019
1902	0.73	26.83	26.83		26.96	11.322	238.142
1903	0.77	28.30	28.30		28.44	11.434	248.737
1904	0.81	29.77	29.77		29.92	11.471	260.808
1905	0.89	32.71	32.71		32.87	11.546	284.718
1906	0.82	30.14	30.14		30.29	11.918	254.127
1907	0.79	29.03	29.03		29.18	12.514	233.171
1908	0.99	36.38	36.38		36.57	12.067	303.024
1909	1.02	37.49	37.49		37.67	12.998	289.843
1910	1.02	37.49	37.49		37.67	13.557	277.898
1911	0.93	34.18	34.18		34.35	12.477	275.312
1912	0.94	34.55	34.55		34.72	13.259	261.858
1913	0.97	35.65	35.65		35.83	13.408	267.212
1914	0.95	34.91	34.91		35.09	13.110	267.651

Year	Nominal Price Unit Values (a) (calendar year) ($/bushel)	($/tonne)	(crop year) (b) ($/tonne)	Market price (c) (crop year) ($/tonne)	Calculated price (d) (crop year) ($/tonne)	Deflator (e) (1980=100)	Real Price (Calculated, crop year) ($/tonne)
1915	1.28	47.04	47.04		47.28	13.333	354.580
1916	1.24	45.57	45.57		45.80	16.424	278.850
1917	1.99	73.13	73.13		73.50	22.570	325.663
1918	2.37	87.10	87.10		87.54	25.177	347.687
1919	2.38	87.47	87.47		87.91	26.592	330.572
1920	2.73	100.33	94.97		95.45	29.646	321.955
1921	1.55	56.96	75.03		75.41	18.734	402.536
1922	1.25	45.94	50.53		50.79	18.585	273.268
1923	1.18	43.37	44.44		44.66	19.329	231.050
1924	1.43	52.55	48.72		48.97	18.808	260.366
1925	1.72	63.21	58.77		59.07	19.851	297.546
1926	1.46	53.66	57.64		57.93	19.218	301.423
1927	1.42	52.19	52.80		53.06	18.361	288.999
1928	1.25	45.94	48.54		48.79	18.622	261.978
1929	1.24	45.57	45.72		45.95	18.287	251.295
1930	1.00	36.75	40.43		40.63	16.611	244.594
1931	0.62	22.79	28.60		28.75	14.004	205.289
1932	0.60	22.05	22.36		22.47	12.514	179.552
1933	0.54	19.85	20.76		20.87	12.663	164.800
1934	0.60	22.05	21.13		21.24	14.376	147.730
1935	0.91	33.44	28.70		28.84	15.382	187.498
1936	0.99	36.38	35.16		35.33	15.531	227.516
1937	1.11	40.79	38.96		39.15	16.573	236.229
1938	0.90	33.08	36.29		36.47	15.084	241.807
1939	0.58	21.32	26.22		26.35	14.823	177.745
1940	0.78	28.67	25.60		25.73	15.084	170.591
1941	0.85	31.24	30.17		30.32	16.797	180.495
1942	1.03	37.85	35.10		35.27	18.957	186.069

Year	Nominal Price Unit Values (a) (calendar year) ($/bushel)	 ($/tonne)	 (crop year) (b) ($/tonne)	Market price (c) (crop year) ($/tonne)	Calculated price (d) (crop year) ($/tonne)	Deflator (e) (1980=100)	Real Price (Calculated, crop year) ($/tonne)
1943	1.37	50.35	45.14		45.37	19.851	228.547
1944	1.63	59.90	55.92		56.20	19.963	281.541
1945	1.87	68.72	65.05		65.38	20.335	321.490
1946	2.09	76.81	73.44		73.81	23.203	318.103
1947	2.56	94.08	86.88		87.32	28.491	306.481
1948	2.78	102.17	98.80		99.29	30.838	321.988
1949	2.46	90.41	95.31		95.79	29.311	326.792
1950	1.96	72.03	79.69		80.09	30.465	262.882
1951	2.10	77.18	75.03		75.41	33.929	222.256
1952	2.28	83.79	81.03		81.44	32.998	246.810
1953	2.15	79.01	81.00		81.41	32.551	250.104
1954	1.81	66.52	71.72		72.09	32.626	220.947
1955	1.75	64.31	65.23	65.56	65.56	32.700	200.489
1956	1.70	62.48	63.24	62.34	62.34	33.700	184.985
1957	1.77	65.05	63.98	62.50	62.50	34.700	180.115
1958	1.73	63.58	64.19	62.09	62.09	35.200	176.392
1959	1.71	62.84	63.15	61.73	61.73	35.300	174.873
1960	1.69	62.11	62.41	61.36	61.36	35.300	173.824
1961	1.77	65.05	63.82	62.10	62.10	35.200	176.420
1962	1.81	66.52	65.91	62.83	62.83	35.300	177.989
1963	1.79	65.78	66.09	64.30	64.30	35.200	182.670
1964	1.79	65.78	65.78	66.14	66.14	35.200	187.898
1965	1.63	59.90	62.35	63.93	63.93	35.900	178.078
1966	1.69	62.11	61.19	59.52	59.52	37.100	160.431
1967	1.75	64.31	63.39	67.24	67.24	37.200	180.753
1968	1.68	61.74	62.81	62.46	62.46	38.100	163.937
1969	1.64	60.27	60.88	63.20	63.20	39.600	159.596

Year	Nominal Price Unit Values (a) (calendar year) ($/bushel)	($/tonne)	(crop year) (b) ($/tonne)	Market price (c) (crop year) ($/tonne)	Calculated price (d) (crop year) ($/tonne)	Deflator (e) (1980=100)	Real Price (Calculated, crop year) ($/tonne)
1970	1.58	58.07	58.98	53.27	53.27	41.100	129.611
1971	1.69	62.11	60.42	60.00	60.00	42.400	141.509
1972	1.74	63.95	63.18	60.00	60.00	44.300	135.440
1973	2.94	108.05	89.67	91.00	91.00	50.100	181.637
1974	4.80	176.40	147.92	177.00	177.00	59.500	297.479
1975	4.54	166.85	170.83	164.00	164.00	65.000	252.308
1976	3.98	146.27	154.84	152.00	152.00	68.100	223.201
1977	3.09	113.56	127.19	113.00	113.00	72.200	156.510
1978	4.46	163.91	142.93	116.00	116.00	77.900	148.909
1979	4.29	157.66	160.26	141.00	141.00	87.600	160.959
1980	4.85	178.24	169.66	174.00	174.00	100.000	174.000
1981	4.86	178.61	178.45	182.00	182.00	109.100	166.819
1982	4.46	163.91	170.03	171.00	171.00	111.300	153.639
1983	4.41	162.07	162.83	159.00	159.00	112.700	141.083
1984	4.17	153.25	156.92	154.00	154.00	115.400	133.449
1985	3.95	145.16	148.53	148.00	148.00	114.900	128.808
1986	3.34	122.75	132.09	128.00	128.00	111.500	114.798
1987	2.70	99.23	109.03	119.83	119.83	114.400	104.747
1988				132.67	132.67	119.000	111.487
1989				160.58	160.58	124.900	128.567
1990				118.30	118.30	129.380	91.436

Notes:

(a) Average annual unit value of wheat exports, US $ per bushel and per tonne

(b) Converted to crop year, after 1920, using the 5/12ths + 7/12ths adjustment documented in Cooper (1992)

(c) US hard winter no. 2, fob Gulf, US $ per tonne

(d) From 1955 to 1990 this is the market price. Before 1955 the price is calulated by applying the % change in the unit value to the previously calculated value such that the value for 1953 for example is (81.00/71.72)*72.09.

(e) US wholesale prices

Data sources

IMF, 'International Financial Statisics'

USDA, 'Agricultrual Outlook & Situation' November 1990

US Department of Commerce, 'Historical Statistics of the United States: Colonial Times to 1970'

US Bureau of the Census, 'Statistical Abstract of the USA'

Chapter 5

The Links Between AMS, Export Subsidy and Import Protection Commitments

5.1 Introduction

For the first five years of the UR, the EC's reform proposals were presented in terms of an AMS on the grounds that cuts in the AMS (i.e. internal support) would automatically lead to commensurate cuts in export subsidisation and import protection. The USA and CG, on the other hand, consistently proposed separate reform programmes in each of the three areas, export subsidisation, import protection and internal support. The aims of the following two chapters are threefold: firstly, to assess whether AMS reductions do indeed lead to commensurate cuts in border protection and export subsidies; secondly, to establish whether the commitments made in the UR in each of the three areas are compatible (in the sense that they can be achieved simultaneously); and, thirdly, to examine the policy options open to the USA and EC if they wish to support farm incomes and remain within the letter of the UR agreement . The effects of reform on the world wheat market are thus examined to provide an illustration of the three points above, using a simulation model covering seven countries or regions. The analysis centres on the developed countries (especially the EC and USA) as these countries support agriculture more heavily than other areas[1]. Chapter 5 provides a brief review of the modelling procedures used in previous liberalisation studies and a detailed description of the model which is used later in this chapter and in chapter 6 to answer the questions posed here.

5.2 Modelling International Commodity Markets: A Review of Previous Procedures

In recent years interest in the role of international agricultural trade in agricultural policy analysis has grown as policy makers and politicians have realised its import. The result has been a rise in empirical work on trade prospects, especially the effects of liberalising the restrictive trade policies of the industrialised countries, and a re-examination of the

1 An extension of the analysis to consider the effects on developing countries and Eastern Europe for example is a possible area for future research.

analytical procedures appropriate for such studies. The following section is a brief review of some of the modelling procedures used, and the improvements to these procedures made over the last decade.

Agricultural markets have, in general, been analysed using a partial equilibrium approach, usually concentrating on one commodity at a time while implicitly disregarding any cross-commodity effects that may be present. Neither are interactions with other sectors considered. While this allows detailed modelling of the commodity in question, any analyses carried out using the model must be viewed as incomplete (indeed Hertel (1990) argues that partial equilibrium models, especially those in reduced form, lack economic structure and therefore the results can be difficult to interpret and theoretical inconsistencies could arise). The development of multi-commodity partial equilibrium models (for example that of Tyers and Anderson reviewed later in this section) has allowed cross-commodity effects within the agricultural sector to be considered, but any possible cross-sectoral effects (changes in factor requirements for example) are not included, nor do such models allow for endogenous exchange rate changes. The exchange rate can be an important factor when analysing international commodity markets where prices are usually quoted in US dollars. Movements in exchange rates can have effects on the balance of trade valued in domestic currency, and hence on domestic production, consumption and policy decisions. However, one should not overestimate the advantages of general equilibrium modelling (which allows for cross-sectoral effects and endogenous exchange rates) over the partial equilibrium approach. Gardner (1988) describes the advantages and pitfalls of general equilibrium modelling as follows

> 'It seems obvious at first glance that general equilibrium is preferable to partial equilibrium modelling. General equilibrium modelling is more rigorous in that it satisfies more neoclassical restrictions: for example, the adding-up properties of a system of demand equation(s). It also satisfies the constraint that income equals expenditure, so that if protection changes farmers' incomes, this is fed back through the demand side of the model to obtain price effects that a partial equilibrium model would omit' (p362). However, 'in order to make general equilibrium models tractable, their preferences, technology, and endowments have typically been so simplified, and so much has been abstracted, that it is often difficult to take their predictions in some directions seriously. The internal logic of general equilibrium modeling then creates a difficulty in taking *any* of the model's predictions seriously.' (p363)[2]

Also the advantages of partial equilibrium modelling, namely the inclusion of specific market details, especially with respect to policy, should not be underestimated. To give a

2 This latter quotation taken in turn from Sargent T.J. (1987) *'Dynamic Macroeconomic Theory'* Harvard University Press. p7.

general equilibrium model the kind of focus found in partial equilibrium models would require the construction of 'the ultimate model' with every sector modelled in detail. While this would be desirable, the cost of such a model would be great. In practice, general equilibrium models include considerable detail in the sectors of interest, while the other sectors are collapsed into one or two sections.

Of the models reviewed (the majority of which were developed to analyse the effects of a complete liberalisation of agricultural trade) only two were in a general equilibrium format, the OECD WALRAS model and the World Bank (Burniaux) Rural-Urban, North-South (RUNS) model[3].

General Equilibrium Models

The OECD model is a multi-sector, multi-commodity applied general equilibrium model developed 'with the aim of quantifying the long-run effects of agricultural policies on resource allocation between the farm and non-farm sectors, on economic welfare, on factor returns, and on world trade volumes and prices' (Martin *et al.* (1990) p132). It covers the major agricultural trading countries/regions of the OECD in six sub-models which are linked with a residual 'rest of the world' aggregate via a bilateral world trade sub-model. Each country/region sub-models covers thirteen industries, five of which are agricultural. The world trade sub-model treats imports originating in different countries/regions as imperfect substitutes (i.e. the Armington specification[4]), and hence each country is assumed to face a downward-sloping demand curve for all products, and intra-industry trade can occur. The model is completed with an investment equation within which net saving is entirely allocated to investment goods (there are no financial assets in the model)[5]. The model is closed by assuming that the initial government deficit and base-year foreign trade imbalance do not change. This, the OECD argues, 'approximates revenue-neutrality which is considered the appropriate closure to apply to the government sector in long-term simulations' (*ibid* p76). The agricultural policies of the OECD countries/regions are measured using PSEs and CSEs, and, where appropriate for the analysis, the price gap (between internal producer and world market prices) caused by

3 Other general equilibrium models have been developed to study this area, such as the Horridge and Pearce extension of the Tyers and Anderson model (Horridge M and Pearce D (1988) 'Modeling the effects on Australia of Interventions in World Agricultural Trade', IMPACT Preliminary Working paper no. OP-65, University of Melbourne), but are not included here. A review can be found in Hertel (1990).

4 See section 5.2.1 for a discussion of the Armington specification.

5 The OECD freely admits that this is a very simplistic representation.

specific policies. The use of PSEs and CSEs allows the OECD to measure the effects of all agricultural policies (support given to market prices, as measured by the difference between internal and external prices, and transfers from policy measures such as direct payments) simultaneously where other models have only incorporated those effects which influenced the price gap (the OECD's Ministerial Trade Mandate model, reviewed in the next section also uses PSEs and CSEs to measure agricultural policies).

The agricultural section of the 'RUNS' model was developed by Burniaux to assess the overall impact of agricultural protectionism in industrial countries. The model involves ten regions, each of which have a sub-model for the agricultural (rural) sector and one for the non-agricultural (urban) sector; both sub-models are then disaggregated (13 agricultural commodities and 5 industrial). Foreign trade equations imply an imperfectly competitive market for manufactured goods and services but a unique world price for each agricultural product (i.e. perfect competition is assumed for agriculture). While the assumption of perfectly competitive world markets is one which is common to many general and partial equilibrium models, international markets for most agricultural products are dominated by a few powerful exporters (notably the USA and EC) so that some argue that it may be more appropriate to model agricultural trade as imperfectly competitive, or at the very least recognise that a perfectly competitive model is not appropriate[6]. The sectors are linked through price transmissions with domestic agricultural prices responding to world prices of agricultural goods and changes in prices in the urban sector; the effects of agricultural policies are then measured as the price gap between domestic and world prices.

Partial Equilibrium Models

The partial equilibrium models reviewed were, in general, constructed as a system of demand and supply equations for a set of countries which are linked through trade. In its simplest form, the partial equilibrium model becomes a reduced form model of the international market for a limited set of commodities (for example Valdes and Zietz (1988)). Modifications to this basic model have included treating world markets as imperfectly competitive (e.g. Mitchell (1988), McCalla (1966), Schmitz & McCalla (1981)), treating imports from different sources as imperfect substitutes (e.g. de Gorter & Meilke (1987)) and producing multi-commodity models (Tyers & Anderson (*op. cit.*), OECD (1990), Roningen & Dixit (1989)).

The Mitchell and McCalla models view the world market for grains (wheat specifically in

6 See section 5.2.1 for more detail on this point.

the case of McCalla) as a dominant-firm oligopoly. Mitchell asserts that the USA acts as the price leader in the markets for grains, soyabeans, meal and oil, while McCalla assumes Canada to be the 'price leader' in the wheat market. It should be noted that the latter model was developed when the EC was a net importer rather than a significant net exporter. McCalla acknowledged that his dominant firm duopoly model no longer applied post-1970 as the EC would have to then be included as part of the 'dominant firm' group.

The de Gorter & Meilke model of the world wheat market was developed to evaluate the impact of EC wheat policies on domestic wheat consumption (excluding animal feed) and international trade. The analysis distinguishes between the impacts of a change in the intervention price and a change in the threshold (consumer) price. In addition, the model treats imported wheat as a product differentiated from domestic wheat production and exports. The approach taken is to approximate the substitution possibilities between domestic and imported wheat by a two-stage demand system under which total wheat consumption is determined first and then distributed between domestic and imported supplies on the basis of the elasticities of substitution within an almost ideal demand system (AIDS)[7].

The Tyers and Anderson model is perhaps the most well known of the multi-commodity partial equilibrium models used to analyse agricultural trade liberalisation. Their 'Grain, Livestock Products and Sugar' (GLS) model is a dynamic, stochastic, multi-commodity simulation model of world markets in staple products - wheat, course grains, rice, meat, dairy products and sugar. It covers 30 countries or country groups 'so that the international as well as the domestic effects of policy or structural changes in one or more countries or commodities can be determined endogenously' (Tyers & Anderson (1988) p199). Policy and stock-holding behaviour are endogenous and are based on empirical analyses of price transmissions between domestic and world prices and between prices and domestic supply, and of stock level responses to price and quantity changes in each country or country-group respectively. Structurally, the model is a set of expressions for quantities produced, consumed and stored, each of which is a function of known past prices and endogenous current prices. Production is represented by Nerlovian equations and is subject to random disturbances (making the model stochastic); allowance is made for the effects of land set-aside policies on production. Consumption is split into direct human consumption, characterised by price and income elasticities of demand, and livestock feed use which is based on input-output coefficients for each livestock product. The model is

7 This is discussed further in section 5.2.1.

solved for the levels of international and domestic prices, production, consumption and closing stocks which simultaneously clear all markets (markets are assumed to be competitive).

Another multi-commodity, partial equilibrium model was developed by the OECD to analyse the economic effects of domestic agricultural support policies and, subsequently, the impact on domestic and international markets of a reduction in agricultural assistance (described in OECD (1990) pp45-68). The Ministerial Trade Mandate (MTM) model is a medium-term, comparative static model of world agriculture comprising of 11 country or regional models, linked through trade. Each country model contains endogenous relationships explaining the economic factors determining demand, supply and prices for 18 categories of agricultural commodities. The world market is assumed to be competitive and equilibrium occurs when world supply and demand are in balance. Assistance to agriculture is measured by estimates of PSEs and CSEs.

The USDA's 'Static World Policy Simulation Modeling (SWOPSIM) framework' (Roningen & Dixit) is a multi-commodity, multi-region, static, non-spatial price equilibrium model which is calibrated to represent world agricultural markets for a given year. Within the model, it is assumed that (i) world agricultural markets are competitive in that countries act as if they had no market power; (ii) a geographical region is considered as a single marketplace even if it contains more that one country; and (iii) domestic and imported products are perfect substitutes and importers do not distinguish between country of origin. The economic structure of the SWOPSIM model is characterised by constant elasticity domestic supply and demand equations and summary policy measures (price wedges derived from PSEs and CSEs). Stocks are not explicitly modelled because markets are assumed to be in intermediate-run static equilibrium; 'implicitly, though, stocks are presumed to be proportional to consumption flows' (*ibid* p8). Trade is the difference between domestic supply and total demand and is given as a net figure (i.e. it cannot identify imports and exports in the case where a country is an exporter and importer of the same good).

5.2.1 Dealing With Differentiated Products and Imperfect Markets

One of the assumptions made in models of world agricultural markets in the past has been homogeneity of the product under consideration. It has been argued that this assumption is unrealistic given the varieties of agricultural products and different qualities within these varieties, and the fact that countries can import and export the same generic good simultaneously (for example the EC exports soft wheat and imports hard wheat). A popular way of dealing with the simultaneous import and export of the 'same' good is by using an Armington specification.

The Armington Specification[8]

The original model developed by Armington in 1969 was of trade in products differentiated by country of origin. It was based on a 2-stage budgeting process in which total expenditures on the product are determined first using a weakly separable utility function, and then allocated to imports from each source on the basis of a CES function (other types of functional form have been used in some applications of the Armington specification). Using this approach the following import demand function can be specified for a particular product:

$$M_j = \beta_j^{\sigma} M(P_j/P)^{-\sigma} \qquad \text{for } \sigma>0 \qquad (5\text{-}1)$$

where M_j is the quantity of the commodity imported from country j, β_j is a constant, M is the total quantity of the good consumed, P_j is the price of the good imported from country j, P is the price index of the good and σ is the elasticity of substitution between imports from the various sources.

The main advantages of the Armington model are ease of use, flexibility in terms of the functional form of the import demand equation and the fact that the 'model often gives results which are judged to be successful because of both plausible parameter estimates and statistical significance' (Alston *et al.* p445). The main disadvantages are the restrictions placed on import demand. The Armington model assumes that import demands are homothetic and separable by import source. This implies that within a market, trade patterns only change when relative prices change and are not affected by changes in income. Moreover, the elasticities of substitution between imports from any pair of sources are identical and constant, and the income elasticities of demand for all imports of the good from all sources are forced to unity. These are strict restrictions on demand. Alston *et al.* (1990), Goddard (1987) and Winters (1984) find that the Armington specification is not appropriate in the case of wheat and cotton trade, beef trade and UK manufactures respectively. This is because the data do not support the restrictions of homotheticity and separability. Alston *et al.* conclude that if the Armington specification is

8 This section draws on MacLaren (1991).

to be used the data should be tested for consistency with the restrictions, although 'in general, it will be desirable and appropriate to use a less severely restrictive set of assumptions about demand relationships than those of the Armington model' (p466). They suggest using an AIDS specification to give a less restrictive model of import demand[9], but in doing this there is still a risk of specification bias (although a lower risk than with the Armington specification). Used in a model of import demand, the AIDS specification developed by Deaton & Muellbauer (1980) relates the share of expenditure on imports of good j from source i to total expenditure on imports and prices. Deaton & Muellbauer concede that although the AIDS specification usually leads to a high R^2, the homogeneity assumption is often not supported by the data. They suggest that this is likely to be the result of the exclusion of important explanatory variables other than price or total outlay (for example, time trends, lagged dependent variables or short-run price expectations). They further suggest that the price coefficients are likely to be biased by the omissions (pp77-79).

Imperfect Markets

The ability of a small number of countries to influence world markets for many agricultural products indicates clearly that agricultural markets are not perfectly competitive. However, there has been little consensus among agricultural economists on the appropriate model structure for the world market. Models incorporate a variety of assumptions about the extent and nature of market power. The McCalla and Mitchell models mentioned above are fairly typical of the oligopoly models, as is the Cournot structure for the wheat market used by Sarris & Freebairn (1983). The Cournot model, which assumes that the strategic variable is quantity, can be justified if the large developed countries are assumed to pursue policies with an inward-looking nature. This would imply that although these countries recognise that their actions can affect world market prices, their prime concern is with domestic issues such as farm incomes, the level of stocks and budgetary pressures. Perhaps a more applicable model of world agricultural markets is the less naïve, conjectural variations model, which assumes that firms (countries) realise that their output and pricing decisions affect those of other firms and therefore make assumptions ('conjectures') about the output and pricing actions of competing firms. For those large countries which have considerable power on world markets, it is not unreasonable to assume that they have access to the information required to make plausible conjectures about the responses of other countries to changes in their exports (and hence world prices).

9 Winters (1984) also suggests using an AIDS structure to model international trade (p261).

Vasavada (1990) contends that it is not only the supply side that is imperfectly competitive, but that the demand side displays extensive importer power (consider, for example, the ability of the former USSR (and now the CIS) to negotiate favourable terms for their imports of grains and dairy products). He models imports within an Armington framework such that importers do not necessarily display price taking behaviour. Carter & Schmitz (1979) used an 'optimal tariff' framework to examine whether importing countries exerted monopsony power in the world market by comparing actual prices with empirical estimates of the optimal tariff solution. Using data from 1966 to 1977 they concluded that the EC and Japan could have been tacitly colluding with one acting as a price setter by setting prices close to the theoretical optimum. Most modelers, however, view importing countries as price-takers.

5.3 The Model

The model is a partial equilibrium, stochastic, simulation model for wheat. The partial equilibrium format was chosen for several reasons. Firstly, because the analysis centres on the industrialised economies, where agriculture accounts for a small proportion of GNP (less than 5%), and where the impact of changes in the agricultural sector on other sectors is small (exceptions to this are fertilizers and agricultural machinery but these again form a small proportion of the GNP of the industrialised countries). Moreover, as one of the aims of the UR was to reduce the trade-distorting agricultural policies of these industrialised countries, a model used to analyse these negotiations should contain a high level of policy detail; the partial equilibrium format facilitates this type of focus. In addition, a partial equilibrium model can give a fairly full picture of the market under consideration if international and cross-commodity interactions are taken into account.

Initially the model was split into six areas, the USA, the EC, Canada, the CG (without Canada), Eastern Europe and a Rest of the World (ROW) grouping, however, China was separated out from the ROW grouping during the model building process to give a seven are model. The areas are linked through trade with the market clearing price determined when excess supply is equal to excess demand. Note that although the USA, EC and Canada exhibit the ability to influence the world market price, the world market is not explicitly modelled as an oligopoly[10]. Rather, the stocking policies of these countries are assumed to be such as to allow them to react to changes in market conditions and influence

10 The USA in particular has a number of sellers in addition to the government (CCC).

the world price. Thus if the market price falls below a notional trigger level (which is not necessarily the same for all countries), government stocks are accumulated and vice-versa. Also the Export Enhancement Programme of the USA is included specifically as this is another mechanism by which the USA can use its government stocks to influence the world price (it has the effect of dampening it).

The first 4 areas have quite different specifications and are described below. The aim in each of these areas is the same, however; that is to determine net exports (essentially an excess supply function). Available supply is given by the identity

$$AS_t = PROD_t + M_t + STOCKS_{t-1}$$

where M_t are imports and stocks are given by an end of year figure, while usage is given by

$$USE_t = C_t + X_t + STOCKS_t$$

Equating supply and demand and re-arranging gives exports as

$$X_t = PROD_t + M_t - C_t - (STOCKS_t - STOCKS_{t-1}) \qquad (5\text{-}7)$$

5.3.1 The USA

Production

As with the other three areas modelled in some detail, production in the USA is calculated as the product of the area planted and yield. Yield is calculated on trend, from the base period t=0, but with a random element introduced to allow for unpredictable events, weather induced shocks for example. This formulation is the same for each of the four areas modelled in detail.

$$YIELD_t = YIELD_0 + \phi TREND + \varepsilon_t \qquad \varepsilon_t \sim NID(\mu,\sigma^2) \qquad (5\text{-}8)$$

In order to account for the voluntary nature of the support programmes in the USA, the area planted is the sum of the areas planted by participants and by non-participants.

$$AREAUS_t = AREAN_t + AREAP_t \qquad (5\text{-}9)$$

The area equations are based on the methodology used by Haley (1991) to model the provisions of the 1990 Food, Agriculture, Conservation and Trade Act (FACT). The area planted by non-participants is given as

$$AREAN_t = \gamma_1 + \gamma_2 E(RETN_t) \tag{5-10}$$

where $E(RETN_t)$ is the expected return, per hectare, when not participating in the farm programmes; $E(RETN_t)$ is calculated as the expected price (E(P)) in time t multiplied by the expected yield (E(Y)) - the trended value for year t. Price expectations are formed according to the formulation used by Haley in his model of US cereals sector: that is, they are equal to the minimum of either last year's price or the average of the 3 previous years' prices. Haley argues that farmer pessimism regarding market returns can be reflected by this specification, but it also allows farmers to apply a discount factor to 'abnormal' prices. Thus if prices in year t are high due to some abnormal event, a drought for example, rational farmers do not expect those prices to carry through to t+1.

The area planted by participants in the programmes is calculated as follows

$$AREAP_t = (PT_t * BASE_t) - SET_t \tag{5-11}$$

where $BASE_t$ is the base area set under the farm program (calculated as the average of the acres planted and considered planted during the previous five years); PT_t is the participation rate in year t, which can vary between 0% and 100% and is dependent on the relative returns from participation and non-participation; and SET_t is the area set-aside in year t such that

$$SET_t = \tau(ARP_t * BASE_t * PT_t) \tag{5-12}$$

where ARP_t is the percentage of the base area required to be set aside under the Acreage Reduction Program. The ARP variable, like all other policy variables, is assumed to be exogenous but is restricted by the provisions of the 1990 FACT, namely that the range of ARP levels available to decision-makers is determined by the ratio of ending stocks to total use. The constant τ is expected to be larger than 1 as the total area set aside includes area registered in other programmes (for example paid land diversion and the 50/92 and 0/92 programmes).

The assumption of exogenous policy decisions is made while recognising that events on the world market will influence policy makers so that policy could be made endogenous (using game theory or a 'satisficing' model, for example). However, it is useful for this analysis to investigate whether governments can adjust certain policies, leaving others unchanged (or even increased) while still meeting any UR agreement. By making this assumption various policy options can be easily tested.

The participation rate (registered acres as a percentage of the base area) is given by

$$PT_t = \lambda_1 + \lambda_2 E(RETP_t) - \lambda_3 E(RETN_t) \tag{5-13}$$

where $E(RETP_t)$ is the *minimum* expected return per hectare from participation.

Note that given the formulation above and the fact that all farmers face the same expected returns in any one year, the existence of a participation rate of between 0% and 100%, rather than exactly 0% or 100% reflects the differing perceptions of risk by individual farmers. The difference between the known minimum expected return from participation and the unknown expected return from the market can be thought of as a measure of risk.

$E(RETP_t)$ is calculated as the sum of the expected deficiency payment and the expected price support from the non-recourse loan program.

$$E(RETP_t) = [E(DP_t) * YDP_t * (1\text{-}ARP_t)] + [E(Y_t) * LR_t * (1\text{-}ARP_t)] \tag{5-14}$$

The expected deficiency payment, $E(DP_t)$, is defined as the minimum target price (as fixed in the FACT) minus the average market price in the previous 12 months, or the previous 3 years, whichever is the lower. YDP_t is the programme yield, fixed in the FACT as 'the average of farm program payment yields for the 1980-85 crop years excluding the highest and lowest years' (USDA (1990)) - i.e. a constant. The loan rate, LR_t, although an exogenous policy variable, is constrained by the provisions of the 1990 FACT. Thus it is set at 85% of a 5-year moving average of market prices, excluding the high and low years, providing it is not less than 95% of the year earlier loan rate. Discretionary reductions of up to 10% are allowed if the ending stocks-to-use ratio is over 15%.

As the participation rate can only take values from 0 to 1 (values outside this range do not make sense), predicted values from the linear formulation in equation (5-13) need to be restricted such that negative values are made equal to 0 and values which exceed 1 are made equal to 1. It is acknowledged that this is somewhat arbitrary and could lead to some misleading results, for example predicted values of 1.01 and $+\infty$ would both be set to 1.

However, it was found that values only slightly outside of the specified range (less than 0.1 in either direction) did not occur until the difference in expected return from participation and non-participation was over $90 per tonne (the difference would have to be over $597 per tonne to gain a negative number). This has not occurred during the time period under consideration, indeed the average difference between E(RETP) and E(RETN) was $54.60.

Note that an alternative formulation was considered, that of a logit transformation of the linear function which ensures that the predicted values fall within the specified range[11]. However, this formulation could be used to estimate the *probability* of one farmer participating in the commodity programs but not to estimate the actual participation rate for the whole of the USA.

Results

The results of an estimation of equation (5-8), using crop year data from 1968 to 1990 are shown below.

$$\underset{}{YIELDUS} = \underset{(25.97)^*}{1.7124} + \underset{(9.733)^*}{0.04621}TREND + \underset{(3.125)^*}{0.24444}\ D83 - \underset{(-2.840)^*}{0.22419}\ D86 - \underset{(-4.216)^*}{0.34662}\ D88 - \underset{(-5.734)^*}{0.48283}\ D89$$

R^2 0.9218 DW 1.7700
$\bar{R}^2$ 0.8827

(t-statistics in parentheses; * significant at the 95% level)

The dummy variables are included to account for the variable weather conditions during the late 1980s. As the DW statistic was in the inconclusive region an LM test was carried out to test for first-order autocorrelation. The calculated χ^2 was less than the critical value so that the null hypothesis of $\rho=0$ (i.e. no autocorrelation) could not be rejected.

The area planted by non-participants was calculated using data derived from equations (5-9) and (5-11) as below

$$AREAN_t = AREAUS_t - [(PT_t * BASE_t) - SET_t]$$

This data, and the calculated expected return, were then used to calculate the parameters of equation (5-10) using the Cochrane-Orcutt (C-O) method for second-order autocorrelation

11 A detailed exposition on the logit function can be found in Cramer (1991).

$$LnAREAN = -3.122 + 2.2902LnE(RETN)$$
$$\quad\quad(-1.038) \quad (4.053)^*$$

R^2 0.7325 DW 1.738
$Rbar^2$ 0.6879

Data availability meant that the participation rate and the area set aside were estimated over the 1983/84 - 1990/91 crop years; the following results were obtained. The dummy variable was included in the participation rate equation to explain an outlying value, possibly caused by the change in the base area in that year (when calculated on the basis of the old base area, the participation rate is 70% as opposed to 60% calculated using the actual base area). It is postulated that farmers needed time to adjust to the new permitted area before changing their decision to participate.

$$PT_t = 108.49 - 0.156\,E(RETN) + 0.022\,E(RETP) - 15.25\,D84$$
$$(9.284)^* \quad (-2.389)^\dagger \quad (0.463) \quad (-2.97)^*$$

R^2 0.8858 DW 2.8215
$Rbar^2$ 0.8001

(† significant at 90% level)

Again the DW statistic was in the inconclusive region but the Lagrange Multiplier test showed that the null hypothesis of no first-order autocorrelation could not be rejected.

The coefficient on the E(RETP) variable in equation (5-13) is insignificant which suggests that the decision made by farmers is really whether not to participate rather than a positive decision to participate. It could be argued that this is a result of the derivation of the E(RETP) variable, but substituting the expected market price for the loan rate in equation (5-14) does not give a significant coefficient on E(RETP) either.

τ in the set-aside equation is taken as the average value for the period.

$$SET = 1.257(ARP * BASE * PT)$$

Estimation of the coefficient, using the C-O method for second-order autocorrelation, gave a τ value of 1.256.

$$SET = 1.256(ARP * BASE * PT)$$
$$(29.338)^*$$

R^2 0.9548	ρ1 0.882
$Rbar^2$ 0.9548	ρ2 -0.759

The dynamic nature of the overall model would have been affected with the inclusion of such second-order lagged terms (see section 5.4); also as the coefficient is not significantly different from the average value (H_0: τ = 1.257, t = -0.023358), and in the interests of parsimony, the average value is used in the overall model.

Note that a systems approach to estimating the last three equations was tried, but no significant correlations were found between the residuals, and the results were not improved.

Consumption

Wheat consumption is modelled in two sections, one section covers feed consumption, CF_{it}.(good i being wheat) while the other covers non-feed, direct consumption, CD_{it}.

$$C_{it} = CD_{it} + CF_{it} \tag{5-15}$$

In previous studies, such as that of Tyers and Anderson (*op. cit.*), direct human consumption has been modelled as a function of population, national income and prices. The first two of these are both highly trended, therefore for this model it was postulated that direct consumption is a function of a trend and price such that

$$CD_{it} = \delta_0 + \delta_1 TREND_t - \delta_2 P_{it} \tag{5-16}$$

The model for feed consumption, like that of Tyers and Anderson, is based on the premise that feed consumption of wheat is determined by livestock numbers and the price of wheat[12]. However in this model feed use is constructed in a two-stage process, such that

12 An attempt was made to apply the exact Tyers & Anderson formulation to each country's data up to 1990, using the coefficients published in Tyers & Anderson (1993). However, this resulted in consistent underestimation of feed use of wheat. One explanation may be that in the Tyers and Anderson model, the outputs of livestock are endogenous and the reported data may not include all of the elements in the model. A simpler explanation may be that by 1986-88, the 1982 feed use coefficients, on which the Tyers nad

the consumption of wheat for feed (CF_t) is determined as a proportion of the feed use of all grains ($CFTOT_t$); this in turn is a function of livestock numbers

$$CFTOT_t = \upsilon_0 + \upsilon_1 LIV_t \tag{5-17}$$

$$CF_{it} = \Psi_{it}\ CFTOT_t \tag{5-18}$$

$$\Psi_{it} = \Theta\ (Pw_{it}/Pw_{jt}) \tag{5-19}$$

where Ψ_{it} is the proportion of total feed use accounted for by wheat and Pw_{it}/Pw_{jt} is the market price of wheat relative to that of other cereals. The price of a representative cereal is taken as a proxy for an 'other cereals' price; for the US the representative price is for maize.

Results

Equation (5-16) was estimated using crop year data from 1961 to 1989. The real world market price (1986 prices) was used under the assumption that the agricultural policies of the USA only affect the receipts of farmers not the price paid by consumers.

$$\underset{}{\ln CDUS} = \underset{(92.432)^*}{9.4785} + \underset{(7.491)^*}{0.0136}\ TREND - \underset{(-0.219)}{0.0053}\ \ln P$$

R^2 0.9713 ρ 0.7918
$\bar{R}^2$ (Rbar2) 0.9691

The price variable in the USA case is not significant - this is to be expected given the strength of the trend in non-feed consumption (figure 5.1) - so the equation was re-estimated excluding the prices, and in linear form, with the following result.

$$CDUS = \underset{(33.54)^*}{14008} + \underset{(11.48)^*}{262.79}\ TREND$$

R^2 0.9634 ρ 0.63103
Rbar2 0.9621

Anderson estimates were based, were no longer applicable (due to changes in feeding patterns or technology for example)

Human Consumption of Wheat in the USA

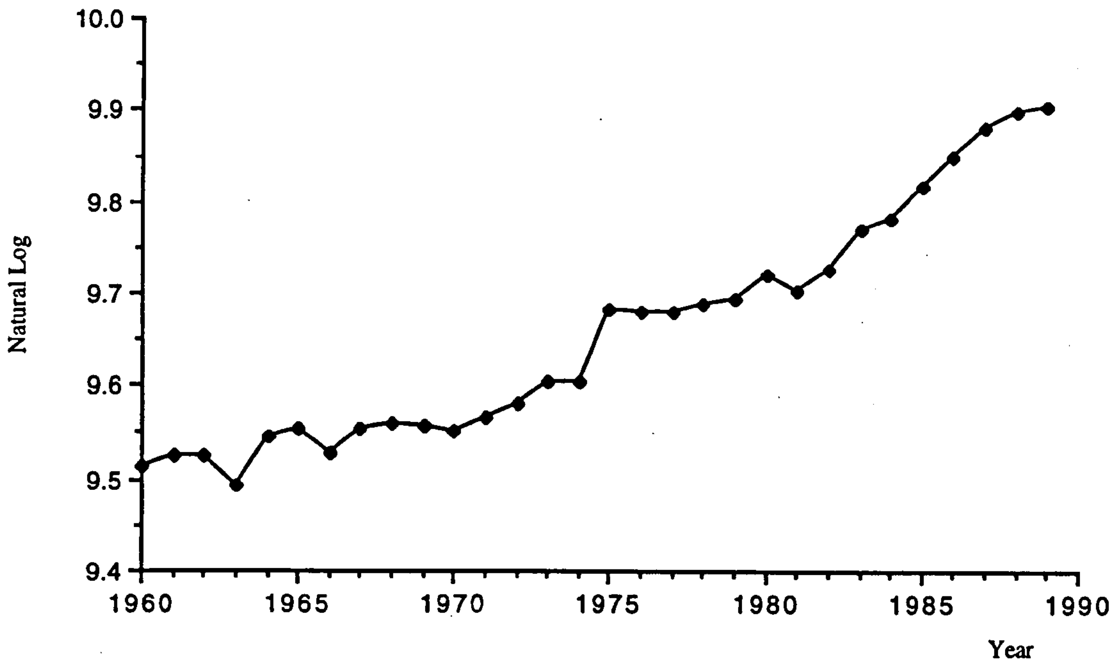


Figure 5.1

For feed use of wheat the following coefficients were estimated.

$$CFTOT_t = 0.72994CFTOT_{t-1} + 0.22226LIV_t - 43764\ D75 + 16100\ D87 - 25376\ D89$$
$$(5.755)^* \quad (2.327)^* \quad (-5.221)^* \quad (1.8332)† \quad (-2.940)^*$$

R^2 0.7508 DW 2.2886
$Rbar^2$0.7092

$$\Psi_{it} = 0.065133 + 0.41974\Psi_{it-1} - 0.033681Pw_{it}/Pw_{jt} + 0.036414D84 + 0.046529D86$$
$$(3.697)^* \quad (3.419)^* \quad (-2.928)^* \quad (2.692)^* \quad (3.426)^*$$

R^2 0.7078 DW 1.9250
$Rbar^2$0.6569

Stocks

Levels of private and government stocks are modelled separately such that

$$STOCKS_t = CCC_t + PRIVATE_t + FOR_t \tag{5-20}$$

where FOR is the Farmer Owned Reserve. Sharples & Holland (1981) argued that wheat stocks accumulated in the FOR partially substitute for wheat that would otherwise have been stored privately by farmers, and therefore should be included separately in any modelling of total wheat stocks. Here it is modelled as a function of the market price relative to the FOR loan rate, $FORLR_t$,

$$FOR_t = \eta\left(\frac{P_{it}}{FORLR_t} \right) \tag{5-21}$$

Private stocks are modelled as a function of the change in the current market price relative to the expected market price in the next year.

$$PRIVATE_t = \pi_0 - \pi_1 \Delta\left(\frac{P_{it}}{E(P_{i(t+1)})} \right) \tag{5-22}$$

The level of CCC (Commodity Credit Corporation) stocks is hypothesised to be a function of the loan rate, such that stocks are accumulated if the price received by farmers is below the loan rate and released if not (the CCC minimum release price was effectively circumvented by the Export Enhancement Program (EEP) after 1985 and does not apply from the 1990 FACT in any case). The change in CCC stocks due to redemption of EEP certificates is modelled separately. Note that it was initially thought that production changes would be an important determinant of these stocks, but these proved to be insignificant. Thus

$$CCC_t = \xi LR_t - EEP_t \tag{5-23}$$

The EEP, initiated in 1985, is aimed at increasing exports of agricultural products above what would have occurred in the absence of the programme, in specifically targeted areas, under the condition of budget neutrality. The programme is operated using a bidding process whereby the CCC requests offers for exports to a target country up to a specified maximum; after negotiations with the importing country, qualified exporting firms submit bids for EEP bonuses. A bid takes the form of a per-unit bonus (in dollars) that the firm requires to make the US product competitive with those of other exporting countries. A firm with a successful bid is then given a bonus certificate by the CCC which can be exchanged for commodities from government stocks (valued at market prices). The use of payment in kind (PIK) certificates will increase the market supply of wheat by reducing

CCC stocks. However, because the certificates are generic those issued to wheat sales need not necessarily be redeemed for wheat (the same is true for any EEP commodity). Brooks *et al.* (1990) state that for 1986/87 18.2% of the total certificates issued were redeemed for wheat and the 1987/88 the figure was 21.2% (p266). In modelling the impact of the EEP they assume that PIK certificates are redeemed at the historical rate (approximately 20%). Anania *et al.* (1992) add to this that only around 40% of the certificates awarded for wheat EEP sales are exchanged for wheat (p539). In this model, the effects of the EEP for wheat on wheat CCC stocks[13] are given by

$$EEP = \omega\Big(EEPTOT/(\max(LR,P)\Big) \qquad (5\text{-}24)$$

where EEPTOT is the total value of the bonus section of the EEP sales for all commodities and is a policy variable (hence it is exogenous), and ω is the proportion of the certificates redeemed as wheat (assumed to be 20%; see above). The CCC stocks available to the policy makers are assumed to be sufficient to meet the PIK redemption demands. This does not seem an unreasonable assumption to make given that it is the CCC that initiates the EEP bidding process and sets the maximum quantity to be exported. The available stocks are given by the closing stocks in the last period less the 4 million tonnes of emergency reserve which the CCC is required to hold.

Anania *et al.* (1992) point out that all EEP studies prior to theirs assume that the volume of subsidised exports is unconstrained. In this formulation, the quantity of EEP exports is constrained only to the extent of CCC stocks and the size of the EEP budget. It is accepted that this is a shortcoming of the model, but its effects are expected to be mitigated in the full simulation model where exports from other regions, especially the EC, will limit sales from the EEP.

Results

As the farmer owned reserve has only been operating since the 1977/78 marketing year

13 The overall effect of the EEP will be to reduce world market prices through two mechanisms ; (i) an increase in US market supply as modelled here and (ii) a price depressing effect on other exporters (assuming a quasi-competitive market). The direct price effect is captured in the overall model by adjusting the transmission mechanism of world market prices (Gulf US $ prices) into national, domestic currency prices. For the EC where the transmission is virtually zero the price effect is assumed to manifest itself as increased export refunds.

equation (5-21) was estimated using data from this date. An outlying value was found in 1982, so that a dummy variable was included for this year. Roberts *et al.* (1989) argue that the cause of the sudden large accumulation of FOR stocks in 1982 was the FOR policy itself, with farmers producing specifically for this reserve (p58).

$$FOR_t = \underset{(6.267)^*}{29771} - \underset{(-4.068)^*}{9225.6}\left(\frac{P_{it}}{FORLR_t}\right) + \underset{(6.117)^*}{11525D82} + \underset{(2.413)^*}{4453.4D86}$$

R^2 0.9191 ρ 0.58276
Rbar^2 0.8921

The private stocks equation was estimated using closing stocks data from 1961 to 1990 and real market prices (1986=100). Expectations are again formed according to the Haley specification.

$$PRIV_t = \underset{(4.617)^*}{8486.6} + \underset{(2.530)^*}{0.3546PRIV_{t-1}} - \underset{(-1.462)¥}{3391.4}\Delta\left(\frac{P_{it}}{E(P_{i(t+1)})}\right) + \underset{(4.532)^*}{13878D76} + \underset{(3.239)^*}{11397D85} - \underset{(-2.021)^*}{7158.1D88}$$

R^2 0.7090 DW 2.1332
Rbar^{2}0.6362

Note: ¥ significant at the 80% level

ξ was estimated using the dependent variable DEPVAR = CCC+EEP, calculated from data for 1960 to 1990, where EEP has been calculated for the relevant years according to equation (5-24) with ω as 20%.

$$DEPVAR = \underset{(3.233)^*}{81.875\ LR_t} + \underset{(3.233)^*}{11997\ D86}$$

R^2 0.7728 ρ 0.62885
Rbar^2 0.7539

It was originally thought that in the short-run CCC stocks would respond to annual changes in production; however, the variable did not prove to be significant. Given that the loan rate changes annually, it is possible that the short-run effects are already encapsulated within this formulation.

5.3.2 The European Community

Production

As with the USA, production is postulated to be equal to yield, estimated by equation (5-8), multiplied by the area planted. In the EC the area planted is modelled using the relative returns from wheat and a substitute crop, barley.

$$AREAEC_t = \theta_0 + \theta_1 \frac{E(RETWH)}{E(RETBA)} \tag{5-23}$$

The expected returns are calculated as the price that the farmer expects to receive for the particular crop times the expected yield. The expected yield is simply calculated on the trend for each crop using equation (5-7). For the expected prices, market prices are used in preference to intervention prices for the following reason. It should be the case that the intervention prices for both wheat and barley are announced prior to the planting decision so that farmers are certain of the minimum price they will receive. However, in practice, Commission delays mean that farmers have been uncertain about the levels of prices at the time of ordering seed, and in later years have also been uncertain about the level of co-responsibility levy to be paid and any price adjustments due to the stabiliser mechanism. On the other hand the Cunha reforms mean that from 1992/93 farmers will know the intervention price level before planting. Thus in the simulation for years after 1992/93, the intervention price was incorporated into equation (5-28) as the expected price but in order to model the situation up to 1992/93 it was decided to apply the Haley rules for price expectations to the market prices of wheat and barley in the EC.

Using crop year data from 1973/74 to 1990/91, adjusted so that they were for the EC 12 for the entire period (see appendix A5.2 for the methodology of the data transformation). Equation (5-8) was estimated for wheat and for barley with the following results:

$$\underset{}{YIELDEC} = \underset{(32.01)^*}{2.8933} + \underset{(14.0)^*}{0.12784TREND} + \underset{(4.338)^*}{0.79897\,D84} - \underset{(-0.894)}{0.16933\,D87}$$

R^2 0.9485 DW 1.6029
$Rbar^2$ 0.9366

The dummy variable for 1987 was included as part of the calibration process for the overall model; although is is not statistically significant in the individual equation above, it was necessary to prevent a misleading change in EC production in the fully assembled trade model. This should not be viewed as a manipulation of the data but rather as a recognised practice when calibrating a dynamic simulation model (see below and Pindyck & Rubinfeld (1981)). The same logic applies for the inclusion of the dummy variable in 1988 in the barley yield estimation.

$$\underset{}{\text{YIELDBAREC}} = \underset{(31.36)^*}{3.138} + \underset{(5.020)^*}{0.05129}\text{TREND} + \underset{(3.237)^*}{0.65674}\text{ D84} + \underset{(1.243)}{0.26359}\text{ D88}$$

R^2 0.7868 DW2.0901
Rbar^{2}0.7376

The market prices of wheat and barley used in formulating the expected prices were calculated as a production weighted average of the market prices in major producing countries - France, Germany and the UK - in ECU, converted at market rates.

Using the calculated expected returns, equation (5-28) was evaluated using OLS as below. Note that RELRET is used to denote the relative expected returns to wheat and barley.

$$\text{AREAEC} = \underset{(5.185)^*}{10439} + \underset{(2.603)^*}{4329.1}\text{ RELRET} - \underset{(-2.653)^*}{1101.6}\text{ D77} + \underset{(1.305)}{453.28}\text{ D84} - \underset{(-1.512)¥}{582.08}\text{ D88}$$

R^2 0.7918 DW 1.5076
Rbar^2 0.6993

It is interesting to note that it is the expected yield which dominates the expected price in planting decisions; using simply relative expected prices in the formulation does not yield satisfactory results. Given the divergent yield trends for wheat and barley this was not unexpected. The result is consistent with the findings of Burton (1992) for the UK.

Consumption

As with the USA, wheat consumption is modelled using separate functions for direct (non-feed) and feed use (as in equations (5-15) to (5-17)). Crop year data from 1974 to 1990 were used in the estimation but had to be adjusted to take account of the two enlargements of the Community during the period. For direct consumption, the total non-feed usage figure was divided by the population of the EC'9', EC'10' or EC'12' as applicable. This per caput figure was then multiplied by the population of the total twelve to give an EC figure. A dummy was included for an outlying value in 1984/85.

$$CDEC_t = 126.6POP_t - 28.693P_t + 1533.7D84$$
$$(30.324)^* \quad (-3.411)^* \quad (2.615)^*$$

R^2 0.6031 ρ 0.21518
$Rbar^2$ 0.5464

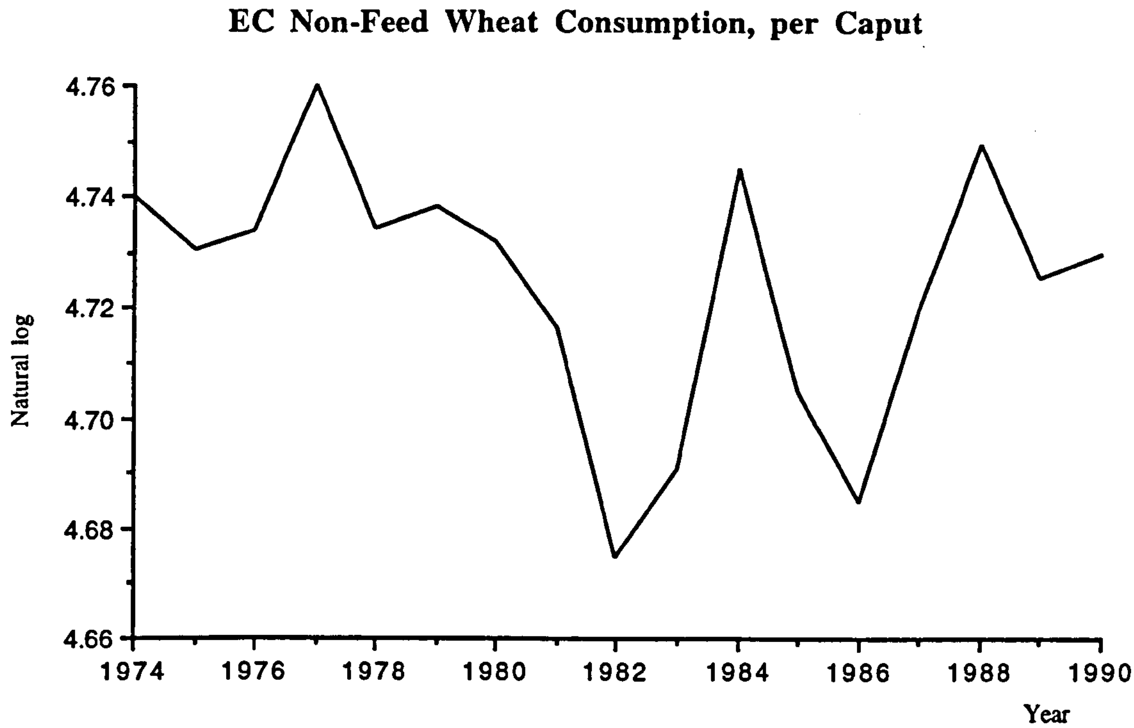


Figure 5.2

The statistical fit of the feed-use section of the EC model was improved by estimating the level of wheat feed consumption directly as a function of total livestock numbers and the real market price of wheat. Again a dummy variable was included for an outlying value in 1984/85.

$$CFEC_t = 0.03684\ LIV_t - 34.785\ P_t + 2211.1\ D84$$
$$(15.29)^* \quad (-5.621)^* \quad (2.350)^*$$

R^2 0.9177 ρ_1 0.91397
$Rbar^2$ 0.9050 ρ_2 -0.5666

Stocks

Stock levels in the EC are modelled as the sum of the change in private stocks and the change in intervention stocks (Private Storage Aid stocks are included in the private stocks). Private closing stocks are estimated as a function the market price in time t, the expected market price in time t+1, and some proportion of the change in production in year t.

$$PRIVATE_t = \zeta_0 - \zeta_1 P_t + \zeta_2\, E(P_{t+1}) + \zeta_3\, \Delta PROD_t \qquad (5\text{-}24)$$

Following work by Ackrill (1993), closing intervention stocks were postulated to be a function of the opening stock level (if this is high, closing stocks could also be expected to be high) and the variation of production around a trend. The latter is included to account for the short term stabilisation function of intervention

$$INTERV_t = \varsigma_0 + \varsigma_1 RESIDPRO_t + \varsigma_2 OPSTK_t \qquad (5\text{-}25)$$

where $RESIDPRO_t$ are the residuals from

$$PROD_t = \Phi_0 + \Phi_1 TREND_t \qquad (5\text{-}26)$$

Results

1984/85 was identified as an outlying year so that a dummy variable was included in the estimation of equation (5-24) for that year. Intervention stocks were affected by this outlying value in 1985/86 so a dummy was included for this year in the estimation of equation (5-25).

$$PRIVATE = \underset{(3.647)^*}{0.16162\, \Delta PROD} - \underset{(-5.369)^*}{57.86 P_t} + \underset{(3.165)^*}{102.75\, E(P_{t+1})}$$

R^2 0.7321 DW 2.148
$Rbar^2$ 0.6786

$$INTERV = \underset{(2.469)^*}{1346.6} + \underset{(2.141)\dagger}{0.15348 RESIDPRO} + \underset{(5.283)^*}{0.62304\, OPSTK} + \underset{(4.424)^*}{5154.6 D85} + \underset{(3.411)^*}{5002.6 D90}$$

R^2 0.8647 DW 'h' -1.0154
$Rbar^2$ 0.8196

(The DW 'h' statistic is used because OPSTK is essentially a lagged dependent variable) where RESIDPRO is given by the residuals from the equation below. Note that the formulation does not contain a dummy variable for the outlying year 1984 because it is aimed at finding the deviations from the trend forecast.

$$PROD_t = 43187 + 2265.0\ TREND$$
$$\quad (16.95)^* \quad (9.108)^*$$

R^2 0.8469 DW 1.9338
$Rbar^2$ 0.8366

5.3.3 Canada

Canadian wheat farmers receive support from two main sources - the Canadian Wheat Board (CWB) and the government (indirectly through the railway system). The CWB and the Canadian government set an initial price at the start of each marketing year based on the expectations of US and world market prices. The producer price for the whole marketing year is then a 'pooled' price of average export and domestic prices, weighted by quantities sold (as exports are large relative to domestic sales, the CWB pooled price is primarily determined by export returns). If the pooled price is less than the initial price, the federal government makes up the difference; thus the initial price is in effect a guaranteed minimum price. Producers in the Western prairies benefit from reduced freight charges on the rail network if the wheat is bound for the Eastern ports and export (currently under the Western Grain Transportation Act (1983)[14]); grain producers in general benefit from transport subsidies if the grain is to be sold for animal feed (under the Feed Freight Assistance Act (1943)). The main effect of the transport subsidies has been to encourage production in the prairies to the detriment of other areas (the FFAA was aimed at equalising the feed grain prices in deficit areas, but also encouraged production in the surplus areas by effectively raising producer receipts), but they also increase the pooled price received by farmers. This being the case the transport subsidies *per se* have not been included in the estimations which follow, rather they are assumed to be implicit in the CWB pooled price.

Production

Production in Canada was initially hypothesised to fit the same model as for the EC (using CWB prices instead of intervention prices). A model by Bailey and Goodloe (1987)

14 Rail freight subsidisation for grains has been in force since 1897 (the so called 'Crow Rates'); the WGTA is simply the latest form of this.

proposes a similar formulation, but uses the difference between returns to wheat and barley rather than the relative returns. However, examination of the data from 1960 to 1990 (crop year) revealed an upward trend in the area planted both prior to and after a suspected structural break in 1970 (figure 5.3), and a yield which appeared to vary around a constant (albeit with a suspected structural break in 1974) rather than a trend. The break in the area series was assumed to be the result of Canadian participation in the USA's Operation LIFT (Lower Inventories For Tomorrow) which advocated a reduction in the area planted to reduce cereal stocks.

The yield equation, post 1974, was therefore estimated as a constant with a random element; the constant being the average for the period.

$$YIELDCAN = 1.86 + \varepsilon_t \qquad \varepsilon_t \ NID \sim (\mu, \sigma^2)$$

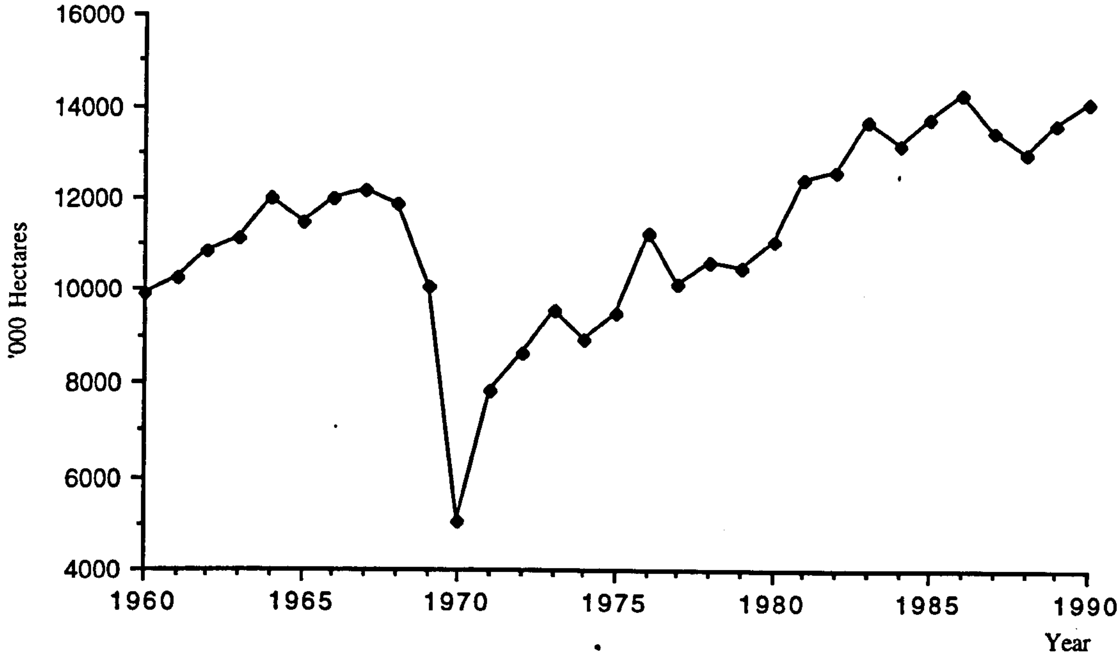
The area planted was modelled, for the period 1971 to 1990, as a function of the expected, nominal market price (the CWB pooled price) and the area planted in the previous year. Expected prices were used in preference to expected returns as the expected yield, taken from the equation above, is a constant.

$$AREACAN_t = \underset{(2.937)^*}{2746.5} + \underset{(8.746)^*}{0.74514} AREA_{t-1} + \underset{(0.7049)}{4.6239} E(P_t)$$

R^2 0.8610 DW'h' -0.625
$Rbar^2$0.8437

Although the expected price variable is not significant, it was decided to include it in the overall model at the calibration stage because without it estimated Canadian production was consistently too low.

Canadian Wheat Area



Canadian Wheat Yield

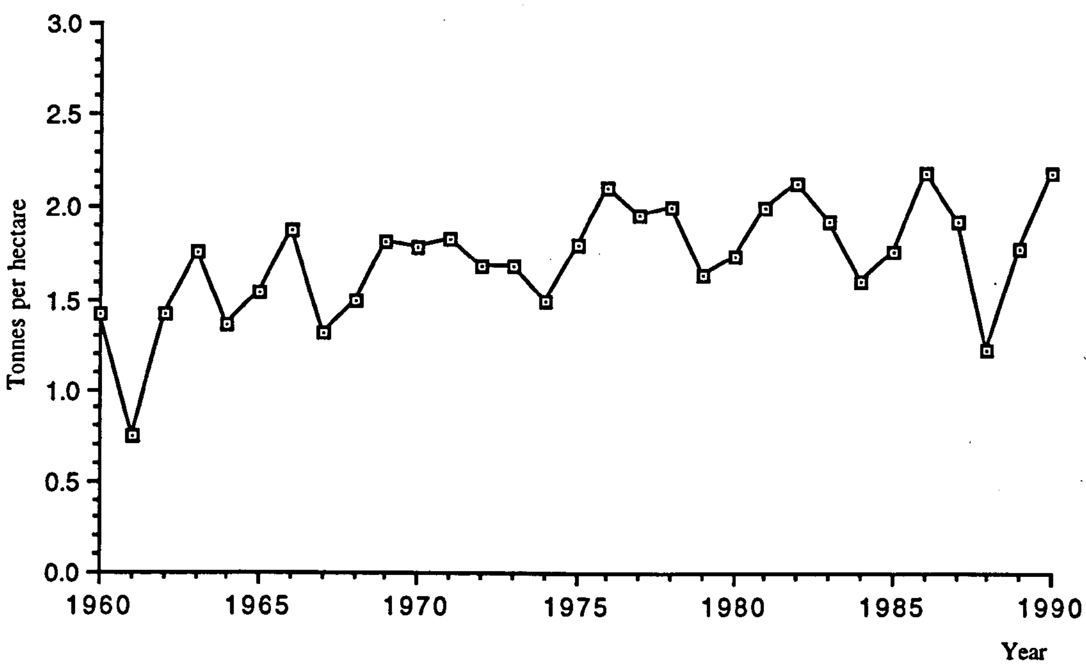


Figure 5.3

Consumption

Consumption was again modelled by separating feed and non-feed (direct) use. Direct consumption was estimated using a trend and the market price. Note that the Bailey and Goodloe model used income per caput instead of the trend, but as has been mentioned before the two essentially do the same job. In estimation, however, the market price variable was not significant. Thus Canadian non-feed use is given by the following (OLS estimation in natural logs gave the best fit).

$$\underset{}{LnCDCAN} = \underset{(365.8)^*}{7.8171} + \underset{(10.24)^*}{0.01576}\, TREND + \underset{(5.622)^*}{0.28143}\, D75$$

R^2 0.8635 DW 2.2796
$Rbar^2$ 0.8499

Feed use of wheat in Canada did not display any significant movement from a constant value, and certainly did not show any relationship with livestock numbers or its own price. The constant value base level value was thus used as the estimate for feed use.

Stocks

The CWB does not operate a 'buyer of last resort' policy like those of the CCC or the EC's intervention agencies, and is therefore assumed to act as if it were a private firm. Thus stocks are modelled as a function of nominal market prices. Border prices are used in the estimation in recognition of the large proportion of Canadian wheat production that is exported[15]. These prices were in nominal terms as an interest rate was included to account for the costs of storage. Also included in the stocks equation is the change in production in t.

$$STOCKS = \underset{(3.301)^*}{4575.9} + \underset{(3.490)^*}{0.28869}\, \Delta PROD - \underset{(-1.789)\dagger}{26.317}\, (P_t - E(P_{t+1}))$$

R^2 .0.6767 DW'h' -0.0774
$Rbar^2$ 0.6120

5.3.4 The Cairns Group

The CG as a whole (minus Canada which is dealt with above) is a net exporter but within the group several countries are non-producers and consume only imported wheat.

15 Western Red, Spring no.1 13.5%, in store, Thunder Bay.

Therefore Fiji, Indonesia, Malaysia, the Philippines and Thailand are excluded when estimating the production equations, but are included in the consumption and stocks sections. The model is a relatively simple one but, given the aggregated nature of the CG data, representation of a single country's policies is meaningless. Also, apart from Argentina where direct producer subsidies are still in operation, the CG countries included in this analysis give little or no governmental support to agriculture[16]. The CG section of the model is described by the following equations.

Production

$$PRODCG_t = YIELDCG_t * AREACG_t \tag{5-27}$$

$$YIELDCG_t = \Omega_0 + \Omega_1 \, TREND_t + \varepsilon_t \qquad \varepsilon_t \, NID \sim (\mu, \sigma^2) \tag{5-28}$$

$$AREACG_t = \Gamma_0 + \Gamma_1 \, AREACG_{t-1} + \Gamma_2 \, [E(Pw_{it}) - E(Pw_{jt})] \tag{5-29}$$

where good i is wheat, good j is maize and P^w is the world market price.

Results

The yield data for the CG were derived by summing production and area planted across countries and then dividing one by the other. The resulting series was quite volatile, hence a trend estimation does not give a particularly good statistical fit.

$$\underset{(19.692)^*}{YIELDCG = 1.1787} + \underset{(6.423)^*}{0.02097 \, TREND}$$

R^2 0.5872 DW 1.8015
Rbar^{2}0.5730

$$AREACG_t = \underset{(3.024)^*}{6821.4} + \underset{(5.426)^*}{0.641 \, AREACG_{t-1}} + \underset{(1.825)\dagger}{22.537 \, [E(Pw_{it}) - E(Pw_{jt})]} - \underset{(-3.182)^*}{4108.7 \, D70}$$

R^2 0.8008 DW'h' -0.4288
Rbar^2.7676

16 Wheat exports from Australia must be made though the state trading organisation, the 'Australian Wheat Board' (AWB). Although it has been suggested that the AWB is a policy instrument and distorts trade in favour of Australian farmers, its actions could also be seen as the rational response of a private firm operating in as part of a non-co-operative oligopoly. In this analysis, the ABW is assumed to be a 'free trader' in the sense that it does not provide subsidies to farmers.

Consumption

Consumption in the CG is modelled using the same equations as for the USA (equations (5-15) to (5-17)), with the price in equation (5-16) being the world market price.

Results

As with the other countries, direct consumption of wheat in the CG countries is dominated by a trend; the world market price did not prove to be a significant explanatory variable.

$$CDCG = \underset{(48.135)^*}{11328} + \underset{(32.567)^*}{431.73}\ TREND$$

R^2 0.9743 DW 1.9668
$Rbar^2$ 0.9734

Feed was postulated to be determined according to equations (5-17) to (5-19). During estimation it was found that while equations (5-17) and (5-18) did apply, Ψ_{it} could be better represented by a constant given by the average for the period (7.9934%).

$$CFTOTCG_t = \underset{(1.295)¥}{0.22319}\ CFTOTCG_{t-1} + \underset{(4.909)^*}{0.038782}\ LIV + \underset{(4.132)^*}{802.0}\ TREND + \underset{(1.987)\dagger}{3198.1}\ D86$$

R^2 0.9854 DW'h' -1.0476
$Rbar^2$ 0.9836

The TREND variable was included to remove the effects of a distinct upward trend in both the total feed use and head of livestock data series.

Stocks

$$STOCKS_t = \Theta_0 + \Theta_1 STOCKS_{t-1} + \Theta_2 RESCG_t - \Theta_3(Pw_t - E(Pw_{t+1})) \qquad (5\text{-}30)$$

where RESCG are the residuals from the estimation of equation (5-30).

Results

As in the case of human consumption, the price variable was not significant in explaining stocking behaviour in the CG. Hence stocks are given by

$$STOCKS_t = \underset{(4.415)^*}{2124.1} + \underset{(6.158)^*}{0.5441}\ STOCKS_{t-1} + \underset{(6.639)^*}{0.4068}\ RESCG + \underset{(3.095)^*}{3854.7}\ D68$$

R^2 0.7893 DW 1.8780
Rbar^{2}0.7650

where RESCG are the residuals from an estimate of production on trend.

$$PROD_t = \underset{(11.19)^*}{15335} + \underset{(11.12)^*}{831.23}\ TREND$$

R^2 0.8100 DW 1.8018
Rbar^{2}0.8035

5.3.5 Eastern Europe

For the purposes of this analysis Eastern Europe (EE) was defined as Albania, Bulgaria, Czechoslovakia, East Germany, Poland, Romania, the USSR and Yugoslavia. It is acknowledged that this group of countries can no longer be regarded as a coherent unit, but the import demand estimations presented below owe more to normative judgements about the prospects for agricultural production in the countries, and the willingness of the main exporters to provide credit, than to formal econometric analyses based on past data. However, that said, the data are used as a basis for the normative judgments.

EE as a whole is a net importer of wheat, but most of the import demand is from the former USSR (until recently the group of remaining countries were net exporters); thus conditions in the former USSR are likely to dominate the demand for imports in the whole EE group at least for the foreseeable future. It is contended that the quantities imported by the Soviet Union from 1971 were intended to make up any shortfall in domestic production (thereby smoothing consumption from year to year), and were not governed by the general level of world market prices; rather they were constrained by the extent to which the exporting countries were prepared to offer special concessions - subsidised prices, credit arrangements and, more recently, 'barter' deals (Agra Europe no.1532 pM11). Therefore world market prices are not included in the EE import demand equation. Note that another reason for the exclusion of world market prices is the unclear direction of the relationship between world prices and EE imports. Some commentators argue that as the quantities imported by the USSR especially are so large, they have an impact on the amount the exporting countries can sell to other importers, and hence have an impact on the world price; inclusion of a world price in an import demand function would imply price taking behaviour[17].

On comparing wheat consumption and production in EE for the period 1960 to 1990 (figure 5.4), it is evident that although both move more or less in the same direction, production has been considerably more volatile than consumption. However, if production is compared to net domestic consumption (defined as total consumption less net imports), both are extremely volatile albeit in the same direction (with the exception of 1971). A rank correlation coefficient of 0.938 (Spearman's) was calculated for the two series indicating that the inclusion of both production and net domestic consumption in an import demand function for EE would have led to autocorrelation problems. On average the former was approximately double the latter although the range of the scaler was quite large (0.66 to 5.21).

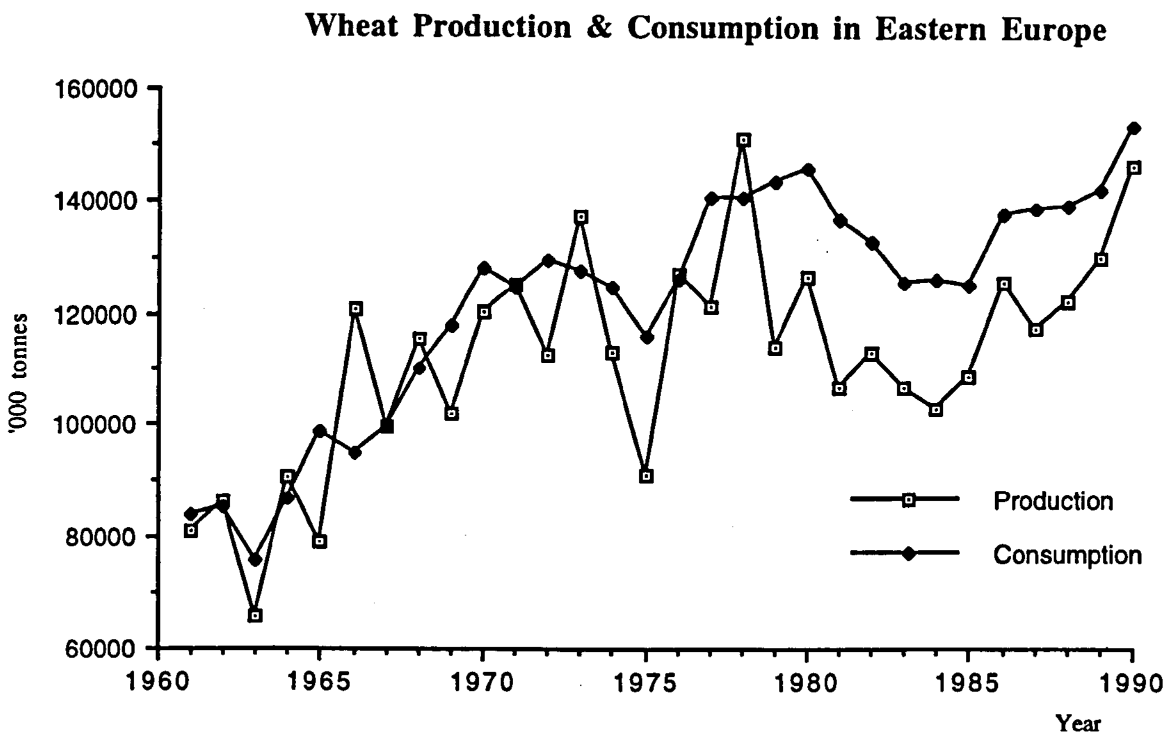


Figure 5.4

17 Note that when all 7 areas are brought together in the final model, the world market price will be determined when excess supply is equal to demand. Thus the quantities imported by the EE will influence the overall level of P^W.

It was decided to included production changes in the estimation of an import demand function, whilst remembering that the corresponding change in net domestic consumption was likely to be around twice any change in consumption (the result of this is that imports would have to be double any deficit in production in order to maintain consumption at previous levels and vice versa following a rise in production).

The function was estimated using data for the shortened time period 1980-1990 due to a structural break in production (and by implication imports) in the Soviet Union. Desai (1991) argues that Soviet policy changes from 1980/81 changed production patterns, especially in terms of yields. The adoption of intensive agrotechnology - high-yielding seeds, better fertilisers and pesticides - and an increase in land set aside as fallow led to a large increase in yields (after adjustment for the unpredictable weather element). Desai also argues that from 1987, the 'Glasnost' reforms supplemented the yield increase and further encouraged production as procurement by the state was reduced.

A distinct downward trend in net imports (NETM) was accounted for by including a trend as an independent variable and a dummy was included for 1984.

$$\underset{}{NETM} = \underset{(16.727)^*}{24722} - \underset{(-3.384)^*}{762.35}\ TREND - \underset{(-2.885)^*}{0.1937}\ \Delta PROD + \underset{(2.956)^*}{6920.6}\ D84$$

R^2 0.8703 DW 1.6662
Rbar^{2}0.8147

To test the hypothesis that the world market price should not be part of an import demand equation for EE, it was included in the above formulation (in real terms). This resulted in an increase in the explanatory power but caused autocorrelation problems. Also, the real world price variable was only significant when the dummy for 1984 was excluded and in this case it had a positive sign. This would suggest that it was only picking up the effects of the outlying year and not explaining much in other years[18].

In order to make predictions of future import demand by EE using the above equation, it is necessary to make some inferences about the prospects for production. Post-1980 production has been considerably less volatile than in previous years but still exhibits some variability. If we decompose production into the area and yield elements, it can be shown

18 When estimated over a longer period (1971-1990) the real price variable had a negative sign but the relationship was again distorted by extreme values in the early 1970s.

that the main cause of this variability is the yield element. This is done by decomposing the multiplicative relationship using the formula for decomposition of the variance of a product[19] as approximated by Burt & Finley[20]. Specifically, taking the production of wheat as the identity

$$PRODEE_t = AEE_t * YEE_t \tag{5-31}$$

where AEE is the area planted in year t and YEE is the yield in year t. Each independent variable can be thought of as being composed of a deterministic or trend value and a random variation around that trend

$$AEE = AEE^m + u_t \tag{5-32}$$

$$YEE = YEE^m + v_t \tag{5-33}$$

where AEE^m and YEE^m are the mean or trend values and u_t and v_t are random disturbances. The variance of $PROD_t$ can be written as[21]

$$Var(PRODEE) = YEE^{m2}\sigma^2_u + AEE^{m2}\sigma^2_v + 2AEE^mYEE^m cov(uv) + var(z) \tag{5-34}$$

where $z = u*v$. The terms of equation (5-34) can be interpreted as follows. The first term represents the direct area effect, the second the direct yield effect, the third a linear interaction effect and the final term a quadratic effect. The result of applying this analysis to the EE data are given in table 5.1. The analysis was carried out for two time periods, 1960 to 1990 and 1980 to 1990 and using two values as the 'mean' area and yield; the first in the mean of the individual time series and the second the value predicted from the time trend for 1990.

It is evident from the table that yield variations are the most important element in production changes; therefore, we need to be able to forecast yield changes before we can make any inferences about the future import demand of EE for wheat.

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19 Bohrnstedt G.W. & Goldberger A.S. (1969) 'On the Exact Covariance of Products of Random Variables' *Journal of the American Statistical Association* vol.64 pp1439-42.

20 Burt O. & Finley R.M. (1970) 'Statistical Identities in Random Variables' *American Journal of Agricultural Economics* vol.50 pp734-44.

21 A proof from first principles can be found in Jennings (1981) pp3.10-3.12.

Table 5.1

Variation in Area and Yield as a Percentage of Total Variation in Production

	1960-1990		1980-1990	
Term	Mean	Trend	Mean	Trend
1	11.02	23.65	13.28	1.5E-7
2	82.84	68.2	82.71	99.99
3	6.04	8.02	3.97	3.8E-8
4	0.11	0.13	0.04	3.5E-10

Following the format of the areas modelled in detail, yield for EE is given by a trend and a random element. For the 1980 to 1990 period yields were estimated as

$$\underset{(17.027)^*}{Y = 1.5008} + \underset{(6.104)^*}{0.07933}\ \text{TREND}$$

R^2 0.8055 DW 1.523
$Rbar^2$ 0.7838

5.3.6 The Rest of the World

Changes in imports from the ROW throughout the 1980s are dominated by changes in imports by China; these have sometimes been dramatic and distort any estimation of imports by the ROW. Indeed, when China is removed from the ROW grouping, the remaining countries imports can be estimated by using a simple trend (recall that the trend is used to represent growth in population and income).

$$NETM = \underset{(16.529)^*}{16852} + \underset{(22.448)^*}{1289.2}\ \text{TREND}$$

R^2 0.9474 DW 1.636
$Rbar^2$ 0.9455

The problem then becomes one of how to explain Chinese import behaviour. Figure 5.5 shows Chinese net imports of wheat from 1960 to 1990. Net imports were fairly stable and insignificant until the mid 1970s. During the late 1970s and early 1980s, the Chinese authorities allowed more wheat to be imported for urban use as part of a set of programmes to incorporate some market forces into the economy. The resultant increase in production in the 1981-84 period prompted the government to order a drastic cut in all grain imports (and vigorously promote corn exports to Asian markets). In the late 1980s, production began to stagnate (yields were already relatively high and further expansion of irrigated land was limited) while demand continued to increase, thus imports rose again. "After four years of fluctuating grain harvests, China's government leaders re-emphasized the importance of grain production and decided at the end of 1988 to raise 1989 grain procurement prices and increase both central and local government investment in crop cultivation" (Tuan & Ru (1992) p193); net imports of wheat have again begun to fall. What of China's future import demand?. Continued population growth and economic development would require an increase in imports unless agriculture is reformed and allowed to grow further, but the increase would be constrained to the extent of foreign exchange earnings, and the ability of China's infrastructure to absorb the imports. Tuan & Ru suggest that wheat imports could approach 20 million tonnes by 2000 if the foreign exchange situation does not deteriorate (p194). Tyers & Anderson, on the other hand, estimate that under certain optimistic assumptions import demand could reach as much as 46.2 million tonnes ((1992) p289).

Net Imports of Wheat by China : 1960-1990

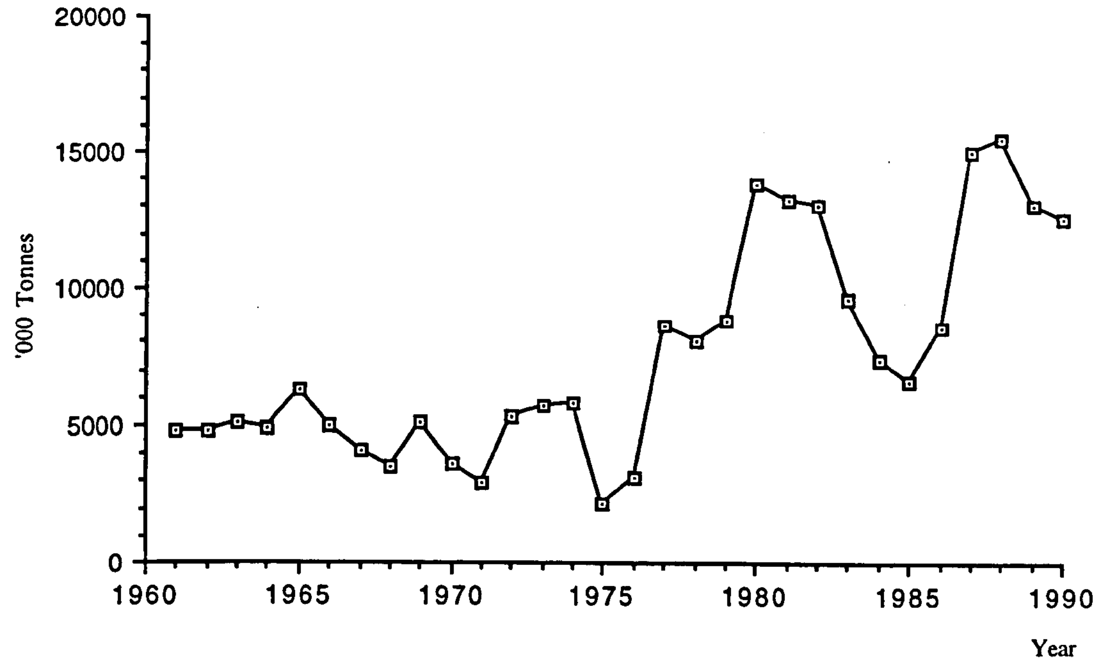

Figure 5.5

5.4 The Calibration Process

The simulation model was calibrated such that the levels of excess supply, excess demand, and world market prices corresponded closely to those seen in the base period suggested in the the Dunkel Final draft, confirmed in the November 1992 Blair House Agreement, and specified in the final UR agreement, in other words the average 1986-88 value (in order to simplify the calibration process the 1986-1990 base for the volume of subsidised exports agreed in December 1993 is ignored at this stage). In order to do this the estimated, strucutral model was solved for the equilibrium value of the nominal world market price (P^w_t) in each year by equating net excess supply for that year (given by the equations detailed above for the USA, EC, Canada and CG) and net excess demand (given by the import demand functions of Eastern Europe, China and the Rest of the World grouping).

$$\sum_{i=1}^{4} ES_{it} - \sum_{j=1}^{3} ED_{jt} = 0 \qquad (5\text{-}35)$$

When the estimated equations are substituted into (5-35) the overall model collapses to a quadratic in the current, nominal, world market price (see appendix A5-1 for details).

$$\alpha Pw_t^2 + \beta Pw_t + \gamma = 0 \tag{5-36}$$

The 'constant' term (γ) represents the change in CCC stocks which is due to the EEP. Recall that to convert the EEP term from dollars to tonnes the expenditure figure is divided by the higher of the loan rate or the market price. In the period considered, the market price is always above the loan rate, hence solving the model for the market price results in a quadratic. Note that as EEP expenditure is a policy variable it is determined exogenously and can change from year to year; as such it is only a constant in the sense that it is fixed for any one year (this latter point also applies to the α and β parameters). The parameter α contains those terms of the model which are dependent on the market price; domestic market prices are converted to world market levels using the average exchange rate in each of the years of the base period, and any necessary adjustments are made (see below). The parameter β encompasses those elements which are independent of Pw_t, but which may contain past values of the price.

A simple average of the 1986,1987 and 1988 estimates for ES_{it}, ED_{it} and Pw_t is taken as the base period value.

Note that with this solution method, the value of Pw_t is very sensitive to both the parameters of the excess supply equations and the dynamic behaviour of the model. The former can be seen in a simple diagrammatic way by referring to figures 5.6 and 5.7. As the net import demand functions of the model are independent of Pw_t, the excess demand schedule is vertical in each year. If we assume for the purposes of this simple example that total excess supply is represented in a linear form, $ES_t = \lambda + \delta Pw_t$, figure 5.5 illustrates the effect of a change in λ, given δ, on the equilibrium market price, and figure 5.6 the effect of a change in δ, given λ. In addition, although only the positive quadrant is shown, it is possible for negative equilibrium prices to occur for certain values of λ and δ.

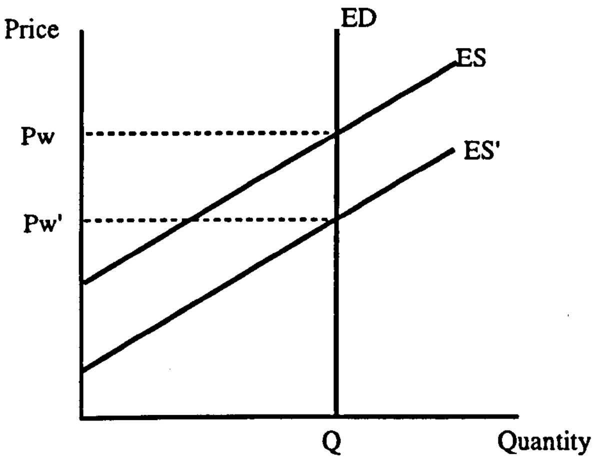

Figure 5.6

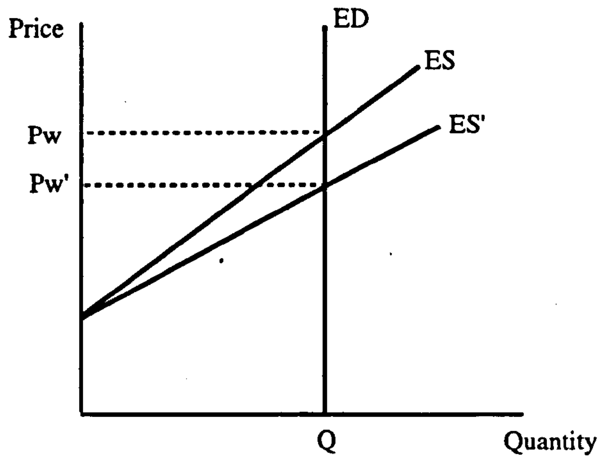

Figure 5.7

The dynamic behaviour of the model is not straight-forward. Lags occur in several of the equations of the model, for example those for feed use in the USA and CG, the stock equations in all 4 areas, and the area planted equations in Canada and the CG, but they also occur due to the C-O technique of correcting for autocorrelation. Consider equations 5-37 and 5-38, which represent a linear regression model with errors that are autocorrelated to the first order.

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \varepsilon_t \qquad (5\text{-}37)$$

$$\varepsilon_t = \rho\varepsilon_{t-1} + \upsilon_t \qquad \upsilon_t \sim NID(0,\sigma^2) \qquad (5\text{-}38)$$

Estimation of model using the C-O technique gives an estimated value of ρ, in the transformed model 5-39[22].

$$Y_t - \rho Y_{t-1} = (1-\rho)\beta_0 + \beta_1(X_{1t} - \rho X_{1t-1}) + \beta_2(X_{2t} - \rho X_{2t-1}) + \upsilon_t \qquad (5\text{-}39)$$

Hence it can be seen that the C-O technique has introduced lags into the model. For the wheat market model the additional lags due to the C-O technique will affect the overall dynamic structure. Note that for higher orders of autocorrelation further lags are introduced.

Because of the two sources of dynamic elements in the model and the fact that the overall model structure is quite complex (although it is essentially linear), there is no way of

22 A more detailed description can be found in Pindyck & Rubinfeld (1981) p157.

knowing, *a priori*, whether the model will converge smoothly, converge with oscillations, or diverge (oscillatorilly or non-oscillatorilly). The calibration process will force the model to converge on the average 1986-88 values, but the final model will then need to be tested to see if it adequately fits the historical data and produces reasonable forecasts (section 5.5).

Computer hardware limitations meant that the full simulation model, with the dynamic and stochastic elements included, had to be run on a mainframe computer. Thus a FORTRAN programme was used to run the completed model (see appendix A5-4). For the calibration process the stochastic elements were suppressed (these are discussed later in section 5.7), but because values in each of the years 1986 to 1988 were estimated individually, the dynamic elements were retained. The calibration method was a two-stage process. Firstly programmes were written to test the fit of the individual models, for the 4 exporting areas, to actual values. This was done because although the parameter estimates given above were the 'BLUEs' for the individual equations, simply having a good fit in the individual equations does not guarantee an overall simulation model that reproduces the historical data (Pindyck & Rubinfeld (1981) p355). The base values and the policy were input into the separate programmes as required (see appendix table A5-3.1). The programmes were then run for the three year period without any further exogenous data except for the actual value of the nominal world market price in each year (with the areas being tested separately, the equilibrium market price cannot be determined within the programme).

At this stage it was necessary to examine the extent of the transmission of world market price signals to the domestic market, and from the domestic market to farmers. In this model the world market price, in US$ terms, was used as the domestic, market price in the USA and the CG; for the former a relationship between $P^w{}_t$ and $P^d{}_t$ of close to 1:1 was found; and for the latter the world price was used for two reasons: (i) the CG is assumed to represent the 'free' trading group which takes $P^w{}_t$ as the domestic market price; and (ii) a CG exchange rate, although not impossible to calculate, would not be very meaningful. For Canada it was found that the domestic price was equal to the world price adjusted by the exchange rate. In the EC section of the model the direct transmission of world prices to domestic wholesale prices is assumed to be close to zero when P^w is below the threshold price (for ease of exposition this is defined as 110% of the domestic price). In this case the effective domestic market price is assumed to be the 'buying-in' intervention price (i.e. 94% of the intervention price), less the co-responsibility levy. Note that while it is recognised that it is more usual to account for the co-responsibility levy in the farm gate price rather than the market price, in this case the two are almost identical (see below). The structure of this model makes it possible for P^w to be above the threshold price (the UR agreement is expected to produce a modest price rise, and when this is combined with the possible effects of the stochastic elements of the model, such a situation could occur), and in this case the domestic wholesale price is taken as P^w adjusted by the $/ECU exchange rate and factors to account for 'Community Preference' (which is still held in place even with the UR agreement (see section 3.9, p3-20)), and the switchover mechanism.

The farm gate prices in the USA were found to be in general around 60-61% below the nominal world market price (unfortunately 1986 was an outlying year at 51%; this figure was used for 1986 and 60.5% for the other two years). For the EC a small adjustment had to be made to get from market prices to farm prices during the calibration process (a 0.8% increase), while for Canada and the CG no adjustments were made.

Table 5.2 shows the actual and estimated values of the elements pertinent to excess supply, for the 4 areas, for the 1986-88 base period. The estimated values gave a fairly close approximation to the actual values for the base period; hence the econometrically estimated, structural models for the 4 areas were included, without adjustment, in the next stage of the calibration process.

Table 5.2

Actual and Estimated Excess Supply: Average 1986-88

(using actual world market prices)

Actual Values

	USA	EC12	CANADA	CG
Production	54526.00	72941.00	24454.33	37381.33
Area	22913.00	15697.33	13570.67	20329.67
Consumption	29561.00	59310.33	6730.00	26827.33
Feed Use	7605.00	22109.33	3310.00	4202.33
Non-Feed Use	21956.00	37201.00	3420.00	22625.00
Stocks	35856.17	14700.00	8368.33	5582.67
Gov't	11826.26	6017.00		
Private	11459.75	8683.00		
FOR	12570.16			
Excess Supply	37361.89	15464.00	18896.33	11536.33

Estimated Values

	USA	EC12	CANADA	CG
Production	56584.23	72919.98	22312.55	38385.78
Area	25907.43	15674.75	13225.15	21717.73
Consumption	29294.84	57165.20	6813.14	26944.31
Feed Use	7997.90	21130.13	3420.00	4109.58
Non-Feed Use	21697.01	36035.07	3393.14	22834.73
Stocks	37088.57	14238.08	8372.21	4819.32
Gov't	11150.02	6352.87		
Private	12809.80	7885.21		
FOR	13128.75			
Excess Supply	39264.62	17953.23	16316.23	12658.64

This second stage entailed checking whether the model structures used to determine the values above, when combined with those for Eastern Europe, China and the ROW (Table 5.3), gave a close approximation to the actual world market price. The individual FORTRAN programmes were combined, the determination of excess demand incorporated, and equation 5-36 solved using a subroutine from the NAG library. This NAG routine uses the 'standard' closed formula for solving quadratic equations, via a variant of Laguerre's method due to B.T. Smith (1967). The routine allows the roots of the quadratic to be either real or complex. Since an imaginary value of Pw_t would make no sense, a safeguard was written into the programme to prevent imaginary numbers feeding through the model. In the event, this safeguard proved to be unnecessary as no complex roots were found. Also, as a quadratic equation has two roots, a procedure was needed to decide on the correct root. It was decided to firstly exclude one root, and use the other root, if the former was outside a given range; 4 standard deviations from the mean of the nominal world price series was chosen as this allowed results that were obviously not credible to be dismissed, but at the same time left enough of the distribution intact so as not to bias the stochastic simulation results. Secondly, if both roots were within this range, repeated tests showed that the larger of the two should be selected (the smaller root was usually around 70-100 US cents per tonne, i.e. too small to be regarded as a credible world market price).

Table 5.3

Actual and Estimated Excess Demand: Average 1986-88

(using actual world market prices)

	Actual Values	Estimated Values
E.E.	20897.00	22301.54
ROW	56371.67	54481.20
China	13000.00	13000.00

When solved, the model appeared to be oscillating towards a stable value; however, due to the short base period, the convergence was not achieved. The average world market price given as a solution to the model was \$170 (nominal terms) while the actual base period price was \$126.83. In the process of 'tuning' the model[23] to reduce this discrepancy the model structure was changed slightly; specifically the Eastern Europe section was split such that it became a CIS (former USSR) section with the other Eastern European countries being incorporated into the ROW group. This was done to correct for the intra-Eastern Europe trade in wheat which could not be isolated from the data. The following equations, therefore, became part of the model. Note that the new net import functions for the CIS and ROW were accepted as improvements to the original equations on the basis of an improved statistical fit; had R^2 or $Rbar^2$ been lower than in the previous formulations, the new equations would not have been incorporated into the model.

CIS

$$NETMCIS_t = \underset{(2.012)\dagger}{2968.6} - \underset{(8.349)*}{0.90464}NETMCIS_{t-1} - \underset{(-5.254)*}{0.18038}\Delta PROD + \underset{(2.117)\dagger}{4933.2}D84 - \underset{(-4.068)*}{11023}D85 - \underset{(-2.895)*}{6761.7}D88$$

R^2 0.9400 DW 1.6586

$Rbar^2$ 0.9066

$$YCIS = \underset{(15.170)*}{1.4575} + \underset{(1.122)}{0.01362}\,TREND + \underset{(2.593)*}{0.4225}\,D78 + \underset{(1.761)¥}{0.5870}\,D86 + \underset{(3.076)*}{0.4499}\,D89plus$$

R^2 0.7514 DW 1.7519

$Rbar^2$ 0.6519

where NETMCIS are the net imports by the CIS and YCIS is the wheat yield per hectare in

23 See Pindyck & Rubinfeld p403-405 for a discussion on tuning simulation models.

the CIS. The dummy variables were largely introduced to facilitate calibration of the model, but were only accepted if they were statistically significant.

R.O.W.

$$\text{LnNETM}_t = 10.117 - 0.029752\ \text{TREND} - 3.5548\ \Delta\text{PROD}_t$$
$$(238.2)^* \quad (12.78)^* \quad (-1.729)^\dagger$$

R^2 0.9281 ρ 0.3358

Rbar^2 0.9228

As expected the overall model proved to be quite sensitive to changes in the parameters and the calibrated values are presented in table 5.4. Recall that the actual value for the nominal world market price is \$126.83 (real price is \$123.07), and note that these values are obtained without referring to the actual values of P^w or adjusting any of the parameters during the 3-year running period.

Table 5.4

Calibrated Values: Average 1986-88

	USA	EC12	CANADA	CG
Production	58161.85	72920.02	22326.43	38452.75
Area	26096.52	15674.76	13231.43	21755.88
Consumption	28156.58	57165.20	6813.25	26944.31
Feed Use	6859.64	21130.13	3420.00	4109.58
Non-Feed Use	21697.01	36035.07	3393.25	22834.73
Stocks	36869.07	14238.09	8359.53	4870.36
Gov't	11150.02	6352.88		
Private	12763.84	7885.21		
FOR	12955.21			
Excess Supply	42274.58	17953.27	16377.09	12718.30

Excess Demand	
CIS	15447.83
China	13000.00
R.O.W.	53507.26

World Market Price	- Nominal	128.11
	Real	124.34

5.5 Evaluation of the Model

As has already been stated, a good statistical fit of individual equations in a simulation model does not guarantee that the overall model will be able to simulate well. In order to evaluate the ability of the model to produce results which are credible, the individual variables need to be tested in a 'simulation context' (Pindyck & Rubinfeld (1987) p362). We would expect a model to produce results which closely reflect the actual data if a historical simulation is carried out (i.e. a simulation over the estimation period); we would therefore expect the errors for each endogenous variable over the historical simulation period to be small. The most common measure of how well an endogenous variable tracks the corresponding historical data is the Root-Mean-Squared Simulation Error (RMS). The RMS for variable Y is defined as

$$RMS = \sqrt{(1/T(\Sigma(Y^s_t - Y^a_t)^2))} \tag{5-40}$$

where Y^s_t is the simulated value of Y in time t, Y^a_t is the actual value of Y in time t and T is the number of simulation periods.

Other measures do exist[24] but are essentially similar to the RMS. The RMS is a measure of the deviation of the simulated variable from its historical time path, however its size can only be evaluated by comparing it to the average size of the variable in question. In general then, for a model to give a good overall fit the RMS should be very small in relation to the variance of the variable in question.

A low RMS is only one desirable property of a simulation model however; the model should also be able to distinguish turning points in the historical data. Consider figure 5.8, where Y represents the original data series and X and B the results from two different, hypothetical simulation models. The RMS for model X is likely to be lower than that for B because it tracks the overall data well. However, model X fails to predict the sudden change in the data which means that model B is in fact the better model. A simple time trend could have given the same results as simulation model X without really explaining the underlying processes. Hence the ability of a model to predict turning points or rapid changes in the historical data is important.

24 These are (i) the RMS% error; (ii) the mean simulation error and (iii) the mean % error.

(i) $RMS\% = \sqrt{(1/T\,(\sum((Y^s_t - Y^a_t)/ Y^a_t)^2))}$

(ii) $\text{Mean Error} = 1/T \sum(Y^s_t - Y^a_t)$

(iii) $\text{Mean\% Error} = 1/T \sum(Y^s_t - Y^a_t)/Y^a_t$

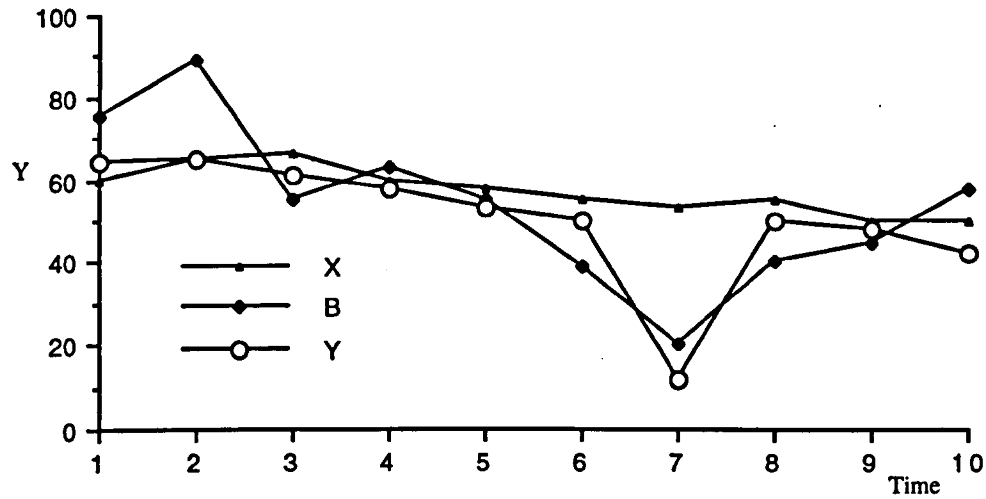

Figure 5.8

The historical tests on the overall wheat market model were carried out for 1989 and 1990. Additional years could not be used because the model requires past values of certain variables (due to the dynamic structure), therefore it could not be run backwards from 1986-88 to say 1980; to run the model forwards from 1980 to 1990 would have implied a 1980 calibration date. The results of the historical tests are shown below. The variables chosen for the tests reflect the analysis to be carried out with the model later in this chapter and in chapter 6; the important variables when examining the possible policy choices for the USA and EC after the UR agreement are the world market price level, the quantity of wheat available for export and the stock levels (particularly government stocks) in the two areas. Note that the level of import demand is also a central variable, and this is included in the table of RMS values (Table 5.5), but in this model its estimated form is dominated by trends. It is accepted that this is a limitation of the model, and the implications of this are discussed in chapter 7.

Table 5.5 shows that the RMS values for all of the variables in question are indeed small in comparison to their variances while graphs 5.9 to 5.11 show that significant turning points are picked up in the P^w series and in the stocks. However, the continued fall of excess supply in 1989 is not reflected by the model, and neither is the full extent of the rise in P^w; it is worth remembering here that 1988 and 1989 were severe drought years in the USA and that world trade in all agricultural products was affected. The individual model equations account for the drought effect to some extent but cannot reflect the overall effect on world markets. As the model had shown movements in the right direction for stocks and P^w, it was decided not to reject the model at this stage.

Table 5.5

Root Mean Squared Simulation Error Test Results

		Variance	RMS	Relative
P^w		478.50242	17.47287	0.03652
Excess Supply				
	USA	68201391	6322.03	9.3E-05
	EC	13560250	6168.731	0.00045
	Canada	12362121	4302.013	0.00035
	CG	9595460.3	1267.08	0.00013
Import Demand				
	CIS	20216556	1953.101	9.7E-05
	ROW	9234860.5	5587.104	0.00061
Stocks				
US	Total	210069466	4470.558	2.1E-05
	CCC	42637789	1770.304	4.2E-05
EC	Total	9354783	3285.775	0.00035
	Intervention	7314952.8	4199.417	0.00057

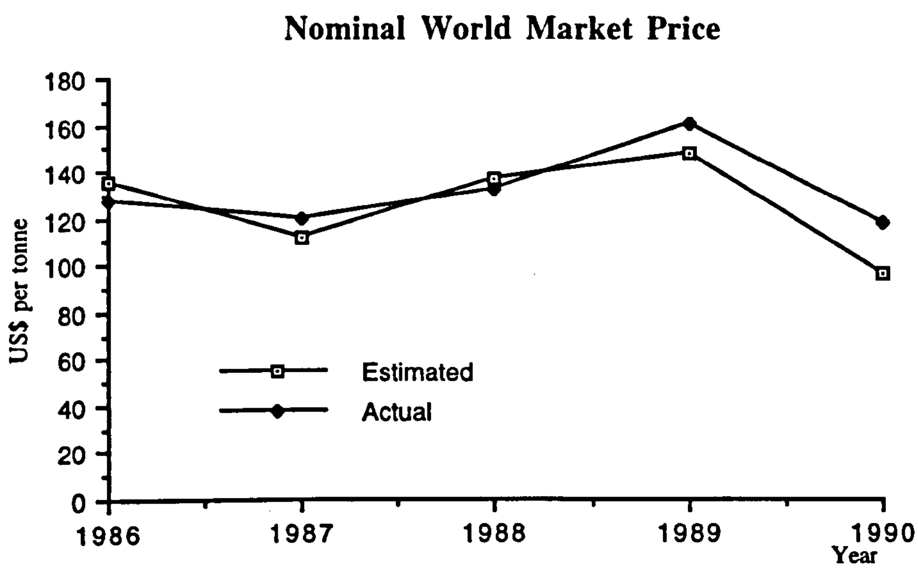

Figure 5.9

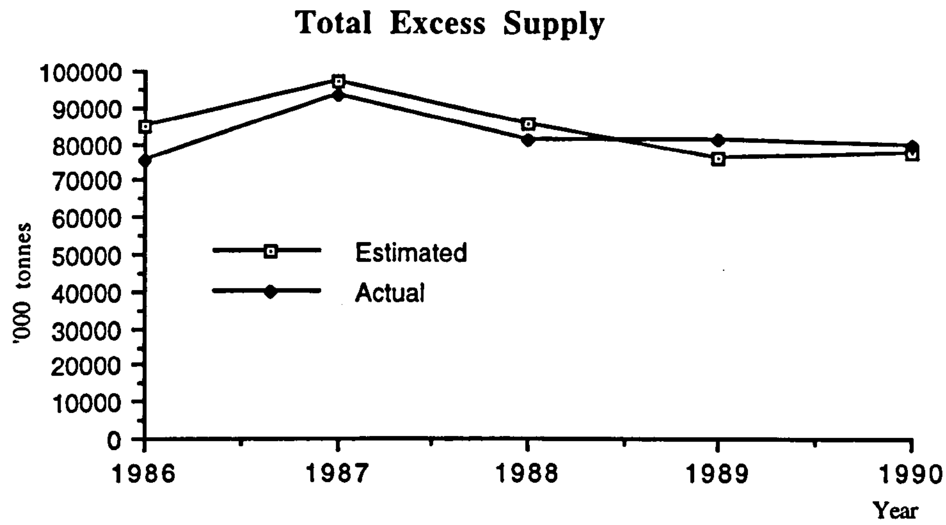

Figure 5.10

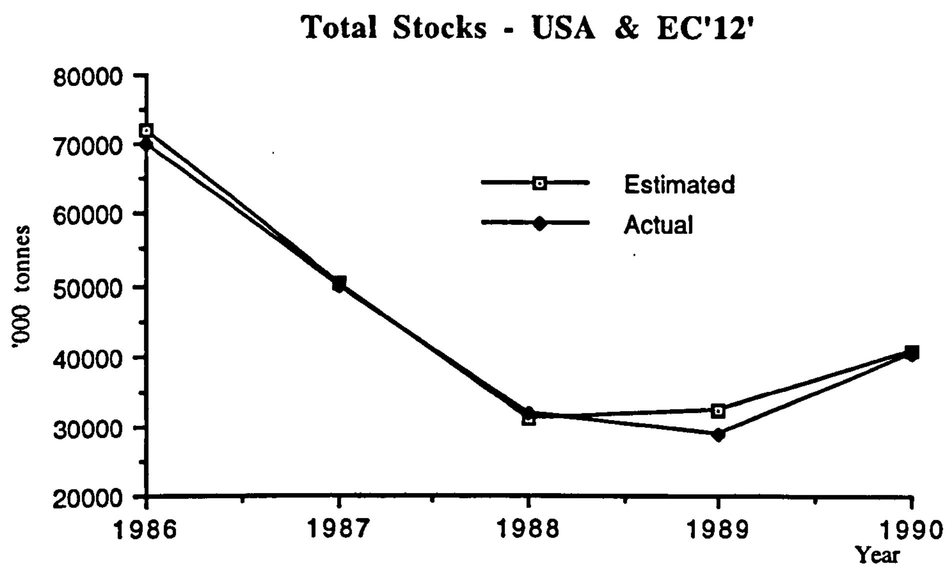

Figure 5.11

5.6 Forecasting the Exogenous Variables

Prior to running the model over the full period (1986-88 to 2000) the exogenous, non-policy variables have to be estimated for the period 1990 to 2000. The exogenous variables in this category are the prices of substitute products in the EC, USA and CG; population in the EC; livestock numbers in the EC, USA, Canada and CG; imports by China, and the yearly change in production for the ROW grouping. The exogenous policy variables for the EC and USA are assumed to be those set out in the 1992 Cunha reforms and the 1990 FACT respectively, until the review dates (1996 & 1995). For the initial run it was assumed that these policies would remain unchanged at the relevant review and continue until 2000. The effects of changes to the policies at the review are considered in chapter 6.

5.6.1 Substitute Prices

Following the methodology in chapter 4, the prices of substitute goods in the USA and CG are estimated by ARIMA models; such a model could not be identified for the EC and a simple lagged dependent variable equation was used instead. Unit root tests showed that the prices should be estimated in log form with the degree of differencing for the ARIMA models being 1.

The US data series (1960-90) contained outlying values in 1973, 1974 and 1986 which were more than 2.5 standard deviations from the mean value. As in chapter 4, these were replaced by estimated values to remove any possible bias in the ARIMA model. The values were estimated using a lagged dependent variable model from 1960 to 1972 to give an 1973 value; from 1960 to 1973 (the estimated value) to give a 1974 value; and similarly for 1986. This adjusted series was then used to estimate the ARIMA model in table 5.6.

For the CG, the correlogram and partial autocorrelation charts seemed to indicate that an ARIMA(2,1,2) would be the most appropriate model; however, when the Akaike and Schwarz criteria were examined, the model presented in table 5.6 performed best.

Table 5.6

ARIMA Coefficients: USA & CG

	AR		MA		Constant
	1	2	1	2	
USA	0.63924		1.4833	-0.74915	-0.009
CG	0.68451	-0.32981	0.53418		0.020

The barley price in the EC was forecast to 2000 using the following equation.

$$\mathrm{LnPBA}_t = \underset{(1.773)\dagger}{1.0003} - \underset{(7.107)*}{0.80265}\ \mathrm{LnPBA}_{t-1}$$

R^2 0.8558 ρ 0.26064

Rbar^2 0.8455

5.6.2 EC Population

A time trend has been used throughout the model to represent changes in income and population, and accordingly EC population is estimated using a trend.

$$\mathrm{LnPOP}_t = \underset{(3902.0)*}{5.7363} - \underset{(7.107)*}{0.003268}\ \mathrm{TREND}$$

R^2 0.9962 ρ_1 1.21152

Rbar^2 0.9959 ρ_2 -0.53976

5.6.3 Livestock Numbers

The livestock data included in the feed equations of this model are calculated total numbers, on a beef-cattle-equivalent basis. The forecasts of these data are made using a simple time trend without any reference to the actual numbers of sheep, pigs etc. This is done in the interests of parsimony but means that the policy conclusions drawn from the model results in chapter 6 may not reflect the full impact of the UR agreement. Multi-product models, such as that of T&A and the SWOPSIM model, with an endogenous livestock sector would be able to give an indication of the effect of the UR provisions for livestock on the wheat market. The T&A model, however, deals with livestock production (meat & milk) rather than livestock numbers, and the SWOPSIM uses only demand elasticities and again does not deal with livestock numbers *per se*. Hence neither of these models could provide the information needed to gain a more detailed forecast of the total livestock data used here.

The livestock series for the EC, USA, and Canada are estimated in log-linear form, those for the CG in linear form, using the C-O technique, and the results are presented below.

USA

$$\mathrm{LnLIV}_t = \underset{(572.9)^*}{12.063} - \underset{(-0.877)}{0.0011733}\ \mathrm{TREND}$$

R^2 0.7230 ρ 0.77951
Rbar^2 0.7046

EC

$$\mathrm{LnLIV}_t = \underset{(1568.0)^*}{13.796} - \underset{(11.01)^*}{0.0097796}\ \mathrm{TREND}$$

R^2 0.9596 ρ 0.4530
Rbar^2 0.9567

Canada

$$\mathrm{LnLIV}_t = \underset{(543.9)^*}{10.795} - \underset{(9.824)^*}{0.010602}\ \mathrm{TREND} + \underset{(1.417)¥}{0.031067}\ \mathrm{D74}$$

R^2 0.9261 ρ_1 0.83553
Rbar^2 0.9208 ρ_2 -0.38074

CG

$$\mathrm{LIV}_t = \underset{(45.08)^*}{270280} - \underset{(22.88)^*}{6944.9}\ \mathrm{TREND}$$

R^2 0.9964 ρ 0.82556
Rbar^2 0.9962

5.6.4 Import Demand: Chinese Imports & ROW Production Changes

For the initial runs of the full model, it was assumed that the forecasts of Tuan & Ru are correct, so that wheat imports into China approach 20 million tonnes by 2000. A smooth move towards this figure is assumed with imports rising by 750,000 tonnes in each year from 1991 to 2000.

Import demand by the ROW grouping requires that the change in ROW production from year-to-year was forecast to 2000, as ROW production was not endogenous to the model. In the 4 areas modelled in some detail, wheat yields, and hence production, are taken to be stochastic; thus a stochastic element was also introduced into the ROW import demand function to account for the uncertain direction and magnitude of production changes post-1990.

Note that the stochastic elements are calculated using a FORTRAN NAG routine for generating pseudo-random numbers. It is not possible to generate true random numbers without special hardware but the NAG routine generates series of numbers with statistical properties which are very close to those of true random numbers. The pseudo-random number generator is initialised to a repeatable state with the actual numbers being calculated from a normal distribution with mean μ and standard deviation σ. The values of μ and σ for each area are taken to be the actual mean and variance of the errors from the econometric estimations (i.e. for the USA the difference between the actual yield and the calculated yield given by YIELDUS = 1.7124+0.04621TREND+0.24444D83-0.22419D86-0.34662D88-0.48283D89). The random number generator is initialised to a repeatable state to allow for an analysis of possible policy changes in chapter 6; if it were to be initialised to a non-repeatable state, each separate run of the model would lead to a different set of random numbers and hence a different set of world market prices, stocks and levels of trade. While the latter may be desirable statistically, it would make policy analysis difficult[25]. In an attempt to avoid distorting the results by extreme values the random numbers obtained were constrained to be within 2.5 standard deviations of the mean value, such that if an individual call returned a random number outside the specified range, it was flagged, and the call was repeated to give another value. The process was repeated for 5.1% of the iterations in any one run of the programme.

In order to ease the interpretation of the results of the simulation model, it was decided to carry through the mean values of the stochastic variables, rather than storing individual values in each year for use in the following year. The effect of this simplifying assumption is to give a series of probability distributions as the output (one from each year) rather than 200^{10} possible equilibrium values by 2000.

5.7 AMS Reductions, Import Protection and Export Subsidies

In this section, the results of the overall model are examined in order to answer one of the questions posed at the beginning of this chapter: namely, do AMS reductions lead to commensurate cuts in border protection and export subsidies?. The reader is reminded that for the first five years of the UR, the EC asserted that a reduction in the AMS would lead to a fall in import tariffs and export subsidies. In the 1990 proposals for a UR settlement the

25 The model was run with the random number generator initialised to a non-repeatable state and the results from successive runs of this model, under the same assumptions, did not indicate that the patterns of world price changes, trade movements or stock levels seen in the repeatable state model were unusual.

EC offered to reduce the SMU by 30% from 1986 levels by 1995, but made no specific offer on reductions in import tariffs and export restitutions except to say that these would be reduced as a consequence of, and in line with, reductions in the SMU. It is this proposal that is examined here.

Recall that for the cereals sector the SMU can be calculated as

$$SMU = Q(P^d - P^{ref}) + (D - DIV - DIS) + B - L$$

where Q is the domestic production level, P^d is the domestic producer price, P^{ref} is the fixed external reference price, D are direct payments, DIV are diversion payments, DIS are disaster payments, B are all other budgetary financed support and L are producer levies.

Import protection is measured as the difference between the internal price and the ECU world price (converted at commercial exchange rates but adjusted for the effects of the switchover mechanism), adjusted for the 10% Community Preference. Unit export subsidies are measured as the difference between the internal price and the ECU world price. Note that a 'quality premium' was found to exist in the $ world price when compared to EC export prices. This was reported by Ackrill *et al.* (1993) to be around 41 ECU per tonne for cereals as a whole; however, using data from the International Wheat Council[26], an average wheat premium of $24 per tonne was calculated. In the model, therefore, P^w is reduced by $24 before the export refund calculations take place.

As stated in section 5.6, the initial run of the full programme is carried out under the assumption that policies by the USA and EC follow those set in 1990 and 1992 respectively. Specifically the following rules are assumed to apply.

(i) The Target Price in the USA is frozen at the 1990 level of $4 per bushel.

(ii) The CCC Loan Rate is taken as 85% of the average market price in the last 5 years, excluding the high and low years. However, it cannot be below $2.44 per bushel; neither can it be less than 95% of the year-earlier value.

(iii) The percentage of land required to be set aside under the Acreage Reduction Program (%ARP) is determined according to the total stocks to total usage ratio: if the ratio is

26 World Grain Statistics (1992), tables 10a & 10b.

less than 40% the %ARP is set at 7.5 while if the ratio is greater than 40% the %ARP is set at 12.5[27].

(iv) Expenditure on the EEP is fixed at 1993 levels.

(v) The intervention prices in the EC are equal to those agreed up to 1994/95. After this point they are held constant at 106.60 ECU per tonne. Compensatory payments and set-aside payments which were part of the Cunha reforms follow the same pattern[28].

(vi) The percentage of required set-aside in the EC is assumed to remain at 15% for the land under the rotational scheme and 20% for the non-rotational scheme. The effective amount of set-aside is assumed to increase linearly from the 1993/94 figure of around 9%[29] of the base area to 15%. This rather optimistic increase is due to the assumed effects of the introduction of the 20% non-rotational set-aside scheme in 1994/95 and of a decrease in the number of farms qualifying for exemptions.

In addition to the assumptions about policies in the USA and EC, the following also apply: the price deflator is assumed to rise by 3 percentage points per annum from 1991 (as in section 4.4.5.3); budgetary expenditure for items other than the compensatory payments and set-aside payments is assumed to be constant and can therefore be ignored in comparisons across years[30]; the US$/ECU and US$/Canadian$ exchange rates are held constant at their average 1993 levels (1.1724 and 1.3240 respectively) for the period 1994 to 2000.

The dynamic structure of the model means that a single extreme value of a stochastic variable in any one year feeds through into the following years, via a distorted average value. In order to counter the possibility of the distortions leading to the simulation exploding over time (an extreme value in year t feeds through into year t+1, which causes a further distortion that feeds through into t+2 etc.), the calculated values of P^w were

27 The 1990 FACT states that if the stocks to usage ratio is less than 40% the %ARP can be set between 0 and 15 while if the stocks to usage ratio is greater than 40% the % ARP can be set between 10 and 15. The values chosen represent the mid points of these possible ranges.

28 Note that in the model the compensatory payments are not included in the area calculations because they are the same for all cereals and therefore do not affect the *relative* returns from wheat and barley.

29 See Rayner *et al.* (1993)

30 In this case the SMU is calculated as

$$SMU = Q(P^d - P^{ref}) + D.$$

constrained to fall within certain limits; these are based on the mean and standard deviation of the nominal price series for the period 1974-1990. So as not to bias the results by excluding extreme, but possible, values, the lower bound is set as the mean value less 4 standard deviations and the upper bound as the mean plus 5 standard deviations. This wider band is set for the upper limit for two reasons; firstly, over time we would expect there to be a rise in nominal prices due to the effects of inflation and secondly, the 1992 reform of the CAP, and the probable effects of the UR settlement, are expected to lead to an increase in the mean value of the real world price (and hence the nominal price). If a calculated price is outside of the specified range (56.03947 to 262.2068 US dollars) that particular iteration is ignored when calculating the moments for all variables, for the year in which it occurs. The total number of times a set of values was ignored formed less then 1.37% of the number of iterations performed in any one run of the programme.

Further constraints are placed on the model to ensure that, for example, negative stocks do not occur. For all areas, if calculated stock levels do become negative, they are set to zero. In the USA, deficiency payments are set to zero if the market price is above the target price and the participation rate is constrained to be between 0 and 100 (as detailed in section 5.3.1). In the EC, if the world price is above the internal price, import protection and export refunds are also set to zero.

The tables below give the mean values, and 95% confidence intervals, for the variables relevant to this analysis, which are obtained from a run of the model over the full 15 year period, with 200 iterations of the model in each year to gain the probability distributions. Note that 1989 and 1990 are not included in the tables as these years have already been discussed.

Table 5.7

World Market Price

(US$ per tonne, nominal terms)

Year	Mean	95% confidence interval (a) From	To
1991	146.58	141.430	151.730
1992	162.93	160.183	165.677
1993	197.08	193.751	200.409
1994	221.41	218.020	224.800
1995	185.53	181.799	189.261
1996	159.60	155.825	163.375
1997	175.00	171.273	178.727
1998	201.39	197.622	205.158
1999	215.18	211.293	219.067
2000	208.70	204.618	212.782

(a) Calculated using the sample standard deviation, and the Central Limit Theorem

Table 5.7 shows the mean world price level. The price rises after 1993 in this case reflect the change in policy by the EC in the 1992 reforms rather than the effects of a UR agreement. P^w rises initially, falls around the time of the 1995/6 review date set for CAP reform, but then begins to rise again. This is plausible for two reasons: the first of these is the predictable effect of the price increases in the early 1990s, namely that production is encouraged in all areas and stocks are run down as the current price is above the expected price in the next year, leading to a situation of oversupply in 1995. The second reason is that world price levels for commodities are often observed to follow fluctuating patterns[31].

Table 5.8 shows the mean level of the SMU in each year and the corresponding mean level for total export restitutions. The SMU is calculated as detailed above with the external reference price for wheat set at 93.0254 ECU per tonne (the world price, less the adjustment for quality differences (section 5.7), converted at commercial rates and then adjusted for the switchover coefficient). Measured in this way, the 1986 value of the SMU for wheat is 6276.13 million ECU[32]; for the EC to meet the target it proposed in 1990, it

31 The magnitude of the calculated values is discussed in chapter 6.

would have had to reduce the SMU to 4393.29 (a 30% reduction). From the table it is clear that under these assumptions the EC would not have been able to meet this by 1995, (or indeed by 2000, the final date set in the actual UR agreement, although the 1999 figure is below the target). Recall that in this measure of the AMS, the compensatory payments introduced in the Cunha reforms are included, in the final agreement they are not. The compensatory payments are assumed to remain constant at 45 ECU until 2000, however, given the market prices in table 5.7, it is unlikely that this will be the case (this is discussed further in chapter 6) and the calculated SMU would be reduced.

The actual reduction in the SMU is 29.33%. We can now examine the EC's contention that export restitutions would be reduced by a commensurate amount. Total export restitutions in 1986 are calculated as 631.98 million ECU. The export refund bill is below this value in all years except 1999 and 2000. A 29.33% reduction in the export subsidy bill would take it to 446.62 million ECU; only in 1992 and 1994 is the total bill below this. It is worth noting that by 2000, the agreed final date, the average unit export refunds is 24.56 ECU, representing most the adjustment for quality differences (21.15 ECU at the assumed exchange rate). Were the quality of wheat exported by the EC experiences price to rise in the same proportion as the American price shown in table 5.7, unit export restitutions would be much smaller at 3.41 ECU, giving a 2000 export subsidy bill of 96.24 million ECU, and the export subsidy reduction could have been met by then.
The table above shows that a reduction in the SMU of almost 30% by 1995 does not necessarily lead to a commensurate fall in export subsidies. Indeed, with the policy conditions, inflation rates, exchange rate and quality adjustment assumed here, the export restitution bill is 36.91 million ECU above the required level.

Import tariffs cannot be measured accurately using this model because it calculates net excess supply. However, the mean difference between the internal and external price[33] suggested by the model would imply to an average import tariff of 17.99 ECU by 1995 (after accounting for Community Preference). This compares to an average variable import levy of 184.03 ECU in 1986. This very simple comparison would lead us to conclude that the commitment to reduce import tariffs by an amount commensurate with the cut in internal support could have been met after the 1992 reforms.

32 The reader should remember that the SMU calculated here does not include a measure of budgetary expenditure on items other than the compensatory payments (set aside payments are excluded from the SMU). Moreover it is only calculated for wheat. It is therefore not comparable to the SMU measure shown in table 4.3.

33 Unadjusted for quality differences as the EC imports the higher quality wheat.

Table 5.8

The Wheat SMU & Export Restitutions

(million ECU)

	SMU			**Export Restitutions**		
		95% confidence interval(a)			95% confidence interval(a)	
Year	Mean	From	To	Mean	From	To
1991	6811.92	6784.294	6839.546	912.34	814.543	1010.129
1992	2150.49	2142.276	2158.704	203.52	179.018	228.025
1993	2695.30	2690.611	2699.989	457.43	451.866	462.998
1994	3471.38	3466.976	3475.784	300.27	294.553	305.991
1995	4435.33	4430.877	4439.783	483.53	474.553	492.507
1996	4439.06	4434.414	4443.706	553.35	529.882	576.828
1997	4082.30	4078.130	4086.470	621.37	609.566	633.181
1998	4240.33	4235.954	4244.706	560.38	554.701	566.066
1999	4290.39	4285.555	4295.225	655.61	649.336	661.890
2000	4508.00	4503.603	4512.397	693.21	687.407	699.017

(a) Calculated using the sample standard deviation, and the Central Limit Theorem

The 1990 offer analysed above was made before the first drafts of the 1992 reforms were presented; in other words when the stabiliser mechanism was still in force. In this case it is interesting to examine the results of a run of the model under the assumption that the policies in the EC do not change in 1993 and the stabiliser mechanism continues until 2000. The stabiliser mechanism allowed a maximum, guaranteed, total cereal production (MGQ) of 160 million tonnes. If production exceeded this amount the intervention price would be reduced by 3% for the next marketing year, and the co-responsibility levy would be 6% of the intervention price rather than the basic rate of 3% (until 1991, 5% after 1991). For this model, a wheat MGQ was derived using the average proportion of wheat to total cereal production (47.66%) to give a wheat MGQ of 76.25 million tonnes. The effective internal market price continued to be the buying-in price (94% of the intervention price) less the co-responsibility levy. Note the stabiliser mechanism is invoked if the mean EC production level in any one year is above the wheat MGQ, rather than if any one iteration in a year exceeds it. This is consistent with the simplifying assumption made earlier about the dynamic mechanism of the model; namely that the mean values of variables in year t feed through into t+1 to give a series of probability distributions over the estimation period, rather than 200^{10} possible answers by 2000. The results are shown in tables 5.9 and 5.10.

Table 5.9

The SMU and Export Restitutions with the Stabiliser Mechanism

(million ECU)

	SMU			Export Restitutions			
		95% confidence interval(a)			95% confidence interval(a)		
Year	Mean	From	To	Mean	From	To	
1991	4258.55	4241.280	4275.820	642.70	558.493	726.909	*
1992	3865.45	3850.684	3880.216	79.90	51.187	108.611	*
1993	3202.08	3188.710	3215.450	408.60	397.273	419.918	*
1994	2116.98	2104.775	2129.185	327.39	317.549	337.231	*
1995	2963.91	2952.923	2974.897	185.56	145.121	226.004	*
1996	2316.53	2307.757	2325.303	246.60	207.157	286.039	*
1997	2043.56	2036.140	2050.980	440.03	432.366	447.686	*
1998	1825.44	1818.864	1832.016	503.57	497.267	509.873	*
1999	1607.68	1601.439	1613.921	523.26	507.733	538.779	
2000	1269.16	1264.933	1273.387	612.11	588.020	636.190	

(a) Calculated using the sample standard deviation, and the Central Limit Theorem

* A high level of positive skewness and kurtosis demonstrated

It can be seen from table 5.9, that with these new assumptions about policy in the EC, the 1990 proposals for reductions in the SMU are met easily (recall that in this case there are no compensatory payments to include in the SMU and the coresponsibility levies payable are subtracted in the calculation). However, now the export restitutions are reduced by more than the required amount due to a low mean world market price level in 1995 (by 2000 the export restitution bill has risen again).

If we employ the same, rather crude, method for determining a unit import tariff as before, we get a value of zero by 1995 (rising to 10.75 ECU by 2000). Again the import tariff commitment contained in the EC's 1990 proposals would be met.

Table 5.10

Nominal World Market Prices and Intervention Prices Resulting from the Stabiliser Mechanism

	World Price (US$ per tonne)			Intervention price (a)
Year	Mean	From	To	(ECU per tonne)
1991	150.94	145.962	155.918	163.49
1992	186.02	183.175	188.865	158.59
1993	219.22	216.150	222.290	153.83
1994	217.27	213.824	220.716	149.22
1995	170.28	166.611	173.949	144.74
1996	174.18	170.776	177.584	140.40
1997	210.79	207.386	214.194	136.19
1998	216.48	213.109	219.851	132.10
1999	197.71	193.670	201.750	128.14
2000	187.55	183.040	192.060	124.29

(a) In each year the coresponsibility levy was 6% of the intervention price.

In conclusion, therefore, the 1990 proposals to reduce the SMU by 30% could not have been met using the measures introduced in the Cunha reforms. This emphasises the importance of the concession on compensatory payments earned by the EC in the final agreement; as we shall see in chapter 6, the commitment to reduce internal support is not an issue in either the USA or the EC. In addition to the shortfall in the reduction of the SMU, the fall which would have taken place would have lead to a commensurate reduction in import protection but not in export subsidisation. If the analysis is performed using the EC policies in place at the time of the offer (namely the stabiliser mechanism), the SMU reduction can be met, and this does lead to a commensurate fall in import protection and export subsidisation. The EC's argument that separate commitments in each of the three areas would not be needed to achieve a reduction in internal support, border protection and export subsidisation is thus proven to have been true at the time of the proposals. However, it would not have resulted in a reduction in trade-distorting agricultural support of the magnitude proposed by the USA and CG; thus even if it had been accepted that the EC's contention was correct, the former would still have proved to be a major sticking point at the abortive 'final' meeting in December 1990.

Appendix A5.1: Solution to the Overall model

The overall model is solved for the current, nominal world market clearing price P_t^w. Excess supply functions for the exporting countries take the form

$$ES_t = PROD_t - CONS_t - STKS_t + STKS_{t-1}$$

where ES = Excess supply
$PROD$ = Production
$CONS$ = Consumption
$STKS$ = Total, year end stocks

Import demand (ED) functions are calculated for the remaining areas and the equilibrium price is found when

$$\sum_{i=1}^{4} ES_{it} - \sum_{j=1}^{3} ED_{jt} = 0 \qquad \text{(A5-1)}$$

Due to the way in which FORTRAN programmes are written, those terms which are not in P_t^w are included in subroutines such that these would then form a 'constant' unique to any one year. The returned 'constants' from the subroutines are USCAL, ECCAL, CANCAL and CGCAL. The calculation of these is shown below; note that only the equations with terms in P_t^w are shown in detail and dummies for years prior to 1986 are not included (as these would effectively be zero). The full set of equations can be found in Chapter 5.

A5.1.1 USCAL

$$PRODUS_t = AREAUS_t * YUS_t \qquad \text{(A5-2)}$$

$$CONSUS_t = CDUS_t + CFUS_t \qquad \text{(A5-3)}$$

$$CFUS_t = PROPUS_t + TOTGRUS_t$$

$$\begin{aligned} TOTGRUS_t = {} & 0.72994 TOTGRUS_{t-1} + 0.22226 LIVUS_t \\ & + 16100 D87 - 25376 D89 \end{aligned} \qquad \text{(A5-4)}$$

$$\begin{aligned} PROPUS_t = {} & 0.065133 + 0.41974 PROPUS_{t-1} - 0.033681 \frac{PUS_t}{PJUS_t} \\ & + 0.046529 D86 \end{aligned} \qquad \text{(A5-5)}$$

$$\left(\text{note:} \quad PUS_t = \alpha\left(\frac{P_t^w}{DEFP_t^w} * 100\right); \alpha = 0.51 \text{ in 1986, } 0.6049 \text{ otherwise}\right)$$

$$STKUS_t = CCC_t + FOR_t + PRIVUS_t \tag{A5-6}$$

$$FOR_t = 12423.652 - 9225.6\frac{Pw_t}{LRFOR_t} + 5376.3107\frac{P_{t-1}^w}{LRFOR_{t-1}} + 0.58276FOR_{t-1} \tag{A5-7}$$

(note: taking account of the *C-O* technique, $\rho = 0.58276$)

$$PRIVUS_t = 8486.6 + 0.35466PRIVUS_{t-1} - 3391.4\left(\frac{Pw_t}{E\left(P_{t+1}^w\right)} - \frac{P_{t-1}^w}{E\left(P_t^w\right)}\right) - 7158.1D88 \tag{A5-8}$$

$$CCC_t + \frac{0.2EEPTOT}{P_t^w} = 8.875\left(LR_t - LR_{t-1}\right) + 0.62885CCC_{t-1} + 11997086 \tag{A5-9}$$

(note: Due to the deficiency payments programme operated in the USA, the internal price PUS_t is assumed to be equal to the world price P_t^w).

$$= USCAL_t + P_t^w\left(\frac{9225.6}{LRFOR_t} + \frac{3391.4}{E\left(P_{t+1}^w\right)} + \frac{0.033681 \; TOTGRUS_t}{PJUS_t}\right) - \frac{0.2EEPTOT_t}{P_t^w} \tag{A5-10}$$

A5.1.2 EC '12'

The policies pursued by the EC Member States drive a wedge between the world market price and the internal EC market price. For this reason it is assumed that the EC price is the internal (intervention buying-in) price unless the world price is above the threshold price (*TP*). Therefore all of the elements of excess supply in the EC are initially calculated in a subroutine to give $ECCAL_t = ESEC_t$; if the level of P_t^w subsequently calculated is above *TP*, P_t^w is recalculated to take account of elements in the EC affected by the current market price. These are

$$CDEC_t = 125.6(POP_t - 0.21518POP_{t-1}) - 28.693(\mathrm{P_t} - 0.21518P_{t-1}) + 0.21518CDEC_{t-1} \quad \text{(A5-11)}$$

(note: taking account of the *C-O* technique, $\rho = 0.21518$)

$$CFEC_t = 0.91377CFEC_{t-1} - 0.56663CFEC_{t-2} + 0.036836LIVEC_t - 0.33654LIVEC_{t-1} + 0.020869LIVEC_{t-2} - 3487.5\frac{P_t}{DEFEC_t} + 3178.5\frac{P_{t-1}}{DEFEC_{t-1}} - 1971.0225\frac{P_{t-2}}{DEFEC_{t-2}} \quad \text{(A5-12)}$$

(note: *C-O* method; $\rho_1 = 0.91377$; $\rho_2 = 0.56663$)

$$PRIVEC = 0.16162\Delta PRODEC_t + 102.75E(P_{t+1}) - 57.86P_t \quad \text{(A5-13)}$$

A5.1.3 Canada

$$PRODCAN_t = AREACAN_t * YCAN_t \quad \text{(A5-14)}$$

$$CONSCAN_t = CDCAN_t + CFCAN_t \quad \text{(A5-15)}$$

$$STKCAN_t = 4575.9 + 0.5047STKCAN_{t-1} + 0.28869\Delta PRODCAN_t - 26.317(PCAN_t - E(PCAN_{t+1})) \quad \text{(A5-16)}$$

where $PCAN_t = \dfrac{P_t^w}{\text{Exchange rate}}$

$$\begin{aligned} ESCAN_t &= PRODCAN_t - CONSCAN_t - (4575.9 + 0.5047STKCAN_{t-1} + 0.28869\Delta PRODCAN_t + 26.317E(PCAN_{t+1})) + 26.317PCAN_t \\ &= CANCAL + \left(\frac{26.317}{ER_t}\right)P_t^w \end{aligned} \quad \text{(A5-17)}$$

A5.1.4 Cairns Group

The CG formulation does not contain any references to the current market price (although past values are incorporated) and hence all of the excess supply calculation takes place in the subroutine and $CGCAL_t = ESCG_t$.

A5.1.5 Solution

The import demand functions of the former USSR (*IMPEE*) and the rest of the world group (*IMPROW*) are determined without reference to P_t^w and the imports of China are taken to be exogenous in this model. Thus we can calculate the market clearing value of P_t^w, using equation A5-1, as

$$\left[USCAL_t + P_t^w\left(\frac{9225.6}{LRFOR_t} + \frac{3391.4}{E\left(P_t^w\right)} + \frac{0.033681}{PJUS_t}\right) + \frac{0.2EEPTOT_t}{P_t^w}\right] + ECCAL$$

$$+\left[CANCAL + \left(\frac{26.317}{ER_t}\right)P_t^w\right] + CCGAL - IMPEE - IMPROW - IMPCHIN = 0$$

$$\Rightarrow [USCAL + ECCAL + CGCAL + CANCAL - IMPEE - IMPROW - IMPCHIN]$$

$$+\left(\frac{9225.6}{LFOR_t} + \frac{3391.14}{E\left(P_{t+1}^w\right)} + \frac{0.033681TOTGRUS_t}{PJUS_t} + \frac{26.317}{ER_t}\right)P_t^w +$$

$$\frac{0.2EEPTOT_t}{P_t^w} = 0$$

$$\Rightarrow \alpha + \beta P_t^w + \frac{\gamma}{P_t^w} = 0$$

$$\Rightarrow \alpha P_t^w + \beta P_t^{w^2} + \gamma = 0 \qquad \text{(A5-18)}$$

Equation (A5-18) is solved for P_t^w using the familiar formula for solving quadratics.

<u>Variable definitions</u>

The postscript ** indicates either US, EC or CAN in the following

PROD**	production of wheat
AREA**	area planted to wheat
Y**	yield of wheat
CD**	direct/non-feed consumption of wheat
CF**	feed use of wheat
CONS**	total usage
LIV**	livestock numbers, beef cattle equivalent
TOTGR**	feed use of all grains
PROP**	proportion of feed grains which is wheat
ES**	excess supply (net)

STK**	total year end stocks
PRIV**	private stocks (year end)
PJ**	price of a substitute good

other variables

FOR	Farmer Owned Reserve Stocks
CCC	US government stocks (Commodity Credit Corporation)
EEPTOT	Total $ expenditure on the Export Enhancement Program
LRFOR	Loan rate for the FOR
LR	CCC loan rate
ER	exchange rate of the Canadian to US dollar
POP	EC '12' population

Chapter 6

The Uruguay Round Agreement and Future Policy Options

6.1 Introduction

The Uruguay Round (UR) agreement, concluded in December 1993, states that each of the Contracting Parties will make reductions in their support of agriculture in three separate areas, with a different required reduction in each of the areas. In this chapter we consider one of the questions posed at the beginning of chapter 5, namely whether the commitments actually made in the UR are compatible in the sense that the reductions in each of the three areas can be achieved simultaneously. In addition the model developed in chapter 5 is used to analyse the effects of various changes in the assumptions about excess demand on the conclusions. Further to this, it is acknowledged that although the agreed UR programme is aimed at reducing the quantities of subsidised exports on the world market, thereby raising the market price above what it would otherwise have been, it also has the effect of limiting the policy options of governments wishing to provide income support to farmers. The second part of this chapter, therefore, concentrates on an examination of the policy options open to the USA and EC in 1995/6 when the present policies are due to be reviewed.

6.2 The Compatibility of the Commitments in the UR Agreement

6.2.1 The Base Scenario

The base scenario is taken to be the one detailed in section 5.7. Briefly, agricultural policies in the USA and EC are assumed to be those agreed in 1990 and 1992 respectively (see section 5.7 for the details); imports by China are assumed to rise linearly from 12.5 million tonnes in 1990 to 20 million tonnes in 2000; exchange rates are fixed at average 1993 levels; inflation is assumed to be 3% per annum; and budgetary expenditure for items other than storage costs, export subsidies, compensatory payments and set-aside payments is assumed to be constant.

In order to focus the discussion, only the salient variables and years are presented in the following tables.

The mean values of the nominal market price (P^w) are presented in table 5.7 but some discussion of the magnitude of these prices is warranted here. The mean value of P^w rises to over $200.00 by the end of the forecast period which is historically a very high level. At first sight, this might suggest that the main achievement of UR was to force the EC to reform the CAP (recall that for this base scenario none of the UR criteria have been imposed on the model) thereby allowing for the desired increase in world prices.

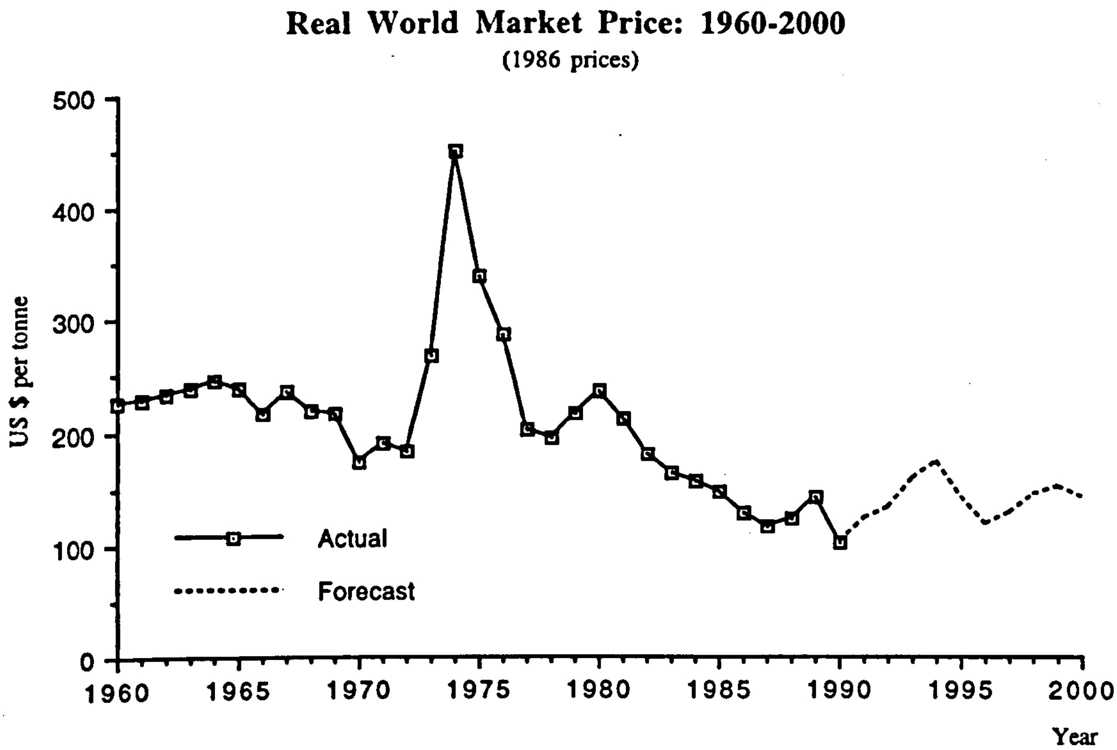

Figure 6.1

Indeed, figure 6.1 shows that the fall in the real price seen in the 1980s has been halted and that under the assumptions of the base scenario real prices do rise in the 1990s. However, even if the extreme values in the early 1970s are discounted, a real price of $143.76 (assuming an inflation rate of 3% per annum as stated on page 5-54) in 2000 is not a historically high value.

That said, what are the probable causes of the forecast increase in the nominal price? They were summed up in section 5.7 as the expected effects of the interaction between supply and demand. It was also observed that world price levels often follow fluctuating patterns. The table below gives a summary of the relevant variables in the base period (1986-88), 1995 and 2000. It shows that total excess supply has increased by 29.6% between the base period and 2000. The share of the market accounted for by US exports has risen from 47.3% to 57.2%, that accounted for by the EC from 20.1% to 24.4%, while the share of the Cairns Group (CG) is greatly reduced - a fall of around 10 percentage points. The main reasons for the fall in the CG's share are twofold. Firstly, the area planted in the CG is determined by the difference between the nominal wheat price and the nominal maize price; the latter is exogenous to the model and is assumed to move according to an ARIMA model (detailed in section 5.6.1). The ARIMA process for the maize price results in an upward movement over the period. Therefore, with both prices rising, the area response to a change in the wheat price is muted. Secondly, the CG stock equation (5-30) is sensitive to changes in nominal prices, therefore with P^w rising to over \$200 it was expected that CG stocks would be quite low. In the early years this has the effect of increasing the CG's share of the world market; however, over time, the level of available stocks for export falls. The overall fall in the CG's market share then is the result of falling stocks coupled with a lack of production response.

While excess supply has risen by around 30% over the forecasting period, excess demand has increased by 58.98%. This is in part due to the assumed increase in Chinese imports (which in turn is based on the assumption that China's is able to finance this quantity of imports) and in part due to the trend nature of the ROW import function. It is also dependent upon the assumption that imports by the CIS continue to follow the pattern of the former USSR. It is likely, therefore, that the historically high prices are the result of very high levels of excess demand rather than any policy change in the EC (the consequences of changing some of these assumptions about import demand are examined in section 6.2.2.).

Table 6.1

Base Period Results: Comparison of 1995 and 2000 with 1986-88 (a)

1. Average 1986-88 (Calibrated Values)

	USA	EC	Canada	CG
Excess Supply	42274.58	17953.27	16377.09	12718.30
Stocks	36869.07	14238.09	8359.53	4870.36
Private	12763.84	7885.21		
Gov't	11150.02	6352.88		
Other	12955.21			

Excess Demand	
CIS	15447.83
China	13000.00
R.O.W.	53507.26

2. 1995

	USA	EC12	Canada	CG
Excess Supply	52556.35	20242.46	15115.63	7882.23
	(52050.31-53062.39)	(20009.55-20475.37)	(14848.44-15382.82)	(7473.85-8290.61)
Stocks (b)	17873.81	16728.34	8557.48	269.26
	(17315.59-18432.03)	(16621.18-16835.50)	(8403.51-8711.45)	(194.39-344.13)
Private	13443.40	14278.91		
	(13378.22-13508.76)	(14223.95-14333.87)		
Gov't	905.07	2449.43		
		(2397.24-2501.62)		
Other	3525.25			
	(3096.04-3954.46)			

Excess Demand	
CIS	21246.41
	(21712.02-22004.87)
China	16250.00
ROW	68356.86
	(68156.86-68556.86)

3. 2000

	USA	EC	Canada	CG
Excess Supply	66223.72	28223.68	15660.70	5693.16
	(65638.80-66808.64)	(27993.76-28453.60)	(15370.30-15951.10)	(5211.95-6174.37)
Stocks (b)	15206.70	17363.34	8514.11	39.80
	(14781.00015632.40)	(17257.56-17469.12)	(8348.73-8679.49)	(16.98-62.62)
Private	13087.08	15719.05		
	(13016.38-13157.78)	(15664.80-15773.30)		
Gov't	769.19	1644.30		
		(1592.81-1695.79)		
Other	1350.43			
	(1022.46-1678.40)			
Excess Demand				
CIS	25029.25			
	(22968.14-27090.44)			
China	20000.00			
ROW	85263.28			
	(84276.89-86249.67)			

Notes
95% confidence interval in parentheses; calculated using the Central Limit Theorem and the sample standard deviation.
(a) '000 tonnes unless otherwise stated.
(b) Numbers may not sum because of rounding.

Internal Support, Export Subsidisation and Import Protection

Given the mean values of the nominal world market price presented in table 5.7, and the excess supply figures presented above, the 3 areas of the UR agreement can now be examined under the base scenario assumptions. The analysis concentrates on the USA and EC as these were the two main protagonists in the UR, and their policies have had the largest effect on world markets in recent years.

The commitments agreed in the UR require the Contracting Parties to reduce import tariffs by 36% over the 6 year reform period, from a 1986-1988 base year; to include internal support policies in a global AMS, expressed in monetary terms, using the 1986-88 base period and then to reduce it by 20% over the 6 year period; and to reduce budgetary expenditure on export subsidies by 36% over 6 years *and* the volume of subsidised exports by 21% over 6 years. Both of these latter commitments are based on a 1986-90 reference period, although the agreement states that where 1991/92 subsidised export levels exceed those of the base period, the former may be used as the starting point for the reductions. However, by the end of the reform period, the resulting reduction must be the same, namely a 21% reduction in the volume of subsidised exports from the average 1986-90 level.

Note that as the agreed AMS does not include deficiency payments in the USA, or compensatory payments in the EC, both areas are expected, *a priori*, to be able to meet the required reductions comfortably.

Base levels, as defined above, are presented for the USA and EC in table 6.2. The fixed external reference price, used to calculate the AMS, is set at the average nominal world market price for 1986-88 ($126.83 per tonne) for the USA, and for the EC at 93.0254 ECU per tonne (as in chapter 5). The supported internal price is the intervention price in the EC, but in the USA it is the market price. This is because deficiency payments are excluded from the calculation, making the target price a meaningless measure of the internal price; this results in an AMS of zero in the base period (recall that budgetary expenditure for items other than the deficiency payments and set-aside payments is assumed to be constant therefore excluded for the AMS comparisons), and as an AMS of zero represents less than 5% of average production, reductions in internal support are not required (see section 3.10)[1].

Expenditure on export subsidies in the USA is taken to be the total expenditure on the Export Enhancement Program (EEP) that can be attributed to wheat (i.e. 20%, see section 5.3.1). The quantity of wheat exported using export subsidies is approximated by the change in wheat CCC stocks because of EEP operations (equation 5-24). Note that the EC will be using the 1991/92 starting date for reductions in subsidised wheat exports, but the average 1986-90 level, as calculated by the model, is presented here because the required reduction is from this level.

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1 Strictly speaking the *de minimis* rule applies to the *total* AMS as a percentage of *total* agricultrual production but as only wheat is dealt with here it is assumed to apply to the wheat market.

Table 6.2

The UR Commitment: AMS and Export Subsidies

(Calibrated Values)

	USA		EC	
	From	To	From	To
AMS	0.0	n.a.	7274.00	5819.20
Export Subsidy				
Total Expenditure	102.36	65.51	1050.37	672.24
Quantity ('000 tonnes)	924.76	731.35	20205.23	15962.13

Notes
n.a. not applicable
Millions of national currency unless otherwise stated.

Recall that import tariffs cannot be specifically measured by the model because it calculates net excess supply and demand. However, the gap between internal and external prices can be measured, and this will be used (as in chapter 5) to give an indication of the likely magnitude of import tariffs. Note that for the EC the tariff equivalent for 1986-88, calculated in December 1993, for common wheat was 149 ECU per tonne[2]. For the USA it is assumed that the domestic market price is equal to the world market price and therefore there are no import tariffs.

If we examine table 6.3, we can see at the EC has no trouble meeting the AMS requirement by 2000, indeed the actual reduction in the AMS is 66%. On the export subsidisation commitment, expenditure on export restitutions is not reduced by the required amount (34%), and the quantity of wheat exported with a subsidy is increased by almost 40% (39.69%) on average 1986-88 values. The import tariff implied by the gap between internal and external prices, adjusted for Community Preference, is 21.27 ECU by 2000, well below the 1986-88 tariff equivalent value. Under the assumptions of the base scenario, therefore, the EC would not be able to meet the commitment to reduce the quantity of supported exports by 21% over the reform period. It is therefore likely that the EC will need to make changes to its agricultural policy if it is to meet the requirement to reduce the quantity of subsidised exports; the possible policy changes are examined in section 6.3.

2 Agra Europe (1993), p8.

In the USA, expenditure on, and the quantity exported under, the wheat EEP are above the amounts required by the UR agreement. Note that the policy assumptions of the base scenario require the total amount spent on the EEP to be constant after 1995; with the world price levels forecast by the model it is unlikely that EEP expenditure would be as high as it is here, and the conclusions about US export subsidisation would be altered.

Table 6.3

AMS and Export Subsidies: Base Scenario

	1995	2000
EC		
AMS (a)	2235.44	2467.88
	(2227.20-2243.68)	(2459.75-2476.01)
Export Subsidies		
Total Expenditure (a)	483.53	693.21
	(474.55-492.51)	(687.41-699.02)
Quantity (b)	20242.46	28223.68
	(20009.55-20475.38)	(27993.76-28453.60)
USA		
Export Subsidies		
Total Expenditure (a)	160	160
Quantity (b)	881.51	782.66
	(862.71-900.31)	(765.50-799.82)

Notes

95% confidence interval in parentheses; calculated using the Central Limit Theorem and the sample standard deviation.

(a) millions of national currency

(b) '000 tonnes

6.2.2 Effects of Alterations to Excess Demand

The results presented above are calculated using historically high nominal world market price levels, which were postulated to have been caused by the high levels of excess demand following from the assumptions made about importing areas. In this section, the effects of changes to the assumptions about import demand are examined. Three alternative scenarios are presented, each of which have been computed with the following changes to the base scenario assumptions:

(A) imports by China remain constant at 1990 levels;

(B) imports by China remain constant at 1990 levels and excess demand in the CIS falls to zero by 2000;

(C) imports by China remain constant at 1990 levels and the CIS becomes a net exporter, having an excess supply of 8.2 million tonnes.

As has already been stated, the assertion that Chinese imports increase to 20 million tonnes by 2000 is based on the assumption that China has the capacity to finance this quantity of imports. China's ability to gain foreign currency depends to a large extent on the amount of textiles it can export; given that the UR provisions for textiles do not come into effect until 2000, thereby leaving the Multi-Fibre Arrangement intact, the Chinese may not be able to finance such large imports. As it is impractical to present the entire range of possibilities for Chinese imports, scenario (A) was chosen to represent a situation where increases in domestic production meet consumption needs above those satisfied by 1990 levels of imports, which could be financed.

The economic reform process in the former USSR makes forecasting any economic variable for that area very difficult. As was stated in chapter 5, the method used to forecast CIS imports is based on a normative view of past production patterns rather than any formal econometric analysis of the expected patterns. Scenarios (B) and (C) are meant to represent degrees of optimism about agrarian reform in the CIS; (B) is a situation where the CIS reaches self-sufficiency levels by 2000, but does not have an exportable surplus (some commentators suggest that there is some evidence of the CIS moving out of the world system, with subsistence farming filling the shortfall in food supply[3]); and (C) represents the results of a simulation of a complete reform of CIS agriculture (using the SWOPSIM model) by Liefert, Koopman & Cook (1993), where they estimate that the former USSR would then be able to export 8.219 million tonnes of wheat.

Simulations of scenarios A, B and C required a small change to the overall model as they

3 For example B.P.Pockney, Agricultual Economics Society Annual Conference, St. Luke's College, Exeter, 1994.

introduced the possibility of complex roots as a solution to the quadratic equation 5-36, with β sometimes being small (recall that the standard method of solving quadratic equations is used). If imaginary roots were found in any one iteration, the iteration was ignored in a similar way to the solutions outside of the limits set for P^w (section 5.7).

Table 6.4

Mean Nominal World Market Prices: Scenarios A, B & C

(US$ per tonne)

	A			B			C		
		Confidence Interval			Confidence Interval			Confidence Interval	
Year	Mean	From	To	Mean	From	To	Mean	From	To
1991	142.41	137.146	147.674	90.19	84.933	95.447	85.03	79.698	90.362
1992	156.78	154.098	159.462	114.47	109.974	118.966	107.02	102.132	111.908
1993	188.43	185.115	191.745	142.46	139.593	145.327	133.68	130.842	136.518
1994	218.90	215.491	222.309	191.88	188.515	195.245	178.83	175.585	182.075
1995	184.32	180.633	188.007	188.94	185.489	192.391	180.12	176.645	183.595
1996	151.92	146.798	157.042	145.52	142.043	148.997	142.86	139.417	146.303
1997	161.54	157.949	165.131	118.87	114.858	122.882	110.63	106.328	114.932
1998	195.16	191.441	198.879	147.28	143.986	150.574	125.13	121.636	128.624
1999	213.98	210.179	217.781	179.65	175.546	183.754	153.32	149.530	157.110
2000	204.53	200.468	208.592	191.62	187.551	195.689	176.93	172.863	180.997

Notes

95% confidence interval in parentheses.

Mean Values of P^w: Base Scenario

1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
146.58	162.93	197.08	221.41	185.53	159.60	175.00	201.39	215.18	208.70

Table 6.4 shows the mean levels of the market clearing, nominal world market prices generated by the 3 scenarios. From the table, we can see that the expected result occurred, namely a fall in the mean values of P^w when compared to the base scenario (included at the foot of the table for reference). The effect of restraining Chinese imports (scenario (A)) is not particularly marked given that each run of the model can be seen as a sample from the population of all possible scenarios; a sample mean of $204.53 is not significantly different

from a mean of $208.70 (99% level) if the latter is thought to be the true mean. However, the combined effect of restraining Chinese imports and agrarian reform in the CIS is significant.

Table 6.5 gives the effects of the change in the import demand assumptions on AMS and export subsidy calculations for the EC and USA.

The conclusions drawn from table 6.3 about AMS reductions in the EC are shown to be robust; in each of the scenarios presented above the AMS target is surpassed. Note that the AMS falls as the average level of world market prices decreases. This is the result of two effects: (i) the price gap in the AMS is calculated as the difference between the intervention price and the fixed external reference price, and hence is unaffected by changes in the market price; (ii) the area planted to wheat in the EC is responsive to changes in the world market price when it is above the intervention price (adjusted as necessary), therefore, with lower world market price levels, production is lower leading to a lower total AMS. This latter point is also an explanation of the smaller exportable surplus in scenario C when compared to scenario B, and scenario B when compared to A. The smaller excess supply in scenario C means that the EC is able to meet both the expenditure and the quantity reductions required by the UR agreement (note that the average import tariff implied in scenario C is 16.39 ECU per tonne by 2000, therefore it is likely that the import protection requirement will also be met).

The USA is unable to meet the export subsidisation requirements in any of the scenarios but this is mainly due to the way in which expenditure on, and the quantity of, subsidised exports is calculated for the USA; the former is constant because of the assumption that total EEP expenditure is constant and the latter rises as P^w falls as it is determined by equation 5-24, in which P^w is the denominator. As has already been stated, with the world price levels forecast by the model in each of the scenarios presented, it is unlikely that EEP expenditure would be as high as it has been assumed so far; section 6.3 will examine the effects of changes in US and EC policies on the compatibility of the UR commitments.

Table 6.5

AMS and Export Subsidies:Scenarios A, B & C

	A	B	C
1995			
EC			
AMS (a)	2199.47	2008.09	1963.67
	(2191.36-2207.58)	(2000.69-2015.49)	(1956.39-1970.95)
Export Subsidies			
Total Expenditure (a)	457.68	328.53	298.31
	(449.17-466.18)	(322.49-334.58)	(291.68-304.95)
Quantity (b)	19154.16	13428.44	12604.38
	(18925.00-19383.33)	(13195.66-13661.32)	(12359.16-12849.60)
USA			
Export Subsidies			
Total Expenditure (a)	160	160	160
Quantity (b)	887.12	862.32	906.33
	(868.29-905.95)	(845.65-878.99)	(887.87-924.79)
2000			
EC			
AMS (a)	2416.97	2131.10	2012.73
	(2409.00-2424.94)	(2124.02-2138.18)	(2005.95-2019.51)
Export Subsidies			
Total Expenditure (a)	632.13	421.32	325.68
	(623.86-640.39)	(414.12-428.53)	(314.80-336.57)
Quantity (b)	25721.41	17371.88	14095.06
	(25496.24-25946.58)	(17129.94-17616.83)	(13860.44-14329.68)
USA			
Export Subsidies			
Total Expenditure (a)	160	160	160
Quantity (b)	798.86	854.61	928.52
	(781.23-816.49)	(832.03-874.19)	(906.13-950.91)

Notes

95% confidence interval in parentheses.

(a) millions of national currency

(b) '000 tonnes

The rather counter-intuitive conclusion we must draw from the analysis of the base scenario and of scenarios A, B, and C, therefore, is that the EC is only able to meet the UR requirements in each of the 3 areas simultaneously, with a continuation of the policies agreed in the 1992 Cuhna reforms, if world prices increase slowly, such that EC production is restrained. This may be an anomaly of the model in which world prices above the intervention price, but below the threshold price, are discounted as the internal market price (which is set at the intervention price) for production decisions; the internal price is thus around 10% lower than the world price, by definition. On the other hand, if the calculated world price is above the threshold price, production decisions are made on the basis of this price, which is by definition at least 10% higher than the intervention price. If world prices are lower (or rise at a slower rate) than in the base scenario, EC production is more likely to be determined by the intervention price and hence be relatively lower. However, the results suggest that if the CIS does not become a net exporter, the EC will have to adjust its policies in order to meet the UR commitments by 2000. For the USA, total EEP expenditure must be reduced if it is to meet all of the UR requirements by 2000, while keeping the other policies of the 1990 farm bill intact.

6.3 Policy Options for the USA and EC

The analysis above suggests that both the USA and EC will need to adjust their polices in the 1995/96 review period if they are to meet the UR commitments by 2000. However, a closer examination of tables 6.3 and 6.5 reveals that in 1995 the EC is able to meet the final UR requirements in scenarios A, B and C, and only fails to meet the export quantity reduction in the base scenario. Therefore there is unlikely to be any pressure on the EC to change agricultural policies in 1995 in order to meet the UR provisions. In the USA, however, expenditure on export subsidisation is above what would be expected if it were to meet the UR commitments by 2000[4], while the quantity of subsidised exports is around the required target in the base scenario and scenarios A & B, but is above the target in scenario C. Note that reducing expenditure on the EEP should have the effect of pushing up nominal world market prices (although the effect is likely to be small) and may affect the EC's ability to make the required reductions by 1995, thus requiring the EC to make policy changes.

It is interesting at this stage to examine the budgetary effects of agricultural support policies

4 In order to meet a 36% reduction by 2000, a compounded fall of 7.17% per annum would be required in expenditure on export subsidies, giving a 1995 value of 95.03. A 21% reduction in the quantity of subsidised exprots would require a 1995 value of 889.29.

in the USA and EC as increasing costs of agricultural support policies are often cited as reasons for policy changes[5]. Note that the figures for budgetary expenditure presented here are only meant to give an indication of the probable magnitude of the EC's and USA's budgets given the assumptions of the model, and are not a representation of the total expenditure expected in these years as they exclude all budgetary contributions not related to income support, for example the Guidance section of the EC budget, and research & development funds in the USA. Budgetary expenditure is calculated, in this case, as follows;

USA: Total deficiency payments + EEP expenditure on Wheat + Storage costs;

EC: Total compensatory payments + Total set-aside expenditure + Export Refunds + Storage costs;

where the storage costs are assumed to be 20 ECU per tonne[6] (converted to US dollars using the commercial exchange rate).

Returning, as a starting point for this policy analysis, to the base scenario, table 6.6 shows that there has been a dramatic fall in the budgetary cost of farm policies in the USA, which has occurred as government stock levels, and hence storage costs, have fallen and because of the increase in world prices (recall from section 5.7 that deficiency payments are set to zero if the market price is above the target price). In the EC, on the other hand, budgetary costs have increased over the forecast period. As intervention stocks are decreased, the reason for the increase is the provisions of the Cuhna reforms; if the compensatory payments remain at their 1995/6 levels until 2000, the Community budget would rise by over 300% compared to average 1986-88 levels. Hence, even if the EC can meet the UR requirements by 1995, the budgetary costs of the current policy are likely to force a change in policy.

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5 There is an area of work on the political economy of agricultural policies which concludes that 'policy inertia' exists such that policy changes only occur in times of crisis, usually of the budgetary sort (see for example Swinnen J. & van der Zee F.A. (1992) or Josling T. (1993) 'Agricultural PolicyReform in the USA and EC' in Rayner A.J. & Colman D. (1993) *Current Issues in Agricultural Economics* pp32-61). If this is the case then the need to meet the UR agreement may not be the only force behind any possible policy changes by the EC and USA.

6 Ackrill (1992) found that EC storage costs for cereals were, on average, 20 ECU per tonne.

Table 6.6

Budgetary Costs of Supporting Agriculture: Base Scenario

(national currency, millions)

	USA	EC
1986-88	4853.40	1021.97
1995	3141.81	3962.88
	(3044.23-3239.39)	(3948.60-3977.16)
2000	3232.93	4184.70
	(3134.82-3331.04)	(4172.26-4197.14)

Notes

95% confidence interval in parentheses; calculated using the Central Limit Theorem and the sample standard deviation.

6.3.1 Policy Changes in the Base Scenario

The initial analysis of possible policy changes in the USA and EC is carried out using the same assumptions as in the base scenario, except for those relating to the continuation of US and EC policies. In other words, imports by China are assumed to rise linearly from 12.5 million tonnes in 1990 to 20 million tonnes in 2000; imports by the CIS are assumed to follow the patterns given by the formulation in section 5.4; exchange rates are fixed at average 1993 levels; inflation is assumed to be 3% per annum; and budgetary expenditure for items other than storage costs, export subsidies, compensatory payments and set-aside payments are assumed to be constant. The policy options examined give rise to the following scenarios;

(D) total EEP expenditure is gradually reduced to a level which gives the required reduction in expenditure on subsidised wheat exports between 1993[7] and 2000; all other policies are assumed to be the same as in the base scenario;

(E) as for (D) except that for the EC the intervention price is reduced gradually to

7 The last year for which data are available.

reach 90 ECU per tonne in 2000, the effective set-aside percentage is raised from 9% in 1993/4 to 18% in 2000, and compensatory payments are reduced by 5 ECU per annum as part of a phasing out procedure (per hectare set-aside payments are assumed to be constant);

(F) for the EC the policies remain the same as in (E), but total EEP expenditure is reduced to zero by 2000;

(G) as for (E) except the compensatory payments policy ceases in the 1996/97 crop year (i.e. payments are zero for 1996 to 2000).

The reasoning behind scenario (D) is clear; however, the others need some explanation. The assumed policy changes in scenario (E) are a reflection of the Commission's desire to introduce a more market-oriented agricultural support system, but are also influenced by the recognised power of the various farming pressure groups throughout the Community[8] such that compensatory payments are likely to be phased out, rather than ended abruptly, even though the intervention price is reduced to a level below the effective EC export price. Scenarios (F) and (G) are introduced to give an idea of the results of extreme policy changes. That said, in the USA, the authorities argue that the EEP was only introduced to counter the price-dampening effects of the EC's export restitutions, if the world price is rising the EEP is unnecessary and EEP expenditures should tend to zero. In the EC it was argued that the compensatory payments would be a temporary measure to allow a smoother adjustment to the CAP reform; if that is the case, they could (should) be ended at the 1995 review.

The mean world market price levels, AMS and export subsidy values, calculated in each of the scenarios above, are given in table 6.7, along with the calculated budgetary costs.

8 See, for example, Winters L.Alan (1993) 'The Political Economy of Industrial Countries' Agricultural Policies' in Rayner A.J. & Colman D (eds.) *'Current Issues in Agricultural Economics'* pp22-31.

Table 6.7

The Effects of Possible Policy Changes in the USA and EC

	D	E	F	G
1995				
World Price	159.61	186.25	186.26	186.26
	(155.83-163.39)	(182.53-189.98)	(182.54-189.99)	(182.54-189.99)
EC				
AMS	2235.44	2229.81	2229.81	2229.81
	(2227.20-2243.68)	(2221.59-2238.03)	(2221.59-2238.03)	(2221.59-2238.03)
Export Subs.				
Expenditure	483.53	481.48	481.48	481.48
	(474.55-492.51)	(472.41-490.56)	(472.41-490.56)	(472.41-490.56)
Quantity	20242.46	20050.30	20050.30	20050.30
	(20009.55-20475.37)	(19817.97-20282.63)	(19817.97-20282.63)	(19817.97-20282.63)
Budgetary Costs	3962.88	3954.0	3954.03	3954.03
	(3948.60-3977.16)	(3940.49-3967.57)	(3940.49-3967.57)	(3940.49-3967.57)
USA				
Export Subs.				
Expenditure	123.97	123.97	123.97	123.97
Quantity	683.00	680.26	627.12	680.26
	(668.44-697.57)	(665.81-694.71)	(613.80-640.44)	(665.81-694.71)
Budgetary Costs	3141.76	3122.90	3122.89	3122.90
	(3044.18-3239.34)	(3025.45-3220.35)	(3025.44-3220.34)	(3025.45-3220.35)
2000				
World Price	208.70	212.75	212.75	212.75
	(204.62-212.78)	(208.89-216.77)	(208.89-216.77)	(208.89-216.77)
EC				
AMS	2467.88	593.3	593.38	593.38
	(2460.04-2475.72)	(591.48-595.28)	(591.48-595.28)	(591.48-595.28)
Export Subs.				
Expenditure	693.21	606.79	606.79	606.79
	(687.41-699.02)	(601.18-612.40)	(601.18-612.40)	(601.18-612.40)
Quantity	28223.79	24440.92	24440.92	24440.92
	(27993.87-28453.71)	(24223.10-24658.74)	(24223.10-24658.74)	(24223.10-24658.74)
Budgetary Costs	4184.71	2234.88	2234.8	797.36
	(4172.27-4197.15)	(2228.26-2241.50)	(2228.26-2241.50)	(790.74-803.98)

<u>USA</u>				
Export Subs.				
Expenditure	65.51	65.51	0.0	65.51
Quantity	320.4	313.83	0.0	313.83
	(313.43-327.47)	(307.23-320.43)	n.a	(307.23-320.43)
Budgetary Costs	3232.82	3128.31	3128.24	3128.31
	(3134.72-3330.92)	(3033.24-3223.38)	(3033.17-3223.31)	(3033.24-3223.38)

<u>Notes</u>
95% confidence intervals in parentheses.
Millions of national currency except 'Quantity of Export Subs.', '000 tonnes.
n.a. not applicable

The first thing to notice from table 6.7 is that the impact of the wheat EEP (20% of the total EEP expenditure) on the world market price is minimal; a reduction in the EEP to the levels required by the UR agreement (scenario D) has no effect on the mean level of P^w in 1995 or 2000 when compared to base levels. Indeed the only effects of the change in the EEP policy are to allow the USA to meet all of the UR criteria by 2000, and reduce the budget slightly (by 50 thousand dollars compared to the base scenario in 1995, and by 110 thousand dollars in 2000); therefore, while this policy change is sufficient for the USA to meet its objectives, changes to EC policies are still needed to ease the budgetary problem in 1995 (and meet the UR objectives by 2000).

The effect of the EC policy change in scenario E is to increase the mean level of the world price, relative to the base scenario, in both 1995 and 2000. This allows the EC to meet all but one of the UR commitments - that of reducing the quantity of subsidised exports. Also, although the budgetary costs of the policy are almost half of those in the base scenario by 2000, they are still at historically high levels. If we compare scenario E with G (where the only difference is that the compensatory payments are zero for 1996 to 2000 instead of decreasing gradually to 20 ECU) we can see that this policy has no effect on the overall level of excess supply, and hence prices, but significantly reduces the budgetary costs. This result stems from the fact that the payments are set for cereals as a whole, therefore for an individual cereal, such as wheat, the returns to that crop relative to another cereal are not altered by the presence of the payment. The cause of the increase in mean levels of world price in scenario E (relative to the base) is therefore the fall in the intervention price to levels which are below the nominal world price level (adjusted by the exchange rate and Community Preference), and the increase in the effective set-aside rate to 18% of the fixed base area (the average 1986-91 of the Cuhna reforms).

A note of caution must be introduced about the conclusions drawn about the EC's inability to meet all of the UR commitments in scenarios E and G; these may be affected by the dynamic structure of the model in which adjusted world prices above the intervention price are fully reflected in the following year's production, consumption and stocking decisions, but are not fed through to the current year's excess supply. This is the consequence of an assumption made to ease the programming of the model, namely that the domestic price in the EC is the intervention price, until it is proven otherwise. If the world price (in ECU, and after the appropriate adjustments) is above the intervention price, the adjusted world price becomes part of the expected price calculation for the following year. Incorporating the world price into the current year would require an iteration process to be introduced into the model (as EC excess supply helps to determine world price, which determines EC excess supply, and so on) in order to find the true equilibrium price. Although it is acknowledged that this would be a desirable feature of the model, and that it is possible to programme the process (with a considerable change to the present dynamic structure of the model), it is an area for future work as a way has not yet been found to ensure convergence in every year and iteration. The effect of not including this iteration process is that the results are probably over-estimating the quantity of subsidised exports in the EC, but not such that the EC would otherwise meet the UR criteria[9]. Moreover, given that the intervention price is known by EC farmers with more certainty than the market price at the time of planting, it is likely that the intervention price will have a strong influence on expectations of returns of wheat, at least for the medium term. Thus the model is not expected to be significantly biased by the solution process assumed in the model.

An examination of the results in scenario F again shows that the EEP has little effect on the equilibrium position in the wheat market, with the main effect being on the size of the USA's budget.

The conclusion to be drawn from the analysis so far is that the EC will have to make very large cuts in the support it gives to farmers if it is to fulfil the UR commitment by 2000, given the assumptions made about excess demand, exchange rates and inflation. Also within the EC there are likely to be budgetary pressures to reduce expenditure on compensatory payments, although this will have little effect on the EC's ability to meet the

9 The iteration process is expected to be similar to a cobweb process which, if it converges, may be likely to give excess supply figures which are not significantly different to the present values, given the magnitude of the coefficients of the EC section of the model. More importantly, the excess supply calculations for 2000 do incorporate the effects of the historically high prices in 1998 and 1999.

UR criteria. and would be likely to meet with strong producer resistance.

6.3.2 Policy Changes and the Excess Demand Assumptions

In section 6.2.2 we examined the effects of a change in the assumptions about excess demand, and found that if Chinese imports are constant and the CIS exports 8.2 million tonnes, the EC can meet all of the UR criteria by 2000 without a change in agricultural policy. However, the budgetary costs of maintaining all of the provisions of the Cuhna reforms are still high (a mean of 3173.65 million ECU in 2000). What follows is an examination of effects of the policy changes in scenarios D to G, given the assumptions about excess demand in scenarios A to C, on the EC's ability to meet its UR commitments by 2000 and on the budgetary costs of support in the EC.

As has already been stated, if excess demand conditions are the same as in scenario C the EC is able to meet all of the UR criteria by 2000 with the Cuhna reforms continuing to 2000, but there would be budgetary pressures to change agricultural policies. If the policy change were the same as in scenario E[10] (the intervention price is reduced to 90 ECU per tonne in 2000, the effective set-aside percentage is raised to 18% in 2000 and compensatory payments are reduced by 5 ECU per annum) the EC budget would be 3314.91 million ECU in 1995 (95 % confidence interval 3304.77 - 3325.05) and 1608.21 in 2000 (1601.84 - 1614.58); this latter figure still represents an increase in budgetary expenditure of 57% compared to the 1986-88 base period. If compensatory payments are now reduced to zero in 1996 (as in scenario G) the picture is much improved with a budget of 431.9 million ECU in 2000 (425.60-438.34)

In scenarios A and B, the EC was unable to make the required reductions in the quantity of subsidised exports but met the other criteria; the policy changes detailed in scenarios E and F make a difference to these conclusions. Table 6.8 gives the quantities of subsidised exports and the budgetary costs resulting from a combination of scenarios A and B with E and F.

Table 6.8 shows a repeated pattern of the impact of a change in the compensatory payments from a gradual reduction to 20 ECU to a sudden fall to zero; the change in budgetary expenditure in scenarios I and K when compared to H and J respectively is quite marked, but no other changes occur. The impact of fixing Chinese imports at 1990 levels (H & I) is to reduce the quantity of, and expenditure on, subsidised exports, and to reduce the EC

10 Recall that simply reducing the EEP has no effect on the position of the EC.

budget relative to scenarios E & G. However, this is not sufficient to allow the EC to meet the UR commitments by 2000.

Table 6.8

The Effects of Policy Changes on the EC: Scenarios H to K(a)

	H	I	J	K
1995				
Export Subsidies				
Total Expenditure	452.85	452.85	323.28	323.28
	(444.22-461.47)	(444.22-461.47)	(317.17-329.39)	(317.17-329.39)
Quantity	18962.00	18962.00	13216.26	13216.26
	(18470.66-18900.62)	(18470.66-18900.62)	(12981.75-13450.77)	(12981.75-13450.77)
Budgetary Cost	3862.77	3862.77	3411.54	3411.54
	(3849.22-3876.32)	(3849.22-3876.32)	(3403.68-3419.40)	(3403.68-3419.40)
2000				
Export Subsidies				
Total Expenditure	546.02	546.02	329.08	329.08
	(540.57-551.46)	(540.57-551.46)	(323.25-334.91)	(323.25-334.91)
Quantity	21992.97	21992.97	13225.01	13225.01
	(21773.68-22212.26)	(21773.68-22212.26)	(13020.03-13489.99)	(13020.03-13489.99)
Budgetary Cost	2124.16	718.28	1735.26	499.54
	(2117.73-2130.59)	(712.00-724.56)	(1729.43-1741.09)	(493.84-505.24)

Notes
95% confidence interval in parentheses.
(a) Scenario H is a combination of A and E, I a combination of A and F, J a combination of B and E, and K a combination of B and F.

On the other hand, the policy changes are sufficient when coupled with constant Chinese import demand and CIS self-sufficiency; in scenarios J and K the EC is now able to fulfil all of its UR commitment (recall that the only difficulty in scenario B was with the quantity of subsidised exports, but this target is now surpassed). In addition, if the compensatory payments are reduced to zero (scenario K), budgetary contributions are below average 1986-88 levels. It would seem, therefore, that given the assumptions made about exchange rates and inflation, CIS self-sufficiency would ensure that the EC is able to fulfil all the its UR commitments with relatively modest changes to the present policies in 1995.

6.3.3 Exchange Rate Considerations

The conclusion from the previous section would appear to suggest that the EC will find it easier to comply with the UR agreement if conditions over which it has no control are favourable. However, it must be remembered that these results are based on views of the inflation rate and the US$/ECU exchange rate which may be too optimistic or pessimistic. The question then remains, is there an exchange rate which will allow the EC to meet the UR criteria without the need to change policies or rely on the effects of excess demand movements?. The answer to this is yes. An exchange rate of 1 ECU to 0.963 US$ would make the difference between the world price level calculated by this model and the export price of EC wheat exactly equal to the $24 adjustment made for the quality discrepancy (see section 5.7). If this is the case, the unit export refund is set to zero and all wheat exported from the EC is then 'free market' wheat, i.e. the quantity of subsidised exports from the EC is zero. Any exchange rate below this figure would also give the same result. If the exchange rate is 0.963, the EC can meet the UR objectives even in the base scenario with no adjustment to policies agreed in 1992 at the 1995 review (although the budgetary problems remain). Note that the USA would still have to reduce EEP expenditure on wheat if it is to comply with the UR agreement.

Note that an exchange rate of 0.963 is not an extreme rate; indeed in the mid-1980s the exchange rate fell to a low of $0.675 per ECU in March 1985[11], and did not surpass 0.963 until mid-1986. However, the latest available figure at the time of writing was for May 1994, a value of 1.164 (an increase after a period of relatively low exchange rates in early 1994), which is not too different to the 1.174 assumed in this model; therefore an analysis of the base scenario and scenarios A to K with this new exchange rate was not performed.

6.4 Conclusions

This chapter has aimed to give some insight into the two remaining questions posed in chapter 5; namely (i) whether the commitments made in the UR in each of the three areas specified by the agricultural agreement can be achieved simultaneously, and (ii) what policy options do the USA and EC have in 1995/6 when the present policies are due to be reviewed, if they wish to remain within the terms of the agreement?

11 Eurostat (1986) 'Data for Short term Economic Analyses'. no.1.

On the first question, the analysis showed that the Cuhna reforms have gone a long way towards ensuring that the EC will be able to meet all of the UR criteria simultaneously, but both the EC and the USA would have difficulty in meeting the commitment to reduce the quantity of subsidised exports by 2000 unless they changed their policies in 1995/6. This compatibility problem was solved to some extent for the EC when changes were made to the model assumptions governing excess demand, and would be solved if the $/ECU exchange rate were to fall to 0.963.

However, the analysis did highlight that the policy choices of the USA and EC in 1995/6 are likely to be constrained by the conditions of the UR. In particular, the EC will not be able to reduce the percentage of land required to be set-aside in the Cuhna reforms, neither is it likely to be able to increase the intervention price; however, this analysis would suggest that the level of compensatory payments is not constrained by the UR provisions (although it is likely to be constrained by budgetary considerations). The USA is likely to be less constrained than the EC but must reduce the amount of wheat exported with the aid of the EEP if it is to meet the UR agreement; given the downward trend already apparent in total EEP expenditure, this unlikely to be a problem for the US government. Note that the provisions of the 1990 FACT were developed within a political framework which was concerned with over-production and the costs of agricultural support; hence it contained provisions to maintain the loan rate below market prices, increase the percentage of land required to be set-aside under the Acreage Reduction Program, and a fixed Target Price[12]. Given this policy position, it was not unexpected that the results of this simulation did not require the USA to change any of the 1990 provisions in 1995 (excepting of course total EEP expenditure).

12 See section 5.7 for details.

Chapter 7

Conclusions

The main aim of this thesis was to examine the GATT Uruguay Round to provide an analysis of the progress of the agricultural negotiations from the Punta del Este Declaration in September 1986 to the agreed programme for reductions in agricultural protectionism in December 1993. The opening chapters gave an introduction to the domestic agricultural support policies of the USA and Western Europe, concentrating on those for the cereals sector, from the 1930s to the present day; a brief history of the GATT, the treatment of agricultural trade by the contracting parties and the attempts to reform agricultural trade in the GATT rounds prior to the UR; and an overview of the agricultural negotiations in the UR. The empirical analysis of the study has concentrated on a detailed examination of two significant stages in the UR; the first is the December 1990 meeting which was to have marked the end of the UR but in the event led to an impasse on the question of agricultural trade reform resulting in a near collapse of the whole Round. The positions of the three major players (the EC, the USA and the Cairns Group (CG)) at this time were therefore examined in chapters 4 and 5. The second significant stage examined in this study is the final agreement; this is analysed in chapter 6 with respect to the compatibility of the agreed reductions in internal support, import protection and export subsidisation (in the sense that the reductions in each of the three areas can be achieved simultaneously), and the policy options open to the USA and EC if they are to continue to provide income support for farmers. A summary of the results of these analyses is presented below.

7.1 Summary of Results

7.1.1 Analysis of the Autumn 1990 Proposals

An analysis of the use of Aggregate Measures of Support (AMS) in chapter 4 showed that by the autumn of 1990 there had been some convergence between the major players on the definition of the AMS to be used. The AMS was based on the OECD's Producer Subsidy Equivalent (PSE), but incorporated the notion of a fixed reference price and made some allowance for supply control, although the US and the EC methods for achieving this allowance were still very different. However, an evaluation of the offers tabled for the EC cereals sector, on a comparable basis, indicated that there was still a considerable gap between the EC and the US and CG proposals. Under the EC proposal, the costs of supporting the EC cereal sector, as measured by the 'Adjusted PSE' (APSE), would have been around 4.5 billion ECU higher in 1995 than under either the US or CG proposals (see table 4.3); EC cereal farmers could thus have been receiving a 1995 'producer price' some 20 per cent higher if the EC's 1990 Uruguay Round proposals, rather than those of the USA or CG, had been implemented. In addition, a comparison of the APSE with the PSEs calculated by the OECD indicated that there would have been a very considerable reduction in the proportion of farmer's receipts made up of governmental support if any of the reform processes had been initiated (since internal farm support in 1995 would have been considerably lower than 1990 levels in percentage PSE terms). However, the EC's reform proposal would have resulted in a 1995 value some 15 percentage points above what would have occurred if either the USA's or CG's had been implemented. Given these divergent positions, it is perhaps understandable that the USA and CG left the negotiating table in December 1990.

The differences in the negotiating positions are emphasised further in chapter 5 with the analysis of the EC's contention that reductions in the AMS would lead to commensurate reductions in border protection and export subsidisation. The analysis is carried out using a partial equilibrium, dynamic, stochastic simulation model, covering 7 main trading areas, for wheat. The results suggest the 1990 proposals to reduce the SMU by 30% could not have been met using the measures introduced in the Cuhna reforms. In addition, the reduction in the SMU which would have taken place would have led to a commensurate reduction in import tariffs but not in export subsidisation. If the analysis is performed using the EC policies in place at the time of the offer (i.e. the stabiliser mechanism), the 30% SMU reduction can be met; in addition this would have led to a commensurate fall in import protection and export subsidisation. The EC's argument that separate commitments in each of the three areas would not be needed to achieve a reduction in internal support, border protection and export subsidisation is thus proven to have been true at the time of the proposals. However, it would not have resulted in a reduction in trade-distorting agricultural support of the magnitude proposed by the USA and CG. Therefore, even if it had been accepted that the EC's contention was correct, the size of the reduction would still have proved to be a major sticking point at the abortive 'final' meeting in December 1990.

7.1.2 The UR Agreement

The final agreement was analysed in chapter 6 with the aim of providing answers to two questions: (i) can the commitments made in the UR in each of the three areas specified by the agricultural agreement be achieved simultaneously?, and (ii) what policy options do the USA and EC have in 1995/6 when the present policies are due to be reviewed, if they wish to remain within the terms of the agreement?.

On the first question, the analysis showed that the Cuhna reforms have gone a long way towards ensuring that the EC will be able to meet all of the UR criteria simultaneously, but both the EC and the USA are likely to have difficulty in meeting the commitment to reduce the quantity of subsidised exports by 2000 unless they change their policies in 1995/6. Under a set of 'base scenario' assumptions[1] which allowed for a continuation of the policies in place in 1993/94, the USA and EC would be able to meet the internal support reduction and the import tariff condition. However, on the commitment to reduce expenditure on export subsidies by 2000, the EC would over-shoot the target by 2 percentage points, and the USA by 146%; on the reduction in the quantity of subsidised exports the EC would exceed the commitment by 77% and the USA by 7%. This compatibility problem for the EC can be solved to some extent by making changes to the model assumptions governing excess demand, or by allowing the $/ECU exchange rate to fall to 0.963 in the base scenario. The changes to the assumptions about excess demand are discussed later in this chapter, but the analysis of these changes underlines the important role of the CIS in the world wheat market. The analysis of the effects of the choice of exchange rate serves to remind the reader that the results presented here are based on a view of the level of inflation which will be occur over the forecasting period, and of exchange rates which are taken to be constant at mean 1993 levels for 1993 to 2000; both of these assumptions may be too optimistic or pessimistic.

The analysis above did, however, highlight that the policy choices of the USA and EC in 1995/6 are likely to be constrained by the conditions of the UR. In particular, the EC will not be able to reduce the percentage of land required to be set aside in the Cuhna reforms, neither is it likely to be able to increase the intervention price; however, compensatory payments did not appear to be directly constrained by the UR provisions[2]. Indeed, the conclusions drawn from the analysis of policy changes were that the EC will have to make

1 See sections 5.7 and 6.2.1 for details of the base scenario assumptions.

2 Although indirectly they are constrained through the resulting production and consumption patterns and their effect on the EC's budget.

very large cuts in the support it gives to farmers if it is to fulfil the UR commitment by 2000, given the base scenario assumptions made about excess demand, exchange rates and inflation. Also, the budgetary pressures will induce the EC to reduce compensatory payments at the review in 1995. Again changes to the assumptions governing excess demand, or an $/ECU exchange rate nearer to 0.963 in the base scenario, would mitigate the need for policy changes, although the budgetary problems would persist without a reduction in the level of compensatory payments.

The USA is likely to be less constrained than the EC, but must reduce the amount of wheat exported with the aid of the EEP if it is to meet the UR agreement. Given the downward trend already apparent in total EEP expenditure, this is unlikely to be a problem for the US government. Note that the provisions of the 1990 FACT were developed within a political framework which was concerned with over-production and the costs of agricultural support; hence it contained provisions to maintain the loan rate below market prices, increase the percentage of land required to be set aside under the Acreage Reduction Program, and a fixed Target Price[3]. Given this policy position, it was not unexpected that the results of this simulation did not require the USA to change any of the policies of the 1990 FACT in 1995 (excepting of course total EEP expenditure).

7.2 Recognised Limitations and Areas for Future Research

As stated in the introduction to this study, the results and conclusions summarised above are to a large extent dependent upon the the appropriateness of the models used to generate them. Perhaps inevitably the answers to the questions posed in the thesis are in some way partial, or warrant further study. Consequently, a retrospective discussion of the limitations and potential weaknesses of the current analysis is required. In addition, some of the limitations and weaknesses of this analysis require that further research is carried out and the specific areas are identified in the discussion below.

The comparison of the APSE with the PSE for 1995 in chapter 4 is made using projections for the world price of 'cereals' based on trend dollar prices for wheat, generated by an ARIMA process, with all of the attendant problems associated with forecasts based solely upon past values of the variable in question. As stated in chapter 4, the levels of P^w thus obtained are baseline figures for comparison. They are generated from a model dominated

3 See section 5.7 for details.

by a downward trend and based on data from a period when the agricultural support policies of the industrial nations affected the world market. With the reform process initiated in December 1993 real wheat prices may fall less quickly over the reform period; a structural simulation model would have been better equipped to assess the effects of reform on the trend in world prices. Consequently, the PSEs calculated for 1995 may overestimate support levels relative to the probable level in 1995. However, as the conclusions from this analysis are dependent on a comparison of the effects of the US, CG and EC proposals, rather than on their magnitude *per se*, this is not as serious a flaw as first it seemed.

A structural simulation model is developed for the analysis in chapter 5, and the limitations of this model must now be examined. The first of these is acknowledged in chapter 6, namely the nature of the excess demand estimations. The fact that the determination of Chinese imports is exogenous to the model stems mainly from a lack of information about the structure of the Chinese wheat sector, but is also influenced by the planned nature of the economy, such that the expected responses of production, consumption and stocking decisions to price changes do not occur. The information available when the model was developed suggested that imports of 20 million tonnes by 2000 could be expected. The changes to this assumed level of imports analysed in chapter 6, however, suggest that Chinese imports do not have as significant an effect on the world market as those of the former USSR.

The nature of the import demand function for the CIS (former USSR) was largely determined by the results of econometric testing in chapter 5; the world market price was not included in the formulation because it did not prove to be statistically significant. This is perhaps unsurprising given that the USSR was for many years the recipient of large quantities of subsidised imports and import credits from the USA and the EC. The subsidies meant that the concept of an 'world' price was meaningless for the USSR. Also, the import demand function is determined using historical data under the assumption that imports by the CIS will continue to follow the same pattern as those of the former USSR. The economic reform process now underway in the CIS makes forecasting any economic variable for that area very difficult. Expectations of future import demand range from zero imports by 2000 to possible exports of 8 million tonnes; the only thing that is certain is that previous patterns are unlikely to continue.

This uncertainty is also a problem for the third importing area, the Rest of the World

Group. Import demand for this group is estimated using a trend to represent population and income growth. However, there are two potential problems with this formulation. The first stems from the use of the model to forecast 12 years ahead when a trend is being used; the limitations of trends in this case are well-known to any economist. The second, however, is potentially more serious. The ROW grouping contains the Eastern European countries, which like the CIS, are at present undergoing a transformation of their agricultural economies from predominantly centrally-planned to more market-oriented. This introduces an additional element of uncertainty about the demand for imports by the ROW group as a whole. It is widely expected that the Eastern European countries will reform their agricultural sectors at least to the extent that significantly reduced quantities of imports will be required[4]. Indeed these countries may have even become net exporters by 2000.

The questions raised about the future direction of excess demand are especially important given that the analysis of the changes to the excess demand assumptions in chapter 6 served to underline the importance of the role of the CIS in the world wheat market. An avenue for future research, therefore, would be the development of structural models for the CIS and other Eastern European countries[5] in order to provide a fuller examination of the demand side of the world wheat market. This would be a significant improvement to the overall model, which at present concentrates on the supply side (mainly because it was developed to analyse the positions of the USA and EC).

A second limitation of the analyses in chapters 5 and 6 is the treatment of the exogenous variables. These are estimated using a variety of methods, and essentially result in trend forecasts. The concerns about predicting values 12 years hence using a trend have already been stated, but an additional weakness remains in the use of trends in the livestock sector. The effects of policy changes due to the 1992 Cuhna reforms, or the UR settlement, on the livestock sector are not accounted for in this model. It is possible that the reforms will reduce livestock production (and hence livestock numbers) below what they would otherwise have been. In this case, the model is over-estimating the feed use of wheat in the USA, EC, Canada and the CG. Also, the derivation of the beef-cattle-equivalent livestock series takes no account of any possible changes in the energy requirements of individual animals as these are assumed to be constant at the average 1981-87 value for the EC and

4 See for example Agra Europe 1/7/94 no 1600 p P/2.

5 The technical problems involved in such a project, for example the availability of the relevant data, are readily acknowledged.

Canada, and the average 1985-90 value for the USA and CG[6]. On this latter point, data unavailability means that it is not possible to update the calculations; however the former weakness could be solved by making the livestock sector endogenous to the model, along the lines of other multi-commodity, partial equilibrium models (e.g. those of Tyers and Anderson or Roningen and Dixit). Given the increase in the complexity of the model which would arise, this was not done for this study, but forms another possible area for future research.

A final limitation of the simulation model used in the current study is that it calculates a net excess supply function for the EC, making a detailed examination of the border protection provisions of the UR settlement difficult, and any analysis of the minimum access commitment impossible. For the USA, the model assumes that there will be no import tariffs (as theoretically the deficiency payments policy means that consumers in the USA should be paying the dollar world market price for their wheat even though farmers may receive a higher price), and that minimum access requirements would be met. This latter assumption is also made for the EC, but an attempt is made here to calculate an import tariff (the difference between the world market and internal prices, adjusted for Community Preference). As stated in chapter 5, several methods of accounting for the simultaneous importing and exporting of a similar product can be used, for example the Armington specification, or the Almost Ideal Demand System (AIDS). These were not used in this study for two reasons. Firstly, neither of the two provide a satisfactory solution to the problem; the Armington specification places strict restrictions on demand which Alston *et al.* (1990) found to be inappropriate in the case of wheat, and while the AIDS is a less restrictive model of import demand, there is still a serious risk of specification bias. Secondly, calculation of the AMSs and export subsidies afforded to farmers in the USA and EC requires a comparison of an internal market price with a measure of the world market price in the national currency; both of the alternative formulations suggested above would result in a world price index rather than an estimation of a single price, making the comparison difficult (though not impossible). Although the results of the model suggest that the EC will have no difficulty in meeting the required import tariff reductions, recent data on the percentage of total use[7] in the EC made up of imports suggest that the 5% access commitment may be a little more difficult to achieve. Further work aimed at adjusting the model to estimate trade flows will be needed if a full analysis of the UR provisions is to be carried out. This will require an examination of the intra-industry trade

6 see appendix A5.7.

7 Imports as a percentage of total use in the EC have fallen steadily from an average 4.43% in 1986-88 to 2.61% in 1991.

literature to try to identify a suitable theoretical model, and a further review of the available data.

Although not a potential weakness or limitation of the present analysis, an interesting improvement to the model would be to give it an 'interactive' slant. An adjustment to the programme could be made to allow policy changes to occur in any one year, using the information from previous years or in response to some 'crisis'; at present, policy decisions for the whole period are made at the beginning of a run of the programme and cannot be altered during it. This 'interactive' change to the programme would be particularly useful given that the EC has the ability to change policy variables annually at the price fixing exercise. The possibility of a temporary 'tweaking' of policies towards the end of the reform period to produce the desired result by 2000 could then be examined.

The areas for potential research presented above by no means form an exhaustive list, but they are the areas where further study may be most fruitful. The possible developments to the simulation model indicated in this section would allow a deeper analysis of the effects of the UR settlement on the policy-making processes in the EC and USA. Given that the main aim of the agricultural negotiations in the UR was to curtail the trade-distorting farm policies of the industrialised countries, further study into whether this was achieved by the final agreement would seem desirable. Moreover, a more complete representation of the world wheat market would allow for analyses of any future moves to reform agricultural policies for this sector.

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1 Refered to hereafter as ABARE.

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Appendix A5.2: Data

A5.2.1: World market price

Year	Nominal (US$/tonne)	Real (US$/tonne)	Deflator (a)
1961	62.10	229.583	27.049
1962	62.83	232.940	26.973
1963	64.30	237.712	27.050
1964	66.14	245.207	26.973
1965	63.93	237.014	26.973
1966	59.52	216.276	27.520
1967	67.24	236.161	28.472
1968	62.46	218.781	28.549
1969	63.20	216.018	29.257
1970	53.27	174.909	30.456
1971	60.00	189.544	31.655
1972	60.00	183.548	32.689
1973	91.00	265.907	34.222
1974	177.00	449.489	39.378
1975	164.00	338.334	48.473
1976	152.00	284.592	53.410
1977	113.00	201.481	56.085
1978	116.00	194.378	59.678
1979	141.00	217.617	64.793
1980	174.00	235.109	74.008
1981	182.00	211.108	86.212
1982	171.00	180.299	94.842
1983	159.00	164.266	96.794
1984	154.00	157.099	98.027
1985	148.00	147.362	100.433
1986	128.00	128.000	100.000
1987	119.83	116.792	102.601
1988	132.67	124.430	106.622
1989	160.58	143.915	111.580
1990	118.30	102.721	115.167

(a) USA wholesale price index, 1986=100

A5.2.2 Canada

Year	Production: Area ('000 ha)	Yield (tonnes/ha)	Production ('000 tonnes)	Consumption: Feed Use ('000 tonnes)	Non-Feed Use ('000 tonnes)	Total ('000 tonnes)	Stocks year end ('000 tonnes)
1967	12190	1.32	16137	1789	2788	4577	18112
1968	11907	1.49	17686	1561	2730	4291	23183
1969	10104	1.84	18623	2671	2253	4924	27452
1970	5052	1.79	9022	1880	2768	4648	19980
1971	7854	1.83	14412	2210	2586	4796	15888
1972	8640	1.68	14514	2087	2676	4763	9944
1973	9430	1.75	16460	1918	2683	4601	10089
1974	8934	1.49	13304	1688	2919	4607	8038
1975	9474	1.80	17081	1061	3791	4852	8220
1976	11252	2.10	23587	1990	2848	4838	13318
1977	10114	1.96	19862	2086	2939	5025	12115
1978	10584	2.00	21145	2347	2918	5265	14909
1979	10488	1.64	17184	2445	3040	5485	10721
1980	11098	1.73	17158	2118	3062	5180	8510
1981	12427	2.00	24802	2019	3149	5168	9713
1982	12533	2.13	26737	1825	3273	5098	9973
1983	13697	1.94	26505	2295	3238	5533	9190
1984	13158	1.61	21199	1992	3257	5249	7598
1985	13729	1.77	24252	2062	3537	5599	8568
1986	14239	2.20	31378	3090	3340	6430	12728
1987	13486	1.93	25992	4510	3390	7900	7325
1988	12987	1.23	15993	2330	3530	5860	5052
1989	13627	1.80	24575	2100	3650	5750	6517

Year	Prices (Can$/tonne unless otherwise stated): Basic support	Market (nominal) Wheat (a)	Market (nominal) Barley	Constructed wheat price (b) Nominal	Constructed wheat price (b) Real	Exchange rate $US/1$can.	Constructed expected wheat prices (c) Nominal	Constructed expected wheat prices (c) Real
1967	55.11	79.46	57.41	62.22	218.55	1.0806	n/a	n/a
1968	71.64	81.08	52.82	58.22	203.93	1.0728	n/a	n/a
1969	71.64	74.27	45.93	58.91	201.36	1.0728	n/a	n/a
1970	55.11	72.40	50.52	52.68	172.97	1.0112	56.60	192.75
1971	55.11	61.60	51.44	59.87	189.13	1.0022	52.68	172.97
1972	53.64	96.02	68.89	60.27	184.36	0.9956	57.60	182.15
1973	64.66	205.21	113.90	91.38	267.03	0.9958	60.27	184.36
1974	137.78	193.00	109.00	178.57	453.48	0.9912	91.38	267.03
1975	137.78	172.00	124.00	161.35	332.88	1.0164	143.77	351.13
1976	110.22	124.00	92.00	150.61	282.00	1.0092	161.35	332.88
1977	110.22	123.00	97.00	103.25	184.10	1.0944	138.41	266.32
1978	100.23	154.00	76.00	97.81	163.89	1.1860	103.25	184.10
1979	156.16	202.00	99.00	120.71	186.30	1.1681	97.81	163.89
1980	196.58	226.00	131.00	145.64	196.79	1.1947	120.71	182.33
1981	174.50	235.00	138.00	153.47	178.02	1.1859	139.94	187.04
1982	174.50	205.00	112.00	139.09	146.66	1.2294	146.07	173.82
1983	170.00	208.00	113.00	129.86	134.16	1.2244	139.09	146.66
1984	170.00	214.00	132.00	116.54	118.89	1.3214	128.50	133.24
1985	160.00	238.00	122.00	105.90	105.45	1.3975	116.54	118.89
1986	130.00	221.00	92.00	92.72	92.72	1.3805	105.06	105.45
1987	110.00	177.00	74.00	92.19	89.85	1.2998	92.72	92.72
1988	150.00	221.00	101.00	111.24	104.33	1.1927	92.19	89.85
1989	155.00	238.00	113.00	138.69	124.30	1.1578	111.24	104.33

(a) In store Thunder Bay, 1967-70 CW Amber Durum; 1971-73, West Red Spring, 14% protein; 1973-89, 13.5% protein.
(b) World market price in US dollars (nominal or real as applicable) multiplied by the US-Canadian dollar exchange rate.
(c) Minimum of the price last year or the average price of the last 3 years
n/a not available

A5.2.3 Cairns Group

(note: The data for the CG as a whole are presented in the first table with the following tables giving data for the individual countries)

Table A5.2.3.1: Total Cairns Group

	Production			Consumption			Stocks	Market Price
	Area	Yield	Production	Feed Use	Non-Feed Use	Total	year end	maize
Year	('000 ha)	(tonnes/ha)	('000 tonnes)	('000 tonnes)	('000 tonnes)	('000 tonnes)	('000 tonnes)	(US$/tonne)
1960	11419	1.26	14339	1036	10522	11558	2141	n/a
1961	13303	1.23	16396	1513	11680	13193	1553	n/a
1962	13186	1.37	18101	920	12607	13527	1929	n/a
1963	14855	1.43	21225	974	12478	13452	3791	n/a
1964	16244	1.58	25722	2044	11981	14025	5092	n/a
1965	14579	1.23	17864	1616	13055	14671	2000	n/a
1966	16426	1.45	23743	1630	13940	15570	3836	n/a
1967	17669	1.14	20123	2351	14749	17100	4049	48.00
1968	20256	1.33	26851	2357	14191	16548	9919	51.00
1969	18771	1.30	24311	2113	15790	17903	9597	56.00
1970	14574	1.33	19339	2358	15044	17402	5374	61.00
1971	16205	1.38	22334	2571	16852	19423	2836	53.00
1972	16448	1.20	19803	2661	16569	19230	1371	85.00
1973	16988	1.55	26408	2959	17491	20450	3935	123.00
1974	17473	1.52	26642	3134	17803	20937	3378	128.00
1975	19283	1.46	28232	3525	17878	21403	4429	119.00
1976	21587	1.53	32933	4508	17744	22252	5365	113.00
1977	19379	1.25	24213	4058	19209	23267	3242	95.00
1978	19958	1.80	35953	4090	20019	24109	6821	101.00
1979	21965	1.49	32713	3408	19724	23132	6570	115.00
1980	21559	1.35	29097	4646	20784	25430	4334	126.00
1981	21777	1.51	32981	3709	19185	22894	7531	131.00
1982	23748	1.38	32857	5186	21156	26342	4757	110.00
1983	23899	1.86	44489	3780	21796	25576	10330	136.00
1984	21986	1.96	43025	4321	20773	25094	10859	136.00
1985	22056	1.71	37748	3704	21051	24755	7575	112.00
1986	22332	1.75	39003	3770	22403	26173	6150	88.00
1987	19497	1.82	35472	4299	22576	26875	5970	76.00
1988	19160	1.97	37669	4538	22896	27434	4628	107.00
1989	19944	1.94	38789	3565	24010	27575	4387	111.00
1990	21074	1.87	39304	3555	25170	28725	5399	109.00

A5.2.3.2: Production

Year	('000 tonnes) Australia	Argentina	Brazil	Chile	Columbia	Hungary	New Zealand	Uruguay
1960	7450	3960	350	n/a	145	1768	253	413
1961	6727	5725	250	1031	142	1936	213	372
1962	8353	5700	256	970	162	1959	249	452
1963	8925	8940	100	1136	90	1523	274	237
1964	10037	11260	226	1159	85	2059	250	646
1965	7067	6079	222	1116	110	2358	292	620
1966	12699	6247	299	1346	125	2350	348	329
1967	7547	7320	365	1203	80	3022	442	144
1968	14804	5740	694	1220	105	3361	457	470
1969	10546	7020	1146	1214	72	3579	287	447
1970	7890	4920	1735	1307	55	2718	326	388
1971	8606	5680	2034	1368	45	3915	384	302
1972	6590	6900	694	900	68	4089	376	186
1973	11987	6560	2031	747	73	4498	215	297
1974	11357	5970	2858	734	49	4968	180	526
1975	11982	8570	1788	1003	40	4005	388	456
1976	11800	11000	3216	866	49	5143	354	505
1977	9370	5700	2066	1219	41	5315	329	173
1978	18090	8100	2691	893	37	5673	295	174
1979	16188	8100	2879	995	42	3703	306	500
1980	10856	7780	2676	966	46	6077	326	370
1981	16360	8300	2217	686	62	4614	292	450
1982	8876	15000	1849	586	74	5751	301	420
1983	22016	12750	2100	850	78	5968	308	419
1984	18666	13200	1900	1150	79	7367	314	349
1985	16167	8500	4300	1600	59	6578	298	246
1986	16119	8930	5600	1874	76	5793	379	232
1987	12369	8800	6100	1734	77	5748	336	308
1988	14054	8400	5800	1760	62	6975	228	390
1989	14121	10150	5550	1700	84	6509	205	470
1990	15500	11500	4000	1390	85	6159	200	470

Note: No data were available for the other countries; however, the countries here are the largest producers

A5.2.3.3: Area

Year	('000 ha) Australia	Argentina	Brazil	Chile	Columbia	Hungary	New Zealand	Uruguay
1960	5439	3599	565	n/a	166	1051	76	523
1961	5958	4421	470	769	160	1014	75	436
1962	6665	3745	270	769	150	1095	92	400
1963	6668	5676	205	751	113	1005	83	354
1964	7252	6135	260	748	100	1148	74	527
1965	7088	4601	290	727	120	1125	81	547
1966	8427	5214	350	780	110	1072	93	380
1967	9082	5812	480	718	68	1160	127	222
1968	10846	5837	790	700	90	1328	130	535
1969	9486	5191	1407	743	65	1321	108	450
1970	6479	3701	1895	740	50	1274	98	337
1971	7138	4315	2261	727	44	1273	107	340
1972	7604	4965	1500	712	57	1317	108	185
1973	8948	3958	1839	534	56	1294	67	292
1974	8308	4233	2471	591	37	1324	58	451
1975	8555	5270	2931	686	30	1251	104	456
1976	8956	6428	3540	698	36	1325	96	508
1977	9955	3910	3153	628	34	1311	91	297
1978	10249	4685	2812	580	29	1324	87	192
1979	11153	4787	3832	561	31	1135	86	380
1980	11283	5023	3062	546	38	1276	81	250
1981	11885	5926	1922	432	39	1151	72	350
1982	11520	7320	2828	359	45	1310	71	295
1983	12931	6880	1900	471	46	1355	63	253
1984	12078	5950	1750	510	42	1361	69	226
1985	11736	5270	2800	570	43	1358	67	212
1986	11135	4982	3900	677	44	1318	91	185
1987	9063	4789	3475	577	42	1301	83	167
1988	8927	4700	3450	540	39	1281	53	170
1989	8936	5450	3355	578	48	1242	55	280
1990	10000	6000	3000	480	49	1221	44	280

Note: Yield for the CG was calculated as total CG production divided by total CG area.

A5.2.3.4: Total Consumption ('000 tonnes)

Year	Australia	Argentina	Brazil	Chile	Columbia	Fiji	Indonesia	Malaysia	Hungary	New Zealand	Philippines	Thailand	Uruguay
1960	1982	3294	2235	n/a	302	0	161	280	2182	289	393	32	408
1961	1959	3529	2442	1287	299	0	150	265	2077	397	372	35	381
1962	2053	3643	2432	1303	292	0	24	273	2280	439	390	32	366
1963	2018	3771	2559	1296	236	48	100	316	1813	443	441	35	376
1964	2607	3846	2109	1298	287	44	20	249	2171	418	418	37	521
1965	2591	3658	2476	1374	346	45	20	218	2509	446	487	45	456
1966	2460	4078	2676	1822	324	13	40	320	2397	462	561	54	363
1967	2672	4393	2820	1556	343	25	170	338	3217	493	640	61	372
1968	2584	3794	3037	1546	300	20	279	270	3274	419	592	63	370
1969	2540	4768	3219	1677	315	17	567	367	3177	207	545	65	439
1970	2625	4056	3689	1517	430	22	396	305	3028	389	573	64	308
1971	2899	4356	3973	1720	430	24	683	318	3582	441	649	79	269
1972	3328	4301	3764	1859	404	29	546	366	3164	398	630	83	358
1973	3539	4221	4322	1900	464	37	694	370	3566	318	564	83	372
1974	3119	4498	4695	1623	387	44	810	360	4076	314	506	81	424
1975	2312	5380	5598	1800	386	41	819	350	3331	341	535	85	425
1976	2843	4242	5823	1707	406	45	913	396	4357	350	675	105	390
1977	2629	4349	5955	1963	477	35	1042	423	4755	350	750	145	394
1978	2531	4093	6789	1776	512	35	1148	426	5134	355	770	175	365
1979	3369	4020	7100	1890	472	40	1220	410	2854	358	819	180	400
1980	3503	3950	6600	1797	530	40	1388	420	5377	370	865	190	400
1981	2620	4300	6300	1852	545	45	1440	490	3416	341	890	205	450
1982	4087	4849	6300	1780	757	45	1472	525	4604	372	936	195	420
1983	3441	4700	6400	1830	636	50	1629	580	4568	390	774	195	383
1984	2921	4600	6300	1800	628	50	1498	609	5067	381	712	168	360
1985	2860	4400	6800	1723	655	50	1363	590	4678	358	798	180	300
1986	2573	4526	8000	1750	668	50	1523	580	4693	364	939	192	315
1987	3541	4500	7100	1765	822	96	1600	619	4685	410	1084	240	413
1988	2829	4700	7800	1948	842	50	1600	660	4713	408	1210	275	399
1989	3021	4600	7300	1778	820	50	1750	690	5100	356	1310	390	410
1990	3300	4700	7600	1900	800	50	2000	720	5100	335	1350	460	410

A5.2.3.5: Feed Use ('000 tonnes)

Year	Australia	Argentina	Brazil	Chile	Columbia	Fiji	Indonesia	Malaysia	Hungary	New Zealand	Philippines	Thailand	Uruguay
1960	588	135	0	0	2	0	0	0	217	81	0	0	13
1961	474	134	0	109	2	0	0	0	678	111	0	0	5
1962	405	138	0	111	2	0	0	0	138	123	0	0	3
1963	419	143	0	110	2	0	0	0	175	124	0	0	1
1964	944	146	0	110	2	0	0	0	605	103	0	0	134
1965	721	139	0	117	2	0	0	0	489	127	0	0	21
1966	601	155	0	155	2	0	0	0	542	160	0	0	15
1967	762	167	0	132	2	0	0	0	1123	163	0	0	2
1968	449	144	0	131	2	0	0	0	1491	130	0	0	10
1969	740	181	0	143	2	0	0	0	995	16	0	0	36
1970	653	31	0	130	2	0	0	0	1427	110	0	0	5
1971	822	29	0	146	3	0	0	0	1462	84	0	0	25
1972	1239	54	0	20	2	0	0	0	1279	55	0	0	12
1973	1226	50	0	69	2	0	0	0	1562	40	0	0	10
1974	1000	189	0	0	2	0	0	0	1907	14	8	0	14
1975	1350	982	0	0	2	0	0	0	1121	60	0	0	10
1976	1250	542	0	0	2	0	0	29	2635	50	0	0	0
1977	1280	200	0	0	2	0	12	38	2476	50	0	0	0
1978	1250	100	107	0	2	0	0	46	2530	55	0	0	0
1979	1928	200	0	0	2	0	0	20	1200	58	0	0	0
1980	2014	150	0	0	2	0	0	20	2400	60	0	0	0
1981	1419	150	0	50	15	0	0	20	1995	60	0	0	0
1982	2441	200	200	10	20	0	0	30	2215	55	0	0	15
1983	1258	150	0	50	6	0	0	45	2200	71	0	0	0
1984	1400	75	0	20	10	0	0	45	2700	71	0	0	0
1985	1350	75	0	20	8	0	0	40	2100	65	46	0	0
1986	1500	0	0	10	10	0	0	40	2100	68	42	0	0
1987	1865	100	0	30	44	0	0	50	2100	70	40	0	0
1988	2000	100	0	10	25	0	0	30	2350	23	0	0	0
1989	1000	100	0	60	10	0	0	20	2300	45	0	30	0
1990	1000	100	0	60	5	0	0	20	2300	10	0	60	0

A5.2.3.6: Non-Feed Use ('000 tonnes)

Year	Australia	Argentina	Brazil	Chile	Columbia	Fiji	Indonesia	Malaysia	Hungary	New Zealand	Philippines	Thailand	Uruguay
1960	1394	3159	2235	n/a	300	0	161	280	1965	208	393	32	395
1961	1485	3395	2442	1178	297	0	150	265	1399	286	372	35	376
1962	1648	3505	2432	1192	290	0	24	273	2142	316	390	32	363
1963	1599	3628	2559	1186	234	48	100	316	1638	319	441	35	375
1964	1663	3700	2109	1188	285	44	20	249	1566	315	418	37	387
1965	1870	3519	2476	1257	344	45	20	218	2020	319	487	45	435
1966	1859	3923	2676	1667	322	13	40	320	1855	302	561	54	348
1967	1910	4226	2820	1424	341	25	170	338	2094	330	640	61	370
1968	2135	3650	3037	1415	298	20	279	270	1783	289	592	63	360
1969	1800	4587	3219	1534	313	17	567	367	2182	191	545	65	403
1970	1972	4025	3689	1387	428	22	396	305	1601	279	573	64	303
1971	2077	4327	3973	1574	427	24	683	318	2120	357	649	79	244
1972	2089	4247	3764	1839	402	29	546	366	1885	343	630	83	346
1973	2313	4171	4322	1831	462	37	694	370	2004	278	564	83	362
1974	2119	4309	4695	1623	385	44	810	360	2169	300	498	81	410
1975	962	4398	5598	1800	384	41	819	350	2210	281	535	85	415
1976	1593	3700	5823	1707	404	45	913	367	1722	300	675	105	390
1977	1349	4149	5955	1963	475	35	1030	385	2279	300	750	145	394
1978	1281	3993	6682	1776	510	35	1148	380	2604	300	770	175	365
1979	1441	3820	7100	1890	470	40	1220	390	1654	300	819	180	400
1980	1489	3800	6600	1797	528	40	1388	400	2977	310	865	190	400
1981	1201	4150	6300	1802	530	45	1440	470	1421	281	890	205	450
1982	1646	4649	6100	1770	737	45	1472	495	2389	317	936	195	405
1983	2183	4550	6400	1780	630	50	1629	535	2368	319	774	195	383
1984	1521	4525	6300	1780	618	50	1498	564	2367	310	712	168	360
1985	1510	4325	6800	1703	647	50	1363	550	2578	293	752	180	300
1986	1073	4526	8000	1740	658	50	1523	540	2593	296	897	192	315
1987	1676	4400	7100	1735	778	96	1600	569	2585	340	1044	240	413
1988	829	4600	7800	1938	817	50	1600	630	2363	385	1210	275	399
1989	2021	4500	7300	1718	810	50	1750	670	2800	311	1310	360	410
1990	2300	4600	7600	1840	795	50	2000	700	2800	325	1350	400	410

A5.2.3.7:Stocks (end of year) ('000 tonnes)

Year	Australia	Argentina	Brazil	Chile	Columbia	Fiji	Indonesia	Malaysia	Hungary	New Zealand	Philippines	Thailand	Uruguay
1960	989	764	200	n/a	0	0	0	16	0	125	35	0	12
1961	807	243	200	112	0	0	0	17	0	113	57	0	4
1962	959	504	200	49	0	0	0	18	0	105	60	0	34
1963	880	2213	350	83	0	0	0	20	0	113	130	2	0
1964	989	3340	343	168	0	0	0	20	0	111	88	3	30
1965	774	175	470	252	0	0	0	48	0	106	103	5	67
1966	2516	245	522	341	0	0	0	56	0	92	36	10	18
1967	1737	1008	681	410	10	0	0	35	0	89	49	15	15
1968	7586	850	681	459	71	0	56	34	0	101	45	15	21
1969	7545	780	566	278	45	0	174	28	0	72	60	20	29
1970	3665	675	322	242	15	0	233	29	0	89	55	19	30
1971	1584	370	180	312	66	0	37	33	0	78	95	20	61
1972	565	269	121	121	7	0	81	37	0	56	78	11	25
1973	1982	1026	340	230	73	0	161	46	0	4	38	21	14
1974	1658	714	449	220	74	0	120	43	0	4	35	8	53
1975	2665	742	391	133	67	0	135	14	0	163	50	18	51
1976	2137	1600	513	400	90	0	162	23	0	152	150	29	109
1977	780	1176	245	268	178	0	202	68	0	131	160	34	0
1978	4646	1103	78	335	111	0	208	68	0	103	107	29	33
1979	4268	428	637	168	330	0	197	64	0	105	113	97	163
1980	2044	413	623	406	187	0	283	62	0	114	122	67	13
1981	4776	775	922	190	259	0	234	101	0	116	92	63	3
1982	2285	1056	471	203	170	0	247	103	0	116	81	22	3
1983	7518	1259	367	265	262	0	331	109	0	118	56	27	18
1984	8584	451	657	165	313	0	269	126	0	115	78	49	52
1985	5865	251	357	182	317	0	223	80	0	125	127	35	13
1986	3772	220	757	338	350	0	300	98	0	120	150	40	5
1987	2750	815	1027	350	280	0	300	109	13	131	150	40	5
1988	2600	481	127	222	200	0	200	122	375	111	140	45	5
1989	2700	131	177	194	164	0	250	117	284	90	230	45	5
1990	3900	331	77	134	149	0	250	127	56	85	230	55	5

A5.2.4: European Community '12'

(Note: Data for the EC'12' are presented in table A5.2.4.1, while the derivation of this data is shown in table A5.2.4.2-A5.2.4.5)

A5.2.4.1 EC'12' Data

	Production			Consumption			Stocks	
	Area	Yield	Production	Feed Use	Non-Feed Use	Total	Intervention	Private
Year	('000 ha)	(tonnes/ha)	('000 tonnes)	('000 tonnes)	('000 tonnes)	('000 tonnes)	('000 tonnes)	('000 tonnes)
1974	15773	3.33	52569	13819.75	30625.25	44445.00	2058	7123
1975	14518	3.11	45124	14610.46	30908.85	45519.31	1879	4840
1976	15473	3.02	46776	10897.10	32270.98	43168.08	1243	4642
1977	13976	3.18	44395	11332.27	31416.27	42748.54	611	4410
1978	15109	3.66	55364	12433.01	32554.04	44987.05	1159	6485
1979	14898	3.77	56199	13708.30	32907.39	46615.69	1768	6450
1980	15704	3.93	61718	14340.33	32500.17	46840.49	2746	5509
1981	15673	3.70	58051	13171.00	31790.00	44961.00	2172	5146
1982	16019	4.04	64750	14191.00	30684.00	44875.00	5769	5062
1983	16119	3.97	63989	15612.00	30596.00	46208.00	3956	4624
1984	16178	5.10	82484	21324.00	31545.00	52869.00	5190	10735
1985	15312	4.65	71201	22597.00	31701.00	54298.00	11079	7021
1986	15707	4.59	72138	23637.00	31552.00	55189.00	8936	7064
1987	15860	4.51	71588	21329.00	31888.00	53217.00	5748	9752
1988	15525	4.84	75097	21362.00	31914.00	53276.00	3367	9233
1989	16246	4.87	79183	21250.00	31256.00	52506.00	6417	7683
1990	15748	5.09	80101				10103	6597

A5.2.4.2 Prices

As an EC market price does not exist per se, a proxy was calculated using a production weighted average of the prices of the 3 largest producers - France, Germany & the UK. Rea prices are calculated by deflating the country price before computing the weighted average.

1. Market prices

Wheat

	Market price (a) (ECU/100kg)			Weights - production ('000 tonnes)			Weighted Average Pric (ecu/t)	
Year	France	Germany	UK	France	Germany	UK	Nominal	Real
1974	10.30	12.86	12.06	18549	7761	6126	112.449	394.881
1975	11.19	14.03	10.12	14229	7014	4438	117.808	338.375
1976	12.92	16.62	11.65	15599	6702	4773	136.120	343.146
1977	13.30	17.23	12.85	17177	7126	5229	141.686	322.811
1978	13.87	18.00	13.15	20663	8118	6612	146.828	304.702
1979	14.16	18.21	14.99	19202	8061	7169	152.810	291.492
1980	14.96	18.54	16.76	23357	8156	8470	160.716	279.252
1981	16.17	19.09	19.89	22363	8313	8707	176.088	266.191
1982	17.03	20.85	20.41	24987	8630	10317	185.741	248.568
1983	17.42	21.84	21.55	24397	8993	10802	193.290	232.720
1984	16.67	20.98	19.28	32391	10197	14957	181.121	203.074
1985	16.31	18.89	18.98	28091	9779	12022	174.591	183.857
1986	17.09	19.25	16.48	25541	10286	13845	173.673	173.673
1987	16.15	19.12	15.78	25830	9821	11917	166.705	161.960
1988	15.10	17.52	16.09	28557	11856	11726	158.729	149.825
1989	15.55	16.88	16.16	30441	10966	14008	159.674	144.620
1990	14.57	16.29	15.84	31504	11006	13865	152.181	132.769

(a) Soft Wheat selling price

Barley

Year	Market price (ECU/100 KG) France	Germany	UK	Weights - production ('000 tonnes) France	Germany	UK	Weighted Average Price (ecu/t) Nominal	Real
1974	9.95	11.96	11.53	9972	7048	9126	110.433	499.149
1975	10.23	12.88	10.11	9336	6971	8513	109.331	412.018
1976	11.83	15.30	11.97	8319	6487	7793	128.743	388.287
1977	11.84	15.78	12.10	10290	7548	10784	129.770	336.928
1978	11.88	15.90	12.02	11321	8608	9837	130.888	295.870
1979	12.83	16.44	14.20	11196	8185	9631	143.033	294.043
1980	13.24	16.46	15.67	11692	8626	10320	149.651	268.377
1981	14.13	16.74	18.44	10231	8687	10227	164.203	248.112
1982	15.22	18.72	19.84	10036	9460	10956	179.695	238.403
1983	15.95	19.67	20.49	8773	8944	9980	187.872	224.994
1984	15.99	20.04	19.05	11511	10284	11067	182.879	205.718
1985	15.32	17.90	18.10	11442	9691	9740	170.069	180.160
1986	15.39	17.53	16.13	10120	9377	10010	163.211	163.211
1987	13.85	17.37	15.43	10400	8571	9226	154.369	148.479
1988	13.11	16.10	16.09	10086	9587	8765	150.365	138.586
1989	13.45	15.27	16.58	9872	9717	8070	150.026	131.810
1990	12.99	14.83	15.68	10002	9195	7895	143.984	120.492

2. Producer Price - Wheat

Year	National Currency per 100kg France	Germany	UK	ECU/tonne France	Germany	UK	Weighted Average Price (ecu/t) Nominal	Real
1974	59.590	42.600	5.982	103.926	138.155	100.033	111.381	382.171
1975	65.420	47.200	5.575	122.988	154.785	99.548	127.622	364.083
1976	71.370	51.700	7.224	133.529	183.626	116.220	142.879	356.803
1977	74.570	49.100	8.334	133.016	185.402	127.490	144.678	326.930
1978	79.590	48.750	8.564	138.663	190.720	128.993	148.797	307.046
1979	82.530	48.900	9.592	141.573	194.751	148.393	155.443	294.841
1980	87.820	49.400	9.886	149.634	195.706	165.182	162.326	281.131
1981	98.530	47.600	10.891	163.132	189.347	196.905	176.132	266.518
1982	109.250	49.340	11.404	169.875	207.660	203.479	185.188	247.842
1983	117.590	48.800	12.366	173.672	214.931	210.661	191.109	230.201
1984	114.310	44.820	11.165	166.349	200.259	189.035	178.254	199.985
1985	110.470	41.200	11.294	162.575	185.060	191.755	174.014	183.272
1986	115.520	41.700	11.118	169.887	195.940	165.560	174.076	174.076
1987	110.680	38.530	11.194	159.910	185.938	158.436	164.914	160.199
1988	106.240	36.230	10.512	151.064	174.485	157.710	157.884	149.044
1989	109.200	35.250	10.463	155.440	169.642	157.232	158.704	143.794
1990	100.740	32.510	10.977	145.704	158.431	153.761	150.170	131.033

3. Intervention Price - Wheat

Year	U/A per tonne	ECU per tonne (a) Nominal	Real (b)
1974	115.53	139.66	403.29
1975	159.93	193.34	494.17
1976	131.00	158.37	356.50
1977	120.06	145.14	298.02
1978	121.57	146.97	276.74
1979		149.17	263.10
1980		155.88	250.07
1981		165.23	234.67
1982		179.27	229.19
1983		184.58	216.28
1984		182.73	201.62
1985		179.44	187.90
1986		172.58	172.58
1987		173.72	168.99
1988		179.44	169.27
1989		174.06	157.74
1990		168.55	146.79

(a) U/A - ECU exchange rate: 1.2089

(b) Deflated using the average price index

4. Commercial Exchange Rate

Year	(n/c per ECU) France	Germany	UK
1974	5.7339	3.0835	0.5980
1975	5.3192	3.0494	0.5600
1976	5.3449	2.8155	0.6216
1977	5.6061	2.6483	0.6537
1978	5.7398	2.5561	0.6639
1979	5.8295	2.5109	0.6464
1980	5.8690	2.5242	0.5985
1981	6.0399	2.5139	0.5531
1982	6.4312	2.3760	0.5605
1983	6.7708	2.2705	0.5870
1984	6.8717	2.2381	0.5906
1985	6.7950	2.2263	0.5890
1986	6.7998	2.1282	0.6715
1987	6.9214	2.0722	0.7065
1988	7.0328	2.0764	0.6665
1989	7.0252	2.0779	0.6655
1990	6.9140	2.0520	0.7139

5. Price Deflator

Year	Annual % change France	Germany	UK	Index - 1986=100 France	Germany	UK	Average Index 1986=100
1974	15.10	7.50	17.10	25.43	57.75	20.72	34.631
1975	12.10	6.10	23.60	29.95	62.43	24.99	39.124
1976	10.00	4.20	15.80	34.07	66.49	32.71	44.423
1977	9.60	3.40	14.80	37.86	69.40	38.84	48.702
1978	9.00	2.80	9.10	41.88	71.85	45.59	53.106
1979	10.90	4.30	13.70	46.02	73.92	50.16	56.698
1980	13.50	5.90	16.30	51.65	77.24	58.12	62.336
1981	13.40	6.20	11.20	59.71	82.08	69.44	70.410
1982	11.80	5.10	8.70	68.95	87.51	78.20	78.217
1983	9.70	3.30	4.80	78.18	92.21	85.65	85.344
1984	7.90	2.60	4.90	86.57	95.35	89.96	90.631
1985	6.00	2.10	5.40	94.00	97.90	94.60	95.500
1986	2.90	-0.30	4.40	100.00	100.00	100.00	100.000
1987	3.30	0.80	4.30	103.30	100.80	104.30	102.800
1988	2.90	1.40	5.00	106.30	102.21	109.52	106.007
1989	3.60	3.00	5.60	110.12	105.28	115.65	110.349
1990	3.30	2.70	6.00	113.76	108.12	122.59	114.821

A5.2.4.3: Production

Wheat

	Area ('000 ha)					Production ('000 tonnes)				
	EC		All wheat			EC		All wheat		
Year	Common	Durum	Spain	Portugal	Greece	Common	Durum	Spain	Portugal	Greece
1974	9483	1740 (a)	3164	470	916	41900	3435 (a)	4535	546	2153
1975	8632	1834 (a)	2661	466	925	33818	4272 (a)	4303	611	2120
1976	9342	1888 (b)	2772	537	934	35625	3571 (b)	4436	694	2450
1977	8694	1365 (b)	2715	263	939	36090	2246 (b)	4064	229	1766
1978	10010	1987 (b)	2752	360		46013	4290 (b)	4806	255	
1979	10065	1996 (b)	2551	286		47733	4113 (b)	4101	252	
1980	13518	2186 (c)				56693	5025 (c)			
1981	10624	2074 (c)				49984	4343 (c)			
1982	10887	2104 (c)				55843	4052 (c)			
1983	10992	2178 (c)				55387	4005 (c)			
1984	13751	2427 (c)				75908	6576 (c)			
1985	12803	2509 (c)				65338	5863 (c)			
1986	12924	2783 (c)				64900	7238 (c)			
1987	13005	2855 (c)				64064	7524 (c)			
1988	12818	2707 (c)				68430	6667 (c)			
1989	13422	2824 (c)				72752	6431 (c)			
1990	12792	2956 (c)				72966	7135 (c)			

(a) EC'9'

(b) EC'10'

(c) EC'12'

Total area and production, for all wheat, are given by summing the columns as appropriate; e.g. area in 1974 is (EC Common+EC Durum+Spain+Portugal+Greece); yield is given by dividing the total production by the total area.

Barley

	Area ('000 hectares)				Production ('000 tonnes)			
Year	EC	Spain	Portugal	Greece	EC	Spain	Portugal	Greece
1974	8441 (a)	3027	94	412	34736 (a)	5404	75	969
1975	9033 (a)	3262	101	395	32327 (a)	5473	117	916
1976	8888 (b)	3240	143	391	29876 (b)	6728	86	957
1977	9418 (b)	3348	68		37757 (b)	6766	40	
1978	9885 (b)	3519	86		40368 (b)	8068	44	
1979	10011 (b)	3242	72		39917 (b)	6153	41	
1980	9778 (c)	3575	79		41204 (c)	8705	54	
1981	9722 (c)	3508	74		39721 (c)	4757	41	
1982	9319 (c)	3615	77		41165 (c)	5270	51	
1983	8863 (c)	3735	88		36352 (c)	6662	54	
1984	12668 (c)				55218 (c)			
1985	12852 (c)				51472 (c)			
1986	12648 (c)				46839 (c)			
1987	12245 (c)				47287 (c)			
1988	12180 (c)				50801 (c)			
1989	11764 (c)				46773 (c)			
1990	11353 (c)				45730 (c)			

Notes as above

A5.2.4.4 Consumption

Year	Total use ('000 tonnes)	of which Animal Feed	Human	Total, net of imports	EC'12' (d) Animal Feed	Human	Total	Total, net of imports	Imports (e) Common	Durum	Total
1974	39908	11604	25382	34296 (a)	13819.75	30625.25	44445	38833	4248	1364	5612
1975	37504	12285	25552	32121 (a)	14610.46	30908.85	45519.3	40136.31	4394	989	5383
1976	39911	9525	27566	36258 (b)	10897.10	32270.98	43168.1	39515.08	3089	564	3653
1977	40295	9850	26789	35326 (b)	11332.27	31416.27	42748.5	37779.54	3494	1475	4969
1978	42739	10781	27752	38345 (b)	12433.01	32554.04	44987.1	40593.05	3510	884	4394
1979	43628	11919	28050	38718 (b)	13708.30	32907.39	46615.7	41705.69	3793	1117	4910
1980	44132	12388	27665	38887 (b)	14340.33	32500.17	46840.5	41595.49	3938	1307	5245
1981	49590	13171	31790	44561 (c)	13171	31790	44961	39932	3589	1440	5029
1982	50394	14191	30684	46773 (c)	14191	30684	44875	41254	2477	1144	3621
1983	56339	15612	30596	51984 (c)	15612	30596	46208	41853	3518	837	4355
1984	59502	21324	31545	56170 (c)	21324	31545	52869	49537	2675	657	3332
1985	59283	22597	31701	56084 (c)	22597	31701	54298	51099	2631	568	3199
1986	60386	23637	31552	57587 (c)	23637	31552	55189	52390	2172	627	2799
1987	58448	21329	31888	55876 (c)	21329	31888	53217	50645	1763	809	2572
1988	59097	21362	31914	56563 (c)	21362	31914	53276	50742	2103	431	2534
1989	58080	21250	31256	56225 (c)	21250	31256	52506	50651	1606	249	1855

(a) EC'9'
(b) EC'10'
(c) EC'12'
(d) Conversion to EC'12' -Human: kg/cap. for EC'?' * POP of missing countries
added to EC'?' figure
- Feed: per head feed * livestock of missing countries
added to EC'?' figure
(e) calculated on intra-export basis prior to1982/3, intra-import basis after.

Population

Year	Mid-year estimate, millions Belgium	Denmark	France	Germany	Greece	Ireland	Italy	Lux.	Netherlands	Portugal	Spain	UK	EC'12'
1974	9.77	5.05	52.49	62.04	8.96	3.12	55.10	0.36	13.54	8.99	35.22	55.92	310.56
1975	9.79	5.06	52.79	61.83	9.05	3.18	55.40	0.36	13.65	9.43	35.60	55.90	312.04
1976	9.81	5.07	52.91	61.51	9.17	3.21	55.70	0.36	13.77	9.67	35.97	55.89	313.04
1977	9.82	5.09	53.15	61.40	9.27	3.27	55.93	0.36	13.85	9.74	36.55	55.85	314.28
1978	9.83	5.10	53.38	61.31	9.36	3.31	56.13	0.36	13.94	9.80	36.67	55.84	315.03
1979	9.84	5.12	53.61	61.44	9.45	3.37	56.29	0.36	14.03	9.66	36.99	55.88	316.04
1980	9.85	5.12	53.88	61.54	9.64	3.40	56.43	0.36	14.14	9.77	37.54	56.33	318.00
1981	9.86	5.12	54.18	61.66	9.73	3.44	56.51	0.37	14.25	9.86	37.75	56.35	319.08
1982	9.86	5.12	54.48	61.60	9.79	3.48	56.64	0.37	14.31	9.93	37.97	56.31	319.86
1983	9.86	5.11	54.73	61.38	9.85	3.50	56.84	0.37	14.36	10.01	38.16	56.35	320.52
1984	9.86	5.11	54.95	61.13	9.90	3.53	57.00	0.37	14.42	10.09	38.33	56.46	321.15
1985	9.86	5.11	55.17	60.97	9.93	3.54	57.14	0.37	14.48	10.16	38.47	56.62	321.82
1986	9.86	5.12	55.39	61.01	9.97	3.54	57.25	0.37	14.56	10.21	38.60	56.76	322.64
1987	9.87	5.13	55.63	61.08	9.98	3.54	57.34	0.37	14.66	10.25	38.72	56.93	323.50
1988	9.88	5.13	55.88	61.45	10.00	3.54	57.44	0.37	14.76	10.29	38.81	57.07	324.62
1989	9.85	5.13	56.16	62.06	10.03	3.51	57.52	0.37	14.83	10.47	38.89	57.24	326.06
1990	9.87	5.14	56.44	62.87	10.05	3.50	57.66	0.38	14.94	10.53	38.96	57.44	327.78

A5.2.5: USA

A5.2.5.1 General Data

Year	Production: Production ('000 tonnes)	Area harvested ('000 ha)	Yield (tonnes/ha)	Consumption ('000 tonnes): Total Use	Feed Use	Human Use	Non-Feed Use (a)	Stocks ('000 tonnes): CCC	Private	FOR	Total
1960	36877	21012	1.76	16082	816	13527.49	15266	33328.71	7560.60	n.a.	40889.32
1961	33557	20890	1.61	16426	1197	13718.02	15229	29240.87	9422.18	n.a.	38663.05
1962	29719	17692	1.68	16305	952	13690.80	15353	29986.59	4569.57	n.a.	34556.16
1963	31216	18421	1.69	15815	762	13282.53	15053	21767.36	5271.74	n.a.	27039.10
1964	34917	20162	1.73	17263	1497	13990.20	15766	17276.72	7791.94	n.a.	25068.66
1965	34917	20080	1.74	18860	3973	14099.07	14887	8143.03	9833.14	n.a.	17976.17
1966	35788	20080	1.78	18859	2722	13745.24	16137	3320.35	10636.01	n.a.	13956.36
1967	41014	23644	1.73	17037	980	14099.07	16057	2724.32	14427.20	n.a.	17151.52
1968	42375	22186	1.91	20140	4245	14207.95	15895	3796.63	20806.63	n.a.	24603.26
1969	39272	19068	2.06	20794	5116	14153.51	15678	7544.28	19198.17	n.a.	26742.44
1970	36795	17651	2.08	21009	5253	14071.86	15756	9596.36	12796.96	n.a.	22393.32
1971	44052	19298	2.28	23359	7139	14262.38	16220	9664.40	17099.81	n.a.	26764.21
1972	42081	19143	2.20	22285	5470	14480.13	16815	171.46	16079.21	n.a.	16250.67
1973	46560	21913	2.12	20517	3470	14806.75	17047	16.33	9239.83	n.a.	9256.16
1974	48496	26454	1.83	18273	1064	14833.97	17209	0.00	11838.96	n.a.	12328.85
1975	57888	28126	2.06	19731	1034	16031.57	18697	0.00	18114.97	n.a.	18114.97
1976	58487	28692	2.04	20549	2041	16004.35	18508	0.00	30296.85	n.a.	30296.85
1977	55684	26993	2.06	23378	5253	15977.14	18125	1314.53	21446.21	9307.87	32068.61
1978	48336	22865	2.11	22776	4327	16113.23	18449	1390.74	13090.90	10695.89	25177.52
1979	58080	25275	2.30	21311	2341	16222.10	18970	5111.16	12356.06	7073.44	24540.67
1980	64799	28784	2.25	21310	1606	16630.38	19704	5435.04	11675.66	10829.25	27939.95
1981	75795	32635	2.32	23052	3619	16385.41	19433	5179.20	11076.91	15251.85	31507.96
1982	75250	31540	2.39	24682	5307	16766.47	19375	5225.47	7130.59	28865.29	41221.35
1983	65857	24844	2.65	30248	10206	17501.36	20042	5116.61	16329.60	16634.42	38080.63
1984	70618	27085	2.61	31390	11022	17719.11	20368	10276.76	10695.89	17883.63	38856.28
1985	65974	26197	2.52	28620	7737	18345.13	20883	16375.87	23677.92	16231.62	56285.41

1986	56896	24574	2.32	32589	10920	18943.93	21669	22592.00	14370.05	17195.07	54157.12
1987	57362	22640	2.53	29558	7622	19569.95	21936	7702.13	13910.10	12704.43	34316.65
1988	49320	21525	2.29	26536	4273	19869.35	22263	5184.65	6099.11	7810.99	19094.75
1989	55428	25167	2.20	27003	4360	20005.44	22643	3173.39	7511.62	3916.38	14601.38
1990	74669	28066	2.66	34102	11567	n/a	22535	4428.04	18759.99	372.86	23560.89

Notes

(a) Total Use - Feed Use

n/a Not available

n.a. Not applicable

A5.2.5.2 Prices ($ per tonne)

	1.Wheat					2. Corn	
	Farm gate price		Deflator (a)	Loan Rate		Farm gate price	
Year	Nominal	Real	(1986=100)	Nominal	Real	Nominal	Real
1960	47.356	175.074	27.049	48.449	179.114	25.400	93.903
1961	49.805	184.129	27.049	48.721	180.120	27.432	101.416
1962	55.521	205.840	26.973	54.437	201.821	27.940	103.586
1963	50.350	186.139	27.050	49.537	183.136	27.686	102.353
1964	37.286	138.234	26.973	35.384	131.182	29.972	111.118
1965	36.742	136.216	26.973	34.023	126.136	29.464	109.235
1966	44.362	161.197	27.520	34.023	123.628	32.766	119.061
1967	37.830	132.868	28.472	34.023	119.495	26.162	91.886
1968	33.748	118.210	28.549	34.023	119.173	27.432	96.087
1969	34.020	116.280	29.257	34.023	116.290	28.702	98.103
1970	36.197	118.851	30.456	34.023	111.712	33.782	110.921
1971	36.469	115.209	31.655	34.023	107.480	27.432	86.659
1972	47.900	146.533	32.689	34.023	104.081	39.878	121.992
1973	107.503	314.130	34.222	34.023	99.417	64.770	189.262
1974	111.313	282.679	39.378	37.561	95.386	76.708	194.799
1975	96.889	199.883	48.473	37.289	76.928	64.516	133.097
1976	74.300	139.112	53.410	61.241	114.663	54.610	102.247
1977	63.413	113.067	56.085	61.241	109.194	51.308	91.483
1978	80.832	135.447	59.678	63.963	107.181	57.150	95.765
1979	103.421	159.618	64.793	68.046	105.021	64.008	98.789
1980	108.592	146.730	74.008	81.655	110.332	78.740	106.394
1981	100.427	116.489	86.212	87.099	101.029	63.500	73.656
1982	93.895	99.001	94.842	96.625	101.880	68.072	71.774
1983	95.528	98.692	96.794	99.347	102.637	82.550	85.284
1984	92.262	94.119	98.027	89.820	91.628	66.548	67.887
1985	83.825	83.464	100.433	89.820	89.433	60.198	59.938
1986	65.863	65.863	100.000	65.324	65.324	38.100	38.100
1987	69.945	68.172	102.601	62.058	60.485	49.276	48.027
1988	101.244	94.956	106.622	60.152	56.417	64.516	60.509
1989	101.244	90.736	111.580	56.070	50.251	57.150	51.219
1990	71.034	61.679	115.167	n/a	n/a	n/a	n/a

A5.2.5.3 Policy Variables

Year	ARP rate (%)	Target price Nominal	Real	Yield for D. Pay.(a)
1983	15	117.029	120.905	2.240
1984	20	119.203	121.602	2.219
1985	20	119.203	118.689	2.354
1986	22.5	119.203	119.203	2.354
1987	27.5	119.203	116.181	2.354
1988	27.5	115.124	107.974	2.354
1989	10	111.586	100.005	2.354
1990	5	108.864	94.527	2.354

(a) Deficiency payments (D.Pay.) are calculated on the basis of a fixed yield for the whole country. The 1990 FACT fixed these at 1985 levels.

A5.2.5.4 Areas used to calculate AREAN & AREAP

	(million acres)			('000 hectares)					
Year	Area Base	Set aside	Total Planted	Area (a) Base	Set aside	Total Planted	Planted by participants (b)('000 ha)	Planted by non-participants (c)	participation rate (% of base area)
1983	90.9	29.8	76.4	36785.237	12059.407	30917.405	16633.08	14284.33	78
1984	94.0	18.3	79.2	38039.739	7405.609	32050.504	15418.23	16632.27	60
1985	94.0	18.8	75.6	38039.739	7607.948	30593.663	20161.06	10432.60	73
1986	91.6	21.0	72.1	37068.512	8498.240	29177.289	23010.00	6167.29	85
1987	87.6	23.9	65.8	35449.800	9671.806	26627.818	21524.02	5103.80	88
1988	84.8	22.5	65.5	34316.701	9105.257	26506.414	20407.11	6099.31	86
1989	82.3	9.6	76.6	33305.006	3884.910	30998.341	22093.00	8905.35	78
1990	80.5	7.1	77.3	32576.585	2873.214	31281.615	24165.35	7116.26	83

(a) Conversion factor: 2.4711
(b) Calculated as ((Base* Participation rate)-set aside)
(c) Calculated as Total area planted minus area planted by participants

A5.2.5.5 Real Expected returns
($ per ha)

Year	Non -participants	Participants
1983	236.019	243.981
1984	247.767	244.220
1985	236.342	225.927
1986	207.900	238.591
1987	159.684	197.785
1988	172.475	174.684
1989	186.765	168.871
1990	205.342	134.385

(calculated as detailed in section 5.3.1)

A5.2.6: Other Areas

Year	Imports ('000 tonnes) USSR	Other East.	China	R.O.W.	Exports ('000 tonnes) USSR	Other East.	China	R.O.W.
1960	585	4689	1949	18503	5020	537	2	629
1961	239	5060	4893	19370	5338	352	122	925
1962	242	6037	4892	19822	5744	320	89	1059
1963	9746	6437	5208	21466	2655	253	113	1183
1964	2222	6009	5032	23830	2197	299	115	1675
1965	8549	5914	6282	25558	2631	994	4	1366
1966	3082	4592	5025	31297	4387	1654	30	822
1967	1508	4624	4156	28730	5294	1936	13	1053
1968	215	3976	3537	25104	5829	1784	1	905
1969	1147	3665	5125	27021	6441	995	1	1040
1970	484	6859	3661	29466	7203	505	3	626
1971	3525	5053	2968	30687	5828	907	5	496
1972	15590	4931	5290	30245	1300	824	5	2917
1973	4508	5194	5645	35377	5000	997	5	1119
1974	2500	4038	5746	38748	4000	827	5	1506
1975	10100	5099	2200	39795	500	1038	0	1170
1976	4600	5965	3158	37298	1000	1744	0	1601
1977	6649	4887	8600	39779	1000	1666	0	3179
1978	5142	4707	8047	40556	1500	1489	0	3812
1979	12125	6165	8865	43652	500	814	0	2036
1980	16000	5875	13789	43865	500	1219	0	1762
1981	20300	6601	13200	47029	500	972	0	1363
1982	20800	4573	13000	45234	500	1370	0	2469
1983	20500	3757	9600	55488	500	955	0	2820
1984	28100	2528	7400	55754	500	1586	0	2681
1985	15700	3423	6600	50335	500	714	0	2438
1986	16000	3744	8500	53192	500	632	0	3512
1987	21500	3335	15000	57717	500	788	0	4664
1988	15500	2612	15500	57906	500	1729	0	6648
1989	14000	2050	13000	59890	500	1600	0	4339
1990	14000	1300	12500	57393	1000	2300	0	5380

	Production ('000 tonnes)			Area ('000 ha)	
Year	USSR	Other East.	R.O.W.	USSR	Other East.
1960	64299	14735	37082	60393	8674
1961	66483	14788	37134	63000	8794
1962	70778	15454	41370	67411	9049
1963	49688	16008	40227	64609	9001
1964	74399	15988	39061	67887	9274
1965	59686	19567	42971	70205	8862
1966	100499	20338	38639	69958	9165
1967	77419	22457	44626	67026	9173
1968	93393	22038	53590	67231	9426
1969	79917	21962	53737	66426	9530
1970	99734	20322	55469	65230	8977
1971	98760	26348	61324	64035	9389
1972	85993	26572	67189	58492	9462
1973	109784	27133	61113	63155	9041
1974	83913	29262	60936	59676	9318
1975	66224	24705	68578	61985	8745
1976	96882	29871	78560	59467	9071
1977	92161	29268	74079	62030	8806
1978	120820	30238	78020	62898	8913
1979	90200	23922	83936	57682	8124
1980	98182	28525	83178	61475	8441
1981	81100	25977	88165	59232	7893
1982	84300	28942	92504	57278	8083
1983	77500	29462	96103	50800	8641
1984	68600	34692	98309	51061	8797
1985	78100	30567	101910	50265	8810
1986	92306	33365	111315	48728	9180
1987	83312	34117	105673	46684	9227
1988	84445	37785	111980	48058	9462
1989	92307	37652	114914	47676	9412
1990	108000	38233	119131	47500	9448

A5.2.7 Livestock

A5.2.7.1 Total Livestock Numbers
('000 head, Beef cow equivalent (a))

1. EC'12'

Year	Total EC'12'	Bel/lux	Denmark	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	UK
1974	1008786.49	25081.73	30100.60	131403.57	103817.52	22811.74	19329.47	77274.71	41664.42	16748.85	64418.53	115873.07
1975	1001508.43	24721.14	29665.35	133716.97	101701.85	22542.17	18329.87	77345.04	44299.56	15657.63	64307.14	111745.55
1976	1003495.49	24636.67	29776.52	132626.49	100665.98	22285.67	18106.97	78297.61	44859.92	15231.11	66003.52	112667.57
1977	998881.29	24985.46	30357.97	133965.23	102677.96	22424.23	18443.38	79630.42	47022.78	16951.66	67003.36	98391.20
1978	1020128.54	25117.37	32526.16	134884.51	105574.32	21699.15	18557.69	82011.67	50451.04	18856.09	68240.61	97569.45
1979	1036538.03	25191.48	34179.64	134835.50	108818.32	21936.14	18766.47	82153.72	53058.58	20035.60	66915.77	100267.83
1980	1049578.17	24796.99	35483.64	137099.98	107817.46	21831.31	18790.64	83209.20	55165.73	21954.83	69888.85	98575.75
1981	1055462.05	24680.35	34947.31	140329.66	108420.53	22033.09	18025.13	83269.54	56146.48	22903.69	70020.27	97382.99
1982	1072389.01	25839.79	33471.45	141401.27	107095.34	22111.98	18125.44	83410.72	56675.49	22832.17	78560.75	99211.46
1983	1077482.07	25858.55	33383.75	141280.91	108105.05	22280.61	18524.51	83621.36	57193.53	23160.98	77755.58	100998.21
1984	1075760.97	25966.11	31526.46	139714.97	109896.82	22053.34	18670.81	85644.65	58565.72	21343.60	77766.44	100245.71
1985	1089501.47	26190.46	32276.54	143431.31	110949.51	22007.53	19052.15	85187.92	62666.08	21963.03	76095.43	100725.16
1986	1110747.53	26490.30	32199.89	145013.77	111059.88	22090.06	19202.77	85703.75	65615.77	22153.91	82446.68	102259.09
1987	1145056.53	27561.42	32794.05	144634.13	110915.51	22268.90	19461.05	87243.68	68169.73	20771.45	96116.44	106918.63
1988	1156834.27	28128.53	31693.87	144878.78	108177.51	25990.34	20182.31	87874.71	68272.45	21188.43	99387.64	108619.08
1989	1146417.90	29192.52	31956.99	142301.64	104861.77	25524.80	21302.60	88396.29	67288.57	20950.59	98192.42	107917.99

2. Other Areas

Year	CG	Canada	USA
1961	276070.2	50245.855	142295.34
1962	282622.0	48132.095	150450.41
1963	283643.0	49309.356	155562.08
1964	292559.1	51735.549	159205.59
1965	302866.8	50160.632	157705.58
1966	308602.9	50747.804	154893.88
1967	316246.3	52750.001	160880.25
1968	323765.3	51452.036	163218.45
1969	327422.9	52722.463	166402.77
1970	334757.9	58185.375	166502.98
1971	345080.0	57988.055	176167.53
1972	357791.6	57279.76	176302.92
1973	364393.6	57608.527	177034.86
1974	374741.6	56931.935	184525.81
1975	386916.8	52719.199	183924.57
1976	397991.3	53729.102	177033.61
1977	405008.6	54773.467	176402.43
1978	400857.0	56595.883	172381.48
1979	404499.8	62591.266	171370.45
1980	420025.0	64371.463	176777.52
1981	422524.4	64091.808	178381.11
1982	426057.6	62916.501	175100.24
1983	427129.1	63000.963	171561.44
1984	434183.7	63461.251	171731.33
1985	437643.7	62924.83	167457.05
1986	445011.1	62148.875	161436.92
1987	451111.9	65504.408	161221.49
1988	457306.8	66482.012	162773.14
1989	467044.2	66618.367	163921.7
1990	478559.1	65787.785	164964.35
1991	483980.4	66988.523	167799.86

(a) For the weighting system used to gain the beef cattle equivalent see below.

A5.2.7.2 Weighting System
Head of livestock per head of beef cattle

Method 1: EC data
(Av. 1981-1987)

Cattle	1
Dairy Cows	3.838891
Sheep	1.5124652
Pigs	2.6742136
Poultry	0.1788245

Method 2: USA data
(Av. 1985-1990)

Beef Cattle	1
Dairy Cows	2.9642763
Sheep	0.0934991
Pigs	0.7086521
Poultry	0.02584

Method 1 is used of the EC and Canadian livestock conversion, while method 2 is used for the USA and CG

The Weighting System

The livestock numbers above are derived from FAO figures for livestock numbers by type. They are converted to beef cattle equivalent to obtain a total livestock figure (thereby avoiding the familiar 'adding apples to oranges' problem). Two weighting systems were calculated for this puropse (the first based on EC'12' data and the second on USA data) which are based on the relative feed requirements of each type of animal and the proportion of this requirement obtained from grains. Note that although the final weights are given below, some of the data used in their derivation cannot be reported. Therefore the calulation methods are described in detail.

<u>Method 1</u>

(i) Calculate Energy Required per Head (ERH) for each amimal type as the theoretical energy requirement (Eurostat (1990)) divided by the number of livestock for each category (FAO).

(ii) Convert to a cereal requirement by multiplying by the % of energy gained from cereals (EC Commission (1989) p8/6, Table 1)

(iii) Calculate the relative cereal requirement by dividing each individual figure by that for beef cattle.

<u>Method 2</u>

(i) Calculate Total Energy Content of cereals (TEC); total feed use of cereals (as fed)*11.74 mj/kg.

(ii) Calculate TEC as a percentage of total energy required.

(iii) Convert to energy per head form cereals by multiplying the %TEC and the energy requirement per head.

(iv) Divide energy per head form cereals by 11.74 mj/kg to give the ceral requirement per head.

(v) Calculate the relative cereal requirement by dividing each individual figure by that for beef cattle.

Data Sources

1. USA

F.A.O. (1990) Agrostat Data Base

I.M.F. (various) 'International Financial Statistics'

Harwood J.L. & Young C.E. (1989) 'Wheat: Background for 1990 Farm Legislation' USDA ERS Staff Report no AGES 89-56

USDA Economic Research Service (various) 'Wheat Situation Outlook Report'
'Wheat Situation Outlook Yearbook'
'Agricultural Statistics'
'Agricultural Outlook', December 1985
(1990) 'PS & D View '90'

US Department of Commerce, Bureau of the Census (various) 'Statistical Abstract of the USA'

2. EC

Eurostat (various) 'Agricultural Situation in the Community'
'European Economy: Annual Economic Report', Statistical Annex

F.A.O. (various) 'Production Yearbook'
(1990) Agrostat Data Base

Home Grown Cereals Authority (various) 'Cereals Statisitics'

I.M.F. (various) 'International Finacial Statistics'

International Wheat Council (1992) 'World Grain Statisitics'

3. Other Areas

F.A.O. (various) 'Production Yearbook'
(1990) Agrostat Data Base

International Wheat Council (various) 'World Wheat Statistics'
(1992) 'World Grain Statisitics'

OECD (1990) 'Tables of Producer Subsidy Equivalents and Consumer Subsidy Equivalents 1979-89' OECD, Paris

USDA (1990) 'PS & D View '90'

A5.3.1 Data for BASESIM Programme

Data file 1: Unit 5

```
3
89.81,65.318,62.05248,60.14736,119.20308,116.18132,107.97379
2.353871,20.0,20.0,22.5,27.5,27.5
22.5,256.3,927.8,1013.7
38039.739,38039.739,37068.512,35449.8,34316.701
89.432869,65.323898,60.484562,56.416586
172.58,173.72,179.44,87.834,94.375,100.0,103.425,
107.331
159.00,154.00,148.00,96.7941085,98.0271545,100.433276,100.00
102.6009,106.62188,128.0,119.83,132.67
```

Data file 2: Unit 6

```
2.52,161436.92,161221.49,162773.14,
23677.92,16375.87,98.692122,94.119064,83.46365
20883.0,21669.0,16231.62,7405.6088,7607.94788
60.0,73.0,141957.0
59.938,38.1,48.03,60.51,0.054502
4.59273,3.70327,191.1095,178.2545,174.0137,187.8716,
182.8795,170.0691,163.21107,154.36942,150.36466
7021.0,11079.0,193.2897,181.1212,174.5905,0.99842,1.1544,
1.1825
692163.04,691394.63,700545.1168,714235.88,736854.99,
744393.64,21324.0,22597.0
321.15,321.82,322.64,323.5,324.62,36686.0,71201.0
9.5273,8568.0,8.1710,8.1137,13729.0
1.224,1.3214,1.3975,1.3809,1.2998,1.1927,24252.0
1.7465073,22056.0,445011.07,451111.89,457306.83,
136.0,136.0,112.0,88.0,76.0,107.0
7575.0,47770.0
1.8943,1.7846,1.7571,48729.0,46684.0,48058.0,68600.0,
78100.0,15500.0
10.831825,-0.0039475,0.08811536,-0.0343831,0.0689261
8500.0,15000.0,15500.0
```

A5.3.2 Data for BASETEST Programme

Data file 1: Unit 5

```
5
89.81,65.318,62.05248,60.14736,56.06496,53.0712,119.20308,
116.18132,107.97379,100.0051,94.5273
2.353871,20.0,20.0,22.5,27.5,27.5,10.0,5.0
22.5,256.3,927.8,1013.7,338.8,311.8
38039.739,38039.739,37068.512,35449.8,34316.701,33305.006,
32576.585
89.432869,65.323898,60.484562,56.416586,50.25072,46.08594
172.58,173.72,179.44,174.06,168.55,87.834,94.375,100.0,103.425,
107.331,112.396,117.676
159.00,154.00,148.00,96.7941085,98.0271545,100.433276,100.00
102.6009,106.62188,111.58,115.162,128.0,119.83,132.67,160.58,
118.3
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Data file 2: Unit 6

```
2.52,161436.92,161221.49,162773.14,163921.70,164964.35,
23677.92,16375.87,98.692122,94.119064,83.46365
20883.0,21669.0,16231.62,7405.6088,7607.94788
60.0,73.0,141957.0
59.938,38.1,48.03,60.51,53.72,50.29,0.054502
4.59273,3.70327,191.1095,178.2545,174.0137,187.8716,
182.8795,170.0691,163.21107,154.36942,150.36466,150.0263,
143.984
7021.0,11079.0,193.2897,181.1212,174.5905,0.99842,1.1544,
1.1825,1.1017,1.2734
692163.04,691394.63,700545.1168,714235.88,736854.99,
744393.64,737886.169,744681.987,21324.0,22597.0
321.15,321.82,322.64,323.5,324.62,326.06,327.78,36686.0,
71201.0
9.5273,8568.0,8.1710,8.1137,13729.0
1.224,1.3214,1.3975,1.3809,1.2998,1.1927,1.1578,1.1603,24252.0
1.7465073,22056.0,445011.07,451111.89,457306.83,467044.205,
478559.091,136.0,136.0,112.0,88.0,76.0,107.0,111.0,109.0
7575.0,47770.0
1.8943,1.7846,1.7571,48729.0,46684.0,48058.0,47676.0,47500.0,
68600.0,78100.0,15500.0
```

10.831825,-0.0039475,0.08811536,-0.0343831,0.0689261,0.01853,
0.030964
8500.0,15000.0,15500.0,13000.0,12500.0

A5.4 Programme for the complete simulation model

```
C*******************************************************************
C VARIABLE DEFINITIONS
C*******************************************************************
C     Areas - USA (US)
C                 - EC'12' (EC)
C                 - Canada (CAN)
C                 - Cairns Group (CG)
C                 - CIS (EE)
C                 - Rest of the World (ROW)
C
C     RUN         No. of years of the simulation run
C     NIT         No. of iterations in each year (Max. 100)
C     N/KOUNT     Count variables
C     TREND       Time trend from 0 to RUN
C
C     The poscript ** indicates either US, EC, CAN, CG or EE
C     in the following.
C     ER**          exchange rate to the US$
C     Y**           base period yield of wheat
C     YJ**          base period yield of a substitute product
C     AREA**        area planted in each year
C     PROD**        production in each year
C     CD**          direct/non-feed consumption of wheat
C     CF**          feed use of wheat
C     LIV**         total livestock munbers, weighted beef cattle
                    equivalent
C     PFARM**       producer price of wheat
C     PMKT**        market price of wheat
C     PJ**          domestic price of a substitute cereal
C     ES**          excess supply (net exports)
C     **CAL         returns from the individual subroutine, used to
                    determine
C                   the level of PW in each year (in ALPHA)
C     STK**         total stocks
C     PRODCH**      production change year on year
C
C     Policy variables
```

```
C     USA
C     TPUS          target price
C     YDP           yield used to calculate deficiency payments
C     ARP           % reduction for the acreage reduction program
C     BASE          base area
C     LR            CCC loan rate, real terms
C     LRFOR         FOR loan rate, nominal terms
C     EEPTOT        total expenditure on the export enahncement program
C
C     EC'12'
C     INTP         intervention price (used as producer price post '93)
C     SETEC        % area set aside under the Cuhna type policies
C     COMPEC       compensatory payments under the Cuhna reforms (per
                   ha)
C
C     Other variables
C     PW           world market clearing price, nominal terms
C     PWDEF        deflator for PW
C     PX1,PX2,X1,X2  temporary arrays for storing calculated PW
C     IMPEE        net imports by the CIS
C     PRODEE       production in the CIS
C     AREAEE       area planted in the CIS
C     YEE          yield in the CIS
C     IMPROW       imports by the 'rest of the world' group
C     IMPCHIN      imports by China
C
C     ME**       mean of the variable specified
C     SD**       standard deviation of the variable specified
C     SK**       skewness of the variable specified
C     KU**       kurtosis of the variable specified
C
C*******************************************************************
C  MAIN PROGRAMME
C*******************************************************************
      PROGRAM WHTSIM
      INTEGER N,TREND,I,RUN,R,IFAIL,D86,D88,D87,D89,D90,
     * D89PLUS,K,NIT
      EXTERNAL G05CCF,G05DDF
      REAL YUS,YEC,YCG,YEE,YJEC,AREACANB,YCAN,PCAN,PCANR,
```

```
* AREACG,AREAEE,PROPUS,IMPROWB,PRODEE,PX1,PX2,EREC,ERCAN,
* PTEMP,LIVUS,LIVEC,LIVCG,PFARMUS,PFARMEC,PJEC,PJCG,PJUS,
* USCAL,ECCAL,CANCAL,CGCAL,ESUS,ESEC,ESCAN,EPW,STKCAN,
* PW,STKCG,PRIVUS,PRIVEC,FOR,CDUS,PROPCG,EPEC,EPECT,
* PRODCHCAN,CCC,INT,TPUS,YDP,ARP,BASE,LR,POPEC,TOTGRCG,
* LRFOR,EEPTOT,INTP,TOTGRUS,PWTEST,PRODCHROW,LNIMPROW,
* CFCG,LNCDCAN,PT,DEFPW,CFUS,PWTEMP,SETUS,
* PMKTEC,IMPEE,IMPROW,IMPCHIN,ALPHA,GAMMA,BETA,PHI,DELTA,
* XREF,XBILL,DP,X1,X2,PRODEC,CONSEC,PRODUS,CONSUS,AREAUS,
* PRODCAN,PRODCG,CONSCAN,CONSCG,DEFEC,CFEC,CDEC
  REAL LRFORB,AREANUS,LNCDUS,EPWT,LNAREACAN,MTAREC
  DIMENSION PRODUS(15,200),PRODEC(15,200),PRODCAN(15,200),
* AREAUS(15),AREAEC(15),AREACAN(16),AREACG(16),CONSUS(15,200),
* CONSCG(15),CDUS(17),CDEC(16),CDCG(15),CFEC(17),ERCAN(18),
* STKUS(15,200),STKEC(15,200),STKCAN(15,200),PRIVUS(15,200),
* STKCG(15,200),CCC(16),INT(15,200),D89(15),PRIVEC(15,200),
* FOR(15,200),ESUS(15,200),ESEC(15,200),ESCAN(15,200),D86(15),
* CGCAL(15,200),PRODEE(15,200),IMPEE(15,200),IMPCHIN(15),
* PW(15,200),PFARMUS(15,200),DEFPW(18),PFARMEC(15,200),
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* ARP(17),BASE(17),LRFOR(16),LIVUS(15),LIVEC(18),D88(15),
* LIVCG(15),SET(17),EEPTOT(16),PRODCHCAN(15,200),YUS(15,200),
* TOTGRCG(16),PROPUS(15,200),TOTGRUS(16),REALPW(15,200),
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  DIMENSION PJUS(16),X1(2),X2(2),LNCDUS(16),D90(15),PJCG(18),
* LNIMPROW(15,200),AREAEE(15),D89PLUS(15),
* PRODCG(15,200),IMPROW(15,200),PCAN(15,200),D87(15),LR(16),
* PRODCHROW(15,200),COMPEC(15),SETEC(15),TPUS(15),PT(17),
* CFCG(15),CFUS(15,200),PJEC(18),USCAL(15,200),ECCAL(15,200),
* CANCAL(15,200),MTAREC(15,200),XBILL(15,200),XREF(15,200),
* AMSUS(15,200),AMSEC(15,200)
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* MEAREACAN,MEAREACG,MECONSUS,MECONSEC,MECONSCAN,
*  MECONSCG,MECDEC,MECDCAN,MECDCG,MECFUS,MECFEC,
*  MECFCG,MESTKUS,MESTKEC,MESTKCAN,MESTKCG,MEPRIVEC,
*  MEPRIVUS,MECCC,MEINT,MEFOR,MEESUS,MEESEC,MEESCAN,
*  MEESCG,MEPRODEE,MEIMPEE,MEIMPROW,MEIMPCHIN,MEPW,
```

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*   MEREALPW,MEAREAEC,MECDUS,MEYUS,MEPFARMUS,
*   MEPROPUS,MEPFARMEC,MEPCAN,MEPCANR,MEPMKTEC,
*   MELNIMPROW,MEPRODCHROW,MEXREF,MEXBILL,MEAMSEC,
*   MEAMSUS,MEMTAREC,MEANPW,MEANSTKCAN,MEANSTKCG,
*   MEANPRIVUS,MEANPRIVEC,MEANFOR,MEANINT,
*   MEANIMPEE,MEANIMPROW
  REAL SDSTKUS,SDSTKEC,SDSTKCAN,SDSTKCG,SDPRIVEC,
*   SDPRIVUS,SDCCC,SDINT,SDFOR,SDESUS,SDESEC,SDESCAN,
*   SDESCG,SDIMPEE,SDIMPROW,SDIMPCHIN,SDPW,
*   SDREALPW,SDXBILL,SDXREF,SDAMSEC,SDAMSUS,SDMTAREC
  REAL SKSTKUS,SKSTKEC,SKSTKCAN,SKSTKCG,SKPRIVEC,
*   SKPRIVUS,SKCCC,SKINT,SKFOR,SKESUS,SESEC,SKESCAN,
*   SKESCG,SKIMPEE,SKIMPROW,SKIMPCHIN,SKPW,
*   SKREALPW,SKXREF,SKXBILL,SKAMSEC,SKAMSUS,SKMTAREC
  REAL KUSTKUS,KUSTKEC,KUSTKCAN,KUSTKCG,KUPRIVEC,
*   KUPRIVUS,KUCCC,KUINT,KUFOR,KUESUS,KUESEC,KUESCAN,
*   KUESCG,KUIMPEE,KUIMPROW,KUIMPCHIN,KUPW,
*   KUREALPW,KUXREF,KUXBILL,KUAMSEC,KUAMSUS,KUMTAREC
  DIMENSION MEPRODUS(15),MEPRODEC(16),MEPRODCAN(16),
* MEAREACAN(15),MEAREACG(15),MECONSUS(15),MECONSEC(15),
* MECONSCG(15),MECDEC(16),MECDCAN(15),MECDCG(15),
* MESTKEC(15),MESTKCAN(16),MESTKCG(16),MEPRIVEC(16),
* MECCC(15),MEFOR(16),MEESUS(15),MEESEC(15),MEESCAN(15),
* MEESCG(15),MEPRODEE(17),MEIMPROW(16),MEIMPCHIN(15),
* MEREALPW(15),MEAREAEC(15),MECDUS(15),MEPFARMUS(18),
* MEAREAUS(15),MECONSCAN(15),MECFUS(15),MECFEC(17),
* MECFCG(15),MESTKUS(15),MEPRIVUS(16),MEINT(16),
* MEPW(18),MEPRODCG(15),MEPFARMEC(18),MEPMKTEC(18),
* MEPROPUS(16),MEYUS(16),MEPCAN(18),MEPCANR(18),
* MEIMPEE(16),MELNIMPROW(16),MEPRODCHROW(16)
  DIMENSION MEANPW(15),MEANREALPW(15),MEANPRIVEC(15),
* MEANPRIVUS(15),MEANIMPEE(15),MEANSTKCAN(15),
* MEANSTKCG(15),MEANFOR(15),MEANINT(15),MEANIMPROW(15),
* MEXREF(15),MEXBILL(15),MEAMSEC(15),MEAMSUS(15),
* MEMTAREC(15)
  DIMENSION SDSTKEC(15),SDSTKCAN(15),SDSTKCG(15),SDFOR(15),
* SDCCC(15),SDESUS(15),SDESEC(15),SDESCAN(15),SDPRIVEC(15),
* SDESCG(15),SDREALPW(15),SDSTKUS(15),SDPRIVUS(15),
```

```
     * SDPW(15),SDINT(15),SDIMPEE(15),SDXREF(15),SDXBILL(15),
     * SDMTAREC(15),SDAMSEC(15),SDAMSUS(15),SDIMPROW(15)
       DIMENSION SKSTKEC(15),SKSTKCAN(15),SKSTKCG(15),SKFOR(15),
     * SKCCC(15),SKESUS(15),SKESEC(15),SKESCAN(15),SKPRIVEC(15),
     * SKESCG(15),SKREALPW(15),SKSTKUS(15),SKPRIVUS(15),
     * SKPW(15),SKINT(15),SKIMPEE(15),SKXREF(15),SKXBILL(15),
     * SKAMSUS(15),SKAMSEC(15),SKMTAREC(15),SKIMPROW(15)
       DIMENSION KUSTKEC(15),KUSTKCAN(15),KUSTKCG(15),KUFOR(15),
     * KUCCC(15),KUESUS(15),KUESEC(15),KUESCAN(15),KUPRIVEC(15),
     * KUESCG(15),KUREALPW(15),KUSTKUS(15),KUPRIVUS(15),
     * KUPW(15),KUINT(15),KUIMPEE(15),KUXBILL(15),KUXREF(15),
     * KUAMSUS(15),KUAMSEC(15),KUMTAREC(15),KUIMPROW(15)
      DATA PRODUS,PRODEC,PRODCG,PRODCAN,AREAUS,AREAEC,CONSUS,
     * CONSEC,CONSCG,CDUS,CDCAN,CDCG,STKUS,STKEC,ESUS,
     * CGCAL,PRODEE,IMPEE,IMPROW,IMPCHIN,INTP,ESEC,ESCAN,
     * EREC,TPUS/42167*0.0/
      DATA AREACAN,AREACG,CDEC,CFUS,CFCG,STKCAN,STKCG,CCC,INT,
     * PRIVUS,PRIVEC,FOR,ERCAN,LR,LRFOR,LIVUS,EEPTOT/21160*0.0/
      DATA CFEC,DEFPW,DEFEC,ARP,BASE,SET,LIVCG,LIVEC,PT/153*0.0/
     * PW,PFARMUS,PFARMEC,PCAN,PMKTEC,PCANR/18000*0.0/PRODCHCAN,
     * TOTGRUS,TOTGRCG,PROPUS,YUS,PJUS,AREAEE/9063*0.0/
      DATA D86,D87,D89,D90,D89PLUS,D88/90*0/
C
C*****************************************************************
C     Read in Policy vars. & World Price in previous two years
C*****************************************************************
C
      R=1
      READ(5,*) RUN,NIT
      READ(5,*)  (LRFOR(M),M=1,16),(TPUS(L),L=1,15)
      READ(5,*) YDP,(ARP(N),N=1,7)
      READ(5,*)  (EEPTOT(J),J=1,16)
      READ(5,*)  (BASE(I),I=1,7)
      READ(5,*)  (LR(I),I=1,6)
      READ(5,*)  (INTP(L),L=1,15),(DEFEC(J),J=1,17)
      READ(5,*)  (MEPW(I),I=1,3),(DEFPW(K),K=1,18)
      READ(5,*)  (SETEC(J),J=1,15),(COMPEC(K),K=1,15)
```

```
C*********************************************************************
C       Read in Base Level Data
C*********************************************************************
C
      READ(6,*) MEYUS(1),(LIVUS(L),L=1,15),MEPRIVUS(R),CCC(R),
     *    (MEPFARMUS(J),J=1,3)
      READ(6,*) CDUS(1),CDUS(2),MEFOR(R),(SET(L),L=1,2)
      READ(6,*)  (PT(J),J=1,2),TOTGRUS(1)
      READ(6,*)  (PJUS(K),K=1,16),MEPROPUS(1),PREFUS
      READ(6,*) YEC,YJEC,(MEPFARMEC(L),L=1,3),(PJEC(K),K=1,18)
      READ(6,*) MEPRIVEC(R),MEINT(R),(MEPMKTEC(J),J=1,3),
     *  (EREC(K),K=1,15)
      READ(6,*)  (LIVEC(M),M=1,18),(CFEC(L),L=1,2)
      READ(6,*)  (POPEC(L),L=1,17),CDEC(R),MEPRODEC(1),
     *  PREFEC
      READ(6,*) MESTKCAN(R),(LNCDCAN(L),L=1,2),
     *  AREACAN(R)
      READ(6,*)  (ERCAN(K),K=1,18),MEPRODCAN(1)
      READ(6,*) YCG,AREACG(1),(LIVCG(K),K=1,15),(PJCG(J),J=1,18)
      READ(6,*) MESTKCG(1),TOTGRCG(1)
      READ(6,*)  (AREAEE(I),I=1,15),(MEPRODEE(J),J
     *  =1,2),MEIMPEE(1)
      READ(6,*) MELNIMPROW(1),(MEPRODCHROW(K),K=1,6)
      READ(6,*)  (IMPCHIN(I),I=1,15)
C
C*********************************************************************
C       Main computations
C*********************************************************************
C
      IFAIL = 0
      TREND=0
      N=4
      PWTEMP=0.0
      PTEMP=0.0
      DO 90 J=1,3
       MEPCANR(J) = ((MEPW(J)/DEFPW(J))*100)/ERCAN(J)
       MEPCAN(J) = MEPW(J)/ERCAN(J)
90    CONTINUE
```

```
      D86(1) = 1
      D88(3) = 1
      D87(2) = 1
      D89(4) = 1
      D90(5) = 1
      D89PLUS(4) = 1
      D89PLUS(5) = 1
C
      DO 10 I=1,RUN
      CALL G05CCF(123)
      CALL RESET(N,TREND,EPW,PWTEMP,PTEMP,I,EPWT,EPCAN,EPCANT,
     *  EPEC,EPECT)
       PTEMP = (MEPW(N-3)+MEPW(N-2)+MEPW(N-1))/3
        IF(PTEMP.GT.MEPW(N-1))THEN
         EPW=MEPW(N-1)
        ELSE
         EPW=PTEMP
        ENDIF
       PTEMP=0.0
       PTEMP = (EPW+MEPW(N-1)+MEPW(N-2))/3
        IF(PTEMP.GT.EPW) THEN
         EPWT = EPW
        ELSE
         EPWT = PTEMP
        ENDIF
      PTEMP=0.0
      PTEMP = (MEPCAN(N-3)+MEPCAN(N-2)+MEPCAN(N-1))/3
       IF(PTEMP.GT.MEPCAN(N-1)) THEN
        EPCAN = MEPCAN(N-1)
       ELSE
        EPCAN = PTEMP
       ENDIF
      PTEMP = 0.0
      PTEMP = (EPCAN+MEPCAN(N-1)+MEPCAN(N-2))/3
       IF(PTEMP.GT.EPCAN) THEN
        EPCANT = EPCAN
       ELSE
        EPCANT = PTEMP
```

```
      ENDIF
     PTEMP = 0.0
     PTEMP = (MEPMKTEC(N-1)+MEPMKTEC(N-2)+MEPMKTEC(N-3))/3
      IF (PTEMP.GT.MEPMKTEC(N-1)) THEN
       EPEC = MEPMKTEC(N-1)
      ELSE
       EPEC = PTEMP
      ENDIF
     PTEMP = 0.0
     PTEMP = (EPEC+MEPMKTEC(N-1)+MEPMKTEC(N-2))/3
      IF (PTEMP.GT.EPEC) THEN
       EPECT = EPEC
      ELSE
       EPECT = PTEMP
      ENDIF
C
      CALL EESUB(I,N,NIT,TREND,AREAEE,IMPEE,PRODEE,D87,D88,
     * D89PLUS,MEPRODEE,MEIMPEE)
      CALL USSUB(I,N,NIT,TREND,MEPFARMUS,YUS,MEPW,TPUS,YDP,ARP,
     *   LR,BASE,LRFOR,MEPRIVUS,LIVUS,CCC,SET,PT,PRODUS,
     *    AREAUS,CDUS,USCAL,DEFPW,EPW,TOTGRUS,MEPROPUS,PJUS,D86,
     *    MEFOR,D87,D88,D89,D90,MEYUS,MECONSUS)
      CALL ECSUB(I,N,NIT,TREND,PJEC,YEC,YJEC,LIVEC,INT,
     *      PRIVEC,MEPMKTEC,ECCAL,PRODEC,CFEC,POPEC,DEFEC,
     *      CDEC,AREAEC,EPECT,D86,INTP,CONSEC,D88,D87,D90,
     *      MEINT,MEPRIVEC,MEPRODEC,COMPEC,SETEC)
      CALL CANSUB(I,N,NIT,TREND,AREACAN,MEPCANR,EPCAN,EPCANT,
     *   LNCDCAN,CONSCAN,STKCAN,PRODCAN,CANCAL,CFCAN,CDCAN,
     *   PRODCHCAN,D86,MESTKCAN,MEPRODCAN)
      CALL CGSUB(I,N,NIT,TREND,YCG,AREACG,MEPW,PJCG,STKCG,
     *   LIVCG,CFCG,CDCG,CGCAL,PRODCG,CONSCG,TOTGRCG,
     *   D86,D87,MESTKCG)
C
      DO 11 K=1,NIT
      IF (I.LT.6) THEN
       PRODCHROW(I,K) = MEPRODCHROW(N-2)
      ELSE
C     PRODCHROW(I,K) = 0.0380281
```

```
       PRODCHROW(I,K) = G05DDF(0.0370281,0.05911359)
      ENDIF
      LNIMPROW(I,K)=(0.66417*10.874)+(0.029752*(TREND-
     *  (0.33583*(TREND-1))))-(0.35548*PRODCHROW(I,K))+(
     *  0.1193807*MEPRODCHROW(N-3))+(0.33583*MELNIMPROW(N-3))
      IMPROW(I,K) = 2.718281828**LNIMPROW(I,K)
        GAMMA=0.0
        ALPHA=0.0
        BETA=0.0
        PHI=0.0
        DELTA=0.0
      DO 96 J=1,2
       X1(J) = 0.0
       X2(J) =0.0
96    CONTINUE
C
        GAMMA = 0.2*EEPTOT(N-2)
        ALPHA = USCAL(I,K)+ECCAL(I,K)+CANCAL(I,K)+CGCAL(I,K)
     *    -IMPEE(I,K)-IMPROW(I,K)-IMPCHIN(I)
       BETA =(9225.6/LRFOR(N-2))+(3448.9/EPWT)-((0.033681/PJUS(N-2))
     *  *((0.72994*TOTGRUS(N-3))+(0.22226*LIVUS(I))+(16100*D87(I))
     *  -(25373.0*D89(I))))+(26.317/ERCAN(N))
C
      CALL C02AJF(BETA,ALPHA,GAMMA,X1,X2,IFAIL)
       IF((X1(2).NE.0).AND.(X2(2).NE.0))THEN
        WRITE(8,*)'MODEL HAS ONLY COMPLEX ROOTS'
        WRITE(8,*)'GAMMA',GAMMA,'BETA',BETA,'ALPHA',ALPHA
        GOTO 800
             ELSE IF (X1(2).NE.0) THEN
        PWTEMP = X2(1)
             ELSE IF (X2(2).NE.0) THEN
        PWTEMP = X1(1)
       ENDIF
C
C
      IF((X1(1).LT.56.500958.OR.X1(1).GT.235.1715).AND.(X2(1)
     *  .LT.56.500958.OR.X2(1).GT.235.1715))THEN
        CALL ENDSUB(X1,X2,I,K)
```

```
      PWTEMP = X2(1)
     ELSE IF((X2(1).LT.56.500958.OR.X2(1).GT.235.1715).AND.
    *  X1(1).GT.56.500958.AND.X1(1).LT.235.1715) THEN
      PWTEMP = X1(1)
     ELSE IF((X1(1).GT.56.500958.OR.X1(1).GT.235.1715).AND.
    *  X2(1).GT.56.500958.AND.X2(1).LT.235.1715) THEN
      PWTEMP = X2(1)
     ELSE
        PX1 = X1(1)
        PX2 = X2(1)
        PWTEMP = X2(1)
     ENDIF
    DO 97 L=1,2
     X1(L)=0.0
     X2(L)=0.0
97  CONTINUE
C
    IF((PWTEMP*EREC(I)).LT.(1.1*INTP(I)))THEN
      PW(I,K) = PWTEMP
     ELSE
      PHI = BETA+((3478.5/DEFEC(N-1)*EREC(I)*1.212795)+
    *  (28.693*EREC(I)*1.212795)+(57.86*EREC(I)*1.212795))
       IF (I.EQ.1) THEN
      DELTA = ALPHA-((34.9466+(4236.64/DEFEC(N-1))+70.1367)
    *  *INTP(I))
       ELSE
      DELTA = ALPHA-((34.9466+(4236.64/DEFEC(N-1))+70.1367)
    *  *(INTP(I)/1.0751192))
       ENDIF
     CALL C02AJF(PHI,DELTA,GAMMA,X1,X2,IFAIL)
      IF((X1(2).NE.0).AND.(X2(2).NE.0))THEN
    WRITE(8,*)'
      WRITE(8,*)'MODEL HAS ONLY COMPLEX ROOTS'
      WRITE(8,*)'GAMMA',GAMMA,'PHI',PHI,'DELTA',DELTA
      GOTO 800
       ELSE IF (X1(2).NE.0) THEN
      PWTEMP = X2(1)
       ELSE IF (X2(2).NE.0) THEN
```

```
         PWTEMP = X2(1)
         ENDIF
C
        IF((X1(1).LT.56.500958.OR.X1(1).GT.235.1715).AND.(X2(1)
     *     .LT.56.500958.OR.X2(1).GT.235.1715))THEN
         CALL ENDSUB(X1,X2,I,K)
        ELSE IF((X2(1).LT.56.500958.OR.X2(1).GT.235.1715).AND.
     *  X1(1).GT.56.500958.AND.X1(1).LT.235.1715) THEN
         PW(I,K) = X1(1)
        ELSE IF((X1(1).LT.56.500958.OR.X1(1).GT.235.1715).AND.
     *  X2(1).GT.56.500958.AND.X2(1).LT.235.1715) THEN
         PW(I,K) = X2(1)
        ELSE
         PX1 = X1(1)
         PX2 = X2(1)
         PW(I,K) = X2(1)
C
          ENDIF
        ENDIF
        REALPW(I,K) = (PW(I,K)/DEFPW(N))*100
C
C**********************************************************************
C     Using the calculated world prices, year I, iterations 1 to k,
C     to calculate excess supply levels, stocks, EC export refunds,
C     US deficiency payments, means for input to year t+1
C**********************************************************************
C
C  USA
C
       IF (I.EQ.1) THEN
        PFARMUS(I,K)=REALPW(I,K)*0.51
       ELSE
        PFARMUS(I,K)=REALPW(I,K)*0.6049
       ENDIF
C

       IF (I.EQ.1) THEN
        PRIVUS(I,K)=8486.6+(0.35466*MEPRIVUS(N-3))-(3391.4*
```

```
     * ((PW(I,K)/EPWT)-(MEPW(N-1)/EPW)))
      ELSE
       PRIVUS(I,K)=8486.6+(0.35466*MEPRIVUS(N-3))-(3391.4*
     *  ((PW(I,K)/EPWT)-(MEPW(N-1)/EPW)))-(7158.1*D88(I))
      ENDIF
C
      IF (I.NE.2) THEN
      FOR(I,K) = 12423.652-(9225.6*(PW(I,K)/LRFOR(N-2)))
     *  +(5376.3107*(MEPW(N-1)/LRFOR(N-3)))+(0.58276*MEFOR(N-3))
     *  +(4453.3*D86(I))
      ELSE
       FOR(I,K) = 12423.652-(9225.6*(PW(I,K)/LRFOR(N-2)))+(5376.3107
     *  *(MEPW(N-1)/LRFOR(N-3)))+(0.58276*(MEFOR(N-3)-4453.3))
      ENDIF
C
      IF (FOR(I,K).LT.0.0) FOR(I,K)=0.0
C
      PROPUS(I,K) = 0.065133+(0.41974*MEPROPUS(N-3))-(0.033681*
     * (PFARMUS(I,K)/PJUS(N-2)))+(0.046529*D86(I))
      CFUS(I,K) = PROPUS(I,K)*TOTGRUS(N-2)
C
       CONSUS(I,K) = CFUS(I,K)+CDUS(I)
       ESUS(I,K) = PRODUS(I,K)-CONSUS(I,K)-FOR(I,K)-CCC(N-2)
     *   -PRIVUS(I,K)+MEFOR(N-3)+CCC(N-3)+MEPRIVUS(N-3)
C      AMSUS(I,K) = (PREFUS - PFARMUS(I,K))*PRODUS(I,K)
       AMSUS(I,K) =(((TPUS(I)*DEFPW(N)/100)-PREFUS)*PRODUS(I,K))
     * /1000
C
C  EC`12'
C
      IF(PW(I,K).GT.(1.1*INTP(I)/EREC(I))) THEN
        PMKTEC(I,K) = (PW(I,K)*EREC(I))*1.212795
      ELSE IF (I.LT.8) THEN
        PMKTEC(I,K) = (INTP(I)*0.94)-5.38
      ELSE
        PMKTEC(I,K) = INTP(I)
      ENDIF
        IF (I.EQ.1) THEN
```

```
          PMKTEC(I,K) = INTP(I)
          ENDIF
        XREF(I,K) = PMKTEC(I,K)-((PW(I,K)*EREC(I))*1.212795)
C
        IF(XREF(I,K).LT.0.0) XREF(I,K)=0.0
C
        ESEC(I,K) = PRODEC(I,K)-CONSEC(I)-PRIVEC(I,K)-INT(I,K)
     *    +MEPRIVEC(N-3)+MEINT(N-3)
        PFARMEC(I,K) = PMKTEC(I,K)*1.0080354
        XBILL(I,K) = XREF(I,K)*ESEC(I,K)
        AMSEC(I,K) =(((INTP(I)*1.1)-PREFEC)*PRODEC(I,K))/1000
        MTAREC(I,K) = XREF(I,K)*1.1
C
C   Canada
C
        PCAN(I,K) = PW(I,K)/ERCAN(N)
        PCANR(I,K) = REALPW(I,K)/ERCAN(N)
        STKCAN(I,K) = 4575.9+(0.5047*MESTKCAN(N-3))+(0.28869*
     *  PRODCHCAN(I,K))-(26.317*(PCAN(I,K)-EPCANT))
        ESCAN(I,K) = PRODCAN(I,K)-CONSCAN(I)-STKCAN(I,K)+
     *  MESTKCAN(N-3)
C
        STKUS(I,K) = PRIVUS(I,K)+CCC(N-2)+FOR(I,K)
        STKEC(I,K) = PRIVEC(I,K)+INT(I,K)
11      CONTINUE
C
        CALL MEANCAL16(I,NIT,PRODEC,MEPRODEC)
        CALL MEANCAL16(I,NIT,PRODCAN,MEPRODCAN)
        CALL MEANCAL16(I,NIT,STKCAN,MESTKCAN)
        CALL MEANCAL16(I,NIT,STKCG,MESTKCG)
        CALL MEANCAL16(I,NIT,PRIVUS,MEPRIVUS)
        CALL MEANCAL16(I,NIT,PRIVEC,MEPRIVEC)
        CALL MEANCAL16(I,NIT,FOR,MEFOR)
        CALL MEANCAL16(I,NIT,INT,MEINT)
        CALL MEANCAL16(I,NIT,IMPEE,MEIMPEE)
        CALL MEANCAL18(I,NIT,PW,MEPW)
        CALL MEANCAL15(I,NIT,REALPW,MEREALPW)
        CALL MEANCAL18(I,NIT,PFARMUS,MEPFARMUS)
```

```
      CALL MEANCAL18(I,NIT,PMKTEC,MEPMKTEC)
      CALL MEANCAL18(I,NIT,PCAN,MEPCAN)
      CALL MEANCAL18(I,NIT,PCANR,MEPCANR)
      CALL MEANCAL16(I,NIT,YUS,MEYUS)
      CALL MEANCAL17(I,NIT,PRODEE,MEPRODEE)
      CALL MEANCAL16(I,NIT,PROPUS,MEPROPUS)
      CALL MEANCAL16(I,NIT,LNIMPROW,MELNIMPROW)
      CALL MEANCAL15(I,NIT,CONSUS,MECONSUS)
      IF (I.GT.5) THEN
      CALL MEANCAL16(I,NIT,PRODCHROW,MEPRODCHROW)
      ENDIF
C     WRITE(8,*)'MEPRODEC',MEPRODEC(N-2)
C     WRITE(8,*)'MEPRODCAN',MEPRODCAN(N-2)
C     WRITE(8,*)'MESTKCAN',MESTKCAN(N-2)
C     WRITE(8,*)'MESTKCG',MESTKCG(N-2)
C     WRITE(8,*)'MEPRIVUS',MEPRIVUS(N-2)
C     WRITE(8,*)'MEPRIVEC',MEPRIVEC(N-2)
C     WRITE(8,*)'MEFOR',MEFOR(N-2)
C     WRITE(8,*)'MEINT',MEINT(N-2)
C     WRITE(8,*)'MEPW',MEPW(N)
C     WRITE(8,*)'MEPFARMUS',MEPFARMUS(N)
C     WRITE(8,*)'MEPMKTEC',MEPMKTEC(N)
C     WRITE(8,*)'MEPCANR',MEPCANR(N)
C     WRITE(8,*)'MEPRODEE',MEPRODEE(N-1)
C     WRITE(8,*)'MEIMPEE',MEIMPEE(N-2)
C     WRITE(8,*)'MEYUS',MEYUS(N-2)
C     WRITE(8,*)'MECONSUS',MECONSUS(I)
C
10    CONTINUE
      CALL MOMCAL(PW,RUN,NIT,MEANPW,SDPW,SKPW,KUPW)
      CALL MOMCAL(REALPW,RUN,NIT,MEANREALPW,SDREALPW,SKREALPW,
     *  KUREALPW)
      CALL MOMCAL(ESUS,RUN,NIT,MEESUS,SDESUS,SKESUS,KUESUS)
      CALL MOMCAL(ESEC,RUN,NIT,MEESEC,SDESEC,SKESEC,KUESEC)
      CALL MOMCAL(ESCAN,RUN,NIT,MEESCAN,SDESCAN,SKESCAN,KUESCAN)
      CALL MOMCAL(CGCAL,RUN,NIT,MEESCG,SDESCG,SKESCG,KUESCG)
      CALL MOMCAL(STKUS,RUN,NIT,MESTKUS,SDSTKUS,SKSTKUS,KUSTKUS)
      CALL MOMCAL(STKEC,RUN,NIT,MESTKEC,SDSTKEC,SKSTKEC,KUSTKEC)
```

```
      CALL MOMCAL (STKCAN,RUN,NIT,MEANSTKCAN,SDSTKCAN,SKSTKCAN,
     *   KUSTKCAN)
      CALL MOMCAL(STKCG,RUN,NIT,MEANSTKCG,SDSTKCG,SKSTKCG,KUSTKCG)
      CALL MOMCAL(PRIVUS,RUN,NIT,MEANPRIVUS,SDPRIVUS,SKPRIVUS,
     *   KUPRIVUS)
      CALL MOMCAL(PRIVEC,RUN,NIT,MEANPRIVEC,SDPRIVEC,SKPRIVEC,
     *   KUPRIVEC)
      CALL MOMCAL(XREF,RUN,NIT,MEXREF,SDXREF,SKXREF,KUXREF)
      CALL MOMCAL(FOR,RUN,NIT,MEANFOR,SDFOR,SKFOR,KUFOR)
      CALL MOMCAL(INT,RUN,NIT,MEANINT,SDINT,SKINT,KUINT)
      CALL MOMCAL(XBILL,RUN,NIT,MEXBILL,SDXBILL,SKXBILL,KUXBILL)
      CALL MOMCAL(AMSUS,RUN,NIT,MEAMSUS,SDAMSUS,SKAMSUS,KUAMSUS)
      CALL MOMCAL(AMSEC,RUN,NIT,MEAMSEC,SDAMSEC,SKAMSEC,KUAMSEC)
      CALL MOMCAL(MTAREC,RUN,NIT,MEMTAREC,SDMTAREC,SKMTAREC,
     *  KUMTAREC)
      CALL MOMCAL(IMPEE,RUN,NIT,MEANIMPEE,SDIMPEE,SKIMPEE,
     *  KUIMPEE)
      CALL MOMCAL(IMPROW,RUN,NIT,MEANIMPROW,SDIMPROW,SKIMPROW,
     *  KUIMPROW)
C
C*********************************************************************
C   Print Routine
C*********************************************************************
C
C     WRITE(8,*) TITLE
      WRITE(8,*)'                                                  '
      WRITE(8,*)'WORLD MARKET PRICE - NOMINAL'
      WRITE(8,900)
      CALL WTE(RUN,MEANPW,SDPW,SKPW,KUPW)
      WRITE(8,*)'EXCESS SUPPLY'
      WRITE(8,*)'  USA'
      CALL WTE(RUN,MEESUS,SDESUS,SKESUS,KUESUS)
      WRITE(8,*)'                                                  '
      WRITE(8,*)'  EC12'
      CALL WTE(RUN,MEESEC,SDESEC,SKESEC,KUESEC)
      WRITE(8,*)'                                                  '
      WRITE(8,*)'  CANADA'
      CALL WTE(RUN,MEESCAN,SDESCAN,SKESCAN,KUESCAN)
      WRITE(8,*)'                                                  '
```

```
      WRITE(8,*)'CAIRNS GROUP'
      CALL WTE(RUN,MEESCG,SDESCG,SKESCG,KUESCG)
      WRITE(8,*)'                                              '
      WRITE(8,*)'                                              '
      WRITE(8,*)'STOCKS - TOTAL'
      WRITE(8,900)
      WRITE(8,*)'  USA'
      CALL WTE(RUN,MESTKUS,SDSTKUS,SKSTKUS,KUSTKUS)
      WRITE(8,*)'                                              '
      WRITE(8,*)'  EC12'
      CALL WTE(RUN,MESTKEC,SDSTKEC,SKSTKEC,KUSTKEC)
      WRITE(8,*)'                                              '
      WRITE(8,*)'  CANADA'
      CALL WTE(RUN,MEANSTKCAN,SDSTKCAN,SKSTKCAN,KUSTKCAN)
      WRITE(8,*)'                                              '
      WRITE(8,*)'  CAIRNS GROUP'
      CALL WTE(RUN,MEANSTKCG,SDSTKCG,SKSTKCG,KUSTKCG)
      WRITE(8,*)'                                              '
      WRITE(8,*)'PRIVATE STOCKS'
      WRITE(8,*)'  USA'
      CALL WTE(RUN,MEANPRIVUS,SDPRIVUS,SKPRIVUS,KUPRIVUS)
      WRITE(8,*)'                                              '
      WRITE(8,*)'  EC12'
      CALL WTE(RUN,MEANPRIVEC,SDPRIVEC,SKPRIVEC,KUPRIVEC)
      WRITE(8,*)'                                              '
      WRITE(8,*)'OTHER STOCKS'
      WRITE(8,*)'  USA'
      WRITE(8,*)'CCC STOCKS'
      WRITE(8,*)'YEAR'
      DO 67 K=1,RUN
      WRITE(8,911)K,CCC(K+1)
67    CONTINUE
      WRITE(8,*)'                                              '
      WRITE(8,*)'FOR STOCKS'
      CALL WTE(RUN,MEANFOR,SDFOR,SKFOR,KUFOR)
      WRITE(8,*)'                                              '
      WRITE(8,*)'  EC INTERVENTION STOCKS'
      CALL WTE(RUN,MEANINT,SDINT,SKINT,KUINT)
```

```
      WRITE(8,*)'                                                  '
      WRITE(8,*)'                                                  '
      WRITE(8,*)'GATT MEASURES'
      WRITE(8,900)
      WRITE(8,*)'                                                  '
      WRITE(8,*)'AMS'
      WRITE(8,*)'USA'
      CALL WTE(RUN,MEAMSUS,SDAMSUS,SKAMSUS,KUAMSUS)
      WRITE(8,*)'                                                  '
      WRITE(8,*)'EC12'
      CALL WTE(RUN,MEAMSEC,SDAMSEC,SKAMSEC,KUAMSEC)
      WRITE(8,*)'                                                  '
      WRITE(8,*)'IMPORT PROTECTION - EC'
      CALL WTE(RUN,MEMTAREC,SDMTAREC,SKMTAREC,KUMTAREC)
      WRITE(8,*)'                                                  '
      WRITE(8,*)'EXPORT REFUNDS - EC'
      WRITE(8,*)'TOTAL'
      CALL WTE(RUN,MEXBILL,SDXBILL,SKXBILL,KUXBILL)
      WRITE(8,*)'                                                  '
      WRITE(8,*)'UNIT'
      CALL WTE(RUN,MEXREF,SDXREF,SKXREF,KUXREF)
      WRITE(8,*)'                                                  '
C
900   FORMAT(1X,'------------------------------------------------')
911   FORMAT(1X,I3,F11.2)
C
800   STOP
      END
C
C%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
C             End of main programme: Subroutines follow
C%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
C
C***********************************************************************
C       Calculation of USCAL, ECCAL, CANCAL & CGCAL
C***********************************************************************
C
      SUBROUTINE USSUB(I,N,NIT,TREND,PF,Y,MEPW,TP,YDP,ARP,LR,
```

```
     *  BASE,LRFOR,MEPRIV,LIV,CCC,SET,PT,PRODCAL,AREA,
     *  CD,USCAL,DEFPW,EPW,TOTGR,MEPROP,PJ,D86,MEFOR,D87,
     *  D88,D89,D90,MEYEXP,MECONS)
       EXTERNAL G05DDF
      INTEGER N,TREND,I,D87(15),D86(15),D88(15),D90(15),
     *  D89(15)
      REAL PF(18),MEPW(18),YDP,TP(15),ARP(17),LR(16),BASE(17),
     *  LRFOR(16),MEPRIV(16),LIV(15),CCC(16),SET(17),
     *  AREA(15),CD(17),USCAL(15,200),DEFPW(18),MEFOR(16),
     *   PTEMP,MEYEXP(16),ERETN,ERETP,AREAP,AREAN,MECONS(15),
     * LNAREAN,LNERETN,EDP,EPW,TOTGR(16),MEPROP(16),PJ(16),
     * PT(17),PRODCAL(15,200),Y(15,200),YEXP,MINP,MAXP,
     * PTEMP2,PTEMP3,TST
      DATA PTEMP,P,ERETP,EDP,AREAP,LNAREAN,LNERETN,
     *  ERETN,AREAN,MINP,MAXP,PTEMP2,PTEMP3,TST/14*0.0/
C
      PTEMP = (PF(N-3)+PF(N-2)+PF(N-1))/3
       IF(PTEMP.GT.PF(N-1))THEN
         P = PF(N-1)
       ELSE
        P = PTEMP
       ENDIF
      YEXP = (0.30101*2.32)+(0.02934*(TREND-(0.69899*(
     *  TREND-1))))+(0.69899*MEYEXP(N-3))-(0.20422*D86(I))-(
     *  0.28253*D88(I))-(0.48283*D89(I))
      ERETN = P*YEXP
      LNERETN = ALOG(ERETN)
      LNAREAN = -3.1226+(2.2902*LNERETN)
      AREAN = 2.718281828**LNAREAN
      EDP = TP(I) - P
      IF (I.GT.5) THEN
        PTEMP2= (PTEMP*3)+PF(N-4)+PF(N-5)
        MINP= PF(N-5)
       DO 44 K=N-4,N-1
        TST = PF(K)
        IF (TST.LT.MINP) MINP=TST
44      CONTINUE
       TST=0.0
```

```
      MAXP = PF(N-5)
      DO 45 K= N-4,N-1
       TST = PF(K)
       IF (TST.GT.MAXP) MAXP=TST
45    CONTINUE
       PTEMP3= (PTEMP2-MAXP-MINP)/3
       LR(N-2) = (PTEMP3/DEFPW(N))*100
       IF (LR(N-2).LT.85.0) THEN
        LR(N-2) = 85.0
       ENDIF
       IF (LR(N-2).LT.(0.95*LR(N-3))) THEN
        LR(N-2) = LR(N-3)
       ENDIF
C
      PTEMP = 0.0
      PTEMP = (MEPRIV(N-3)+MEFOR(N-3)+CCC(N-3))/MECONS(I-1)
        IF (PTEMP.GT.0.4) THEN
         ARP(N-1) = 12.5
        ELSE
         ARP(N-1) = 7.5
        ENDIF
     ENDIF
C
     ERETP = (EDP*YDP*(1-(ARP(N-1)/100)))+(YEXP*((LR(N-2)
    * /DEFPW(N))*100)*(1-(ARP(N-1)/100)))
     PT(N-1) = 108.49-(0.156*ERETN)+(0.022*ERETP)
     IF (I.GT.5) THEN
      BASE(N-1) = (0.8*BASE(N-2))+(0.2*(AREA(I-1)+SET(N-2)))
     ENDIF
     SET(N-1)=1.257*((ARP(N-1)/100)*BASE(N-1)*(PT(N-1)/100))
     AREAP = ((PT(N-1)/100)*BASE(N-1))-SET(N-1)
     AREA(I) = (AREAP+AREAN)
C
     CD(N-1)= (0.36897*CD(2))+(262.79*(TREND-(0.63103*
    * (TREND-1))))+(0.63103*CD(N-3))
C
     IF((I.NE.3).AND.(I.NE.5)) THEN
     TOTGR(N-2) = (0.72994*TOTGR(N-3))+(0.22226*LIV(I))
    *   +(16100*D87(I))
```

```
     * -(25376*D89(I))
      ELSE IF (I.EQ.3) THEN
      TOTGR(N-2) = (0.72994*(TOTGR(N-3)-116100))+(0.22226*LIV(I))
      ELSE IF (I.EQ.5) THEN
      TOTGR(N-2) = (0.72994*(TOTGR(N-3)+25376))+(0.22226*LIV(I))
      ENDIF
      IF (I.NE.2) THEN
       CCC(N-2)=(8.875*(LR(N-2)-(0.62885*LR(N-3))))+(0.62885*CCC(N-
     *  3))+(11997.0*D86(I))
      ELSE
       CCC(N-2)=(8.875*(LR(N-2)-(0.62885*LR(N-3))))+(0.62885*(CCC(N-
     *  3)-11997.0))
      ENDIF
      DO 15 K=1,NIT
      IF (I.LT.6) THEN
      Y(I,K) = YEXP
      ELSE
      ERROR = 0.0
      ERROR = G05DDF(-0.0331463,0.19386949)
        IF (ABS(ERROR).GT.0.48467373) THEN
         WRITE(8,*)'US ERROR exceeds 2.5 st.dev.',I,K
        ENDIF
      Y(I,K) = YEXP + ERROR
      ENDIF
      PRODCAL(I,K) = AREA(I) * Y(I,K)
      USCAL(I,K)=PRODCAL(I,K)-CD(N-1)-((0.065133+(0.41974*
     * MEPROP(N-3))+(0.046529*D86(I)))*TOTGR(N-2))+(7158.1*
     * D88(I))-8486.6+(0.64534*MEPRIV(N-3))-CCC(N-2)+CCC(N-3)-
     * (5376.3108*(MEPW(N-1)/LRFOR(N-3)))-(3391.4*(MEPW(N-1)
     * /EPW))-12421.653-(4453.3*D86(I))+(0.4173*MEFOR(N-3))
15    CONTINUE
      RETURN
      END
C
C*********************************************************************
C      EC`12'
C*********************************************************************
      SUBROUTINE ECSUB(I,N,NIT,TREND,PBA,YB,YBARB,LIV,INT,
     *  PRIV,PMKT,ECCAL,PRODCAL,CF,POP,DEF,CD,AREA,EPT,D86,
```

```
*  INTP,CONS,D88,D87,D90,MEINT,MEPRIV,MEPROD,
*  COMP,SET)
 EXTERNAL G05DDF
 INTEGER N,TREND,I,D86(15),D88(15),D87(15),D90(15)
 REAL PBA(18),YB,YBARB,MEPROD(16),LIV(18),MEINT(16),
* MEPRIV(16),PMKT(18),PTEMP,CF(17),ECCAL(15,200),YEXPBAR,
* CD(16),RESPROD,AREA(15),ERETWH,ERETBA,P,PJ,POP(17),
* EPT,CONS(15),INT(15,200),PRODCAL(15,200),PRIV(15,200),
* PTEMPBAR,DEF(17),INTP(15),COMP(15),YEXP,SET(15)
 DATA PTEMP,PTEMPBAR,YEXP,YEXPBAR,RESPROD,ERETWH,
*  ERETBA,P,PJ/9*0.0/
C
 YEXP = YB+(0.12569*TREND)-(0.189*D87(I))
 YEXPBAR = YBARB+(0.055285*TREND)+(0.26359*D88(I))
 PTEMP = (PMKT(N-3)+PMKT(N-2)+PMKT(N-1))/3
   IF(PTEMP.GT.PMKT(N-1))THEN
    P = PMKT(N-1)
   ELSE
    P=PTEMP
   ENDIF
 PTEMPBAR = (PBA(N-1)+PBA(N-2)+PBA(N-3))/3
   IF(PTEMPBAR.GT.PBA(N-1))THEN
    PJ=PBA(N-1)
   ELSE
    PJ=PTEMPBAR
   ENDIF
 PTEMP = 0.0
 IF (I.EQ.1) THEN
  PTEMP = INTP(I)
 ELSE
  PTEMP = (INTP(I)*0.94)-5.38
 ENDIF
 ERETWH = YEXP*P
 ERETBA = YEXPBAR*PJ
 IF (I.LT.8) THEN
 AREA(I) = 10439.0+(4329.1*(ERETWH/ERETBA))-(582.08*
*  D88(I))
 ELSE
```

```
      AREA(I) = 10439.0+(4329.1*(ERETWH/ERETBA))-(582.08*
     * D88(I))-((SET(I)/100)*15989)
      ENDIF
      CD(N-2) = (0.21518*CD(N-3))+(125.6*(POP(N-1)-(0.21518*
     * POP(N-2))))-(28.693*(PTEMP-(0.21518*PMKT(N-1))))
      CF(N-1)=(0.91377*CF(N-2))-(0.56663*CF(N-3))+(0.036836*
     * LIV(N))-(0.033654*LIV(N-1))+(0.020869*LIV(N-2))-
     * (3487.5*PTEMP/DEF(N-1))+(3178.5*PMKT(N-1)/DEF(N-2))
     * -(1971.0225*PMKT(N-2)/DEF(N-3))
      CONS(I) = CF(N-1)+CD(N-2)
C
      DO 15 K=1,NIT
      IF (I.LT.6) THEN
       PRODCAL(I,K) = AREA(I)*YEXP
      ELSE
       ERROR = 0.0
        ERROR = G05DDF(0.0,0.16438)
        IF (ABS(ERROR).GT.0.41095) THEN
         WRITE(8,*)'EC ERROR exceeds 2.5 st.dev.',I,K
        ENDIF
        Y = YEXP+ERROR
        PRODCAL(I,K) = AREA(I)*Y
      ENDIF
      RESPROD = PRODCAL(I,K)-(72632+(2265.0*TREND))
      INT(I,K)=1346.6+(0.15348*RESPROD)+(0.62304*(MEINT(N-3)))
C    * -(6370.9*D86(I))))+(5002.6*D90(I))
      PRIV(I,K) = (0.16162*(PRODCAL(I,K)-MEPROD(N-3)))
     * +(102.75*EPT)-(57.86*PTEMP)
C
      ECCAL(I,K)=PRODCAL(I,K)-CONS(I)-PRIV(I,K)-INT(I,K)
     * +MEPRIV(N-3)+MEINT(N-3)
15    CONTINUE
      RETURN
      END
C
C**********************************************************************
C      Canada
C**********************************************************************
```

```
      SUBROUTINE CANSUB(I,N,NIT,TREND,AREA,PCAN,EP,EPT,LNCD,CONS,
     *  STK,PRODCAL,CANCAL,CF,CD,PRODCH,D86,MESTK,MEPROD)
      EXTERNAL G05DDF
      INTEGER N,TREND,I,D86(15)
      REAL AREA(16),LNCD(17),STK(15,200),CANCAL(15,200),CONS(15),
     *  PRODCAL(15,200),Y,EP,EPT,CF,CD(15),PCAN(18),PRODCH(15,200),
     *  LNP,MESTK(16),MEPROD(16),PTEMP,P,Y2
      DATA PTEMP,Y,P,Y2/4*0.0/
C
       PTEMP = (PCAN(N-1)+PCAN(N-2)+PCAN(N-3))/3
        IF(PTEMP.GT.PCAN(N-1))THEN
         P=PCAN(N-1)
        ELSE
         P=PTEMP
        ENDIF
      AREA(N-2) = 2746.5+(0.74514*AREA(N-3))+(4.6239*P)
      CF=3420.00
      LNCD(N-1) = LNCD(2)+(0.01576*TREND)
      CD(I) = 2.718281828**LNCD(N-1)
      CONS(I)=CF+CD(I)
      IF (I.EQ.3) THEN
       Y=1.23
      ELSE
       Y=1.91
      ENDIF
      DO 15 K=1,NIT
      IF (I.LT.6) THEN
       PRODCAL(I,K) = AREA(N-2)*Y
      ELSE
       ERROR = 0.0
       Y2=0.0
        ERROR = G05DDF(-0.076087,0.24583326)
        IF (ABS(ERROR).GT.0.614583) THEN
         WRITE(8,*)'CANADIAN ERROR exceeds 2.5 st.dev.',I,K
        ENDIF
        Y2= Y+ERROR
        PRODCAL(I,K) = AREA(N-2)*Y2
      ENDIF
```

```
      PRODCH(I,K) = PRODCAL(I,K)-MEPROD(N-3)
      CANCAL(I,K)=PRODCAL(I,K)-CONS(I)-4826.1+(0.49677*
     *  MESTK(N-3))-(0.28219*PRODCH(I,K))+(114.14*EPT)
15    CONTINUE
      RETURN
      END
C
C*********************************************************************
C       Cairns Group
C*********************************************************************
      SUBROUTINE CGSUB(I,N,NIT,TREND,YB,AREA,MEPW,PJ,STK,LIV,
     *   CF,CD,CGCAL,PRODCAL,CONS,TOTGR,D86,D87,MESTK)
      EXTERNAL G05DDF
      INTEGER N,TREND,I,D86(15),D87(15)
      REAL YB,AREA(16),MESTK(16),MEPW(18),PJ(18),LIV(15),P,
     * PTEMP,PJTEMP,CONS(15),Y,PRODCAL(15,200),CGCAL(15,200),
     * RESPROD,TOTGR(16),STK(15,200),CF(15),CD(15),PSUB,Y2
      DATA PTEMP,PJTEMP,P,PSUB,RESPROD,Y,Y2/7*0.0/
C
       PTEMP = (MEPW(N-1)+MEPW(N-2)+MEPW(N-3))/3
        IF(PTEMP.GT.MEPW(N-1))THEN
         P=MEPW(N-1)
        ELSE
         P=PTEMP
        ENDIF
       PJTEMP = (PJ(N-1)+PJ(N-2)+PJ(N-3))/3
        IF(PJTEMP.GT.PJ(N-1))THEN
         PSUB=PJ(N-1)
        ELSE
         PSUB=PJTEMP
        ENDIF
      AREA(N-2)= 6821.4+(0.641*AREA(N-3))+(22.537*(P-PSUB))
      TOTGR(N-2) = (0.22319*TOTGR(N-3))+(0.038782*LIV(I))+
     *   (802*(TREND+26))+(3198.1*D86(I))
      CF(I) = 0.079934*TOTGR(N-2)
      CD(I) = 22403.00+(431.73*TREND)
      CONS(I)=CD(I)+CF(I)
      DO 15 K=1,NIT
```

```
      IF (I.LT.6) THEN
      Y=YB+(0.021*TREND)
      PRODCAL(I,K) = AREA(N-2)*Y
      ELSE
      Y2=0.0
      ERROR = 0.0
      ERROR = G05DDF(-0.03754,0.17264)
       IF(ABS(ERROR).GT.0.4316) THEN
        WRITE(8,*)'CG ERROR exceeds 2.5 st.dev.',I,K
        ENDIF
      Y2= Y+ERROR
      PRODCAL(I,K) = AREA(N-2)*Y2
      ENDIF
      RESPROD = PRODCAL(I,K)-(39003.0+(831.23*TREND))
      STK(I,K)= 2124.1+(0.4068*RESPROD)+(0.5441*MESTK(N-3))
C
      IF (STK(I,K).LT.0.0) STK(I,K)=0.0
C
      CGCAL(I,K) = PRODCAL(I,K)-CONS(I)-STK(I,K)+MESTK(N-3)
15    CONTINUE
      RETURN
      END
C
C*********************************************************************
C      Eastern European Imports
C*********************************************************************
C
      SUBROUTINE EESUB(I,N,NIT,TREND,AREA,IMPEE,PROD,D87,D88,
     * D89PLUS,MEPROD,MEIMP)
      EXTERNAL G05DDF,G05CCF
      INTEGER N,TREND,I,D87(15),D88(15),D89PLUS(15)
      REAL AREA(15),MEIMP(16),Y,MEPROD(17),IMPEE(15,200),
     *  PROD(15,200),Y2
      DO 15 K=1,NIT
      IF (I.EQ.1) THEN
       Y=1.8943
      ELSE
       Y=1.60732+(0.013622*TREND)+(0.4499*D89PLUS(I))
```

```
      ENDIF
      IF (I.LT.6) THEN
      PROD(I,K) = AREA(I)*Y
      ELSE
      Y2 = 0.0
      ERROR = 0.0
      ERROR = G05DDF(0.0,0.12591018)
       IF(ABS(ERROR).GT.0.31477544) THEN
        WRITE(8,*)'CIS ERROR exceeds 2.5 st.dev.',I,K
        ENDIF
      Y2= Y+ERROR
      PROD(I,K) = AREA(I)*Y2
      ENDIF
      IMPEE(I,K)= 2968.6+(0.90464*MEIMP(N-3))-(0.18038*(PROD(I,K)
     *  -MEPROD(N-2)))
     *  -(6761.7*D88(I))
15    CONTINUE
      RETURN
      END
C
C**********************************************************************
C       Termination Routine for 2 Roots Outside of the Specified
Range
C**********************************************************************
C
      SUBROUTINE ENDSUB(X1,X2,I,K)
      INTEGER I,K
      REAL X1(2),X2(2)
C     WRITE(8,*) 'In year',I,K
C     WRITE(8,*) 'Both roots are outside of the 2.5 st.dev. range'
C     WRITE(8,*) 'X1 is',x1(1),X1(2)
C     WRITE(8,*) 'X2 is',x2(1),X2(2)
      RETURN
      END
C
C**********************************************************************
C    Subroutines for calculating means of variables with differing
array
C    size
```

```
C***********************************************************************
C
      SUBROUTINE MEANCAL18(I,NIT,ARRAY,ME)
      INTEGER I,NIT
      REAL ARRAY(15,200),ME(18),SUM
      ME(I+3) = 0.0
      SUM=0.0
      DO 1 K=1,NIT
       SUM=SUM+ARRAY(I,K)
1     CONTINUE
      ME(I+3) = SUM/NIT
      RETURN
      END
C
C***********************************************************************
C
      SUBROUTINE MEANCAL17(I,NIT,ARRAY,ME)
      INTEGER I,NIT
      REAL ARRAY(15,200),ME(17),SUM
      ME(I+2)=0.0
      SUM=0.0
      DO 2 K=1,NIT
       SUM=SUM+ARRAY(I,K)
2     CONTINUE
      ME(I+2)=SUM/NIT
      RETURN
      END
C
C***********************************************************************
C
      SUBROUTINE MEANCAL16(I,NIT,ARRAY,ME)
      INTEGER I,NIT
      REAL ARRAY(15,200),ME(16),SUM
      ME(I+1)=0.0
      SUM=0.0
      DO 3 K=1,NIT
       SUM=SUM+ARRAY(I,K)
3     CONTINUE
```

```
      ME(I+1)=SUM/NIT
      RETURN
      END
C
C************************************************************************
C
      SUBROUTINE MEANCAL15(I,NIT,ARRAY,ME)
      INTEGER I
      REAL ARRAY(15,200),ME(15),SUM
      ME(I)=0.0
      SUM=0.0
      DO 4 K=1,NIT
       SUM=SUM+ARRAY(I,K)
4     CONTINUE
      ME(I)=SUM/NIT
      RETURN
      END
C
C************************************************************************
C   Reset subroutine for expected world prices etc.
C************************************************************************
C
      SUBROUTINE RESET(N,TREND,EPW,PW,P,I,EPWT,EPCAN,EPCANT,
     *  EPEC,EPECT)
      INTEGER N,TREND,I
      REAL PW,P,EPW,EPWT,EPCAN,EPCANT,EPEC,EPECT
      IF (I.NE.1) THEN
       TREND = TREND+1
       N=N+1
       PW=0.0
       P=0.0
       EPW=0.0
9      EPWT = 0.0
       EPCAN = 0.0
       EPCANT = 0.0
       EPEC = 0.0
       EPECT = 0.0
      ENDIF
```

```
      RETURN
      END
C
C*******************************************************************
C     Subroutines to calculate the moments of the probability dist.
C*******************************************************************
C
      SUBROUTINE MOMCAL(ARRAY,RUN,NIT,ME,SD,SK,KU)
      REAL ARRAY(15,200),ME(15),SD(15),SK(15),KU(15),SUM1,
     *  SUM2,SUM3,SUM4
      INTEGER RUN,NIT
      DO 10 I=1,RUN
      SUM1 = 0.0
      SUM2 = 0.0
      SUM3 = 0.0
      SUM4 = 0.0
      DO 20 K=1,NIT
       SUM1 = SUM1+ARRAY(I,K)
20    CONTINUE
      ME(I) = SUM1/NIT
      DO 30 J=1,NIT
       SUM2 = SUM2 + (ARRAY(I,J)-ME(I))**2
       SUM3 = SUM3 + (ARRAY(I,J)-ME(I))**3
       SUM4 = SUM4 + (ARRAY(I,J)-ME(I))**4
30     CONTINUE
       SD(I) = SQRT(SUM2/NIT)
       SK(I) = SUM3/NIT
       KU(I) = SUM4/NIT
10     CONTINUE
       RETURN
       END
C
C*******************************************************************
C    Output subroutine
C*******************************************************************
C
      SUBROUTINE WTE(RUN,ME,SD,SK,KU)
      INTEGER RUN
```

```
      REAL SD(15),SK(15),KU(15),ME(15)
       WRITE(8,900)
       WRITE(8,901)
       DO 12 I=1,RUN
       WRITE(8,902) I,ME(I),SD(I),SK(I),KU(I)
12     CONTINUE
900    FORMAT(1X,'YEAR',7X,'MEAN',10X,'ST.DEV.',10X,'SKEWNESS',
     *  10X,'KURTOSIS')
901   FORMAT(1X,'------     -------        ----------        -----------
     *      ---------')
902   FORMAT(1X,I3,F12.2,F13.2,F18.2,F23.2)
      RETURN
      END
```