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The effects of a worldwide liberalisation of the markets for cereals, oilseeds and pulses on agriculture in the European Union

eurostat

Joint publication of Eurostat
and the Institute for Agricultural Policy of the University of Bonn

The effects of a worldwide liberalisation of the markets for cereals, oilseeds and pulses on agriculture in the European Union

Results obtained using mutually linked models at various levels of analysis

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server (http://europa.eu.int).

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Wilhelm Henrichsmeyer
Institute for Agricultural Policy of the University of Bonn

1. THE PROBLEM

A high level of state intervention has long been a typical feature of agricultural market policy in most countries of the world. The nature and extent of such intervention differ widely, however, depending above all on the level of development and the status of the agricultural sector in the economy as a whole. In western industrialised countries, for example, measures for protecting domestic agriculture are usually in the foreground, though to varying extents, depending on the political and economic situation. In developing countries the dominant objectives are usually to provide cheap food for the urban population and to obtain government revenue (e.g. through export duty on agricultural products), which often results in negative protection rates for farm products. As their level of income rises, however, many emergent countries (such as Korea) are also beginning to apply protection measures to their agriculture.

These multiple and variable interventions seriously distort international output and trade structures. Such distortions, in turn, not only cause substantial losses of wealth in individual countries, but also constantly give rise to serious trade conflicts. A particular disadvantage for EU agricultural policy is the heavy pressure exerted on the world market prices of many agricultural products as the western industrialised countries try to outbid each other's export subsidies, further escalating market regulation costs.

The first attempt to stem the tide of agricultural protection came with the GATT agreements in the Uruguay Round. Consensus was reached on the first steps towards liberalising the world agricultural economy: to reduce external protection and to limit domestic intervention at the same time. The EU agricultural reform of 1992 was part of this move. On the one hand it enabled the EU to play a part in the GATT negotiations and agree to the final compromise solutions; and on the other, the GATT decisions in the Uruguay Round limit the room for manoeuvre for EU agricultural policy until the year 2000. Moreover, the start of the negotiations for the next round of WTO talks, due in 1999, is already looming. As early as 1996 the USA took a significant stride towards further liberalisation in the form of the new Farm Bill, converting product-linked subsidies to direct income transfers ("decoupling"). Various other countries are heading in the same direction and so, of course, is the Cairns Group. Further steps towards liberalisation of the world agricultural market can therefore be expected to emerge from the next WTO round. These are likely to come in the form of *basic framework agreements* such as:

- external protection not through import levies, but only through fixed customs duties ("tarification");
- prohibition of product-linked subsidies (including the current form of price-compensatory payments in the EU), to be replaced by product-independent direct income transfers ("decoupling");
- possible prohibition of, or at least severe restrictions on, export subsidies.

A further reduction in external protection (in the forms still permitted), perhaps of a size similar to that agreed during the Uruguay Round, is also likely to happen.

This basic trend in efforts towards world-wide policy reform is the background to the political scenarios analysed in this study. No attempt will be made to predict the results of the multilateral negotiation process or to build these into the scenario. Instead a few very simple basic assumptions will be used as the basis for a rigorous abstraction of the effects of full world-wide liberalisation in some crucial areas of crop production (cereals, oilseeds and pulses) while existing agricultural policy continues in other areas (particularly milk and sugar).

This asymmetrical policy scenario may not be so totally removed from reality, since the two global players in agriculture, the USA and the EU, have already achieved (USA) or taken large strides towards (EU) extensive liberalisation in cereals, oilseeds and pulses, and both will be reluctant, at least in the medium term, to abandon their existing milk and sugar quota systems, linked to high external protection, even under heavy negotiation pressure.

2. THE ANALYTICAL APPROACH

The world-wide liberalisation of the markets for cereals, oilseeds and pulses will have an impact at various levels through a variety of interlinked mechanisms. This study attempts to throw light on aspects of this complex state of affairs by using quantitative model analysis, taking into account the interactions between the various levels of investigation through specific scenarios.

It is evident that this type of approach can be used for a study of this kind only if a well-chosen set of validated models is already available at the various levels. The models used for this study have been developed over the past 15 years by the Institute for Agricultural Policy of the University of Bonn contracted by the European Commission and the Federal Ministry of Agriculture in Germany for co-operation on a series of research projects on various topics.

(1) The global effects of the liberalisation of cereals, oilseeds and pulses on international agricultural trade and world market prices are examined on a world scale. These comprehensive impact analyses are carried out with the help of the **World Agricultural Trade Simulation Model (WATSIM)**, whose medium-term version provides a differentiated picture of protection policies and is thus eminently suited to the impact analyses in this study. This model was developed at the end of the 1980s as a tool for analysing GATT scenarios for the European Commission (DG VI).

(2) The world market price effects derived from the global trade model form a basis for specific impact analyses at *EU-15 level*. The **Medium-term Forecast and Simulation System of the Sectoral Production and Income Model for Agriculture of the European Union (SPEL/EU-MFSS)** is used for this, enabling a differentiated picture of market and income policy measures under EU agricultural policy and the effects of (partial) liberalisation on output, resource allocation and income in the Member States.
The SPEL system was developed as part of a joint long-term research contract with Eurostat's unit "Economic and structural statistics for agriculture" (project leader: Dr. F. Pfähler).

(3) World-market-orientated liberalisation in such a crucial area of crop production can also be expected to have very different impacts on land use, the environment, agricultural income and employment from region to region. The results of a **highly differentiated regional agriculture/environment model for the Federal Republic of Germany (RAUMIS)** have been used to enable the associated problems to be identified. The RAUMIS model system has been developed over the past decade for the Federal Ministry of Agriculture and is currently being used for policy analyses and simulation calculations.

(4) The liberalisation of cereals, oilseeds and pulses will not only affect different regions in highly disparate way, it will also have disparate effects on the various types and sizes of holding. As a first attempt to illustrate this we show the results of some simple calculations of comparative-static models with the help of a **farm-holding group model for German agriculture (the DIES Model)**, based on accounting data. This model has been developed with the Federal Ministry of Agriculture, and is currently being used to analyse the income situation in German agriculture (*Agrarbericht der Bundesregierung* – "Federal Government Agricultural Report") and for policy-related simulation calculations.

The models used in this study have so far been applied only to analyses and simulation calculations at the level of observation concerned, not interactively for analysing complex problems of the type examined here. The study therefore has methodological as well as content-related aims:

- for *methodological* purposes, we examine the possibilities and problems of linking different models at various levels of aggregation;
- the *content-related* aim is to throw light on the complex effects of a world-wide (partial) liberalisation at various levels of observation by means of a collective interpretation of the model results.

Martin von Lampe
Institute for Agricultural Policy of the University of Bonn

1. DESCRIPTION OF THE MODEL

1.1. Theoretical concept and methodological approach

The World Agricultural Trade Simulation Model (WATSIM) was developed for the European Commission at the end of the 1980s. It was initiated as a tool for analysing the effects of agricultural policy instruments on trade in agricultural products in the various regions of the world, with particular reference to the Uruguay Round of the GATT negotiations. Methodologically, it can be described as a comparative-static, non-spatial model covering the most important agricultural products and depicting the world in 24 regions[1, 2].

Each region of the world has its own sub-model depicting agricultural output and demand by product, the latter being subdivided into human consumption, animal feed, industrial processing, seed use, losses and other uses. Products are considered homogeneous, and the corresponding quantities depend on the regional prices. The own and cross price elasticities controlling these responses in the various regions are drawn from a variety of publications, incorporating the expertise of a number of research teams.

The balancing of regional quantities for supply and demand and a change in stocks that is assumed to be constant for the simulation period gives the net trade positions of the regions.

The regional models are connected by a global core model, which interlinks the regions for both trade quantities and prices.

The price transmission equations describe the functional relationship between world and regional market prices. Apart from price differences resulting from transport costs and differences in quality, these linear equations also include trade barriers in the form of specific and ad-valorem tariffs. Production and demand are also stimulated by direct and indirect subsidies. These are converted into price effects in the form of producer and consumer subsidy equivalents and embedded in the price transmission equations. The incentive prices so defined determine supply and demand in the regions and thus the net trade.

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1 Half of the regions are defined by national frontiers (e.g. China, Brazil and the USA), the remainder being defined according to socio-economic and geographical criteria (e.g. the EU).

2 For a more detailed description cf. HENRICHSMEYER, W., BRITZ, W., EIDMANN, U., and VON LAMPE, M. (1995) *SPEL-TRADE Final Report - Documentation to the SPEL-TRADE Model, Version 95.* Institute for Agricultural Policy, Bonn (unpublished), p. 8ff. (At this time the model's name was SPEL-Trade, a name which is somewhat misleading.)

Finally, the net trade positions of all regions meet on the world market for each product, which is assumed to be a *spot market*. The solution algorithm balances these net trade positions by adjusting world market prices so that the sum of all net exports is equal to the sum of all net imports for each product[3].

1.2 Data sources

The WATSIM modelling system is based on an extensive database containing macroeconomic data, policy parameters and price and income elasticities of supply and demand as well as regional quantity and volume figures for output, demand and trade in agricultural products[4].

The most important source for quantities and volumes is the statistical material of the *United Nations Food and Agriculture Organization (FAO)*, in particular the regional *supply and utilization accounts (SUA)* and *trade domain*, from which data for some 200 countries of the world and about 190 primary and processed agricultural products are extracted. These are supplemented from further sources, particularly the *SCI World and FSU Agriculture Review*[5] for the states of the former Soviet Union.

The most important source for the elasticities used in the model is the *Static World Policy Simulation Modeling Framework (SWOPSIM)*[6]. Most macroeconomic data are taken from World Bank publications. Further sources are also used, such as OECD and USDA publications for creating policy parameter sets and the *GATT Schedules* prepared by the FAO. For some countries, specific studies are also referred to.

Mainly based on the SPEL model's data management system, the data from the various sources are subject to a thorough consistency assurance procedure and are aggregated to the regional and product sample used in WATSIM. In principle, these routines are designed in a way that different levels of aggregation can be formed with relatively little effort.

1.3 Representation of regional supply and demand quantities

1.3.1 General principles

The model depicts regional supply and demand quantities endogenously as a function of regional prices. The relevant functions basically consist of two parts:

- On the supply side, the trend-related constant takes account of technical progress, structural changes and set-aside measures; on the demand side it includes mainly the

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3 Statistical deviations may make the net world trade in a product different from zero. In such a case, these inconsistencies are taken into the simulation period unchanged in order to avoid repercussions for the model results.

4 Because price data are regularly lacking, the price results shown by the model must be interpreted primarily as price changes - the absolute levels are mostly *unit values*, sometimes only estimates, and must therefore be used with caution. Since the model operates with relative price changes, however, this is not a major limitation for the simulation results.

5 SPARCS COMPANIES, INC. (1994): SCI World and FSU Agriculture Review. Memphis/USA.

6 Cf. SULLIVAN, J., RONINGEN, V., LEETMAA, S., GRAY, D. (1992): A 1989 Global Database for the Static World Policy Simulation (SWOPSIM) Modeling Framework. ERS, Staff Report No. AGES 9215, Washington, D.C.

preference structure caused by different factors such as urbanization and a changing age structure.

- In addition, changes in the regional price structure also result in adjustments of supply and demand.

The equations for regional supply, demand for human consumption, animal feed and industrial processing therefore have the following structure:

$$(1)\quad Q_{i,r}^{sim} = Q_{i,r}^{trend} + Q_{i,r}^{bas} * \sum_{j} \varepsilon_{ij,r} * \left(\frac{P_{j,r}^{sim}}{P_{j,r}^{bas}} - 1 \right)$$

where:

Q	regional quantity of supply, demand for human consumption, animal feed or industrial processing
P	the corresponding incentive price (for supply: *producer incentive price*; for demand components: *consumer incentive price*)
ε	the price elasticity of the respective quantity response
i, j	product indices
r	regional index
sim	simulated value
$trend$	trend value
bas	base year value

1.3.2 *Representation of demand for animal feed*

Demand for animal feed is linked to livestock production through regional energy balances. A mixed estimation approach[7] is used to estimate energy requirement coefficients from the ex-post data for each animal product. Changes in feed efficiency resulting e.g. from technical progress are taken into account. The consistency of the energy balance sheets is assured both when determining the trendvalues and - by modifying the price elasticities of feed demand - in the market equilibrium.

1.3.3 *Calculation of trends*

The calculation of quantity trends for supply and the various components of demand takes place in three stages, in ascending order of priority:

1. The ex-post statistical trend is estimated in the light of product characteristics and regional peculiarities.
2. Since reliable data on regional price developments are missing and the effect of price changes thus cannot be isolated when estimating the trend, and because historical trends are often not a reliable guide to future developments, additionally the results of various other studies and model simulations are brought in to improve those of the trend projections. In this context the FAO projections for developing countries and the findings

[7] Cf. THEIL, H. (1971): Principles of Econometrics. Santa Barbara, New York, London, Sydney, Toronto: Wiley/Hamilton. p. 347ff.

mentioned in particular.

3. Finally, the knowledge of specialists can be brought directly into the projections. This is particularly necessary where there are major policy changes, the effects of which extend beyond the price structure, e.g. Common Agricultural Policy (CAP) reform in the EU.

1.3.4 *Calibration of elasticity sets*

In order to ensure that the elasticities derived from other sources are consistent with the model's data and with microeconomic theory, they are calibrated in a non-linear optimization procedure. The resulting elasticity sets satisfy the conditions of symmetry and homogeneity; additionally the correct signs of the diagonal elements of the substitution matrices are guaranteed. The objective function is to minimize the quadratic relative deviations from the original values; this ensures that the elasticities differ as little as possible from their original values.

For the calibration of demand elasticities, the available income is approximated by the regional gross domestic product since more precise data are unavailable.

Feed elasticities are first calibrated using the *conditional factor demand* approach[8] so that the total energy intake of animals remains constant when the price structure within feedingstuffs changes. The elasticities calibrated in this way are then extended to the feed energy requirement response due to changes in livestock production. This two-stage method of calibration ensures that the regional feed input and requirement are kept in balance during the simulation[9].

1.4 Price transmission

Changes in world market prices are mapped to regional markets by means of linear price transmission functions. Apart from representing transport costs and quality differences these explicitly contain various policy parameters affecting prices.

WATSIM uses two concepts to map price policy. First, it depicts the measurements of the PSE/CSE[10] concept. However, the specific and ad-valorem tariffs provided for in the GATT agreements are also captured by the equation. The resulting regional prices are called *incentive prices*, since they combine supply and demand incentives both due to regional market prices and agricultural policy. Equations (2a) and (2b) represent the price transmission equations used in WATSIM:

$$(2a)\quad PPRI_{i,r}^{sim} = \frac{UVEX_{i,wor}^{sim}}{UVEX_{i,wor}^{bas}} * UVEX_{i,r}^{bas} * \left(1 + AVTR_{i,r} / 100\right) + SPTR_{i,r} + PSEM_{i,r} + PSED_{i,r} + PSEI_{i,r}$$

$$(2b)\quad CPRI_{i,r}^{sim} = \frac{UVEX_{i,wor}^{sim}}{UVEX_{i,wor}^{bas}} * UVEX_{i,r}^{bas} * \left(1 + AVTR_{i,r} / 100\right) + SPTR_{i,r} + CSEM_{i,r} - CSED_{i,r} - CSEI_{i,r}$$

where

[8] cf. VARIAN, H. R. (1992): Microeconomic Analysis. 3rd ed., New York/London. p. 53.

[9] For details of this procedure cf. HENRICHSMEYER, W. et al. (1995): loc. cit., p. 21ff.

[10] PSE/CSE: producer subsidy equivalent/ consumer subsidy equivalent

growth in population and per capita incomes as well as changes in the consumer preference structure caused by different factors such as urbanization and a changing age structure.

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[10] PSE/CSE: producer subsidy equivalent/ consumer subsidy equivalent

PPRI	producer incentive price
CPRI	consumer incentive price
UVEX	regional foreign trade (r) or world market (wor) price
AVTR	ad-valorem tariff (%)
SPTR	specific tariff (US$/t)
PSEM	market price support (PSE component) (US$/t)
PSED	direct payments to producers (PSE component) (US$/t)
PSEI	other producer support measures (PSE component) (US$/t)
CSEM, CSED, CSEI	corresponding measurements on consumer side, with *CSEM = PSEM*
i, r, sim, bas	indices as defined above

1.5 Solution of the model

The solution algorithm ensures that, at the world level, supply and demand quantities on all (world) markets must balance. The algorithm looks for a vector of world market prices which, when transferred to regional markets, triggers the very supply and demand adjustment required for the purpose. In this way, a static equilibrium is reached for the simulation period; the resulting price and quantity changes give information about the anticipated developments under the assumed scenarios (trends, policy changes).

2. REFERENCE RUN: DEVELOPMENT OF WORLD MARKETS FOR GRAINS AND OILSEEDS UP TO 2005 IF EXISTING POLICIES ARE CONTINUED

2.1 Representation of policy assumptions in WATSIM

EU

The reduction in intervention prices on the grain and beef markets is depicted by the nominal fixing of internal market prices. This means that real prices fall in line with the assumed future rate of inflation (+2.3% p.a., World Bank G5 MUV index).

The limits on the quantities of subsidized exports, in particular wheat, are explicitly formulated in the model, which also takes account of restrictions applicable to subsidy expenditure, regardless of whether this has any real effect.

The area-based compensation payments are converted into product-based payments. These compensation payments, too, are held constant in nominal terms. The complexity of the various EU policies, which cannot be modelled by WATSIM without some simplification, means that exogenous assumptions on quantity developments must be employed in several cases. Following this line of reasoning, the more detailled results of the model SPEL/EU-MFSS are used for the calculations of WATSIM. For example, since WATSIM does not distinguish between area and yield developments, set-aside obligations cannot explicitly be taken into account; therefore, the development of the production quantities in WATSIM is derived from the SPEL/EU-MFSS results. A similar approach is used for the determination of feed use of marketable products; since WATSIM does not model the use of non-marketable feed, it makes use of the results of the SPEL/EU-MFSS.

For the milk and sugar markets, production is set according to the quota systems.

USA

WATSIM charts the 1996 Farm Bill (FAIR Act[11]) by completely dismantling the production support measures. Accordingly, the remaining payments are completely decoupled from production and are therefore not taken into account.

Other regions

Compliance with the GATT schedule tariff rates is modelled by making a corresponding reduction in the levels of protection. Even if the schedules in some cases allow for higher levels of support in the target year than in the base year, it is assumed that, in accordance with GATT rules, support is not increased.

2.2 World trend in production and demand

Between 1992 and 2005, the world output of cereals and oilseeds is expected to grow at a significant faster rate than the world population.

According to the model's calculations, the average annual rate of growth in cereals production will be +1.9% and will thus continue to be higher than the population growth rate of just under +1.4% p.a.[12]. Nevertheless, this annual rate of growth in cereals production is less than the corresponding rate recorded for the previous two decades (cf. Figure 1). High growth rates in the output of the main types of cereals are mostly expected to be in the rapidly developing countries of the so-called "Third World". In the countries of the former Soviet Union and particularly in Central and Eastern Europe, agricultural output is expected to recover by 2005 with better realisation of existing production potential. With the exception of Australia and New Zealand, the production growth rates of the industrialized nations are estimated to be significantly lower (cf. on the EU below).

In the case of oilseeds, too, the rapid growth of the last few decades will slow down, with an annual rate of growth of +2.4% p.a. being only slightly higher than for cereals. Within the oilseeds group, the growth in the world output of soya beans, sunflower seed and rape seed will be somewhat slower because of the lower increases in the USA (soya beans), Argentina (sunflower seed) and Canada (rape seed) and the marked reduction in cultivated areas in the EU resulting from the virtually compulsory set-aside. On the other hand, it is estimated, that the output of "other oilseeds" will expand appreciably in many countries of south and southeast Asia as well as in Chile, Colombia and Uruguay.

Unlike cereals and oilseeds, the 1970s saw hardly any growth in the output of pulses. It was not until the 1980s that there was a rapid increase in production, which will continue in abated form until 2005.

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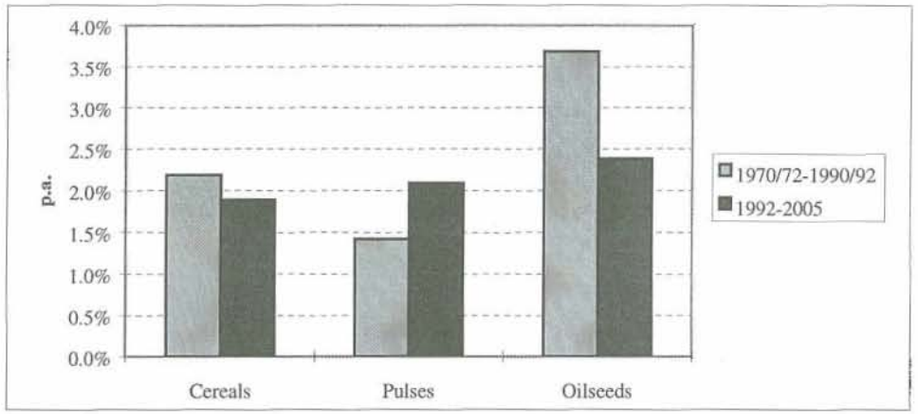
[11] YOUNG, E., SHIELDS, D.A. (1996): *Provisions of the 1996 Farm Bill - the Federal Agricultural Improvement and Reform (FAIR) Act*; Economic Research Service, United States Department of Agriculture: *Agricultural Outlook*, Special Supplement. Washington, D.C.

[12] According to: UNITED NATIONS (1996): World Population Prospects: The 1996 Revision - Annex I: Demographic Indicators. New York: United Nations.

Figure 1: Trends in world output of cereals, pulses and oilseeds (average annual rates of growth)



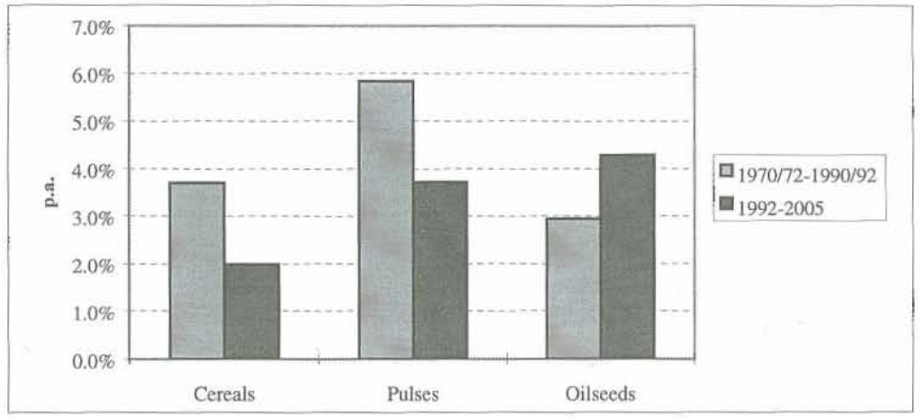
The pattern of demand for cereals and oilseeds is greatly influenced, via the feed sector, by the growth in livestock production. The expanding production of pig and poultry meat and eggs in Asia, in particular, will require considerable quantities of feed, so that between 1992 and 2005 the amount of maize used as feed in the countries of Asia[13] will rise from just under 15% to over 18% of world maize consumption. In the "cakes of other oilseeds and oil fruits", this share, already just under 40% in 1992, will pass the 50% mark. In the industrialized countries the requirement for feed grains and wheat will rise only slowly as livestock production is estimated to increase only to a relatively limited extent with some of this being met by further improvements in feeding efficiency.

Population and income growth increases not only the consumption of animal products but also the consumption for food of high-grade cereals, with the result that the use of wheat, barley and rice for human consumption (including processing) globally grows twice as fast as that of "other cereals".

World trade in cereals and pulses will not expand as quickly as in the past, but, like that of oilseeds, will still increase at a faster rate than that of production. As Figure 2 shows, trade in oilseeds and pulses in particular will continue to grow at high rates.

[13] Not including Japan and the Asian countries of the former Soviet Union.

Figure 2: Development of world trade[14] in cereals, pulses and oilseeds (average annual rates of growth)



2.3 Development of output and demand in the European Union

Demand for cereals hardly changed between the early 1970s and the early 1990s. However, it is expected to rise by about +1 % p.a. during the simulation period because of falling internal prices. With meat production forecast to rise slightly and milk production to fall slightly, the use of wheat and barley for animal feed will expand at the expense of cereals substitutes such as cassava; the share of wheat in the EU's feed grain mix would increase markedly to around 39% according to the assumptions of SPEL/EU-MFSS. There will be hardly any change in the amount of cereals used for human consumption up to 2005.

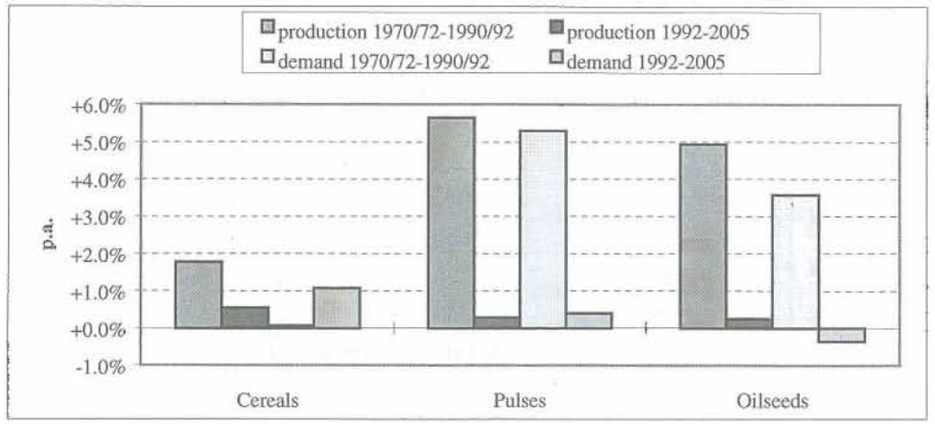
Despite increasing demand and lower tariff protection in the framework of the Common Agricultural Policy (CAP), the reduction of subsidized exports (to around 14.5 million t for wheat including flour) agreed in the Uruguay Round of the GATT would probably not be achieved without adjustments to the rate of set-aside. Pre-calculations with SPEL/EU-MFSS gave a rate of at least 30% to comply with this restriction. The corresponding quantity of cereal production for 2005 is estimated at about 190 million t in these circumstances which would mean that EU cereals production will be only some 13 million t above the base year quantity. This is assuming that the export restrictions are complied with by cutting production and not by increasing stocks.

Under these changed conditions, both the production of and demand for oilseeds is seen as declining appreciably in the EU. Demand for oilseeds would decline as a result of falling cereal prices, whilst the supply of soya beans, sunflower seed and rape seed is estimated to decline by -0.3% a year, mainly as a result of set-aside. A slight increase in the use of sunflower seed is seen mainly due to an average +2.8% p.a. growth in the consumption of sunflower oil.

The production of and demand for pulses is estimated to increase slightly.

[14] Sum of regional net exports.

Figure 3: Development of production of and demand for cereals, pulses and oilseeds in the EU (average annual rates of growth)



2.4 Trend in world market prices for cereals and oilseeds

The model calculations for the period to 2005 show a further decline in real world market prices for cereals and oilseeds. Nevertheless, the drop in prices would be less steep than in the past (Figure 4).

Cereal prices are projected as declining relatively uniformly by about -1.7% p.a. to -1.8% p.a. in real terms. In the case of rice, the calculated decline is somewhat smaller (-1.1% p.a.). The historical long-term trend of sharply falling world market prices would therefore be modified: between 1950 and 1990, world market prices for cereals fell by an average -2.5% p.a to -3.3% p.a. in real terms[15]; particular circumstances made the trend even less favourable to producers in the last decade (cf. Figure 4). Compared with this long-term trend, the agricultural terms of trade can be expected to become more favourable. With inflation on world markets at around +2.3% p.a.[16], nominal prices will rise slightly.

A similar picture is viewed for oilseeds; nominal prices rise on world markets, but after accounting for inflation, real world market prices would fall of about an average -1.1% p.a., this being a less sharp fall than in the past.

The World Bank forecasts world market price developments that are even more favourable to producers: an average decline in real prices of -0.4% p.a. for cereals, oils and cakes until 2005[17]. The FAPRI[18] projections also show somewhat more favourable price changes

[15] Data of USDA, according to: MITCHELL, D.O.; INGCO, M.D. (1993): The World Food Outlook. Washington, D.C.: The World Bank, p. 179.

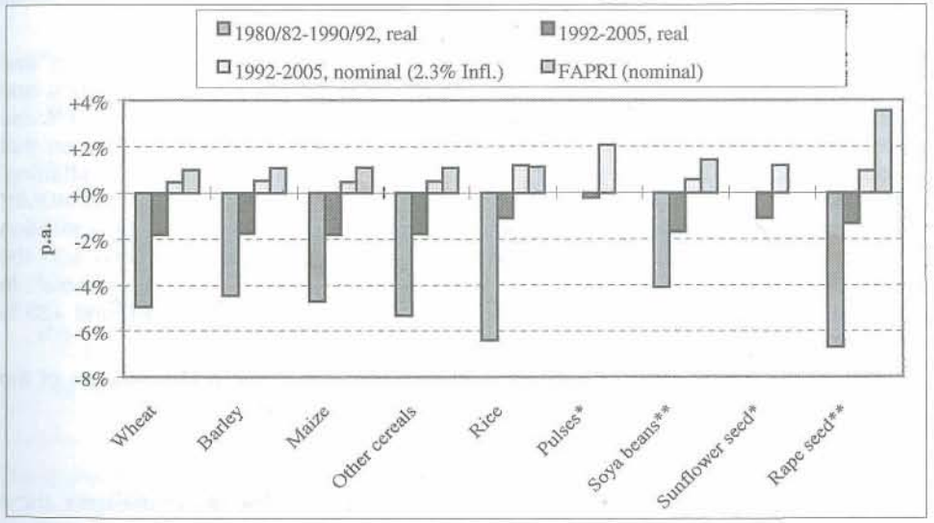
[16] World Bank G5 MUV index. The MUV index is based on the weighted US$-based unit values of processed products exported by the G5 nations (Germany, France, Japan, United Kingdom and United States). Source: THE WORLD BANK (1996): Commodity Markets and the Developing Countries - A World Bank Quarterly. November issue, p. 36.

[17] THE WORLD BANK: loc. cit.

for cereals than WATSIM; the predicted average annual rates of increase in nominal world market prices between 1992 and 2005 are +1.0% for wheat and +1.1% for the various feed grains. More favourable price trends are also expected for oilseeds (soya beans and rape seed) with +1.4% p.a and +3.5% p.a. in nominal terms, respectively (cf. Figure 4). According to these forecasts, wheat exports by the EU would be possible without subsidies after 2000[19].

The developments of world market prices as calculated by WATSIM would mean a marked reduction in the difference between the EU's foreign trade prices and internal market prices, in particular for intervention products. With this narrowing of prices, the GATT restrictions concerning subsidized exports allowed are less likely to be limited through the budget expenditure criteria and more likely will be limited by the volume of exports criteria.

Figure 4: Real and nominal change in world market prices between 1992 and 2005 compared with the FAPRI projection and with the period 1980/82-1990/92 (average annual rates of growth)[20]



[18] FOOD AND AGRICULTURAL POLICY RESEARCH INSTITUTE (FAPRI) (1997): World Agriculture Highlights. FAPRI-ISU#01-97, Ames/Iowa

[19] FOOD AND AGRICULTURAL POLICY RESEARCH INSTITUTE (FAPRI) (1997): loc. cit., p. 9.

[20] Sources for ex-post prices: MITCHELL, D.O., INGCO, M.D. (1993): The World Food Outlook. Washington, D.C.: The World Bank (for wheat, maize and rice); FAPRI database, 1997 (for barley, other cereals (sorghum), soya beans and rape seed). *) No prices for 1980/82 or FAPRI projections are available for pulses and sunflower seed. **) Prices are available only from 1981/82 for soyabeans and rape seed.

3. SIMULATION OF A COMPLETE LIBERALISATION OF THE MARKETS FOR CEREALS AND OILSEEDS

3.1 Mapping the scenario in the WATSIM model

A complete liberalisation of the markets for cereals, pulses and oilseeds would involve the abolition of all tariff protection or direct and other support measures in the various regions still in existence under the 1993 Uruguay Round GATT arrangements. The "negative protection" aimed at supporting domestic consumers, which was found in 1992 e.g. in the countries of the former Soviet Union, China and a few other regions for certain products, is also assumed to be abolished. The dismantling of protection is also assumed in regions not belonging to the GATT. The markets for rice and "other oilseeds and oil fruits" are not included in the liberalisation. Not liberalised either in these calculations is the Chinese market for maize germ oil; the policy assumed in the reference run is also assumed in the liberalisation scenario in order to avoid errors due to biased estimations, for information about this market is extremely problematic and maize consumption in China depends heavily on the production of maize germ oil and cake.

For the European Union it is assumed that set-aside as well as price support and compensatory payments are discontinued. The reference run's assumption of a 30 % rate of obligatory set-aside by 2005 is therefore dropped. However, any rule of thumb 43 % rise in production would be tempered by the small producer regulation and by the fact that production might no longer be profitable at world market prices on some of the "returning" area. Therefore, there is a marked increase in fallow land (cf. the results of the RAUMIS calculations), as there was some voluntary set-aside in the past. The effect on production of abandoning set-aside, as assumed in this simulation run, was determined with the model SPEL/EU-MFSS and ranges from +11% for wheat to +19% for "other cereals". In the case of oilseeds, the production impact ranges from +16 % (rape seed) and +28 % (sunflower seed), whereas the set-aside impact for pulses is +12 %.

To simplify the interpretation, a second simulation was run in which liberalisation of the cereals, pulses and oilseed markets was assumed for the EU only.

3.2 Results of the simulation calculations

Liberalisation of the world markets for cereals, pulses and oilseeds would have three principal effects, which are contrary to some extent:

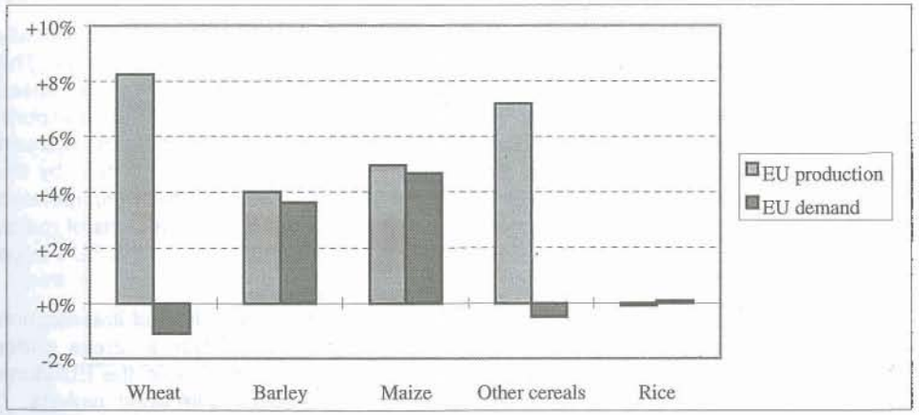
- In many regions, including most industrial nations, the dismantling of the existing protection of agriculture would reduce domestic producer prices. This would create an incentive to limit production in those countries, and falling consumer prices would often also stimulate demand.
- In some countries, negative protection would be dismantled; i.e. subsidies would be removed from food prices. In these countries, consumption might well decline, whilst producers would often have greater incentives to increase production.
- Finally, the abolition of compulsory set-aside in the EU would result in a considerable expansion of production (see above).

3.2.1 Cereals

It is forecast that world trade in cereals will expand with rising prices.

In the European Union, liberalisation is seen as leading to an expansion of cereals production, mainly as a result of the abolition of compulsory set-aside (cf. Figure 5). Wheat and "other cereals" in particular will become relatively more profitable, suffering smaller price reductions on the internal market than barley or maize. Cultivation of wheat and "other cereals" therefore expand by more than +8% and +7%, respectively, whilst the lower prices entail a smaller increase in production of barley and maize. The considerable expansion in wheat production in this scenario and the slight decline in its use for feed would result in the EU's net wheat exports increasing by +73%. On the other hand, greater use would be made of barley and maize for feed because of lower internal prices. In total, the EU's net export of cereals is estimated to increase to some 36 million t.

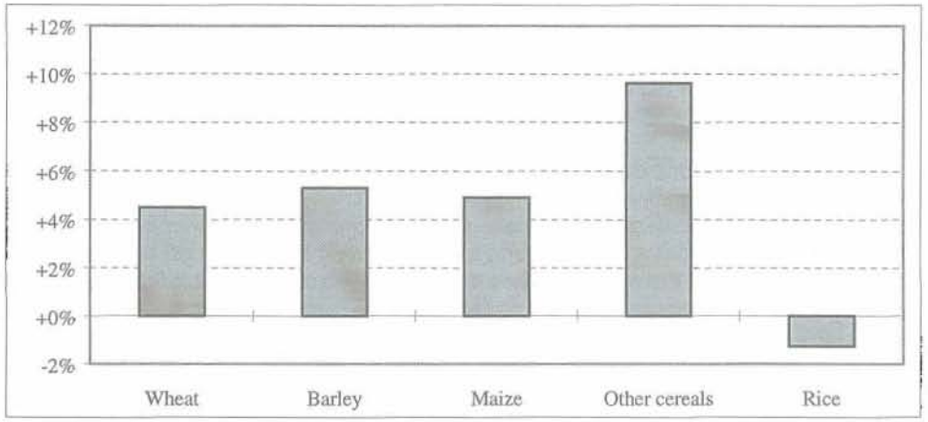
Figure 5: Change in production of and demand for cereals in the EU following liberalisation



The dismantling of the in some cases substantial protection for the various types of cereals would lead to a cutback in production and an increase in demand in various regions. For example, in the countries of the Community of Independent States (CIS) this would lead to an increase in their net imports of cereals by 4.8 million t. At the same time, other regions significantly increase their net exports, as for example the USA, which export an additional 1 million t barley, 1.4 million t maize and 1.3 million t of "other cereals" on the liberalised markets.

Overall, liberalisation results in increased world trade in cereals. As Figure 6 shows, world exports of "other cereals" in particular, but also of wheat, barley and maize, increase.

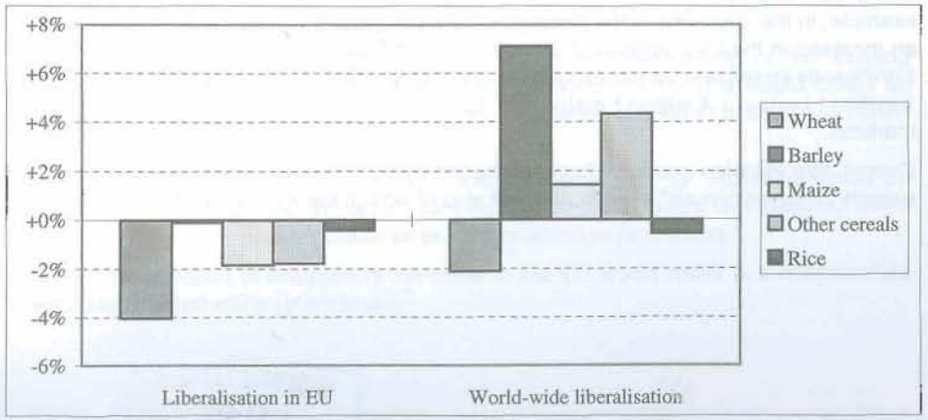
Figure 6: Change in net world exports of cereals following liberalisation



Worl market prices for barley and "other cereals" are viewed as increasing substantially (+7.1% and +4.3%, respectively) under this scenario of liberalisation (Figure 7). The abolition of protection in the countries of the CIS, Latin America and other regions causes production in those regions to decline. This more than offsets the EU's increased exports following the abolition of set-aside. The world market price increase for maize is much smaller at +1.4%. The reason for this is the large share of the world market held by the USA (46% of world production in 1992): After the FAIR Act, which is already incorporated into the reference run, the USA responds to rising prices with increased exports of maize (see above), with a stabilizing effect. Conversely, prices are depressed by the EU's large wheat exports.

Figure 7 also shows how price increases are almost exclusively the effect of liberalisation in other countries than the EU. Because of the associated increase in areas under cultivation and the structural shift from oilseeds to cereals, liberalisation in the EU alone would in some cases result in appreciable price reductions for cereals on world markets.

Figure 7: Change in world market prices for cereals



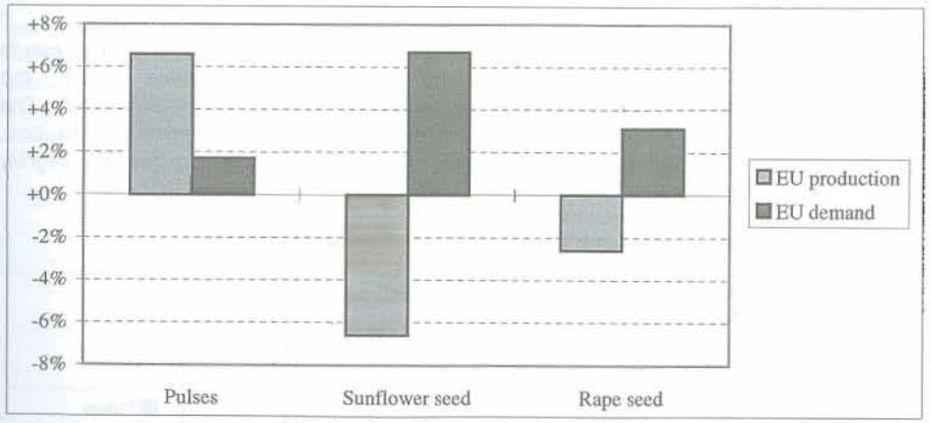
3.2.2 Pulses and oilseeds

As with cereals, world liberalisation results in rising prices and higher quantities traded, especially on the markets for sunflower seeds and rape seed. Pulses and soya beans, on the other hand, are much less affected by liberalisation.

Oilseed production in the EU falls considerably with the abolition of subsidies. Sunflower cultivation in particular, but also rape seed production, become much less competitive (cf. also the results of SPEL/EU-MFSS and RAUMIS), declining by around -7% and -3% respectively (Figure 8). As there is hardly any support for internal market prices under the CAP, there is little change in demand, and the EU's import gap for sunflower seed and rape seed grows strongly, with considerable repercussions for international markets given the EU's major share of the world market in these products (see below).

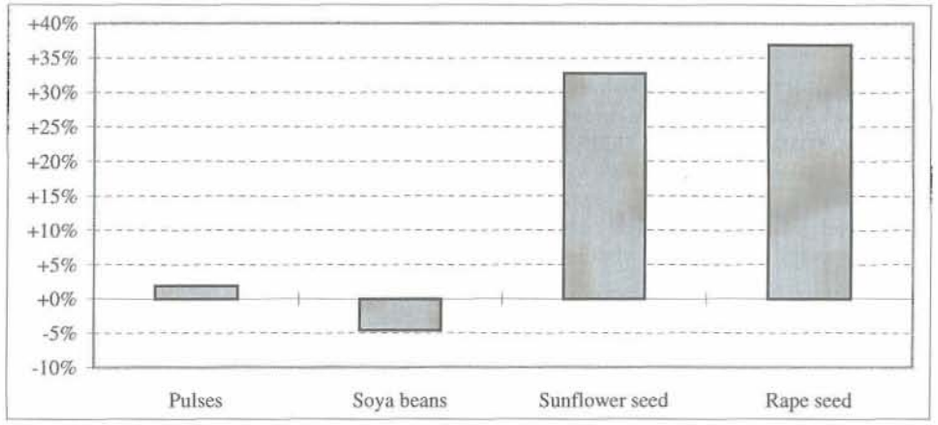
Cultivation of pulses, on the other hand, expands.

Figure 8: Change in production of and demand for pulses and oilseeds in the EU following liberalisation



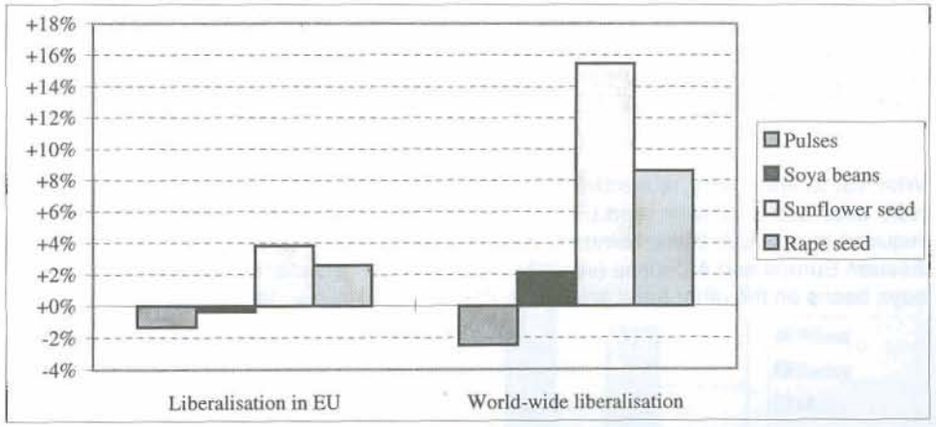
With +37% and +33% respectively, there is an appreciable expansion in world trade in rape seed and sunflower seed (Figure 9). The reason for this is the high level of imports required by the EU, these being covered by increased exports, mainly from Central and Eastern Europe and Argentina (sunflower seed) and from Canada (rape seed). Pulses and soya beans on the other hand are hardly affected by liberalisation at the world level.

Figure 9: Change in net world exports of pulses and oilseeds following liberalisation



The consequence of the significant increase in net imports into the EU is a marked rise in world market prices for sunflower seeds and rape seed, underpinned also by the dismantling of protection in other regions, especially the CIS states (cf. Figure 10). The markets for soya beans and other oilseeds and fruits hardly respond at all to liberalisation. Because of the slight fall in the USA's soya exports, world market prices are slightly increasing.

Figure 10: Change in world market prices for pulses and oilseeds



4. DISCUSSION AND CONCLUSION

World markets for agricultural products are greatly influenced by changes in the European Union's Common Agricultural Policy. The effects of the high level of protection that still exists in terms of intervention and area-related compensation payments even after EU agricultural reform are to some extent offset by the large amount of set-aside required to comply with the GATT-induced export limits on wheat in particular and under the Blair House agreement on oilseeds. Different levels of protection in other regions of the world and negative protection in some developing countries also have a distorting effect on world markets.

Complete liberalisation of the markets for cereals, pulses and oilseeds in all regions of the world produces correspondingly different changes on individual markets. For most of the markets that were analysed here increases of world market prices have been calculated. This effect is reversed by the extension of the cultivated areas for some other products in the EU, however.

By incorporation of the results from the model SPEL/EU-MFSS into the specification of the reference run and, in particular, of the effects on production of the abolition of compulsory set-aside, the calculations with WATSIM were build on an improved basis. On the other hand, with its simulated changes in world market prices the WATSIM world market model provides important indicators for the scenario design in SPEL/EU-MFSS and in the Regionalized Agricultural and Environmental Information System RAUMIS.

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6. TABLES

Table 1: Simulation results for cereals, world-wide and in the EU

	Wheat	Barley	Maize	Other cereals	Rice
	World production 1000 t				
1992	560452	167515	520716	162163	526023
Reference 2005	727996	206875	654435	184820	696063
Change p.a.	2.03%	1.64%	1.77%	1.01%	2.18%
Liberalization 2005	729094	207808	650949	185450	696171
Deviation from reference	0.15%	0.45%	-0.53%	0.34%	0.02%
	EU production 1000 t				
1992	87891	47474	30849	10174	2116
Reference 2005	97703	45624	34055	12094	2194
Change p.a.	0.82%	-0.31%	0.76%	1.34%	0.28%
Liberalization 2005	105751	47450	35740	12961	2192
Deviation from reference	8.24%	4.00%	4.95%	7.17%	-0.08%
	Total EU demand 1000 t				
1992	66034	40382	30364	10712	2823
Reference 2005	83393	43681	31452	12026	2270
Change p.a.	1.81%	0.61%	0.27%	0.89%	-1.66%
Liberalization 2005	82483	45262	32917	11968	2271
Deviation from reference	-1.09%	3.62%	4.66%	-0.49%	0.08%
	Change in real world market prices				
1992-2005, p.a.	-1.80%	-1.74%	-1.79%	-1.77%	-1.09%
Effect of liberalization	-2.10%	7.11%	1.43%	4.33%	-0.56%

Table 2: Simulation results for oilseeds, world-wide and in the EU

	Pulses	Soya beans	Sunflower seeds	Rape seed	Other oilseeds
	World production 1000 t				
1992	49284	113633	21782	26686	153179
Reference 2005	64498	149655	27720	33529	217236
Change p.a.	2.09%	2.14%	1.87%	1.77%	2.72%
Liberalization 2005	64850	150344	27909	33251	217197
Deviation from reference	0.55%	0.46%	0.68%	-0.83%	-0.02%
	EU production 1000 t				
1992	4844	1639	4135	6926	8537
Reference 2005	5029	1573	3865	6855	9661
Change p.a.	0.29%	-0.32%	-0.52%	-0.08%	0.96%
Liberalization 2005	5360	1894	3610	6677	10088
Deviation from reference	6.58%	20.44%	-6.59%	-2.59%	4.43%
	Total EU demand 1000 t				
1992	6990	16650	5027	7354	9718
Reference 2005	7356	15483	5813	7365	8345
Change p.a.	0.39%	-0.56%	1.12%	0.01%	-1.17%
Liberalization 2005	7481	15946	6201	7594	8461
Deviation from reference	1.70%	2.99%	6.69%	3.11%	1.40%
	Change in real world market prices				
1992-2005, p.a.	-0.22%	-1.68%	-1.09%	-1.32%	-0.93%
Effect of liberalization	-2.48%	2.12%	15.48%	8.62%	-2.61%

Table 3: Simulation results for animal products, world-wide and in the EU

	Pigmeat	Poultry	Eggs	Beef	Other meat	Milk	Butter & cream
	World production 1000 t						
1992	72335	43817	36687	51090	9740	459348	8858
Reference 2005	109645	68884	50371	59307	13685	529507	10552
Change p.a.	3.25%	3.54%	2.47%	1.15%	2.65%	1.10%	1.36%
Liberalization 2005	110180	69094	50630	59265	13679	530077	10571
Deviation from reference	0.49%	0.30%	0.51%	-0.07%	-0.04%	0.11%	0.18%
	EU production 1000 t						
1992	15399	6929	5214	8820	1173	120814	3017
Reference 2005	18241	9285	5615	8194	1087	117864	3004
Change p.a.	1.31%	2.28%	0.57%	-0.56%	-0.58%	-0.19%	-0.03%
Liberalization 2005	18697	9472	5727	8288	1092	117864	3013
Deviation from reference	2.50%	2.02%	1.98%	1.15%	0.39%	0.00%	0.30%
	Total EU demand 1000 t						
1992	14930	6619	5146	8089	1386	120690	2864
Reference 2005	17143	8783	5452	8176	1434	117446	2843
Change p.a.	1.07%	2.20%	0.45%	0.08%	0.26%	-0.21%	-0.06%
Liberalization 2005	17236	8800	5459	8118	1429	117769	2848
Deviation from reference	0.54%	0.19%	0.13%	-0.71%	-0.32%	0.28%	0.18%
	Change in real world market prices						
1992-2005, p.a.	-0.27%	-0.56%	-0.45%	-0.75%	-0.11%	-0.15%	0.28%
Effect of liberalization	-2.53%	-2.95%	-3.80%	-2.13%	-1.09%	-0.55%	-3.51%

MODELLING THE EFFECTS ON EU AGRICULTURE WITH THE SPEL/EU-MFSS MODEL

Gerald WEBER

Statistical Office of the European Communities, Luxembourg

1. INTRODUCTION

This contribution examines the possible effects on European Union (EU) agriculture of a greater liberalisation than that resulting from the Uruguay Round of GATT and the 1992 Common Agricultural Policy (CAP) reform. The calculations, based on the SPEL/EU-MFSS[21] model, form a link between the WATSIM model's global analysis of world trade and the results calculated for an individual EU Member State at NUTS 3 level by the RAUMIS model.

The effects of liberalisation are examined by comparing the results of a policy simulation with those of a reference projection or "base run". The *base run* looks at the potential developments in the EU farm sector up to the year 2005, assuming that existing agricultural policies are continued . The *policy simulation*, on the other hand, takes as its scenario the complete liberalisation of agricultural policies for cereals, pulses and oilseeds.

2. METHODOLOGICAL APPROACH

2.1 The SPEL/EU data for the ex-post period

The "SPEL/EU data" database provides sectoral information about trends in agriculture. It has ex-post time series on the production, consumption and prices of agricultural products and on the quantities and prices of the intermediate inputs consumed by agriculture in the EU Member States and the EU as a whole. Production, intermediate consumption and agricultural value added are shown broken down according to production activities: for each activity a vector of output and input coeffcient is calculated, which allows, in conjunction with the price data, activity related gross value addeds at market prices (per hectare or per animal) to be derived. At the same time, the data are integrated into a self-contained and consistent system of accounts.

2.2 Medium-term Forecast and Simulation System

The SPEL/EU-MFSS system is designed for policy-oriented analyses, forecasts and simulations. Its structure is described briefly below.[22]

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[21] SPEL/EU = Sectoral Production and Income Model for Agriculture in the European Union

MFSS = Medium-term Forecast and Simulation System

[22] A detailed methodological description is given in Eurostat: SPEL-System - Methodological documentation (Rev. 1), Vol. 2: MFSS, Luxembourg 1995. Some information on the method is also given in Eurostat: SPEL-System - Overview of the SPEL-System (Rev. 1), Luxembourg 1996.

Supply component

The supply component explains the *adjustment responses of agricultural production* to changes in the agricultural policy and economic environment.

(1) Trend-based projections of all individual elements of the SPEL matrix (of output and input coefficients in particular) are made on the basis of the SPEL/EU data's time series. They include detailed analyses of ex-post trends and consistency checks.

(2) The adjustment responses (to the trends) that can be expected as a result of the changed agricultural policy and economic conditions are estimated . The model depicts them in three recursively interlinked sub-models: a *price expectation model*, a *yield model and* the central *activity model*, which models the changes in the levels of production activities as a function of the changes in value added per unit of production activities.

Demand component

The demand component consists of the various components of domestic consumption of processed and unprocessed agricultural products outside the agricultural production sector. The key sector of food demand is captured by an elasticity-based analysis and forecasting system.

Linking the various components into an overall system

The various components are interlinked in an overall system. Agricultural price formation is explained from the interplay of the supply of goods, domestic demand and international trade in the light of the policy effect. *Market clearance* is one of the key constraints. Activity-based accounts and self-contained physical supply balance sheets are compiled by combining the results of the individual components.

3. BASE RUN: CONTINUATION OF EXISTING EU AGRICULTURAL POLICY

3.1 Scenario

The base run scenario assumes that the CAP reform measures adopted by the Council of Ministers in 1992 are retained for the projection period 1997-2005. It is further assumed that the production quota arrangements for sugar and milk continue unchanged and that the measures within the Blair House Agreement to limit oilseed production are applied throughout the period. The present system of intervention prices remains in place.

The detailed exogenous model variables derived from these basic assumptions are described below. For the EU as a whole, the level of and changes to these variables depend both on the specific scenarios at Member State level and on the development of the physical variables (areas, livestock numbers and production quantities) in the Member States.

Prices

The price index of gross domestic product (a measure of inflation) in the projection period is assumed to rise by +2% p.a. at aggregated EU level (EUR 15[23]).

[23] EUR 15 = European Union with 15 Member States

In the case of *cereals*, producer prices, which are initially higher than the intervention prices, are assumed to move closer to the intervention prices in the period to the year 2000; for the period 2000-2005 producer prices in ECU are assumed to be constant at Member State level. For *oilseeds, pulses, sugarbeet, wine, beef, veal, sheepmeat and goatmeat*, producer prices in ECU are assumed to be constant at Member State level for the projection period 1997-2005.

The producer prices for *pig meat, eggs and poultry meat* are calculated endogenously as market clearance prices for the entire period. They therefore depend on the level of production costs and factors other than price that affect demand.

The purchase prices for *animal feed* and seeds follow the corresponding prices for raw materials (cereals and milk). The purchase prices of all *other inputs* follow the pattern of the GDP price index; they are therefore constant in "real" terms.

Subsidies and taxes on production

Compensatory payments for cereals, pulses and oilseeds and set-aside premiums remain unchanged in national currencies per hectare of eligible land. The model takes account endogenously of any proportionate reductions in eligible areas where the national areas set by CAP reform and the guarantee areas for oilseed production laid down in the Blair House Agreement are exceeded.

The per capita premiums for sheep and cattle are also unchanged in national currency terms.

The aggregate sectoral values of other subsidies and of taxes on production in the respective national currencies are held unchanged at 1996 levels for the projection period 1997-2005.

Set-aside

For purposes of the base run variant described in this publication, the compulsory set-aside introduced with the 1992 CAP reform is assumed to be progressively increased from 17.5% in 1998 to 30% in 2005[24].

3.2 Projected results

3.2.1 Production and consumption of selected agricultural products

The following description of the base run projections concentrates on the areas directly affected by the liberalisation analysed later in section 4 (cereals, pulses and oilseeds) and on those areas indirectly affected through feed costs (meat and eggs).

The introduction of compulsory set-aside in the 1992 CAP reform resulted in a marked decline in the areas under **cereals** in EUR 15 from 38.3 million hectares to 35.4 million ha in the first year of reform (1993) (Figure 1). Since then, the set-aside requirement has been progressively reduced from an initial 15% (1993 and 1994) to 12% (1995) and then 10% (1996), with some of the land originally set aside being once again planted with cereals.

The base run results show that with agricultural policy in other respects unchanged, the set-aside obligation would have to be increased to at least 30% by 2005 if, given average

[24] Another variant of the base run, not discussed here, assumes a constant set-aside rate of 17.5%.

weather conditions, cereals production were to be kept to a level more or less within the upper limits for subsidized cereals exports (wheat in particular) under the GATT obligations.

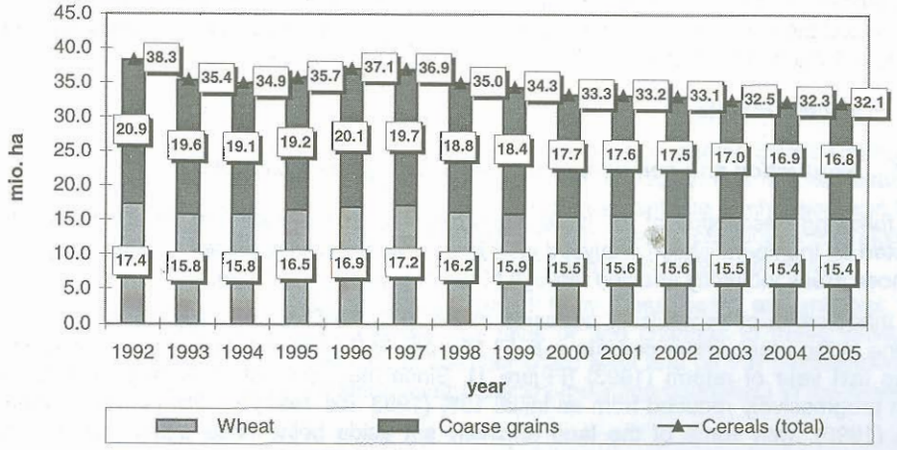
Under this scenario, the *cultivated area* of cereals would fall to around 32.1 million ha by the year 2005 (Figure 1). If yields per hectare continued to rise (Table A.2), *production* in 2005 would be around 193 million t (Figure 2). The total *net surpluses* for cereals would then be 24.4 million t , including 15.7 million t wheat and 8.7 million t coarse grains (Tables A.3-A.4). Even without including imports, this would in the case of wheat be higher than the 14.4 million t upper limit for subsidized wheat exports allowed under the GATT obligations. In the case of coarse grains, the net surpluses would be below the agreed 10.8 million t upper limit for subsidized feed grain exports. This result already takes into account an anticipated increase in the *use of cereals as animal feed* to 103 million t (2005) (Tables A.3-A.4) and an increase in the amount of wheat in the cereal ration.

The result shows that the trend in the use of cereals as animal feed and in particular the proportion of wheat in the ration is crucial for compliance with the GATT obligations. A set-aside rate of anything less than 30% would suffice only if there was a further increase in the use of cereals as animal feed with a greater proportion of wheat in it.

On the basis of the assumptions taken, there would be 5.1 million ha under **oilseeds** in 2005 (Figure 3). Even if taken into account that up to 950,000 ha may be planted with oilseeds for non-food purposes without penalty, this means that the penalty-free areas for oilseed cultivation for food purposes[25] are expected to be exceeded.

Figure 1

Area under cereals (excl. rice), 1992-1996 and base run 1997-2005, EUR 15



[25] Penalty-free area for oilseed cultivation for food purposes= 5.482 million ha x (1 - set-aside rate (%) / 100)

Figure 2

Production and use of cereals (total, excl. rice), 1992-1996 and base run 1997-2005, EUR 15

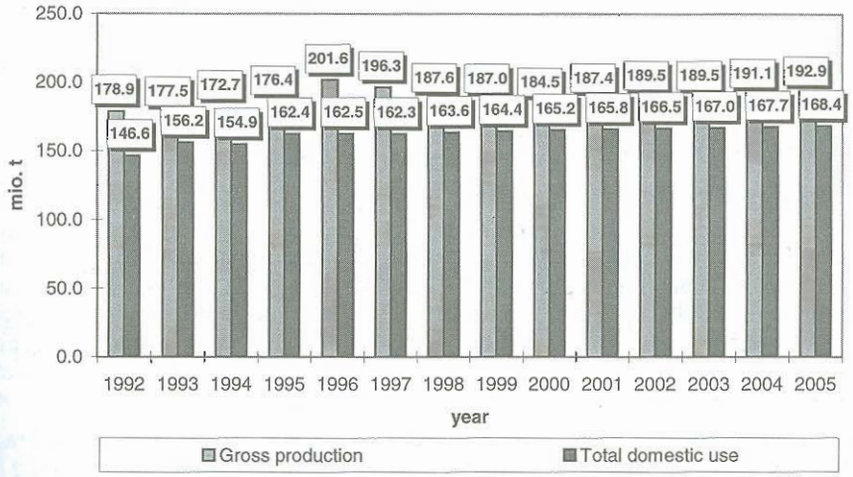
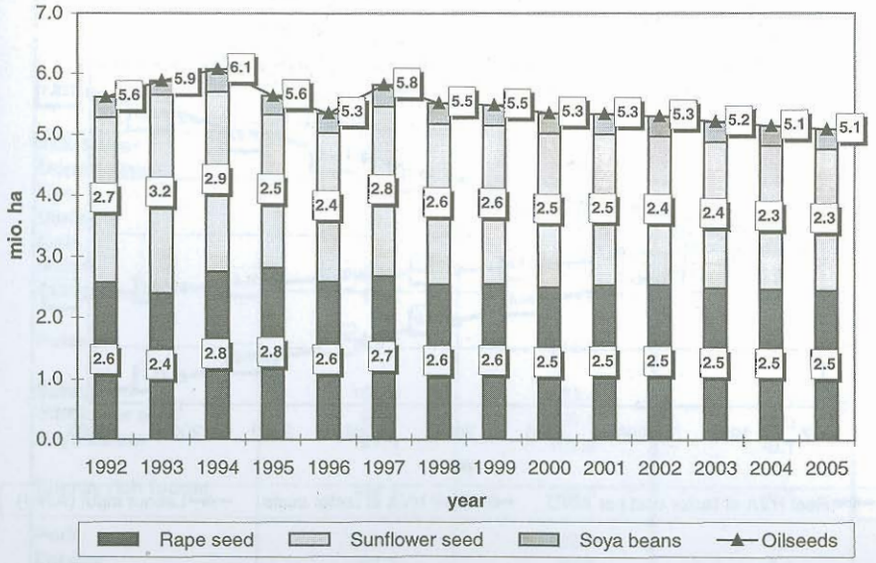


Figure 3

Area under oilseeds, 1992-1996 and base run 1997-2005, EUR 15



Under the base run scenario, the increase in per hectare yields (Table 13) would lead to a slight rise in the output of **pulses** The balance of supply and demand, expressed as the degree of self-sufficiency, would be more or less unchanged (see Tables A.8-A.10).

Despite the current BSE crisis, the per capita consumption of **meat** is expected to rise in the long term, with the increased demand for meat concentrated on that produced by intensive farming methods (pigs, poultry). On this basis a marked rise in the production of pig and poultry meat in the EU is foreseen, while that of meat from cattle, calves, sheep and goats would be more likely to stagnate (Tables A.11-A.12). With demand slightly increasing, a modest rise in egg production is expected (Table A.13).

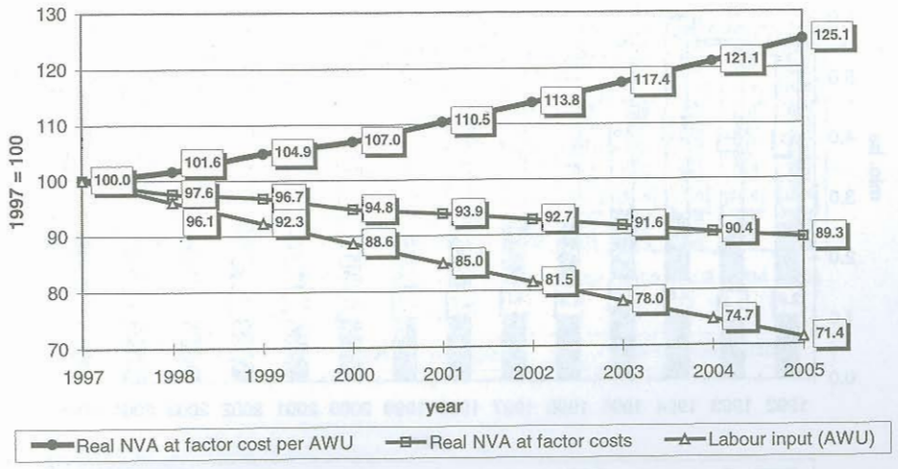
3.2.2 Agricultural value added

With the orientation of the CAP under its 1992 reform away from price support to one more centred towards direct aid to producers (hectare premiums and animal premiums), there has been an increase in subsidies as a proportion of sectoral net value added at factor cost. In the implementation phase of this CAP reform (1993-1995), the nominal net value added at factor cost of EU agriculture increased, mainly because high world market prices meant that producer prices for cereals did not decline to the same extent as support prices. Real net value added at factor cost per annual work unit (AWU) rose mostly because of the steady decline in labour input during the period.

If the labour input were to continue to decline at -4.1% p.a. as forecast, the average increase in real net value added at factor cost per AWU for agriculture in the EU would be at about +2.8% p.a. over the projection period 1997 to 2005 (cf. Figure 4 and Table A.14).

Figure 4

Trends in agricultural value-added, base run 1997-2005, EUR 15



4. POLICY SIMULATION: WORLDWIDE LIBERALISATION OF MARKETS FOR CEREALS, OILSEEDS AND PULSES

4.1 Scenario

As with the WATSIM model, the liberalisation scenario assumes that EU *area-related compensatory payments* for cereals, pulses and oilseeds are *abolished* and that prices for these products are not supported. It is also assumed that *EU set-aside obligations and EU set-aside premiums are discontinued.*

The *producer price changes* in the EU are the combined direct effect of the dismantling of price support and the indirect effect of changes in world market prices following world-wide liberalisation. For *cereals, pulses and oilseeds* the producer price changes are taken from the WATSIM model's calculations. In the case of coarse grains this means a marked decline in prices as compared to the base run scenario, whilst EU prices for wheat are declining slightly. The purchase prices of energy rich fodder are assumed to follow the cereal prices. For pulses there is a also slight decline as compared to the base run scenario. EU prices for rape seed and soya beans are virtually unchanged, whereas they increase for sunflower seed.

The changes in producer prices as compared to the base run for products of intensive animal production (*pig and poultry meat, eggs*) are arrived at endogenously by the MFSS model. With demand relatively inelastic, the decline in feed costs following price reductions for cereals and cereal substitutes results in a slight decline in producer prices.

Table 1

Impact of liberalisation on prices (average 1992-1996 = 100), EUR 15

	Base run 2005	Liberalisation 2005	Difference between liberalisation and base run 2005 (%)
Soft wheat	79.1	77.7	-1.8
Durum wheat	79.0	77.7	-1.6
Rye	90.5	87.4	-3.5
Barley	86.8	72.9	-16.0
Oats	134.8	105.4	-21.8
Maize	83.0	67.4	-18.9
Other cereals	56.6	53.6	-5.3
Pulses	119.3	115.5	-3.2
Rape seed	102.9	103.4	0.4
Sunflower seed	94.9	109.1	15.0
Soya beans	107.4	107.3	-0.1
Energy rich fodder	129.1	120.4	-6.7
Pork	123.3	122.4	-0.8
Poultry	94.1	93.5	-0.7
Eggs	97.4	95.9	-1.5

4.2 Simulation results

4.2.1 Effects on the production and consumption of cereals, oilseeds and pulses

By abolishing set-aside, liberalisation would result in more land being available for cultivation in the EU. The complete removal of area-related compensation payments would result in a decline in the area-related value added of combine-harvested crops, so that some of the additional land available, however, would not be used for growing them.

The model calculations nevertheless show that world-wide liberalisation of agricultural policies would cause areas under cereals in the EU to rise by +8.6% and those under pulses by +15.5% as compared to the base run (Table A.15). Areas under oilseeds, on the other hand, would increase less than areas under cereals and pulses (+3.4% compared with the base run). This would be due to a shift in the area-related value-added ratios in favour of cereals and pulses: the per-hectare compensatory payments for oilseeds are initially higher than for cereals and pulses, which means that cultivation of oilseeds would be more severely affected by their abolition than that of cereals or pulses.

Assuming that average yields per hectare in the Member States are unchanged, the *quantity of cereals produced* in the EU in 2005 would be around 203 million t, +5.3% more than the base run quantities in 2005 (Table A.17).

Despite the reductions in cereal prices resulting from liberalisation, the EU would see only a relatively small rise in *demand for cereals*. The positive effect on demand for feed as falling cereal prices increase the amount of cereals in animal feeds and as intensive animal production expands (see below) will be offset in part by the decline in prices of cereal substitutes (high energy feeds) and by an increase in farm-produced fodder.

Overall, therefore, liberalisation is expected to result in a significant increase in cereals production but only a small increase in demand with the growing difference being available for exports.

Figure 5

Impact of liberalisation on areas under cereals, pulses and oilseeds, EUR 15

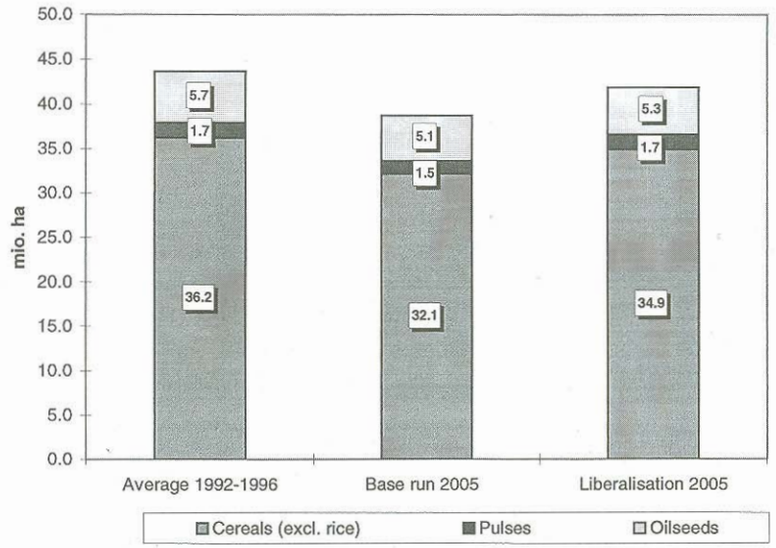


Figure 6

Impact of liberalisation on production of cereals, pulses and oilseeds, EUR 15

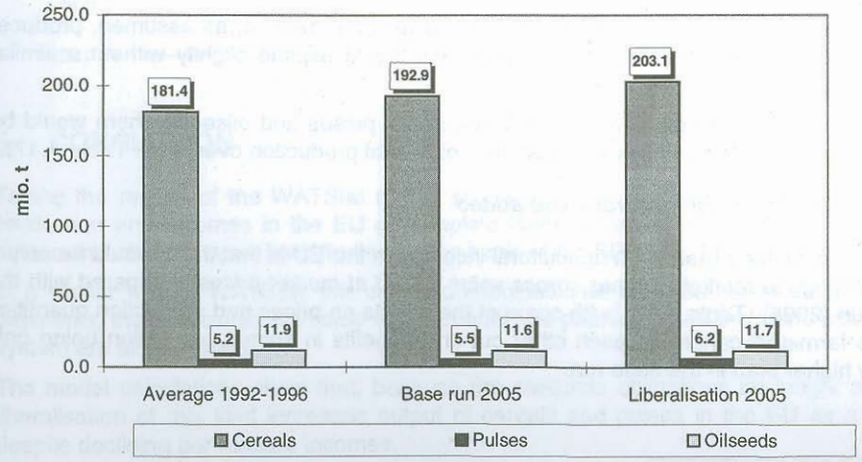
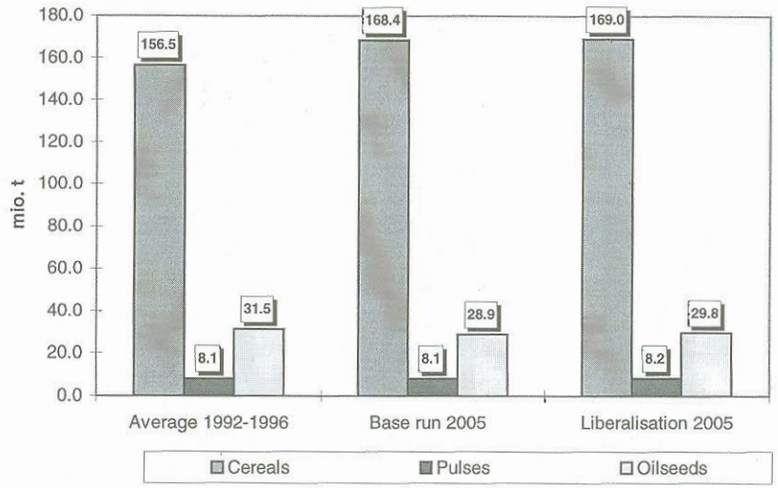


Figure 7

Impact of liberalisation on use of cereals, pulses and oilseeds, EUR 15



4.2.2 *Effects on the production and consumption of meat and eggs*

The markets for animal products are closely linked to the cereals markets by way of feed costs. Generally speaking, if prices for cereals and cereal substitutes decline, then feed costs fall. With demand for meat and eggs relatively inelastic, declining cereal prices point to lower producer prices for meat and eggs. World-wide liberalisation of the cereals market is therefore likely to lead to a slight expansion in EU intensive animal production (pig and poultry meat, eggs) with slightly increased demand.

Feed prices for beef and veal production would also be lower. If, as assumed, producer prices for these products were fixed, production would expand slightly without a similar increase in demand.

Therefore, if liberalisation were confined to cereals, pulses and oilseeds, there would be only a modest effect on prices and quantities of animal production overall (cf. Table A.17).

4.2.3 *Effects on agricultural value added*

The impact of liberalisation on agricultural incomes in the EU is that there would be only a small change in market incomes (*gross value added at market prices*) compared with the base run (2005) (Table A.18), with some of the effects on prices and production quantities in crop farming[26] cancelling each other out and benefits in animal production being only slightly higher than in the base run.

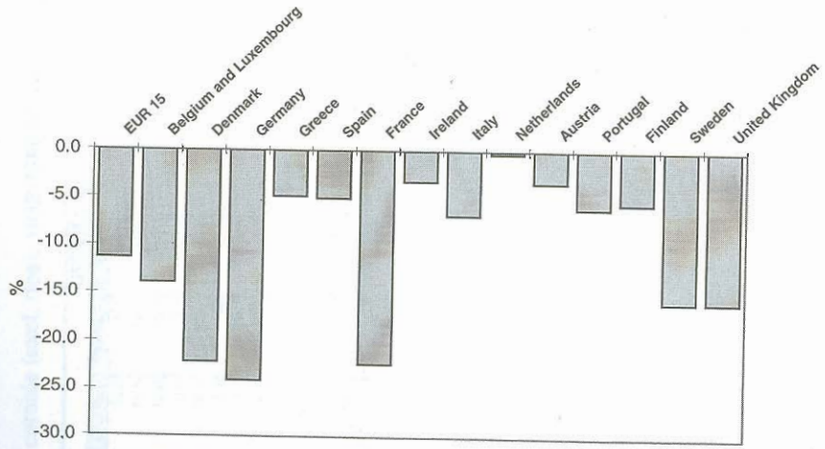
[26] e.g. lower prices for cereals but higher quantities produced

The abolition of area-related deficiency payments and set-aside premiums would bring the decline in incomes from agricultural activity (*sectoral net value added at factor costs*) to – 11.3% in all (assuming that depreciations and taxes on production are unchanged) (Figure 8). The question is how far these reductions in sectoral income could be cushioned by greater structural change. If the net value added at factor cost per annual work unit is to be unchanged compared to the base run, the annual decline in agricultural labour input over the period 1997-2005 would, arithmetically, have to be 1.5 percentage points higher than the base run.

The income results, however, differ greatly from one Member State to another depending on the structure of their production: the decline in net value added at factor cost resulting from liberalisation is higher than average in Germany (-24.1%), France (-22.3%) and Denmark (-22.2%).

Figure 8

Impact of liberalisation on net value added at factor costs (liberalisation scenario vs. base run, 2005)



5. CONCLUSION

Taking the results of the WATSIM model as a starting point, the effects on agricultural production and incomes in the EU of complete liberalisation of the markets for cereals, pulses and oilseeds were investigated on the basis of the SPEL/EU-MFSS model.

In a similar way to WATSIM, this scenario assumes that the area-based compensation payments, the associated set-aside requirements and premiums and the intervention price system are all abolished.

The model calculations show that, because the set-aside obligations no longer apply, a liberalisation of this kind increases output of cereals and pulses in the EU as a whole, despite declining per-hectare incomes.

The declines in purchase prices of feed grains entail only a slight increase in the use of cereals as feed if prices for cereal substitutes follow cereal prices. The lower feed costs can in part be passed on to the consumer in the form of lower prices for products of intensive animal production (pig and poultry meat, eggs).

Overall, a liberalisation scenario of this kind could bring about a decline in sectoral net value added at factor cost of around -11% in the EU. The question is to what extent these reductions in income could be offset by a greater movement of labour away from farming in order to avoid negative effects on per capita incomes in agriculture.

6. ANNEX WITH TABLES

Table A.1

Area under cereals (excl. rice), 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)						
		1992	1993	1994	1995	1996
Cereals (total)	mio. ha	38.3	35.4	34.9	35.7	37.1
Wheat	mio. ha	17.4	15.8	15.8	16.5	16.9
Soft wheat	mio. ha	14.1	12.9	12.8	13.4	13.7
Durum wheat	mio. ha	3.2	2.9	3.0	3.1	3.2
Coarse grains	mio. ha	20.9	19.6	19.1	19.2	20.1
Rye	mio. ha	1.1	1.1	1.2	1.3	1.3
Barley	mio. ha	12.7	11.3	10.9	10.9	11.3
Oats	mio. ha	2.1	2.1	2.2	2.0	2.1
Grain maize	mio. ha	4.0	3.9	3.8	3.8	4.2
Other cereals	mio. ha	1.0	1.0	0.9	1.1	1.3

SPEL/EU-MFSS: base run (forecast)												
		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cereals (total)	mio. ha	36.3	35.3	34.9	35.9	36.9	35.0	34.3	33.3	33.2	33.1	32.5	32.3	32.1
Wheat	mio. ha	16.7	16.5	16.2	16.6	17.2	16.2	15.9	15.5	15.6	15.6	15.5	15.4	15.4
Soft wheat	mio. ha	13.7	13.5	13.1	13.3	13.8	13.0	12.8	12.5	12.6	12.6	12.5	12.4	12.4
Durum wheat	mio. ha	3.0	3.0	3.1	3.3	3.4	3.2	3.2	3.1	3.0	3.0	3.0	3.0	3.0
Coarse grains	mio. ha	19.6	18.9	18.6	19.3	19.7	18.8	18.4	17.7	17.6	17.5	17.0	16.9	16.8
Rye	mio. ha	1.3	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.9
Barley	mio. ha	11.4	10.8	10.8	11.2	11.4	10.8	10.6	10.2	10.1	10.0	9.7	9.7	9.6
Oats	mio. ha	2.1	2.2	2.1	2.1	2.1	2.1	2.1	2.0	2.0	2.0	1.8	1.8	1.8
Grain maize	mio. ha	3.9	3.8	3.7	3.9	4.1	3.8	3.8	3.7	3.7	3.7	3.7	3.7	3.7
Other cereals	mio. ha	0.9	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8

Table A.4

Balance sheet - coarse grains, 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Gross production	mio. t	91.1	93.6	87.5	89.2	103.2
Total domestic use	mio. t	80.5	86.1	78.6	88.3	90.9
Human consumption	mio. t	6.2	6.3	6.4	6.5	6.6
	kg/head	*16.8*	*16.9*	*17.1*	*17.4*	*17.6*
Feed use	mio. t	58.9	63.8	56.7	65.3	66.0
Other domestic use	mio. t	15.4	16.1	15.5	16.5	18.3
Net surplus	mio. t	10.6	7.4	9.0	0.9	12.3
Self-sufficiency index	%	113.2	108.6	111.4	101.1	113.5

SPEL/EU-MFSS: base run (forecast)

		1993	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Gross production	*mio. t*	*91.2*	*90.4*	*90.3*	*95.2*	*99.2*	*95.0*	*94.5*	*92.6*	*93.2*	*93.9*	*93.0*	*93.5*	*94.2*
Total domestic use	mio. t	82.1	85.8	84.5	85.8	87.4	88.2	88.7	88.8	88.7	88.1	87.0	86.2	85.5
Human consumption	mio. t	6.4	6.4	6.5	6.6	6.6	6.7	6.7	6.8	6.8	6.9	6.9	7.0	7.0
	kg/head	17.2	17.1	17.4	17.5	17.7	17.8	17.9	18.0	18.1	18.2	18.2	18.3	18.4
Feed use	mio. t	60.7	64.4	62.7	63.6	65.1	65.8	66.1	66.3	66.0	65.2	64.2	63.2	62.2
Other domestic use	mio. t	15.1	15.1	15.3	15.6	15.8	15.7	15.9	15.7	15.9	16.0	16.0	16.1	16.3
Net surplus	mio. t	9.1	4.6	5.8	9.3	11.8	6.8	5.8	3.8	4.5	5.8	5.9	7.3	8.7
Self-sufficiency index	%	111.1	105.4	106.8	110.9	113.5	107.7	106.5	104.3	105.1	106.6	106.8	108.5	110.2

net surplus = gross production - domestic use

self-sufficiency index = (total domestic use + net surplus) / total domestic use

Table A.5

Area under oilseeds (rape seed, sunflower seed, soya beans), 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Oilseeds	mio. ha	5.6	5.9	6.1	5.6	5.3
Rape seed	mio. ha	2.6	2.4	2.8	2.8	2.6
Sunflower seed	mio. ha	2.7	3.2	2.9	2.5	2.4
Soya beans	mio. ha	0.3	0.2	0.4	0.3	0.3

SPEL/EU-MFSS: base run (forecast)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Oilseeds	mio. ha	5.7	5.5	5.5	5.6	5.8	5.5	5.5	5.3	5.3	5.3	5.2	5.1	5.1
Rape seed	mio. ha	2.7	2.7	2.6	2.6	2.7	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5
Sunflower seed	mio. ha	2.6	2.5	2.5	2.6	2.8	2.6	2.6	2.5	2.5	2.4	2.4	2.3	2.3
Soya beans	mio. ha	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Table A.6

Yields in oilseed production, 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Rape seed	absolute (t/ha)	2.57	2.75	2.51	2.89	2.74
	annual rate of change (%)		*6.8*	*-8.7*	*15.4*	*-5.2*
Sunflower seed	absolute (t/ha)	1.51	1.12	1.38	1.34	1.55
	annual rate of change (%)		*-25.8*	*23.2*	*-2.5*	*15.5*
Soya beans	absolute (t/ha)	3.70	3.67	3.00	3.26	3.21
	annual rate of change (%)		*-1.0*	*-18.2*	*8.8*	*-1.6*

SPEL/EU-MFSS: base run (forecast)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Rape seed	absolute (t/ha)	2.68	2.68	2.68	2.68	2.69	2.68	2.67	2.68	2.69	2.69	2.70	2.69	2.69
	annual rate of change (%)		*-0.2*	*0.2*	*-0.1*	*0.4*	*-0.5*	*-0.2*	*0.5*	*0.1*	*0.0*	*0.3*	*-0.1*	*-0.1*
Sunflower seed	absolute (t/ha)	1.56	1.61	1.60	1.59	1.60	1.59	1.60	1.61	1.63	1.63	1.64	1.65	1.66
	annual rate of change (%)		*3.5*	*-1.2*	*-0.6*	*0.6*	*-0.5*	*0.5*	*1.0*	*0.9*	*0.5*	*0.3*	*0.8*	*0.5*
Soya beans	absolute (t/ha)	3.71	3.70	3.74	3.71	3.69	3.71	3.70	3.69	3.69	3.69	3.69	3.70	3.70
	annual rate of change (%)		*-0.1*	*1.0*	*-0.9*	*-0.3*	*0.3*	*-0.2*	*-0.2*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*

Table A.7

Balance sheet - oilseeds (rape seed, sunflower seed, soya beans), 1992-1996 and base run, 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Gross production	mio. t	11.9	11.1	12.1	12.6	11.9
Total domestic use	mio. t	28.0	31.1	31.2	34.0	33.2
Processing	mio. t	26.0	28.5	29.0	31.3	31.2
Other domestic use	mio. t	2.1	2.6	2.2	2.7	2.0
Net surplus	mio. t	-16.1	-20.0	-19.1	-21.4	-21.3
Self-sufficiency index	%	42.6	35.7	38.7	36.9	35.9

SPEL/EU-MFSS: base run (forecast)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Gross production	mio. t	12.6	12.4	12.3	12.4	13.0	12.3	12.2	12.0	12.1	12.0	11.9	11.7	11.6
Total domestic use	mio. t	30.2	29.8	29.5	30.1	30.5	29.7	29.5	29.1	29.1	29.2	29.0	28.9	28.9
Processing	mio. t	28.1	27.8	27.6	27.8	28.3	27.6	27.5	27.1	27.1	27.0	26.8	26.6	26.5
Other domestic use	mio. t	2.0	2.0	1.9	2.3	2.2	2.1	2.1	2.0	2.0	2.2	2.2	2.3	2.4
Net surplus	mio. t	-17.6	-17.4	-17.2	-17.7	-17.5	-17.4	-17.3	-17.1	-17.0	-17.2	-17.2	-17.2	-17.3
Self-sufficiency index	%	41.7	41.6	41.6	41.2	42.6	41.3	41.4	41.2	41.5	41.2	40.8	40.6	40.3

net surplus = gross production - total domestic use
sulf-sufficiency index = (total domestic use + net surplus) / total domestic use

Table A.8

Area under pulses, 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Pulses	mio. ha	1.5	1.6	1.6	1.8	1.9

SPEL/EU-MFSS: base run (forecast)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Pulses	mio. ha	1.7	1.5	1.4	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

Table A.9

Yield in pulses production, 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Pulses	absolute (t/ha)	3.39	3.76	3.39	2.52	2.53
	annual rate of change (%)		*10.8*	*-9.9*	*-25.6*	*0.2*

SPEL/EU-MFSS: base run (forecast)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Pulses	absolute (t/ha)	3.07	3.16	3.12	3.19	3.27	3.30	3.36	3.42	3.47	3.51	3.54	3.59	3.63
	annual rate of change (%)		*3.1*	*-1.3*	*2.2*	*2.6*	*0.7*	*1.9*	*2.0*	*1.4*	*1.2*	*0.8*	*1.3*	*1.1*

Table A.10

Balance sheet - pulses, 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Gross production	mio. t	5.2	6.0	5.5	4.6	4.8
Total domestic use	mio. t	7.8	7.8	8.1	8.4	8.6
Human consumption	mio. t	0.9	0.8	0.8	0.9	0.9
	kg/head	*2.4*	*2.3*	*2.2*	*2.4*	*2.4*
Feed use	mio. t	6.4	6.5	6.8	7.0	7.2
Other domestic use	mio. t	0.5	0.5	0.5	0.5	0.5
Net surplus	mio. t	-2.7	-1.8	-2.6	-3.8	-3.7
Self-sufficiency index	%	66.1	76.8	67.6	54.4	56.5

SPEL/EU-MFSS: base run (forecast)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Gross production	mio. t	5.1	4.7	4.5	4.7	5.1	4.9	5.0	5.0	5.2	5.3	5.3	5.4	5.5
Total domestic use	mio. t	8.0	8.1	8.0	7.9	7.9	7.9	7.9	8.0	8.0	8.0	8.0	8.1	8.1
Human consumption	mio. t	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2
	kg/head	*3.0*	*2.9*	*2.9*	*2.8*	*2.9*	*2.9*	*3.0*	*3.0*	*3.1*	*3.1*	*3.2*	*3.2*	*3.3*
Feed use	mio. t	6.3	6.5	6.4	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.4
Other domestic use	mio. t	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Net surplus	mio. t	-2.9	-3.3	-3.5	-3.2	-2.7	-3.0	-3.0	-2.9	-2.8	-2.7	-2.7	-2.7	-2.6
Self-sufficiency index	%	63.4	58.7	55.9	59.6	65.3	61.9	62.8	63.1	65.0	65.9	66.5	66.9	67.4

net surplus = gross production - domestic use
sulf-sufficiency index = (total domestic use + net surplus) / total domestic use

Table A.11

Gross production of meat, 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Meat	mio. t	33.6	33.7	33.6	33.9	35.0
Beef	mio. t	8.5	7.9	7.4	7.6	8.4
... of which from male cattle	mio. t	*4.6*	*4.2*	*3.9*	*4.0*	*4.1*
... of which from female cattle	mio. t	*4.0*	*3.7*	*3.5*	*3.6*	*4.4*
Veal	mio. t	0.9	1.0	1.0	0.9	0.9
Pigmeat	mio. t	15.7	16.5	16.6	16.5	16.5
Poultry	mio. t	7.1	7.1	7.4	7.7	8.1
Meat of sheep and goats	mio. t	1.3	1.2	1.2	1.2	1.2

SPEL/EU-MFSS: base run (forecast)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Meat	mio. t	33.2	34.1	34.4	35.0	35.2	35.7	35.8	36.1	36.4	36.6	37.0	37.3	37.6
Beef	mio. t	7.7	7.5	7.6	7.9	8.1	8.1	8.0	8.0	8.0	7.9	8.0	8.0	7.9
... of which from male cattle	mio. t	*4.2*	*4.1*	*4.1*	*4.2*	*4.3*	*4.3*	*4.3*	*4.3*	*4.2*	*4.2*	*4.2*	*4.1*	*4.1*
... of which from female cattle	mio. t	*3.5*	*3.4*	*3.5*	*3.7*	*3.8*	*3.7*	*3.7*	*3.7*	*3.8*	*3.8*	*3.8*	*3.9*	*3.8*
Veal	mio. t	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Pigmeat	mio. t	16.1	16.8	17.0	16.9	17.0	17.2	17.3	17.4	17.6	17.8	17.9	18.1	18.2
Poultry	mio. t	7.2	7.6	7.7	8.1	8.1	8.5	8.5	8.7	8.8	9.0	9.1	9.3	9.5
Meat of sheep and goats	mio. t	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2

Gross production = slaughterings + exports of live animals (sum of 15 Member States)

Table A.12

Balance sheet - meat (total), 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Gross production	mio. t	33.6	33.7	33.6	33.9	35.0
Intra EU trade with live animals	mio. t	1.0	0.7	0.8	0.8	0.8
Gross production adjusted	mio. t	32.6	33.0	32.8	33.2	34.3
Total domestic use	mio. t	30.9	31.1	31.6	31.5	32.4
Human consumption	mio. t	30.9	31.1	31.6	31.5	32.4
	kg/head	*83.6*	*84.0*	*84.8*	*84.4*	*86.5*
Other domestic use	mio. t	0.0	0.0	0.0	0.0	0.0
Net surplus	mio. t	1.8	1.9	1.3	1.7	1.9
Self-sufficiency index	%	105.7	106.1	104.0	105.3	105.8

SPEL/EU-MFSS: base run (forecast)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Gross production	mio. t	33.2	34.1	34.4	35.0	35.2	35.7	35.8	36.1	36.4	36.6	37.0	37.3	37.6
Intra EU trade with live animals	mio. t	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Gross production adjusted	mio. t	32.5	33.3	33.6	34.2	34.5	34.9	35.0	35.4	35.6	35.9	36.2	36.6	36.8
Total domestic use	mio. t	30.7	31.5	32.1	32.7	32.7	33.2	33.4	33.8	34.1	34.4	34.7	35.0	35.3
Human consumption	mio. t	30.7	31.5	32.1	32.7	32.7	33.2	33.4	33.8	34.0	34.4	34.7	35.0	35.3
	kg/head	*82.9*	*84.7*	*86.1*	*87.4*	*87.4*	*88.5*	*88.8*	*89.6*	*90.1*	*90.7*	*91.2*	*91.8*	*92.3*
Other domestic use	mio. t	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net surplus	mio. t	1.7	1.8	1.5	1.5	1.8	1.8	1.7	1.6	1.6	1.5	1.6	1.6	1.6
Self-sufficiency index	%	105.6	105.8	104.6	104.6	105.6	105.3	105.0	104.7	104.6	104.5	104.5	104.6	104.5

Gross production = Slaughterings + Exports of live animals (sum of 15 Member States)
Gross production adjusted = Gross production - Intra EU trade with live animals
Net surplus = Gross production adjusted - Total domestic use
Sulf-sufficiency index = (Total domestic use + Net surplus) / Total domestic use

Table A.13

Balance sheet - eggs, 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

		1992	1993	1994	1995	1996
Gross production	mio. t	4.9	4.8	4.9	4.9	4.9
Total domestic use	mio. t	4.7	4.6	4.7	4.8	4.8
° Human consumption	mio. t	4.6	4.5	4.7	4.8	4.8
	kg/head	*12.6*	*12.2*	*12.6*	*12.9*	*12.8*
° Other domestic use	mio. t	0.0	0.0	0.0	0.0	0.0
Net surplus	mio. t	0.2	0.2	0.2	0.1	0.1
Self-sufficiency index	%	105.0	105.4	104.5	102.0	102.0

SPEL/EU-MFSS: base run (forecast)

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Gross production	mio. t		5.0	5.0	5.0	5.0	5.1	5.1	5.1	5.1	5.1	5.2	5.2	5.2	5.2
Total domestic use	mio. t		4.8	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.9	5.0	5.0	5.0	5.0
° Human consumption	mio. t		4.7	4.8	4.8	4.8	4.9	4.9	4.9	4.9	4.9	4.9	5.0	5.0	5.0
	kg/head		*12.7*	*12.9*	*12.9*	*12.9*	*13.0*	*12.9*	*13.0*	*13.0*	*13.0*	*13.0*	*13.0*	*13.1*	*13.1*
° Other domestic use	mio. t		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net surplus	mio. t		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Self-sufficiency index	%		104.5	104.8	104.0	103.9	103.9	103.9	103.9	103.9	103.8	103.8	103.8	103.8	103.8

(1) Net surplus = gross production - total domestic use
(2) Self-sufficiency index = (total domestic use + net surplus) / total domestic use

Table A.14

Trends in agricultural value-added, 1992-1996 and base run 1993-2005, EUR 15

SPEL/EU data (ex-post)

	1992	1993	1994	1995	1996
GVA at market prices (mio. ECU)	121103	107968	112416	112718	124375
Depreciation (mio. ECU)	31575	31086	31418	32963	33198
NVA at market prices (mio. ECU)	89528	76882	80998	79754	91177
Subsidies (mio. ECU)	19122	25703	28598	33165	34297
Production taxes (mio. ECU)	4257	3917	3586	3589	3733
NVA at factor cost (mio. ECU)	104393.3	98668.42	106009.9	109330.9	121740.8
GDP price index (1990=100)	110.0	113.9	117.0	120.4	123.6
Real NVA at factor cost (mio. ECU)	94873	86604	90619	90786	98503
Labour input (1000 AWU)	8233	7817	7527	7274	7028
Real NVA at factor cost per AWU					
absolute (ECU)	11524	11078	12039	12481	14017
annual rate of change (%)	-3.6	-3.9	8.7	3.7	12.3

SPEL/EU-MFSS: base run (forecast)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GVA at market prices (mio. ECU)	118545	123453	124085	119135	129275	128703	130199	130231	131703	132773	133771	134718	135753
Depreciation (mio. ECU)	31086	31418	32856	33089	32793	32777	32777	32777	32777	32777	32777	32777	32777
NVA at market prices (mio. ECU)	87460	92035	91229	86046	96482	95926	97422	97454	98926	99997	100994	101941	102977
Subsidies (mio. ECU)	26068	28936	32539	33966	33781	33917	33848	33692	33549	33457	33403	33375	33374
Production taxes (mio. ECU)	3899	*3579*	*3567*	*3711*	*3762*	*3762*	*3762*	*3762*	*3762*	*3762*	*3762*	*3762*	*3762*
NVA at factor cost (mio. ECU)	109629	117393	120201	116302	126501	126082	127508	127384	128713	129692	130635	131554	132588
GDP price index (1990=100)	114.03	117.2	120.8	124.0	126.5	129.2	131.7	134.4	137.1	139.8	142.6	145.5	148.4
Real NVA at factor cost (mio. ECU)	96142	100181	99476	93786	100043	97618	96787	94797	93907	92766	91609	90444	89368
Labour input (1000 AWU)	7709	7422	7196	6952	6621	6360	6108	5864	5626	5394	5166	4944	4727
Real NVA at factor cost per AWU													
absolute (ECU)	12472	13498	13824	13490	15109	15349	15846	16165	16691	17199	17732	18293	18908
annual rate of change (%)	8.2	8.2	2.4	-2.4	12.0	1.6	3.2	2.0	3.3	3.0	3.1	3.2	3.4

Table A.15

Impact of liberalisation on areas under cereals, pulses and oilseeds, EUR 15

		Average 1992-1996	Base run 2005	Liberalisation 2005	Difference between liberalisation and base run 2005 (%)
Cereals (excl. rice)	mio. ha	36.2	32.1	34.9	8.6
Wheat	mio. ha	16.5	15.4	16.7	8.4
Soft wheat	mio. ha	13.4	12.4	13.6	9.8
Durum wheat	mio. ha	3.1	3.0	3.1	2.5
Coarse grains	mio. ha	19.8	16.8	18.2	8.8
Rye	mio. ha	1.2	0.9	0.7	-20.5
Barley	mio. ha	11.4	9.6	10.4	8.7
Oats	mio. ha	2.1	1.8	2.4	29.8
Maize	mio. ha	3.9	3.7	3.8	4.1
Other cereals	mio. ha	1.1	0.8	0.9	18.3
Pulses	mio. ha	1.7	1.5	1.7	15.5
Oilseeds	mio. ha	5.7	5.1	5.3	3.4
Rape-seed	mio. ha	2.6	2.5	2.4	-0.4
Sunflower seed	mio. ha	2.8	2.3	2.4	6.1
Soya beans	mio. ha	0.3	0.3	0.4	13.4

Table A.16

Impact of liberalisation on production and use of cereals, pulses and oilseeds, EUR 15

		Average 1992-1996	Base run 2005	Liberalisation 2005	Difference between liberalisation and base run 2005 (%)
		Production			
Cereals	mio. t	181.4	192.9	203.1	5.3
Wheat	mio. t	88.5	98.6	105.5	6.9
Soft wheat	mio. t	80.7	90.3	96.6	7.0
Durum wheat	mio. t	7.8	8.4	8.9	5.8
Coarse grains	mio. t	92.9	94.2	97.6	3.6
Rye	mio. t	4.8	4.2	2.9	-31.9
Barley	mio. t	46.3	45.2	46.1	1.9
Oats	mio. t	7.0	7.1	8.9	24.8
Maize	mio. t	31.3	34.1	35.9	5.2
Other cereals	mio. t	3.6	3.5	3.8	8.5
Pulses	mio. t	5.2	5.5	6.2	13.2
Oilseeds	mio. t	11.9	11.6	11.7	0.7
Rape-seed	mio. t	7.1	6.6	6.4	-3.3
Sunflower seed	mio. t	3.8	3.8	4.0	3.9
Soya beans	mio. t	1.0	1.2	1.4	12.2
		Use			
Cereals	mio. t	156.5	168.4	169.0	0.3
Wheat	mio. t	71.7	82.9	83.1	0.2
Soft wheat	mio. t	64.8	75.4	75.5	0.2
Durum wheat	mio. t	6.9	7.5	7.6	0.9
Coarse grains	mio. t	84.9	85.5	85.9	0.4
Rye	mio. t	3.9	3.1	3.0	-1.9
Barley	mio. t	39.7	43.2	43.4	0.3
Oats	mio. t	6.2	5.5	5.7	3.8
Maize	mio. t	32.0	30.2	30.3	0.2
Other cereals	mio. t	3.1	3.4	3.5	0.4
Pulses	mio. t	8.1	8.1	8.2	1.7
Oilseeds	mio. t	31.5	28.9	29.8	3.1
Rape-seed	mio. t	8.7	6.9	7.1	2.5
Sunflower seed	mio. t	5.5	4.9	5.2	5.5
Soya beans	mio. t	17.4	17.1	17.6	2.7
		Net surplus			
Cereals	mio. t	24.9	24.4	34.1	39.4
Wheat	mio. t	16.8	15.7	22.4	42.1
Soft wheat	mio. t	15.9	14.8	21.0	41.9
Durum wheat	mio. t	0.9	0.9	1.3	46.9
Coarse grains	mio. t	8.1	8.7	11.7	34.4
Rye	mio. t	0.9	1.2	-0.1	-110.7
Barley	mio. t	6.7	2.0	2.7	36.6
Oats	mio. t	0.8	1.6	3.2	97.2
Maize	mio. t	-0.8	3.9	5.6	43.9
Other cereals	mio. t	0.5	0.0	0.3	1174.1
Pulses	mio. t	-2.9	-2.6	-2.1	-22.1
Oilseeds	mio. t	-19.6	-17.3	-18.1	4.7
Rape-seed	mio. t	-1.6	-0.3	-0.7	132.8
Sunflower seed	mio. t	-1.7	-1.1	-1.2	11.1
Soya beans	mio. t	-16.3	-15.9	-16.2	1.9

Table A.17

Impact of liberalisation on production and use of meat and eggs, EUR 15

		Average 1992-1996	Base run 2005	Liberalisation 2005	Difference between liberalisation and base run 2005 (%)
		Production			
Meat	mio. t	33.96	37.60	37.67	0.21
Beef	mio. t	7.98	7.92	7.94	0.22
Veal	mio. t	0.93	0.77	0.77	0.15
Sheep- and goatmeat	mio. t	1.22	1.17	1.18	0.22
Pigmeat	mio. t	16.34	18.24	18.29	0.26
Poultry	mio. t	7.49	9.50	9.51	0.11
Eggs	mio. t	4.89	5.20	5.21	0.20
		Use			
Meat	mio. t	31.49	35.26	35.32	0.16
Beef	mio. t	7.22	7.10	7.10	0.00
Veal	mio. t	0.70	0.63	0.63	0.00
Sheep- and goatmeat	mio. t	1.38	1.47	1.47	0.00
Pigmeat	mio. t	15.19	17.00	17.04	0.28
Poultry	mio. t	6.99	9.07	9.08	0.11
Eggs	mio. t	4.72	5.01	5.02	0.21

Table A.18

Impact of liberalisation on EU agricultural incomes (average 1992-1996 = 100)

	Base run 2005	Liberalisation 2005	Difference between liberalisation and base run 2005 (%)
	GVA at market prices		
EUR 15	117.3	117.0	-0.2
Belgium and Luxembourg	114.6	103.4	-9.7
Denmark	88.3	87.7	-0.7
Germany	116.6	114.5	-1.8
Greece	147.4	146.7	-0.4
Spain	157.5	160.5	1.9
France	91.0	89.9	-1.2
Ireland	72.2	72.8	0.9
Italy	127.7	128.8	0.8
Netherlands	173.2	174.0	0.5
Austria	137.9	141.9	2.9
Portugal	83.2	85.3	2.6
Finland	63.8	57.9	-9.3
Sweden	58.4	54.5	-6.6
United Kingdom	104.0	102.5	-1.5
	Subsidies		
EUR 15	118.4	66.3	-44.0
Belgium and Luxembourg	121.4	92.1	-24.1
Denmark	123.1	28.3	-77.0
Germany	97.2	34.1	-64.9
Greece	146.2	114.9	-21.4
Spain	119.6	73.7	-38.4
France	112.4	36.6	-67.5
Ireland	134.7	123.3	-8.4
Italy	103.6	48.7	-53.0
Netherlands	129.0	92.6	-28.2
Austria	158.6	138.4	-12.7
Portugal	101.9	74.2	-27.2
Finland	106.1	104.8	-1.2
Sweden	145.3	133.1	-8.4
United Kingdom	181.0	120.1	-33.6
	Net value added at factor costs		
EUR 15	122.7	108.8	-11.3
Belgium and Luxembourg	118.2	101.7	-13.9
Denmark	91.0	70.9	-22.2
Germany	117.2	89.0	-24.1
Greece	150.0	142.8	-4.8
Spain	154.6	146.8	-5.1
France	94.4	73.4	-22.3
Ireland	84.2	81.5	-3.2
Italy	131.6	122.7	-6.8
Netherlands	202.6	202.1	-0.3
Austria	175.5	169.6	-3.4
Portugal	83.9	78.9	-6.0
Finland	87.1	82.3	-5.6
Sweden	70.4	59.3	-15.8
United Kingdom	125.8	105.9	-15.8

7. EUROSTAT PUBLICATIONS ON THE SPEL SYSTEM

Methodological Documentation

SPEL System - Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS
Luxembourg 1995
Theme 5: Agriculture and Forestry, Fisheries (green), Series E: Methods

SPEL System - Methodological Documentation (Rev. 1), Vol. 2: MFSS
Luxembourg 1995
Theme 5: Agriculture and Forestry, Fisheries (green), Series E: Methods

Technical Documentation

SPEL System - Technical Documentation (Rev. 1), Vol. 1: Basics
Luxembourg 1995
Theme 5: Agriculture and Forestry, Fisheries (green), Series E: Methods

SPEL System - Technical Documentation (Rev. 1), Vol. 2: BS, SFSS, MFSS
Luxembourg 1995
Theme 5: Agriculture and Forestry, Fisheries (green), Series E: Methods

SPEL Data

a) Electronic media

SPEL/EU Data for Agriculture 1973-96: CD-ROM version
Luxembourg, 1997
Theme 5: Agriculture, forestry and fisheries (green), Series C: Accounts and surveys

b) Other publications

SPEL data for EU agriculture, 1985-1996
Luxembourg 1997
Theme 5: Agriculture, forestry and fisheries (green), Series C: Accounts and surveys

Other publications on SPEL

Agricultural Sector Modelling
Luxembourg 1995
Theme 5: Agriculture, forestry and fisheries (green), Series E: Methods

Overview

SPEL System - Overview of SPEL-System (Rev. 1)
Luxemburg, 1996
Theme 5: Agriculture, forestry and fisheries (green), Series E: Methods

The above-mentioned Eurostat publications were all published by the Office for Official Publications of the European Communities and can be ordered there.

THE USE OF THE RAUMIS MODELLING SYSTEM TO ANALYZE REGIONAL EFFECTS ON AGRICULTURE AND THE ENVIRONMENT IN GERMANY BY REGION

Wolfgang LÖHE und Reinhard SANDER
Institute for Agricultural Policy of the University of Bonn

1. DESCRIPTION OF THE RAUMIS MODELLING SYSTEM

At the end of the 1980s, a regional agricultural and environmental information system (RAUMIS) for the former territory of the Federal Republic of Germany was developed on behalf of the Federal Ministry of Food, Agriculture and Forestry (BMELF). It was based on the fundamental concepts of the DIES and SPEL modelling systems.[27] The objective was to develop a model for mapping the interplay of various economic factors affecting agriculture and to take account of the interrelationship between agriculture and the environment. It should be created a policy information system making it possible to quantify the effects of alternative agricultural and environmental policies on agriculture and the environment.

RAUMIS is a comparative-static, medium-term programming model taking an activity-based approach to depict the German agricultural sector as defined in the Economic Accounts for Agriculture. It specifies 431 models (roughly equivalent to NUTS III), each distinguishing 77 crop[28] and 16 animal production processes. Each regional model maximizes the income of agricultural producers, the allocation mechanism being an optimization approach with a non-linear objective function and linear restrictions ("Positive Quadratic Programming").[29] The various regional models provide results on production structures and quantities, factor and intermediate inputs, incomes and environmental indicators.

As a national model, RAUMIS captures only the supply side, since price formation takes place on the common EU market and this in turn is affected by developments on world agricultural markets. Policy scenarios are therefore analysed by linking RAUMIS with the WATSIM and SPEL/EU-MFSS models already described. RAUMIS makes use of the results supplied by these models in the following areas:

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[27] STROTMANN, B. (1992): Analysis of the effects of a nitrogen tax on production, factor input, agricultural incomes and nitrogen balance under alternative agricultural policy scenarios - a regional sector analysis for regions of the old Länder of the Federal Republic of Germany, dissertation, Bonn and HENRICHSMEYER, W., DEHIO, J., KAMPEN, R. V., KREINS, P., STROTMANN, B. (1992): Final report on the research project "Building a computerized regional agricultural and environmental information system for the Federal Republic of Germany", model description, Bonn and WEINGARTEN, P. (1995): "The Regional Agricultural and Environmental Information System for the Federal Republic of Germany" (RAUMIS), *Berichte über Landwirtschaft* (73).

[28] Including set-aside activity and 46 more extensive production activities.

[29] Cf. HOWITT, R.E (1995): Positive Mathematical Programming. In: American Journal of Agricultural Economics. Vol. 77, p. 329-342 and CYPRIS, CH. (1997): Positive Mathematische Programmierung im Agrarsektormodell RAUMIS, dissertation in preparation.

- Prices: The information on changes in the market prices of agricultural products in the alternative scenarios (specifically: continuation of the status quo policy or world-wide liberalisation) is generated in the WATSIM modelling system and used in RAUMIS as exogenous assumptions.
- Set-aside, quotas: The necessary minimum rate of compulsory set-aside required to comply with GATT restrictions is determined for the reference scenario using the SPEL/EU-MFSS EU model, taking into account (export) quantity trends. Regionally differentiated policy measures (e.g. quotas) can be explicitly mapped in the RAUMIS model.

Additional scenario parameters are also specified for the RAUMIS modelling system:

- Agricultural and environmental policy parameters on a regional basis: quota systems for milk and sugar, area premiums for EU agricultural reform, small-scale producers' shares, animal stocking limits, etc.
- Development of primary factors and macroeconomic aggregates: utilised agricultural area, family workers in agriculture, non-agricultural wage-rate[30],prices of intermediate inputs, etc.

For each of the regional models, the historical database is first constructed (base model). The base model contains the fully quantified activity-based differentiated model matrices for the ex-post years[31]. Data from a variety of sources are combined within a consistent framework:

- Agricultural statistics: These provide data on changing yields, land use and livestock numbers for each region. Information on the use of labour in agriculture can be obtained from the labour force statistics.
- The SPEL modelling system provides sectoral statistics on production volumes and quantities, factor and intermediate inputs and prices.
- Other statistics provide data on price trends of inputs and the use of commercial fertilisers at sector level.
- Calculation data for agriculture[32] are used for details of specific intermediate inputs, technology dependent depreciation costs and labour requirements.

This data base forms the foundation on which exogenous variables (e.g. yield trends for regions or processes) are projected for the simulation model.

The *Medium-Term Simulation Model* is used for comparative-static analyses of the effects of alternative agricultural and environmental policies. The consequences of these policies are compared with a reference scenario that depicts the continuation of the status quo policy. To capture different possibilities for technological adjustments, the following elements are included in the model:

30 To take account of the opportunity costs of labour.

31 For the regions of the former Federal Republic there are base model matrices for the years 1979, 1983, 1987. For 1991 there are base model matrices for all 431 model districts. The 1995 base year at district level is currently being prepared.

32 The main source for calculation data is the *Kuratorium für Technik und Bauwesen in der Landwirtschaft (KTBL).*

- Based on the *concept of neoclassical yield functions*, the optimal special intensity for yield-enhancing inputs is determined on the basis of the relative product/input price ratios.[33]
- Further inputs unrelated to yield are regarded as *linear limitational* and updated by technical progress ratios (e.g. feed requirement coefficients).
- A set of *alternative mechanical/technical processes* is defined for plant production (conventional tillage by plough, conservational tillage, no-tillage and extensive grassland production) that differ according to the use of machinery and thus decision-related depreciation costs[34], labour requirement, yield, yield-enhancing inputs and other variable costs.

The economic core model has downstream environmental modules linked to the structure and intensity of production as determined endogenously by the model. The *nutrient balance* takes account of nitrate, phosphate and potassium. Regional nutrient requirements and extractions are appraised in order to estimate the potential threat to the environment from agriculture. The modelling system not only balances nutrients ex post for the base years but also makes the balance in the simulation analyses for projection purposes. Comparison of how these indicators develop allows the effects of agricultural and/or environmental policies to be analysed.

The modelling system maps the effects of different types of agricultural land utilization on nature and the landscape by means of a *biodiversity indicator.* Experts evaluated the production processes formulated in the modelling system in a Delphi survey using particular criteria of landscape ecology, marking them on a scale ranging from "criterion not satisfied" (0 points) to "criterion satisfied to a very large extent" (4 points). The information provided by the indicators for each process and by the different levels of production is used to derive an average indicator value for each region in the model. This necessarily entails great simplification of complex ecological interactions. Nevertheless, this indicator can be used for an initial estimate of the different regional consequences of alternative policies for species and biotope conservation.

2. MODEL RESULTS OF THE IMPACTS OF CAP LIBERALISATION ON AGRICULTURE AND SELECTED ENVIRONMENTAL INDICATORS IN THE FEDERAL REPUBLIC OF GERMANY

The results of model analyses of the consequences of a liberalisation of the Common Agricultural Policy in the field of price compensatory payments for major crops ("grandes cultures") are presented. The reference scenario, reflecting a continuation of the status quo policy for the German agricultural sector, is contrasted with the liberalisation scenario. The target year for the simulation analyses is the year 2005.

33 Cf. WEINGARTEN, P. (1990): Development of an approach for estimating the effects of changing nitrogen and product prices on nitrogen application and yield in the regions of the Federal Republic of Germany, taking the example of winter wheat. Diploma thesis, Bonn, and WEINGARTEN, P. (1996): Grundwasserschutz und Landwirtschaft. Eine quantitative Analyse von Vorsorgestrategien zum Schutz des Grundwassers vor Nitrateinträgen, Kiel.

34 For the purpose of depicting technology-related depreciation costs, the medium-term simulation analyses assume continuous reinvestment.

The results presented here must be seen in the context of the global analyses made with the WATSIM modelling system and those for the Member States of the EU made with SPEL/EU-MFSS. The RAUMIS modelling system allows further statements to be made about specific regional effects (e.g. on favourable sites and marginal sites) and effects on environmental policy targets.

2.1 Development of production structure and quantities

In the *reference situation*, the land use structure is very much determined by the compulsory set-aside of 30% of the basic areas (exogenous scenario assumption of the model analyses of SPEL/EU-MFSS). The area under cereals in 2005 is 11% less than in the base year 1995. With unchanged policies, there is a marked decline in oilseed cultivation as compared to the base year in order to conform with the net guarantee area[35] under the Blair House Agreement. The yield trend is such that the quantities of cereals produced increase slightly despite the reduction in areas. There is a reduction of oilseed output.

With milk yields per cow increasing whilst milk quota is constant, it will be necessary to reduce dairy cattle herds by the year 2005. Since bull fattening is also curtailed in favour of pig and poultry meat production, the basic feed requirement will also fall, entailing a substantial reduction in fodder cropping and meadow land. To stay within the quotas, areas under sugar-beet will fall in line with rising yields. Potato production will be nearly unchanged.

Liberalisation of the markets for cereals, oilseeds and pulses triggers a number of adjustments:

- In favourable locations, the abolition of *compulsory set-aside* is seen as leading to an extension of the area under "grandes cultures", whilst in marginal areas additional land is left fallow (maps A.1 and A.2). The share of arable land left fallow would be particularly high in Brandenburg, the sandy areas of Mecklenburg-Western Pommerania, Saxony-Anhalt and Saxony, in the Lüneburg Heath and in highlands. Low-yield areas would also be left fallow in regions with intensive animal production.
- In an unchanged framework (prices), the abolition of *price compensatory payments* for the "grandes cultures" would lead to a major reduction in the cultivation of oilseeds in particular. Fodder crop cultivation, on the other hand, would benefit from the declining competitiveness of the "grandes cultures" production activities.
- With further liberalisation of "grandes cultures" products, *price trends* produce changes in the competitiveness of cereals and oilseeds in particular. Despite the envisaged small price increases, oilseed production no longer remains a competitive crop option in most of Germany's regions.

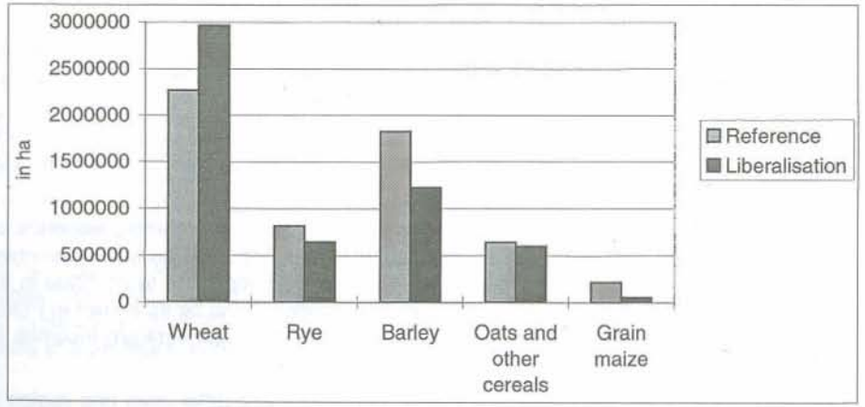
[35] 929 thousand ha gross guarantee area, less the applicable minimum rate of set-aside (30%) but at least 10%.

Table 1: Structure of land use

	Germany (RAUMIS)			
	Base year	Reference	Lib.	Lib.
	1995	2005	2005	% change over
	1000 ha	1000 ha	1000 ha	reference
Cereals	6507.0	5761.9	5475.4	-5.0
Pulses	122.0	98.6	83.9	-14.9
Oilseeds	850.0	589.1	220.1	-62.6
Potatoes	314.0	286.4	295.0	3.0
Sugar-beet	509.0	474.5	476.4	0.4
Forage crops	1755.0	1365.9	1484.3	8.7
Meadowland	5170.0	4872.8	4734.8	-2.8
Set-aside	1400.0	2678.1	0.0	-100.0
Fallow		296.8	3654.0	

The area under cereals and oilseeds is reduced overall. In cereals, there is a shift to wheat growing, since prices of other cereals fall sharply (cf. Figure 1). The cereals output falls less than the cultivated area because area previously set aside in high-yield locations are brought back into production.

Figure 1: Shifts in cultivation of cereals



Production of beef and pig meat increases slightly with the liberalisation of "grandes cultures". It gains from the improved competitiveness of fodder crops as compared to cereals production and from lower prices for feed grain. Because of the lower costs in relation to the feed value, meadowland is replaced by a higher share of fodder crops in the feed rations for livestock production.

Table 2: Production quantities

	Germany (RAUMIS)			
	Base year 1995 1000 t	Reference 2005 1000 t	Lib. 2005 1000 t	Lib. % change over reference
Cereals	39500.0	40311.0	39260.1	-2.6
Pulses	409.0	390.8	339.2	-13.2
Oilseeds	2443.0	2112.2	795.3	-62.3
Beef	1380.0	1173.4	1212.6	3.3
Pig meat	3255.0	3538.5	3574.1	3.3
Poultry meat	585.0	684.2	682.2	-0.3

2.2 Effects on incomes

The model analyses show a negative effect on market incomes[36] overall for the liberalisation scenario as compared to a continuation of the status quo policy.

Abolition of compulsory set-aside has positive effects on allocation as production is resumed on favourable sites. These effects, however, are compensated by the price effects of world-wide liberalisation of "grandes cultures". Both effects produce a slightly falling *market income* overall as compared to reference scenario (cf. Table A.1 in the Annex).

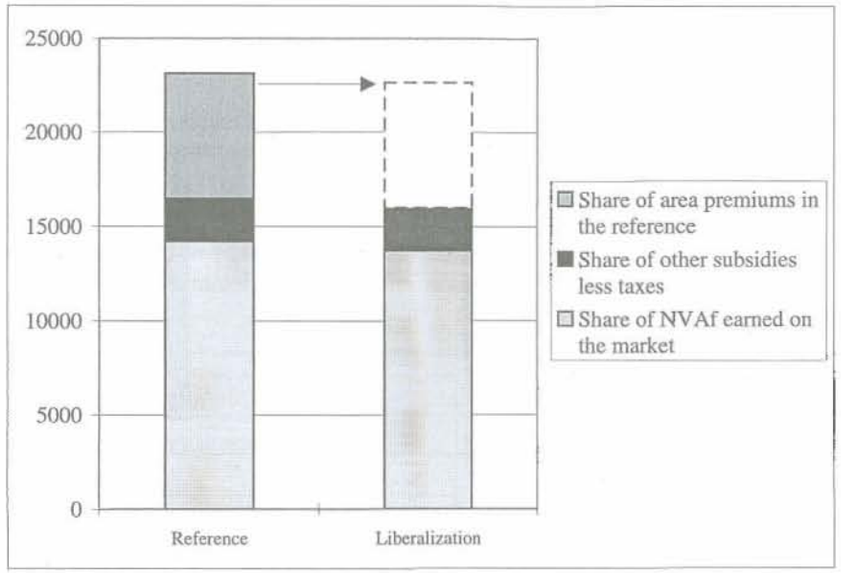
Total incomes from agricultural activity (net value added at factor cost) fall by about 31%, mainly because under the liberalisation scenario area premiums are abolished and *subsidies* to agriculture fall (-67%). Without an adjustment in farm structures under the conditions of the liberalisation scenario, the average drop in income in the sector would be a good DM 13 000 per worker. This drop in income per worker would be alleviated if farm structures were adapted to the changed conditions. The shape of transfer payments also has an effect on farms' adjustment responses.

The trend in overall agricultural incomes in the liberalisation scenario also depends on whether existing subsidy payments are continued in the form of fully decoupled transfers. If the budget for compensatory payments in the reference situation was to continue in the form of fully decoupled transfer payments, the consequences would be as shown in Figure 2. In the liberalisation scenario, the lower prices for many products diminish incomes by around DM 470 million, mainly through falling market incomes.

The impacts of liberalisation concerning income per labour unit differ from one region to another (cf. Figure 3). In places where conditions are naturally favourable, areas previously set aside are brought back into production. Slightly positive trends in income can be observed in Schleswig-Holstein. The "losers" would include Brandenburg and Saxony, but also Thuringia and Mecklenburg-Western Pommerania. In those Länder, the share of production processes with a falling contribution to incomes or the share of fallow land in total area are particularly high.

[36] *Market income* is defined as: net value added at factor cost (NVAf) - (subsidy payments - taxes on production) and therefore represents the *NVAf earned on the market as a proportion* of total NVAf.

Figure 2: Impacts of liberalisation on the development of sectoral market and transfer incomes (in million DM)

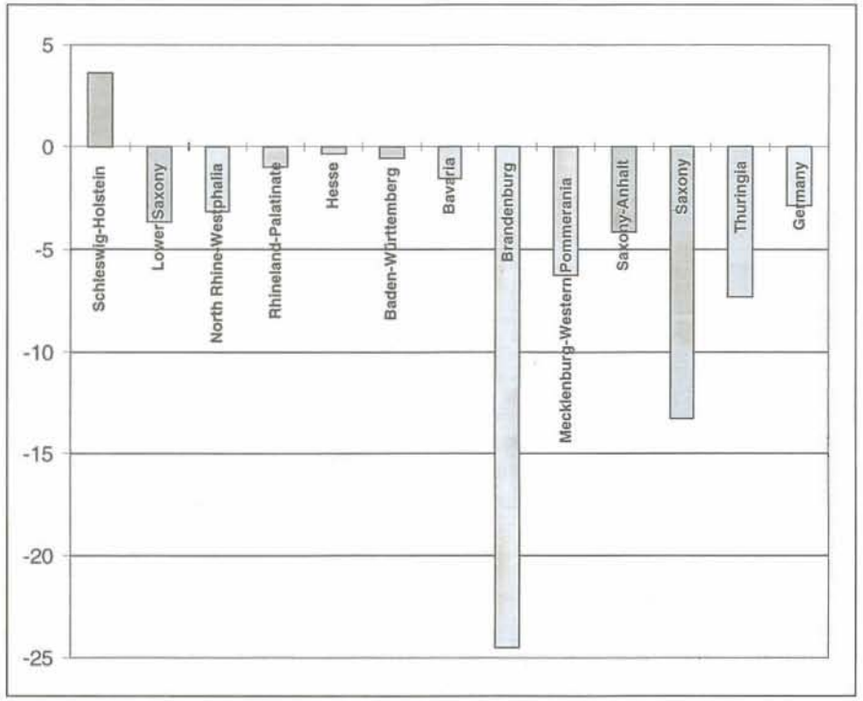


Source: RAUMIS, Institute for Agricultural Policy of the University of Bonn, Bonn 1997.

Employment opportunities in agriculture and with them the necessity for structural adjustment also change with the different trends in the structure of production. If fallow land as a proportion of agricultural area in the various regions (cf. Map A.2) is compared, it becomes clear that the quality of location and thus the regional proportion of fallow land in the liberalisation scenario is the main factor in the difference in deployment of labour between the reference and liberalisation scenarios.

These regionally very different effects of liberalisation underline how important it is that any transfer payments should be tailored to regional needs if they are to have a neutral effect on production. In disadvantaged regions, support should be concentrated on extensive forms of agriculture respectively on integrated rural development.

Figure 3: Effects of liberalisation on the development of incomes (inclusive decoupled transfers) per labour unit in the Länder (in %)



Source: RAUMIS; Institute for Agricultural Policy of the University of Bonn, Bonn 1997.

2.3 Effects on environmental indicators

Comparison of the 1991 base year with the reference scenario for 2005 reveals a clear reduction in environmental pollution from agriculture. This applies both for the nitrogen balance surpluses and for the biodiversity indicator.

Most of the reduction in the sectoral nitrogen balance surplus is the result of reduced applications of nitrogen in farm manure (cf. Table 3). This cuts the total application by more than 9% to around 200 kg/ha agricultural area. Higher nitrogen extraction by crops as a result of increased yields is sectorally almost totally compensated by the high 30% set-aside obligation, so that the crop extraction of nitrogen shown in the table remains virtually the same.

The model analyses show that *liberalisation* for "grandes cultures" relieves pressure on the environment. This impact can be broken down into the following components:

- The optimal special intensity of production processes is changed in line with the change in the ratio between the prices of intermediate inputs and of products.
- The abolition of compulsory set-aside, the additional cultivation of areas in favourable locations and the change in the structure of production in favour of more intensive products (especially wheat) increase pressure on the environment. The marked increase in fallow land has an impact into the opposite direction.

- Slightly more use is made of mechanical/technical production alternatives in crop production. Liberalisation makes no-tillage alternatives in particular become relatively more advantageous.

In summary, the different impact components lead to a marked reduction of the sectoral nitrogen surplus in the liberalisation scenario (cf. Table 3).

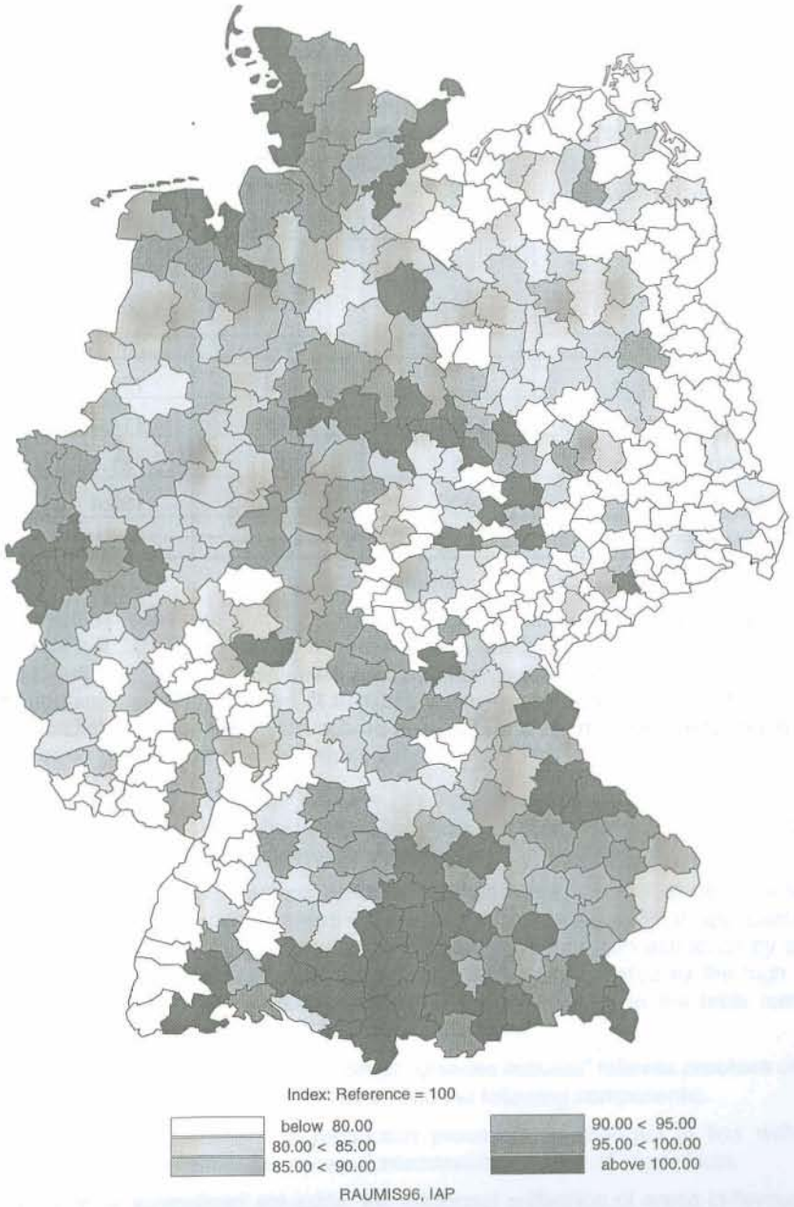
Table 3: Nitrogen balance in the base year 1991 and in the simulation scenarios for the target year 2005 (kg/ha agricultural area)

	Base year 1991	Reference 2005	Liberalisation 2005
Commercial fertilizer	99.3	96.9	88.9
Farm manure	85.9	68.6	69.5
Other inputs	36.5	35.1	36.0
Total application	221.7	200.5	194.4
N-extraction by crops	114.4	112.9	114.4
Ammonia losses	26.3	20.8	21.1
Total extraction	140.7	133.7	135.4
N-balance	81.0	66.9	59.0

Source: Own calculations based on RAUMIS modelling system, 1997.

Map 1 shows the trend in the nitrate surplus from the reference scenario to the liberalisation scenario. As changes in livestock production are only slight, the trend shown on the map is mainly due to adjustments in crop production. Increases in the N-balance surplus are found in regions where areas that had to be brought under compulsory set-aside in the reference scenario are now used productively again for commercial or forage crops.

Map 1: Development of the nitrate surplus between the reference scenario and the liberalisation scenario



Source: Institute for Agricultural Policy of the University of Bonn, Bonn 1997.

These include for example the regions of the Danube basin in southern Germany, the fertile plain in Lower Saxony and Saxony-Anhalt and parts of Schleswig-Holstein. A reduction in nitrogen balance surpluses is found in regions where the liberalisation scenario causes land to be taken out of production (cf. Map A.2). These include typical sandy areas in southern Mecklenburg-Western Pommerania and northern Brandenburg, the highland regions of the Thuringia Forest and the Erzgebirge and regions on the upper Rhine in Baden-Württemberg.

The aggregated *biodiversity indicator* improves slightly under the conditions of the liberalisation scenario. This is mainly due to the expansion in fallow land Map A.3 in the Annex shows the regional differences in the trend of the biodiversity indicator as we move from the reference scenario to the liberalisation scenario. The indicator shows the most favourable trends in regions with a higher proportion of mechanical/technical alternative processes and a high share of fallow land.

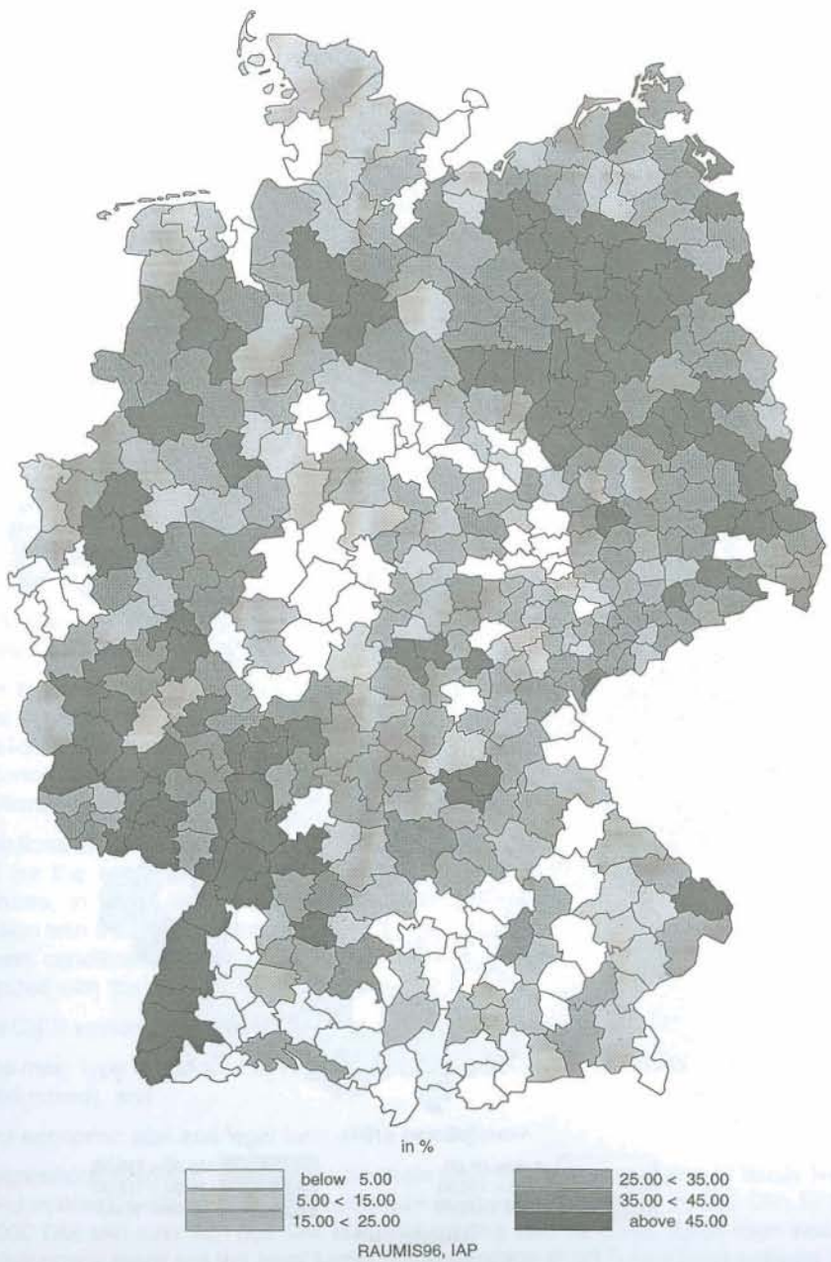
3. ANNEX

Table A.1: Incomes

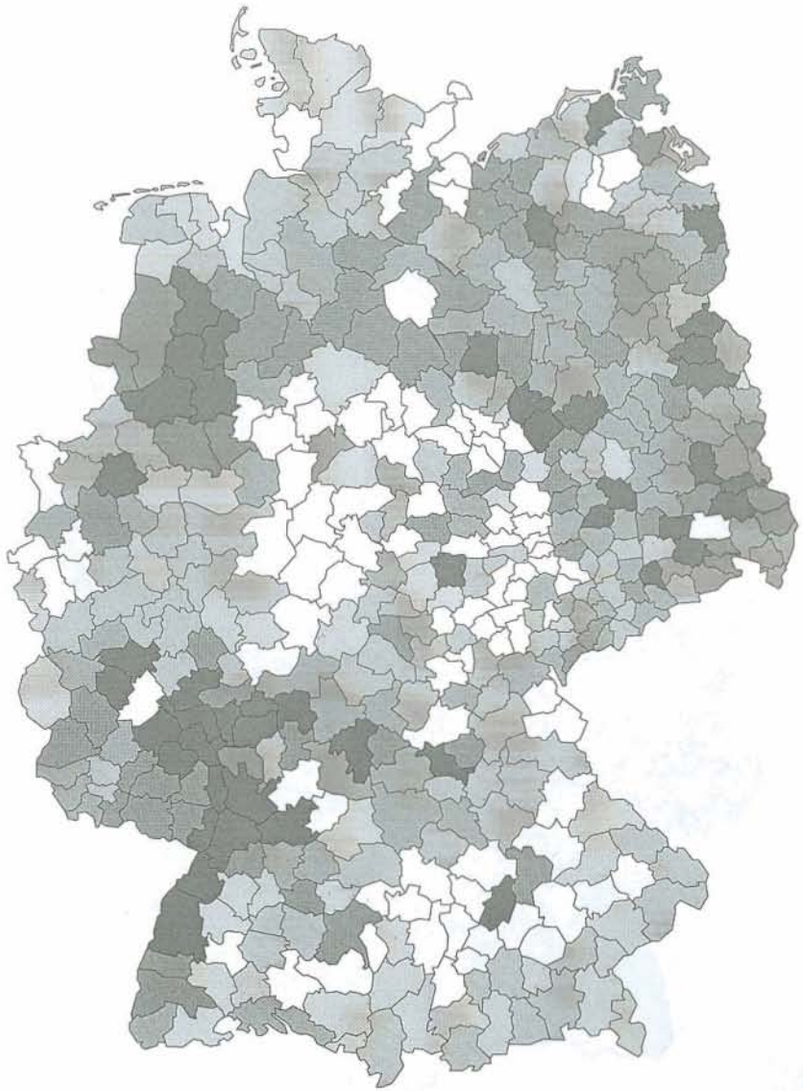
	Germany (RAUMIS)			
	Base year 1995 Million DM	Reference 2005 Million DM	Lib. 2005 Million DM	Lib. % change over reference
Gross output	61313.0	56119.9	55597.9	-0.9
Intermediate consumption	33675.0	28673.7	28644.1	-0.1
Gross value added (M)	27638.0	27446.1	26953.8	-1.8
Subsidies	10296.0	10175.4	3363.4	-66.9
Area premiums		6658.6	0.0	-100.0
Animal premiums		745.7	788.2	5.7
Taxes on production	1208.0	1259.6	1148.2	-8.8
Depreciation	13043.0	13229.9	13207.0	-0.2
Net value added (F)	23683.0	23132.0	15962.0	-31.0
Workforce	703800.0	522628.5	520631.5	-0.4

Map A.1: Reference scenario
Set-aside as a proportion of agricultural areas in %

Map A.2: Liberalisation scenario
Fallow land as a proportion of agricultural areas in %



Map A.3: Trend in the species and biotope conservation indicator between the reference scenario and liberalisation scenario



Source: Institute for Agricultural Policy, Bonn 1997.

MODELLING EFFECTS ON GROUPS OF HOLDINGS IN GERMANY WITH THE DIES MODEL SYSTEM

Claus MÖLLMANN
Institute for Agricultural Policy of the University of Bonn

1. ORIGIN AND MODEL CHARACTERISTICS OF DIES

Since the 1950s the Federal German government has presented an annual report on the income situation in the agricultural sector, which is now known as the "Agricultural Report". To serve as the basis for the data, a national network of test holdings was set up which also forms part of the European "Farm Accountancy Data Network". At the Institute for Agricultural Policy of the University of Bonn, this network was used to develop the DIES model system ("Dispositive Information System for Incomes in the Agricultural Sector"), which has been used in the German Ministry of Agriculture since 1978. The DIES system has the following applications:

- Ex-post analysis of production and income in groups of holdings and analysis of the income trends based on German FADN data.
- Annual forecasting of income trends in holding groups. Selected results are published as part of the Agricultural Report.
- Comparative static simulations of agricultural policy scenarios, in some cases with freely defined model holdings.

When the DIES system is presented in the following simulations, the sectoral results of trends in production volumes, yields and prices are taken from the RAUMIS model system and allocated to holding groups. The input coefficients are extrapolated using calculation functions taken from technical literature. The DIES model integrates these data within a definitionally, numerically and technically restricted framework.

Simulations are carried out on the assumption that productivity changes are in line with the trend for the sector and on the basis of no adjustments occurring within the holding structures, in other words, the number of holdings in the individual groups and their provision with the primary factors of land, labour and capital remaining unchanged. Subject to these conditions, the effects on specific holding groups of the liberalisation scenario, compared with the reference scenario, are analysed for the various holding groups.

In the DIES system the **holding groups are distinguished** according to:

- the main type of production (marketable crop production, cattle production, pigs/poultry and mixed), and
- the economic size and legal form of the holdings.

For agricultural holdings operated as the main activity, mostly consisting of family holdings located in Western Germany regions, the size classes are 15 000 to 50 000 DM, 50 000 to 100 000 DM and over 100 000 DM standard holding income (SHI). Apart from these sole proprietorships there are the legal forms of partnerships (PART) and legal persons (LEG).

The latter are found exclusively in the new *Länder* and play a considerable role as successors to the former production cooperatives.

2. RESULTS OF MODEL ANALYSES OF THE EFFECTS OF A LIBERALISATION OF THE CAP ON AGRICULTURE IN THE FEDERAL REPUBLIC OF GERMANY

The effects of liberalisation on income for the different groups of holdings are explained below.

The success variable "Profit plus staff costs" is chosen for comparing holding groups with different types of ownership (cf Table 1). For comparisons of the success of firms and the income situation according to legal form, profit alone is not a suitable yardstick. In sole proprietorships and partnerships, the living costs of unpaid labour have to be covered. In the case of legal persons, on the other hand, all persons working in the enterprise are paid before profits (staff costs).

A comparison of the model's results for the different forms of holding shows, as expected, that marketable crop production holdings in particular suffer substantial losses of earnings as a result of the liberalisation when the compensatory payments for "grandes cultures" areas and the set-aside premiums are no longer paid. For sole proprietorships, a fall in income of an average of 76% is calculated, with only slight differences between the holding size classes. In enterprises specializing in livestock there is a much more reduced effect on income (10 to 15%) which remains to be explained by other analytical methods implemented in the DIES system (cf Table 2).

As far as trends are concerned, the effects of a liberalisation indicated for the average of the mainly western German family holdings are also similar to the special effects in the enterprises of the new *Länder*. However, in marketable crop production holdings, which suffer from a lack of capital, the abolition of subsidies means the loss of an important source for covering costs, and therefore the normal business activity produces only a negative result. The success variable Profit plus Staff Costs declines by just under 175% compared with the reference period. These enterprises could not continue doing business in these circumstances. If the subsidies are abolished without replacement as part of the liberalisation policy, not only will the capital and the entrepreneurial activity invested in the company not be remunerated but it will also be impossible for wages and salaries to be paid.

On the other hand, however, attention should be drawn to the assumptions on which this simulation is based: the design of the model does not allow a change in structure to be depicted with the DIES system. In realistic conditions, however, a substantial adjustment process would have to be expected. In such a situation, the losses in income indicated in Table 1 could also be interpreted as "relative pressure of adjustment".

The average result for all types of holding and legal form is a decline in income of 43%.

Table 1: Comparison of the change in Profit plus Staff Costs in the liberalisation and reference scenarios (in %)

Legal form	Sole proprietorship				PART	LEG	ALL
Type of activity	Holdings operated as main activity						
Size class	15-50 StHI	50-100 in thous.	> 100 of DM	total	total	total	total
Type of holding							
Marketable crop production	-73	-71	-80	-76	-173	-177	-112
Cattle production	-7	-10	-14	-10	-29	-58	-26
Pigs/poultry	-11	-14	-15	-14	-13	-30	-17
Mixed	-21	-14	-14	-15	-13	-66	-33
Total holdings	-19	-21	-32	-25	-72	-78	-43

Abbreviations/Notes: Sole proprietorships are generally family holdings operated as the main or secondary activity. Holdings operated as a secondary activity have been left out of this simulation. PART = partnerships, which can be civil law associations, general partnerships or limited partnerships (KG). LEG = legal persons, which comprise registered associations, limited companies, registered societies and foundations. Limited companies include limited liability companies (GmbH), mixed forms of companies (GmbH &Co. KG) and joint stock companies (AG). ALL = all agricultural enterprises, StHI = Standard Holding Income.

Source: Institute for Agricultural Policy of the University of Bonn, Bonn 1997.

The influence of policy measures on individual income or expenditure headings, as analysed by the DIES system, results in characteristic differences in volume and price effects (cf Table 2).

Table 2 shows for the average of all holdings specialising in marketable crop production, cattle production and pigs/poultry how the different components contribute to the change in profit. The overall effect of an income or expenditure heading depicts the percentage change in profit over a base year which would have occurred as a result of a change only in the income or expenditure heading concerned.

For example, the overall effect of 20.2% in the marketable crop production holdings for "grandes cultures" means that the change in turnover on "grandes cultures" alone would have decreased the profit by 20.2%. The volume effect means that 12% of this effect would be the result of decreases in volume. and that 11% of this effect would be caused by price reductions. The mixed effect depicts the additonal simultaneous effect of volume and price changes.

Table 2 also shows that the abolition of area subsidies would reduce the success variable of marketable crop production holdings by about 87%. The same measure would have a much milder effect on holdings specialising in livestock production, where the profit plus staff costs would be reduced by 25% (for cattle production) or 14% (for pigs/poultry) because area-based subsidies are less important to these holdings. All farm types can, however, compensate a part of their income fall by reducing input to crop production.

Table 2: Effect of changing only the income and cost heading to the Profit plus Staff Costs following liberalisation (in %, for all legal forms)

	Marketable crop production				Cattle production				Pigs/poultry			
Income headings	Volu -me	Price	Mix	All	Volu -me	Price	Mix	All	Volu -me	Price	Mix	All
"Grandes Cultures"	-11.8	-11.0	2.7	-20.2	-7.5	-3.4	2.0	-8.9	-7.8	-1.2	0.5	-8.4
Livestock production	1.8	-3.3	0.0	-1.5	1.3	-0.9	0.0	0.4	3.4	-6.8	-0.1	-3.5
Other income	-15.6	-1.7	0.0	-17.3	-7.0	-0.2	0.0	-7.2	-3.0	-0.1	0.0	-3.1
Area subsidies	-86.7	0.0	0.0	-86.7	-25.0	0.0	0.0	-25.0	-13.8	0.0	0.0	-13.8
Livestock premiums	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Enterprise income	-112.2	-16.0	2.6	-125.6	-38.0	-4.5	2.0	-40.5	-21.1	-8.1	0.5	-28.7
Enterprise expenditure	-11.2	-2.9	0.1	-14.0	-9.2	-5.6	0.0	-14.8	-5.5	-6.0	0.0	-11.5
Profit plus Staff Costs	-101	-13	3	-112	-29	1	2	-26	-16	-2	0	-17

Source: Institute for Agricultural Policy of the University of Bonn, Bonn 1997.

Livestock holdings continue to profit from a reduction in feed costs and therefore extend their livestock operations. As a result, their demand for feedingstuffs increases and the enterprise expenditure drops by 14%. On the income side, declines in prices for animal products (the negative price effect of -0.9% for cattle production and -6.8% for pigs/poultry) can be partly offset by increases in supply.

On the basis of the DIES system, net losses in income are calculated for average holdings in Germany as follows: 112% for marketable crop production holdings, 26% for cattle production holdings and 17% for pigs/poultry holdings. Again, for an appropriate interpretation of these effects, attention should be drawn to the assumptions on which this simulation is based: to determine the "pure" effect of liberalisation, it is assumed, that the price cuts are not compensated by direct payments. Further on, it is not taken into account, that the distinctive price cuts might accelerate the process of structural adjustment in the farming sector.

Wilhelm HENRICHSMEYER
Institute for Agricultural Policy of the University of Bonn

In this study an attempt has been made to indicate the complex implications of complete liberalisation in the cereals, oilseeds and pulses sectors using a set of model analyses performed at different levels. The individual model assumptions and results have been indicated individually for each level of investigation, and the results presented in a condensed form at the end of each section. It was therefore felt unnecessary to present the results globally once more in this final section. Instead, it was decided to highlight only a few results of relevance to policy and to indicate how the results of the model analyses complement each other at the different levels and how they can be linked for the purpose of interpretation.

In all the models the effects of liberalisation are analysed by comparing the results of a projection under the basic conditions of the liberalisation scenario with those of a reference calculation based on a continuation of current agricultural policy. In the reference calculation, it is assumed that, with regard to EU agricultural policy, the agricultural reform measures adopted in 1992 are maintained over the projection period 1997-2005. For all the countries in the world, the principle applies that the GATT agreements of the Uruguay Round determine the level of agricultural protection (external protection and internal intervention). In the liberalisation scenario it is generally assumed that price support for cereals, oilseeds and pulses will be completely abolished together with area-based compensatory payments and set-aside payments.

At the different levels of study in the model analysis, different aspects of the effects of liberalisation are scrutinised: the WATSIM world trade model looks at the effects of world-wide liberalisation on the structure of world market prices; the agricultural sector model for EU-15 (SPEL/EU-MFSS) checks the effects on production, use of factors and farm income in the individual Member States; RAUMIS, the model for the Federal Republic of Germany, looks at the regionally varying effects on the target figures for agricultural and environmental policy; the farm group model DIES examines the different effects on income for the different types and sizes of holding. The most important results obtained about these aspects of the impact of liberalisation, which illustrate the different dimensions of its effects, are summarised in the following section.

1. THE EFFECTS OF LIBERALISATION ON WORLD MARKET PRICES

The result of the *reference calculation* with the world trade model (WATSIM) implies that the world market prices for cereals and oilseeds in the current agricultural policy environment will continue to fall in the projection period (up to 2005) too, but at a much slower rate than in the past four decades: from 1950 to 1990, world market prices for cereals fell by about 2.5 to 3.3% per annum in real terms, whereas according to the model calculations they will fall by only 1.7 to 1.8% per annum in the period from 1992 to 2005. This is mainly due to increasing demand in the Asian region combined with slightly slower increases in yields in world agriculture. For the EU, this means that the gap between the

world market prices and the EU intervention prices would close substantially even in the current agricultural policy environment.

In the situation of the *world-wide liberalisation scenario*, world market prices for cereals and oilseeds would develop even more favourably, mainly because of the removal of protection in the other regions of the world, whereas in the EU the abolition of set-aside payments would lead to a substantial extension of production and consequently to a mitigation of the positive price trend on the world market; for wheat this would even cause prices to fall compared with the reference calculation.

2. EFFECTS ON PRODUCTION, USE OF FACTORS AND AGRICULTURAL INCOME IN THE EU

At EU level, the effects of liberalisation are examined on the basis of the SPEL/EU-MFSS medium-term agricultural sector model. The results of the *reference calculation* show that, on the basis of an unchanged agricultural policy environment up to the year 2005 and average weather conditions, an increase in the land set-aside rate to about 30% would be necessary to keep within the thresholds for subsidized cereals exports in line with GATT commitments. If there was no change in the compensatory payments, the real agricultural income (net value added at factor cost) would fall slightly, but if the current rate of decline in the agricultural workforce continued, real farm incomes per AWU (annual work unit) would rise by about 2% per year.

In the overall conditions of the *liberalisation scenario*, there are two diametrically opposed factors influencing the size of areas under combine harvest crops: on the one hand, the abolition of set-aside payments allows more scope for extension but the abolition of area-based compensatory payments reduces the competitiveness of cereals, and even more so that of oilseeds. According to the model calculations, liberalisation would increase the EU's area under cereals by about 8%, the area under oilseeds by 3% and the area under pulses by 15% compared with the reference calculation. EU-15 would then produce about 203 mill. t. of cereals in the year 2005, or about 5% more than in the reference scenario.

By contrast, demand for cereals would increase only slightly. Although low cereals prices affect the trend of an increase in the cereals share of feedingstuffs, this effect will be only a limited one if the prices of cereals substitutes rise as well and the use of farm-produced feed increases. The same applies to demand for cereals products and livestock fattening products which are not very much affected by falling prices. The EU's extra production will therefore be mainly exported (without export subsidies).

In the analysis of the *effects on income* of liberalisation, a careful distinction must be made between market income (gross value added at market prices) and overall agricultural income including transfer payments (net value added at factor cost). Through the abolition of price support, the market income of EU agriculture changes only slightly because the effects of lower prices (reduced to a world market price level which is higher as a result of world-wide liberalisation) and increasing volumes (following the discontinuation of set-aside payments) offset each other more or less for the EU as a whole, but to differing degrees depending on the Member State concerned.

In the wake of the abolition of area-based compensatory payments in the liberalisation scenario, the overall agricultural income compared with the reference calculation would fall on average by about 10%, but would again differ substantially from one Member State to another. The question is then, first of all, to what extent a thorough structural change can

help to improve the incomes situation (a mobility effect which is not explicitly depicted in the model). In the liberalisation scenario conditions, there also remains the basic possibility of making direct income transfers (disconnected from production). Even if no further structural change resulted from the liberalisation scenario and if full income compensation was ensured by direct income transfers, this could be achieved on a neutral financial basis according to the results of the model calculation.

3. REGIONAL EFFECTS ON LAND USE, FARM INCOME AND ENVIRONMENTAL INDICATORS IN THE FEDERAL REPUBLIC OF GERMANY

The RAUMIS model system provides a regionally broken down depiction of economic interaction in the agricultural sector and of areas of interdependence between agriculture and the environment. The main emphasis in this study is the analysis of the effects of liberalisation on forms of land use, levels of agricultural income and selected environmental indicators for the entire Federal Republic of Germany.

The *area use structure* is substantially influenced in the *reference situation* by the more or less obligatory set-aside, which accounts for 30% of the basic area in projection year 2005 (see above) and is distributed evenly over favourable and less favourable locations in line with political targets. In the liberalisation scenario, on the other hand, following the abolition of set-aside payments, the usable agricultural areas at the favourable locations come into full use whilst at the unfavourable locations, following the abolition of price compensatory payments, large areas of arable land fall into disuse. In Germany, within the "grandes cultures" the cultivation of oilseeds is less competitive compared with cereals production and therefore oilseed cultivation is substantially cut back.

The effects on income calculated with the RAUMIS model, when examined on a sectorally aggregated basis for the Federal Republic of Germany, have a similar basic trend to the one mentioned for EU-15 in the previous paragraph. The regionally differentiated analysis, however, shows severe regional differences in income even in the reference calculation, which become even more severe in the liberalisation scenario.

The model calculations with the DIES model system analyse the specific effects on the incomes of holding groups as well. As expected, the marketable crop producing holdings in particular suffer very heavy losses in income through liberalisation.

The *environmental effects* are covered by two environmental indicators in the RAUMIS version used for this study: the nitrogen balance surplus and a species and biotope protection indicator. The results of the reference calculation show that in the period concerned the nitrogen balance surpluses fall sharply at most locations, mainly due to a much lower occurrence of farm manure. Liberalisation generally further eases the burden on the environment in both sectors; the changes differ very sharply, however, from region to region.

4. ASSESSMENT OF THE COMBINED USE OF MODELS

The combined use of models at different study levels gives rise to a number of *advantages*:

- First, it should be noted that this forces the analyst to take a broader view of the problem, because if it is only looked at from the overall and/or sectorally aggregated

viewpoint, the structural adjustment problems at regional and holding level are frequently disregarded or suppressed. On the other hand, studies restricted to the holding or subregional level frequently lose sight of the overall sectoral or world economic interrelations. Close intercommunication and co-operation between the research groups of different disciplines helps to prevent this from happening.

- Secondly, a systematically constructed set of models ("family of models") allows the results of a model to be used as a basis for other models. Examples from this study are: the trends of the anticipated world market price movements based on the world trade model serve as a basis for specifying the reference and liberalisation scenarios at EU level (for the SPEL/EU-MFSS) and at the level of the Federal Republic of Germany (the RAUMIS model). On the other hand, with the aid of the SPEL/EU-MFSS the effects on production of an abolition of set-aside payments in the EU are determined and used for the world trade model.
- Finally, models for different stages of aggregation which are systematically harmonised with each other provide better means for comparing and checking model results; in this study, one example is the comparison of the effects of liberalisation on European agricultural markets using the model results of WATSIM, SPEL/EU-MFSS and RAUMIS.

This modelling concept, however, has also some implementation problems and drawbacks: this type of family of models can only be built up step by step as part of a long-term research strategy, thus creating commitments and mutual dependencies for all involved. This is the price to be paid for this kind of research concept.

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The effects of a worldwide liberalisation of the markets for cereals, oilseeds and pulses on agriculture in the European Union

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The publication deals with the possible impacts of a worldwide liberalisation of agricultural and trade policies for cereals, oilseeds and pulses on agriculture in the European Union. This study attempts to throw light on aspects of this complex state of affairs by using quantitative model analysis: the effects on the structure of world market prices with the world trade model Watsim; the effects on production, use of factors and farm income in the individual Member States and for the EU as a whole with the agricultural sector model SPEL/EU-MFSS; the regionally varying effects on target figures for agricultural and environmental policy with the model Raumis for the Federal Republic of Germany; and the effects on income for the different types and sizes of holding in Germany with the model DIES. Interactions between the various levels of investigation are taken into account through specific scenarios.

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