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A new medium-term forecasting and simulation system (MFSS99)

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1 Introduction

The development of the SPEL System began in the early 1980s, initially aiming at short term forecasts and policy analysis for the agricultural sectors of EU member states (Henrichsmeyer 1995, p. 29). The complete SPEL System comprised three parts. The first part was the SPEL/EU Base System (BS). The aim of this Base System was to bring together data from different sources into one consistent framework. It turned out that this Base System required a considerable amount of groundwork before becoming the desired tool for ex-post analyses of the European agriculture and solid basis for modelling. In 1984 EuroCARE has started with the development of the Short-term Forecast and Simulation System (SPEL/EU-SFSS). The aim of this system was to analyse the income situation and simulate the impact of agricultural policy in the short run, that is before a significant response of agriculture to changes incentives takes place. The need of the Commission for a model for medium-term forecasts and policy simulations led to the development of the Medium-term Forecast and Simulation System (SPEL/EU-MFSS). This model has been improved over the years and has been used on various occasions by the Commission to assess the effects of CAP proposals (EU Commission Green Paper 1985, Stabiliser Regulations 1988, MacSharry proposal 1991 and recent Agenda 2000 proposals).

The Medium-term Forecast and Simulation System was a fairly complex partial equilibrium model. Over the years it had become increasingly cumbersome and difficult to handle. There were two main reasons for this. At first the CAP was enriched, every other year, with qualitatively new policy instruments, which had to be integrated in the model, typically under very tight time constraints, which were dictated to a large degree by the political agenda of CAP amendments and reforms. Secondly, because the model was mainly written in Fortran, it was essentially handled by only a couple of people, finally becoming essentially a one man tool, as only a limited number of officials at Eurostat or other EU authorities had reasonable chances to directly look at its technical details. This caused additional delay and friction in the communication between model builder and operators on the one hand and ultimate users on the other.

Because there was a clear demand for speedy policy information systems in Eurostat and DG Agriculture they decided in the beginning of 1999 to lance a new effort to trigger the development of a user-friendly policy information system for the CAP. The call for tender that had been launched was won by the European Centre for Agricultural, Regional and Environmental Policy Research (EuroCARE) in Bonn. The decision was taken on the basis of the long history of EuroCARE with Agricultural Sector Modelling in Eurostat and of the intimate knowledge about strengths and weaknesses of this historically grown modelling framework. Because there was a clear demand for a new model, not just for some additional amendments of the existing SPEL/EU-MFSS, the new project started under the heading “MFSS99”. For better distinction we will refer to the former SPEL/EU-MFSS as “MFSS95” after the detailed documentation of Weber (1995).

The two main goals of this research report are to give an introduction to the objectives, structure and technical implementation of the MFSS99-model and to assess its performance. To this end another analysis of Agenda 2000 CAP reform impacts has been carried out. This modelling exercise comes close to an ex-post evaluation as the results may be compared with well known simulation outcomes (see European Commission 2000) from a number of other models which may thus serve as a yardstick. The report closes with conclusions and an outlook for future work

2 Objectives of the new model

The aim of the call for tender can be summarised as to develop a transparent and user-friendly tool for medium-term projections of sectoral developments and impact analyses of alternative policy scenarios. From the background above follow quite naturally the objectives as well as a number of requirements for future modelling efforts:

- User friendliness: involving ease and speed of operation
- Transparency: for continued operation, maintenance, checking and discussion of model structures or modules by a larger, at least not negligible number of EU officials
- Detailed coverage of products (see the annex) and CAP policies
- Economy in information requirements
- Reliability of results at the EU member state level
- Results for the major variables of political interest: agricultural income, market balances and trade, burden on consumers and budgetary impacts.

These objectives involve a number of evident trade-offs, requiring a compromise between them. Environmental impacts, for example, have not been mentioned even among the desired outputs because an appropriate modelling of environmental issues clearly requires further regional break down beyond the member state level.

Budgetary impacts are not yet integrated into the system although a number of basic variables for them emerge from the system. Past experience has shown that the consolidation of EAGGF data with the MFSS95 framework (attempted for Henrichsmeyer, Witzke 1998) was a quite challenging task, which is postponed for the time being in the framework of MFSS99.

The above requirements call for a lean model, stripped off from all elements, which are inessential for a first quick analysis of some CAP policy scenario. However, reliability clearly remains among the objectives. The next section will reveal how this balance has been struck.

3 Structure of the new model

3.1 Overview

MFSS99 is a purely comparative static modelling tool with behavioural functions driven by a set of synthetic elasticities, not estimated in this project. These behavioural functions derive from some variants of profit and utility maximisation to permit calibration to standard microeconomic conditions. It is well known that profit maximisation and utility maximisation will not hold in general for aggregate agents but these conditions should provide a useful framework even if valid only as an approximation.

Behavioural functions are completed with a number of accounting identities to form a complete set of market balances for agricultural products as covered by the Economic Accounts for Agriculture (EAA). Market clearing basically occurs in one of two ways. For major agricultural commodities such as cereals, oilseeds and beef, exogenous information on world market prices or more precisely EU trade prices is fed into the model, yielding trade or public intervention as endogenous variables. For a number of products with a limited volume of trade in the past such as potatoes, or more importantly pigs and poultry, we assume that trade volume may be determined exogenously and market clearing determines endogenous prices.

Within this simple framework, most CAP instruments can be incorporated quite easily. For this task and for the incorporation of some basic checks for technical feasibility, it is helpful to explicitly distinguish between activity levels and yields on the supply side.

3.2 Production and activity levels

Production

Modelling of the supply side is considerably simplified both from a theoretical as well as from a practical point of view if yields are taken exogenous. There some empirical evidence to the contrary (Jensen 1996; Guyomard, Baudry, Carpentier, 1996), but it appears that variations in intensity add little to the total supply response (FAPRI 2000, p. 55) such that the chosen specification for production is:

$$PRD_{m,i} = \Sigma_j \left(YLD_{m,i,j} * LVL_{m,j}\right) \qquad (1)$$

where

$PRD_{m,i}$ = production of item i in member state m

$LVL_{m,j}$ = level (usually ha or hd) of activity j (crop or animal) in member state m

$YLD_{m,i,j}$ = (exogenous) yield of activity j in terms of output i in member state m

Profit maximisation

To make use of microeconomic theory we consider activity levels and input demand to be profit maximising choices of the member state's agricultural sector. In this setting we assume that the feed technology linking activity levels and feed demand is separable from crop activities. Explicit constraints considered are the balances on land and on young calves:

$$\begin{aligned}
\max_{LVL_m, INP_m} \Big\{ & \sum_{c \in crops} REV_{m,c}\, LVL_{m,c} && \text{crop activity revenues} \\
+ & \sum_{a \in animals} REV_{m,a}\, LVL_{m,a} && \text{animal activity revenues} \\
- & \sum_{n \in nonfeed} PP_{m,n}\, INP_{m,n} && \text{nonfeed cost} \\
- & C\left(PP_{m,f}, LVL_{m,a}\right): && \text{feed cost function} \\
& \sum_{c \in crops} LVL_{m,c} = \text{Total Area}_m, && \text{land balance} \\
& \sum_{a \in cattle} LVL_{m,a}\, \kappa_{m,a,i} = 0, && \text{calves balances} \\
& T_m\left(LVL_{m,c}, LVL_{m,a}, INP_{m,n}\right) = 0 \Big\} && \text{other constraints}
\end{aligned}$$

$$= \pi_m(REV_{m,c}, REV_{m,a}, PP_{m,n}, PP_{m,f}, \text{Total Area}_m) \qquad (2)$$

where

$REV_{m,j}$ = revenue of activity j (crop or animal) in member state m

$LVL_{m,j}$ = level (usually ha or hd) of activity j (crop or animal) in member state m

$INP_{m,n}$ = demand for nonfeed input n in member state m

$PP_{m,i}$ = producer price of item i (feed f or nonfeed input n) in member state m

$\kappa_{m,a,i}$ = input or output coefficient in animal activity a for i = male or female calves and member state m

$T_m(.)$ = operating capacity constraint in member state m

$\pi_m(.)$ = restricted profit function of member state m

According to our assumption, activity revenues of crop and animal activities may be calculated on the basis of exogenous yields and therefore take on the role of given prices in a sectoral profit function. Crop activity levels $LVL_{m,c}$ have to comply with an exogenously given land constraint. Use ($\kappa_{m,a,i} < 0$) or production ($\kappa_{m,a,i} > 0$) of female and male calves by activities $LVL_{m,a}$ in the cattle sector have to be consistent with a given net trade in calves, set to zero in (2) for simplicity.

These physical constraints are relying on rather hard information such that their incorporation is expected to greatly increase the internal consistency of a simulation. For other inputs, say fertiliser per activity, the information from the current SPEL base model is less certain because it relies on little statistical information beyond the sectoral aggregates. Furthermore, it might be questioned whether fertiliser is truly allocatable to single crops at all if a part of the nutrients is stored in the soil and passed on to the next crop year. For general inputs such as insurances and energy, these difficulties are even worse. It was decided therefore to treat all other technological constraints only in implicit form. These constraints stem from the operating capacity linking the activity levels and the use of non feed inputs $INP_{m,n}$ and from the feed technology which links animal production and feed inputs $INP_{m,f}$ in the background of the cost function in (1), see Witzke, Zintl 2001, p 275. Conceptually, feed demand in MFSS99 is derived from this cost function and consequently depends on animal activity levels and prices of feed stuffs (see below). Demand for non feed inputs, and the activity levels themselves, are derived from the profit function in (1) and consequently expressed as a function of revenues and input prices.

Problem (1) provides the microeconomic framework for a calibration procedure of activity elasticities and input demand elasticities based on a maximum entropy approach similar to that described in Witzke, Britz 1998. Starting values and derived support values have been obtained by converting the gross margin elasticities from the former MFSS to revenue elasticities, which is possible given fixed yields. However these elasticities require further testing, updating and potentially econometric estimation, a task postponed to the future.

Activity levels

The calibrated set of elasticities is used as parameters in double log functions, in the case of activity levels:

$$LOG(LVL_{m,j}) = \phi_{m,LVL,j} + CFAC_m$$

$$+ \Sigma_k (LOG(REV_{m,k}) * \varepsilon_{m,j,k}) + \Sigma_i (LOG(PP_{m,i}) * \varepsilon_{m,j,i}) \qquad (3)$$

where

$LVL_{m,j}$ = level (usually ha or hd) of activity j (crop or animal) in member state m

$\phi_{m,LVL,j}$ = constant parameter in level equation j of member state m

$CFAC_m$ = "scaling factor" to enforce the land balance for crop levels in member state m

$REV_{m,k}$ = revenue of activity k in member state m

$\varepsilon_{m,j,k}$ = elasticity of activity j with respect to revenue of activity k in member state m

$PP_{m,i}$ = producer price of item i (feed f or nonfeed input n) in member state m

$\varepsilon_{m,j,i}$ = elasticity of activity j with respect to price of input item i (feed or nonfeed) in member state m

The double log function has the disadvantage of loosing microeconomic consistency when deviating from the point of approximation, that is from the base year situation during simulations. The alternative would be to use a potentially globally convex profit function such as the symmetric normalised quadratic (Diewert, Ostensoe 1988). However simplicity and the advantage of complete control over the elasticities where given preponderance for the time being.
Most functional forms such as the double log but also the symmetric normalised quadratic do not comply with the land balance automatically. Locally, that is near the base year situation, the elasticities may be calibrated (and have been) such that changes in revenues or input prices do not lead to violations of the land balance. For nonmarginal changes this condition would be violated, however, in a double log system of crop levels such as (3). The simple remedy introduced is an endogenous scaling factor $CFAC_m$ which corrects all "area inconsistent" levels proportionally to make them consistent with the land balance included in (2) and which is zero by definition for animal activities.

Revenues

The revenues in (3) usually stem from market revenues and different subsidies:

$$REV_{m,j} = (PP_{m,i} + SUBS_{m,i}) * YLD_{m,i,j} + PREM_{m,j} \qquad (4)$$

where

$PP_{m,i}$ = producer price of output i in member state m

$SUBS_{m,i}$ = Subsidy per ton of item i in member state m

$YLD_{m,i,j}$ = (exogenous) yield of activity j in terms of output i in member state m

$PREM_{m,j}$ = (total) premia per unit (ha or hd) of activity j in member state m

Subsidies per ton of actual production are irrelevant at the moment in the CAP. Due to the fixed yield assumption, there would be no difference in the effects of subsidies per ton of product or in corresponding premia per activity. A detailed analysis of different degrees of decoupling is thus beyond the scope of MFSS99. However, given that unification of premia across activities is the major decoupling device, this limitation does not preclude reasonable analysis of important issues on the structure of support.
Total premia per activity unit are determined in a quite complicated way for a number of products. These include the calculation starting from "historical yields" (subject to political renegotiation) and EU uniform premia per calculatory ton (as for CAP Grandes Cultures), but also plain premia per unit (for durum wheat, suckler cows and male cattle) and the slaughter premia introduced in the Agenda 2000 (EU Commission 2000, pp 27). Premia for activities or groups of activities are frequently subject to a scaling procedure reducing the premia per unit in case that politically set ceilings are exceeded. This applies in Agenda 2000 to premia for Grandes Cultures, for durum wheat, suckler cows, to the special male premium and to the slaughter premia. All these details are not explicitly represented in (4) to save some clutter. Because there is no information on farm structure in the model, farm level upper limits on premia provide a serious challenge to MFSS99. We will see below in the discussion of Agenda 2000 simulations that the standard scaling procedure may be insufficient to depict the strong incentives for farms to comply with them. An alternative, very rigid way to represent this instrument indirectly might be a quota on suckler cows.
Quotas are one of the reasons for further complications concerning revenues. It has to be mentioned that the revenues driving the activity levels in (3) are not always the *actual*

revenues as calculated in (4). To preserve the option of abandoning existing quotas or introducing new ones into the model while working with the same elasticity set, we introduced shadow revenues to drive the behavioural equations. For most activities shadow revenues equal the actual revenues from (4). For activities with exogenous levels (currently grassland, olives, wine, industrial crops, fallow land, and "other animals") or quota products (currently milk and sugar), however, the shadow revenue is a free variable to take on any value necessary to comply with the price independent levels or quotas. Without shadow revenues, the revenue of the quota activity, e.g. dairy cows, would have been eliminated from the behavioural functions and would have been replaced by the exogenous quantity. Otherwise there would be no direct effect of quota increases, for example, on the levels of suckler cows which are likely to be substitutes to dairy cows on the supply side. Consequently, the abolition of the milk quota would involve the transition from one elasticity set to a conceptually completely different one. This has been avoided in the present specification of MFSS99, activities may be introduced or removed from the set of activities with free shadow revenues according to the political variables set by the user.
We assumed that, in the base period, shadow revenues for dairy and sugar beet are only 70% of actual revenues, implying the expectation that actual levels of quota activities would be considerably higher without quotas, all else equal. On the other hand, we expected fallow land to decrease somewhat without the set aside obligations in the base period, therefore we set the shadow revenue of fallow land initially at 110% of actual revenues. In all other cases of exogenous crops, for example grassland, the shadow revenue was set equal to actual revenue in the base period.

Set aside

A special case of an essentially exogenous activity is set aside, which includes voluntary and obligatory set aside. We consider total fallow land LVL_{FALL} to be the sum of exogenous uncompensated fallow land LVL_{EXOF}, and set aside, which follows from the effective set aside rate applied to the Grandes Cultures base area LVL_{CEIL}. The effective set aside rate depends on the obligatory set aside rate SETR with an elasticity of 0.4 for all member states in our initial calibration:

$$LVL_{m,FALL} = LVL_{m,EXOF} + LVL_{m,CEIL} * \phi_{m,SET} * SETR_m^{\ \varepsilon m} \qquad (5)$$

where

$LVL_{m,EXOF}$ = exogenous uncompensated fallow in member state m

$LVL_{m,CEIL}$ = Grandes Cultures base area in member state m

$\phi_{m,SET}$ = constant set aside parameter for member state m

$SETR_m$ = obligatory set aside rate in member state m

ε_m = elasticity of actual set aside to the obligatory set aside rate in member state m

The set aside elasticity captures the opposite change in voluntary set aside which usually accompanies an increase in the obligatory set aside rate. The precise value has been chosen to approximate projections with the CAPRI model (Heckelei, Britz 2001, p. 286) which has been specifically designed for a truly endogenous modelling of set aside. The complete independence of set aside of prices is evidently a considerable simplification which helps to keep the structure of the supply system straightforward.

3.3 Input demand

Non feed inputs

The input demand function for non feed inputs (plant specific and general) is specified analogous to the activity levels:

$$LOG(INP_{m,n}) = \phi_{m,INP,n}$$

$$+ \Sigma_k (LOG(REV_{m,k}) * \varepsilon_{m,n,k}) + \Sigma_i (LOG(PP_{m,i}) * \varepsilon_{m,n,i}) \qquad (6)$$

where

$INP_{m,n}$	=	demand for nonfeed input n in member state m
$\phi_{m,INP,n}$	=	constant parameter in non feed input demand equation n of member state m
$REV_{m,k}$	=	revenue of activity k in member state m
$\varepsilon_{m,n,k}$	=	elasticity of non feed demand n with respect to revenue of activity k in member state m
$PP_{m,i}$	=	producer price of input i in member state m
$\varepsilon_{m,n,i}$	=	elasticity of non feed demand n with respect to price of input i in member state m

Feed demand

As has been explained above, feed demand functions are conceptionally derived from a cost function in MFSS99. They are again approximated with double log functions:

$$LOG(INP_{m,f}) = \phi_{m,INP,f}$$

$$+ \Sigma_a (LOG(LVL_{m,a}) * \varepsilon_{m,f,a}) + \Sigma_g (LOG(PP_{m,g}) * \varepsilon_{m,f,g}) \qquad (7)$$

where symbols are

$INP_{m,f}$	=	demand for feed input f in member state m
$\phi_{m,INP,f}$	=	constant parameter in feed demand equation f of member state m
$LVL_{m,a}$	=	level (in hd) of animal activity a in member state m
$\varepsilon_{m,f,a}$	=	elasticity of feed demand f with respect to level of animal activity a in member state m
$PP_{m,g}$	=	producer price of feed item g in member state m
$\varepsilon_{m,f,g}$	=	elasticity of feed demand f with respect to price of feed item g in member state m

For feed demand, we chose to derive an initial set of level elasticities $\varepsilon_{m,f,a}$ from the SPEL/EU-Base System. However because these rely on a number of strong assumptions underlying the feed allocation within the SPEL base system, it is highly desirable to obtain updated empirical evidence on feed demand for MFSS99. Furthermore the feed demand equations above need not be consistent with energy requirements of individual activities. Only some basic plausibility checks have been incorporated during calibration, for example the requirement that a proportional increase of all livestock levels should lead to the same increase in feed demand, all else equal. The price elasticities $\varepsilon_{m,f,g}$ have been specified starting from an assumed Allen elasticity of substitution. To reflect ongoing gains in feed efficiency the constant parameters $\phi_{m,INP,f}$ have been reduced by 0.5% per year for the projections of feed demand in 2005 presented below.

3.4 Food demand

Food consumption is also specified based on a double log function with elasticities derived from an updated review of the recent literature.

$$LOG(CNS_{m,h}) = \phi_{m,CNS,h}$$
$$+ \Sigma_i (LOG(CP_{m,i}) * \varepsilon_{m,h,i}) + LOG(EXPE_m) * \varepsilon_{m,h,EXPE} \quad (8)$$

where

$CNS_{m,h}$ = food consumption of item h in member state m

$\phi_{m,CNS,h}$ = constant parameter in food demand equation h of member state m

$CP_{m,i}$ = consumer price of item i in member state m

$\varepsilon_{m,h,i}$ = elasticity of food demand h with respect to consumer price of item i in member state m

$EXPE_m$ = total private expenditure (nominal) in member state m

$\varepsilon_{m,h,EXPE}$ = expenditure elasticity of food demand h in member state m

As mentioned above, an effort has been made to impose standard microeconomic consistency including full concavity (see Witzke, Britz 1998) but estimation is again deferred to the future. Given a consistent set of behavioural functions, consumer welfare changes may be easily calculated from the model as well but this has not been implemented so far. For certain items of food demand, such as individual meats and milk products, econometric estimations frequently include, apart from prices and expenditure, a trend variable which is supposed to capture taste shifts. These taste shifts are incorporated in MFSS99 by changing the constants in the demand functions $\phi_{m,CNS,h}$ correspondingly. The applied taste shift away from beef, for example, would decrease food consumption by 3% yearly if nominal expenditure and prices were constant over time.

3.5 Processing

Standard case: Fixed margins

An appropriate modelling of processing and price linkages between producer and consumer prices is beyond the current scope of MFSS99. Political interest is usually not focussing on the processing industry either. Consequently we chose to complete the model at this point as simple as possible. For most products therefore the difference between producer and consumer prices is held constant, that is *fixed margins* apply:

$$CP_{m,i} = PP_{m,i} + CPB_{m,i} - PPB_{m,i} \quad (9)$$

where

$CP_{m,i}$ = consumer price of item i in member state m

$CPB_{m,i}$ = base year consumer price of item i in member state m

$PP_{m,i}$ = producer price of item i in member state m

$PPB_{m,i}$ = base year producer price of item i in member state m

Processing with increasing marginal cost

For a few products *processing* is modelled explicitly, but to keep the model tractable, we assume processing to occur in an aggregated EU processing industry which acts in a profit maximising way given EU prices P_i and the processing technology. Here we work with fixed processing coefficients. For crushing of oilseeds, for example, equality of marginal revenues and marginal costs in processing of oilseeds requires:

$$P_{CAKE}\ \psi_{CAKE} + P_{OIL}\psi_{OIL} \overset{!}{=} P_{SEED} + C_{SEED}(PRC_{SEED}, P_{OTH}) \tag{10}$$

where

P_i	=	EU level price of item i (i = cake, oil, seed, other inputs)
ψ_{CAKE}	=	processing coefficient: tons of cake per ton of processed seed
ψ_{OIL}	=	processing coefficient: tons of processed oil per ton of seed
$C_{SEED}(.)$	=	marginal cost for other inputs in processing of seeds
PRC_{SEED}	=	Processing of seed

Solving the optimality condition (10) for the volume of processing gives processing as a function of net revenues and the price of other inputs relevant in processing. For simplicity we take the latter to be constant and approximate the solution in double log form with an guesstimated processing elasticity:

$$LOG(\ PRC_i) = \phi_{PRC,i} + LOG[\ (\Sigma_h\ \psi_{h,i}\ P_h) - P_i\ ] * \varepsilon_{i,PRC} \tag{11}$$

where

PRC_i	=	total processing of raw product i (e.g. rape seed) in the EU industry
$\phi_{PRC,i}$	=	constant parameter in processing function of raw product i
$\psi_{h,i}$	=	processing coefficient: tons of processed output h per ton of raw product i
P_i	=	EU level price of item i
$\varepsilon_{i,PRC}$	=	elasticity of processing of raw product i with respect to net revenues (value of outputs minus raw product price of item i)

This function determines the volume of EU processing and consequently the origin of the supply of processed products from EU processing as opposed to imports. Apart from oilseeds it applies to the processing of potatoes (to starch), of olives (to oil and cake), and of other cereals (paddy to rice).

Fixed marginal cost in processing of milk and sugar beet

For milk products, there is no significant trade in raw milk and the total of raw milk produced is also processed in the EU. There is thus no need for profit maximisation to determine the level of processing. Processing may thus occur according to a simple constant returns technology with fixed processing costs (see also Bouamra, Requillard 1999) and constraints on milk fat and protein:

$$\sum_{i=BUT,SMP,OMP} \gamma_{i,c}\ PRD_{EU,i} = \gamma_{COM,c}\ PRC_{COM} + \gamma_{SHM,c}\ PRC_{SHM,c} \tag{12}$$

where

$PRD_{EU,i}$ = production of milk product i (BUT = butter, SMP = skimmed milk powder, OMP = other processed milk products) in the EU industry

PRC_i = processing of raw milk i (COM = cow milk, SHM = sheep milk) in the EU industry

$\gamma_{i,c}$ = content of item c (= fat, protein) in milk product i

With constant returns, prices of milk products exactly correspond to the value of contents plus fixed processing costs:

$$P_i = \gamma_{i,FAT} P_{FAT} + \gamma_{i,PRO} P_{PRO} + c_i \quad (13)$$

where

P_i = EU level price of milk product i

$\gamma_{i,c}$ = content of item c (= fat, protein) in milk product i

c_i = fixed processing cost associated with milk product i

Milk fat and protein contents of milk products have been determined ex post, together with processing cost per unit processed, by a maximum entropy approach. More information on these parameters (and their relationship to underlying input prices) would improve this specification and might be obtained in collaboration with specialists on the milk market.
A similar reasoning applies to sugar beet where the whole of EU sugar beet production is processed in the EU. Consequently the price of sugar beet may be simply derived from prices of sugar, molasses and fixed processing costs:

$$P_{SUGB} = \psi_{SUGA,SUGB} P_{SUGA} + \psi_{MOLA,SUGB} P_{MOLA} - c_{SUGB} \quad (14)$$

where

P_{SUGB} = EU level price of item i (SUGB = sugar beet, MOLA = molasses, SUGA = sugar)

$\psi_{h,i}$ = processing coefficient: tons of processed output h per ton of raw product i

c_{SUGB} = fixed cost per ton of processed sugar beet

3.6 Other demand

Certain positions of minor importance are linked to production by fixed relationships:

$$LNK_{m,i} = PRD_{m,i} * LNKB_{m,i} / PRDB_{m,i} \quad (15)$$

where

$PRD_{m,i}$ = production of good i in member state m

$PRDB_{m,i}$ = base period production of good i in member state m

$LNK_{m,i}$ = use of good i linked to production (seed use + losses on farm + consumption on farm) in member state m

$LNKB_{m,i}$ = base period use of good i linked to production (seed use + losses on farm + consumption on farm) in member state m

3.7 Price transmission and price policy

International price transmission

International prices are linked to EU prices using a price transmission equation based on the law of one price. Without border measures, these international prices would directly apply to EU markets. Price policy instruments are tariffs or, until tarification is complete, administered prices with associated flexible levies or export subsidies. Export quantities are constrained by WTO restrictions, possibly requiring public intervention up to maximal intervention quantities.

$$P_i = WP_i * (1+ TARR_i) + TARA_i +FLEV_i + TIMPL_i \quad (16)$$

where

P_i	=	EU level price of product i
WP_i	=	Exogenous world market price
$TARR_i$	=	ad valorem tariff
$TARA_i$	=	specific tariff (fixed amount per t)
$FLEV_i$	=	flexible levy / export restitution
$TIMPL_i$	=	implicit tariff supplement in case of fixed trade volumes

and

$$FLEV_i = WP_i * (1+ TARR_i) + TARA_i - PADM_i \quad (17)$$

where

$FLEV_i$	=	flexible levy / export restitution
WP_i	=	Exogenous world market price
$TARR_i$	=	ad valorem tariff
$TARA_i$	=	specific tariff (fixed amount per t)
$PADM_i$	=	Administered EU price

The implicit tariff supplement is necessary with fixed trade volumes to allow any value for the EU price which might be necessary to clear the EU market (see below).

Intra-EU price transmission

Producer price changes in member states are assumed to equal those on the EU level in relative terms:

$$PP_{m,i} = P_i * PPB_{m,i} / PB_i \quad (18)$$

where

$PP_{m,i}$	=	producer price of product i in member state m
$PPB_{m,i}$	=	base period producer price of product i in member state m
P_i	=	EU level price of product i
PB_i	=	base period EU level price of product i

The proportional differences between member state prices and EU prices reflect differences in composition and in quality of the products involved, taken to be constant in simulation runs.

3.8 Total supply, demand and market clearing

The *market clearing* condition may be expressed as follows:

$$NETTRD_i + ITS_i = SUP_i - DEM_i \qquad (19)$$

where

$NETTRD_i$ = net exports of good i from the EU
ITS_i = intervention sales of good i in the EU
SUP_i = supply of good i in the EU
DEM_i = demand of good i in the EU

Total EU *supply* results from

$$SUP_i = \Sigma_m PRD_{m,i}(P) + PRD_{EU,i}(P) + PRC_h(P) * \psi_{i,h} \qquad (20)$$

where

SUP_i = supply of good i in the EU
$PRD_{m,i}$ = production of item i in member state m
P = vector of EU market prices
$PRD_{EU,i}$ = production of item i in the EU processing industry (only milk products)
PRC_h = processing of raw product h in the EU industry
$\psi_{i,h}$ = processing coefficient: tons of processed output i per ton of raw product h

Total EU *demand* is composed as follows

$$DEM_i = \Sigma_m [INP_{m,i}(P) + CNS_{m,i}(P) + LNK_{m,i} (P) + IND_{m,i} + STC_{m,i}] + PRC_i(P) \qquad (21)$$

where

DEM_i = demand of good i in the EU
$INP_{m,i}$ = input demand (feed or non feed) of good i in member state m
P = vector of EU market prices
$CNS_{m,i}$ = food consumption of good i in member state m
$LNK_{m,i}$ = use of good i linked to production in member state m
$IND_{m,i}$ = industrial use of good i in member state m, exogenous
$STC_{m,i}$ = private stock changes of good i in member state m, exogenous
PRC_i = total processing of raw product i in the EU industry

As is indicated above, most components of supply and demand depend on EU market prices, either directly (EU processing industry) or indirectly over (18) and (9). Two components of demand treated exogenously are industrial uses and stock changes. The first of these is an important component of demand mainly for barley where industrial use is 16% in the base period due to the brewery industry. Lacking more detailed information (prices, product balance on, say, beer) we chose to project industrial uses by trend extrapolations.

More problematic is certainly the treatment of stock changes. With reasonable data on stock changes, a straightforward assumption for a comparative static projection would have been to set them to zero in the projection year, consistent with the view that this projection should depict a "normal" situation, given the scenario. Unfortunately the data on stock changes in the present SPEL/EU-BS are one of the weakest points in the whole database (section 4.2). When checking the sum of stock changes on the farm and on the market for the base period (1993/95), the aggregated stock changes were still surprisingly high (more than 20% of production) for certain countries and important products. Stock changes were used in the SPEL/EU-BS to absorb all kinds of inconsistencies in the market balances, i.e. they are partly an item to collect residual errors. With a view to this last statistical error interpretation it has been decided to keep these BM stock changes simply fixed to their base year value during the simulation.

As mentioned above, markets basically clear either with endogenous excess supply (net trade + intervention sales) or with endogenous EU market prices P. If excess supply on market i is the free endogenous variable, the associated price is fixed by the world market (plus tariffs, with $TIMPL_i = 0$), by domestic policy (flexible levies) or for a number of products, by assumption. Apart from non feed inputs, the latter group mainly includes certain products of limited importance with high uncertainty on elasticities or world market prices (olives, industrial crops, other crops, other animals, wine, rice, olive oil, olive cake).

If net trade is assumed exogenous or if net trade just exhausts export quotas and intervention sales are on an upper bound (potentially a relevant policy instrument), the model calculates the EU market price P_i consistent with this exogenous trade volume. The implicit supplementary tariff $TIMPL_i$ takes on any positive or negative value to comply with the international price linkage equation (16). This case includes products with fixed member state trade and market clearing on the member state level (e.g. grass and other roughage), products with market clearing on the EU level (e.g. pork), and an intermediate case (e.g. calves). In this latter case markets clear on the member state level, but member state net imports are not completely fixed but rise somewhat, if member state prices rise more than an EU average price. Product association to these categories may be changed in a flexible way.

4 Technical implementation

4.1 Programming language

The technical infrastructure of the former MFSS has been thoroughly revised even though a few very efficient utilities remain in use. Most importantly, the majority of data preparation, model simulation and evaluation steps are written in GAMS instead of Fortran. This increases the chances for communication and critical discussion with experts at Eurostat and DG Agri. Furthermore, the use of GAMS instead of Fortran does not only aid in transparency, but also in the application of efficient model solvers.

4.2 Ex post database

In general: SPEL/EU Base model

The MFSS99 database heavily draws upon the last SPEL/EU Base model results (Wolf 1995) which were aggregated, omitting information on a number of items in a GAMS program. Aggregation and elimination of items were undertaken to simplify the solution of the model and facilitate the checking of results. Annex 1 shows the revised list of columns and rows of this aggregated database.

The new EAA concepts (Eurostat 2000) could not be implemented in full conformity with the new definition. However, the traditional SPEL gross concept, that is gross output including output for intrasectoral use, closely matches new EAA definitions, where intrasectoral feed

use *is* included. In addition, simplification of the model suggested to eliminate certain intrasectoral transactions, which are *not* included in the new EAA as output (manure, old cows, milk from suckler cows).
Consequently, the MFSS99 market balance reflects quite well new concepts. However, because the new basic prices and revised accounting of subsidies and taxes have not been available, the output *value* differs to some extent from these new concepts. Only when looking at NVAF, we may expect a close resemblance of MFSS99 and new EAA concepts because the different categories of “product related” and “other” subsidies/taxed are aggregated again. This however is the crucial indicator of sectoral income in agricultural policy.

Exceptions

In a few cases we amended or replaced information contained in the SPEL/EU-BS.

A major deviation from BM data is our distinction of *balances on male and female calves,* more precisely on "young cattle". These balances depict the consolidated flows of young animals between the net producing activities (dairy and suckler cows) on the one hand, the "consuming" activities (fattening of bulls, heifers, calves) on the other, and finally the outside world.
In the disaggregation of calves we relied again on the maximum entropy approach: Adhering to any hard information given, for example the given level of male plus female calves fattening, and staying as close as possible to imprecise a priori expectations in the process of disaggregation. We considered the following information sufficiently hard to preclude any deviations from it:

- activity levels
- calves requirements of fattening activities (equal to 1 or 0 depending on the sex)
- net output coefficients of suckler cows and dairy (as implied by the gross calves production and own requirements according to SPEL-BM when combined with the assumption that 50% of all born calves are male)
- total imports of young cattle (regardless of the sex)

Imports of life young cattle appear to be fairly high according to SPEL-BM data. This should be considered reason to reconsider the treatment of external trade in life animals in general. However, for the time being we considered the import data as given, thereby relegating any revision at this point to the future.
We had clearly imprecise a priori expectations on the following items:

- Activity levels of fattening of male and female calves
- Sex composition of imports of young cattle
- Stock changes of male and female young cattle

To the latter variables we assigned therefore the solution values of the maximum entropy problem.

Milk product items in the market balances, which were in “raw milk equivalents” in the SPEL/EU-BS, have been replaced with original ZPA1 data given in product weight. This change in the database opened the way to an improved description of milk processing with separate balances on fat and protein and a matching price determination (equations (12) and (13)).
As has been the case for the distinction of male and female calves, this framework requires some pieces of information which are not immediately available from official statistics:

- Processing costs c_i for milk products are not included in official statistics

- The contents of fat and protein in milk products, in particular for the large aggregate "other milk products" (OMPR), is known only fairly roughly.
- Prices of fat and protein and of the aggregate OMPR have to be derived

These parameters have been estimated using the maximum entropy approach relying on the following pieces of "hard" information:

- Produced quantities of milk products and processed quantities of raw milk
- Contents on fat and protein conveniently available in ZPA1 for cow milk or rather well known for sheep milk
- Consumer prices for skimmed milk powder and butter have been estimated from intervention prices whereas producer prices for raw milk are known from SPEL/EU-BS.
- For the unknown consumer price of the aggregate OMPR it has been assumed that the processing margin c_i is 20% of the fat plus protein cost. This crude estimate might be replaced with information on consumer expenditure from SEC2 in a revision of the derivation of consumer prices in general, see below.

This information on processing cost, contents, and prices of fat and protein was strictly required only for the base period as we kept processing costs and contents fixed during the simulations.

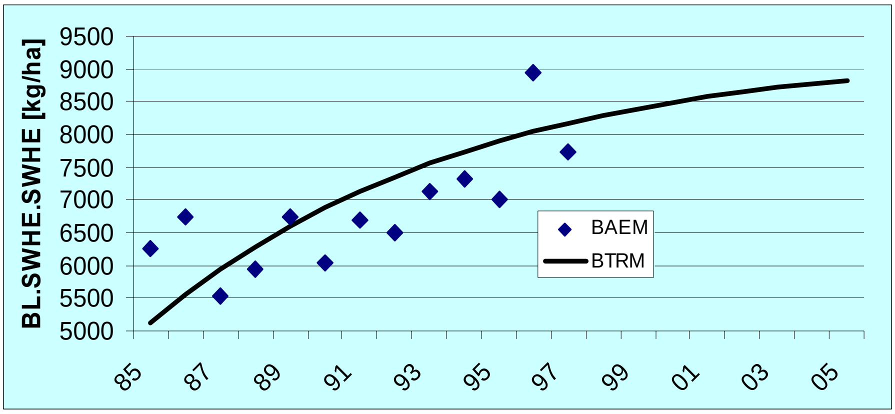
A similar limitation applies to *consumer prices* in general. Due to the fixed margin assumption (9), the model may run given consumer prices for the base period only. As a consequence the opportunity was seized to save time for other tasks, and ex post consumer prices have only be derived for the base period and a few other years in the 90ies.
The procedure to derive consumer prices has been established already a long time ago and the last revision has been undertaken in the MFSS95 framework by Weber. Essentially it involves allocating SEC2 information on consumer expenditure on broad food groups in EU member states to individual products, using information on values at producer prices and auxiliary assumptions regarding processing margins. This procedure yielded in some cases remarkable differences across time and EU member states. If these differences were deemed intolerable, certain observations have been eliminated from the 3-year average for the base period.
Both the fairly ad hoc character of the current procedure as well as partly implausible results would benefit from a more systematic maximum entropy treatment, given that this is again a case of imprecise a priori information to be blended with some hard statistical information acting as constraints.

Finally note that *feedingstuffs* are not aggregated to groups on the input demand side anymore as has been the case in MFSS95. Instead we consider feed use of individual agricultural goods, for example of soft wheat. The disaggregated treatment of feedingstuffs hit upon difficulties for processed products like oil cakes where the SPEL/EU-BS did not include producer prices. These had to be derived at this stage of the model development using assumptions, which require checking and revision as soon as resources permit.
A mayor difference to MFSS95 is the fact that, in principle, MFSS99 does not rely on an allocation of feedingstuffs to animal activities. Only because we had to postpone an extensive literature review for a revision of supply side elasticities did we rely on the available input allocation in the SPEL-BM. With alternative sources of information on elasticities however, this kind of information will not be required anymore.

4.3 Trend projections

With the preparations on the ex post SPEL/EU-Data finished, OLS-estimations establish the trends for the ex-ante period. The standard procedure here is to calculate linear trends on the original, untransformed variables based on ex post data 1985-1996, this being considered a reasonable compromise between degrees of freedom and a sufficient weight for recent data.
However when applied to thousands of time series it is quite clear that due to outliers or particularly strong recent trends the OLS trends would generate a certain percentage of unreasonable projections for our projection year 2005. Given insufficient resources to check and modify all projections case by case, possibly using more sophisticated statistical procedures to detect outliers in the ex-post data, we introduced a robust security device for the trend projections: In case of linear trend projections exceeding base year values (average 1993-95) by more than 25%, the projection is repeated using a non-linear transformation of the variables which imposes an asymptotic value of +30% of the base year value on the projection line (and similar for negative trends). After transformation, the estimation may be performed using the conventional OLS formula. The following figure shows the effect using the projection of soft wheat yields in Belgium as an example:

Figure 1. Example of non-linear trend projection: yields of soft wheat in Belgium

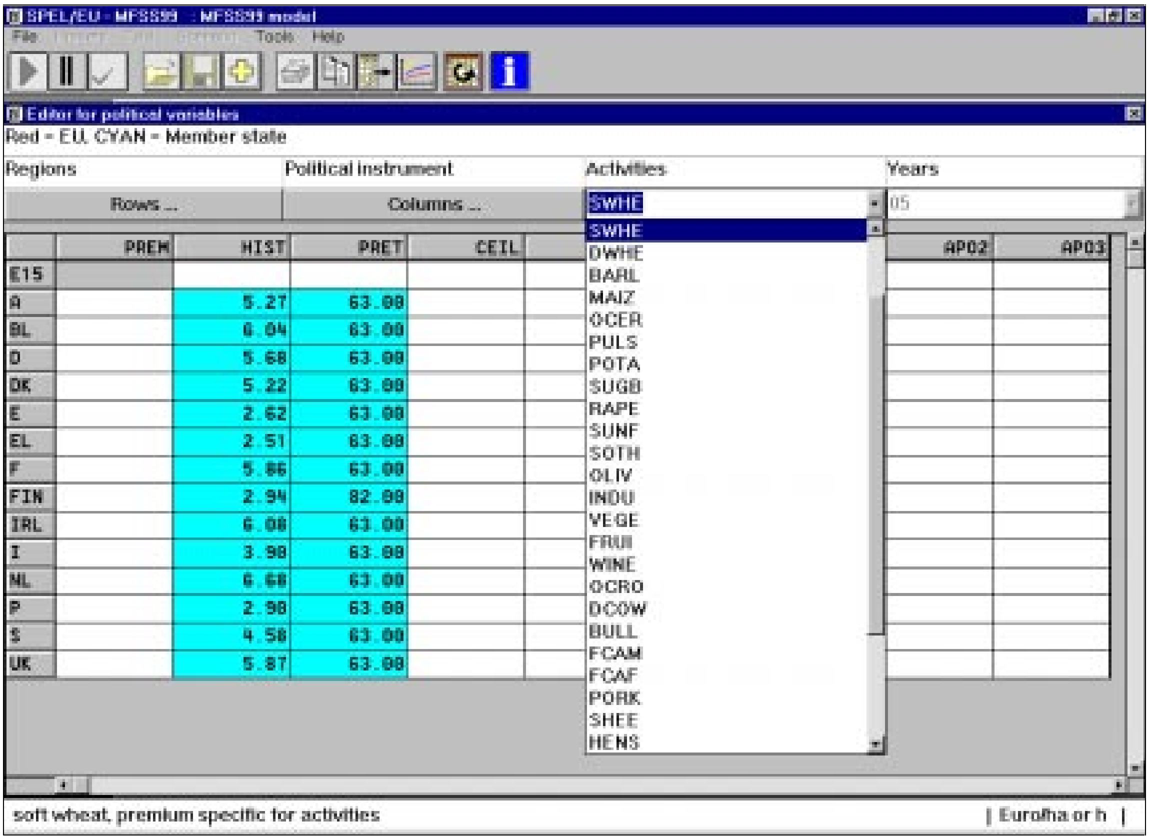


As is evident from he figure, the 1996 observation would have caused a strongly increasing trend which hit upon the above 25% threshold. Our mechanical procedure used the bending trend line in this case and thus prevented unreasonably high projections. Nonetheless we agree that a uniformly imposed upper asymptotic value is a very ad hoc procedure, perhaps defendable as a “last security” device, but certainly to be complemented by some statistical outlier detection strategy (e.g. Judge et al. 1988, p. 892-897).

4.4 User friendly operation

Although the use of the GAMS language automatically yields some improvement in transparency and therefore userfriendlyness for the model builder or model expert the tool should be of use in the EU Commission as well without permanent assistance from the model builders. To this end users with some introduction of 1-2 days should be able to handle the model, guided through different menus to enter or change political variables (see the example below), to enter new world market prices and subsequently to run the model.

Figure 2: Screen to enter political variables in MFSS99



After the simulation, the user is guided to an output viewer permitting to view, arrange and export all output variables as desired, based on a utility called DAOUT which is well known by many users of the SPEL/EU data by now. Alternatively, the user may look at a set of spreadsheets with selected information on activity levels, market balances and income in EU member states, generated by certain macros for condensed presentation of results.

5 Performance of MFSS99

The recent volume "CAP reform decisions – Impact Analyses" (European Commission 2000), collects studies by several independent research teams (SPEL group in Bonn, FAPRI Missouri and Iowa, SOW-VU Amsterdam) as well as from within the Commission herself on Agenda 2000 impacts on agriculture and the whole economy. The models that are used by the research teams in the studies are respectively SPEL/EU-MFSS (MFSS95), FAPRI-I, FAPRI-II and the CAP Modelling and Accounting Tool (CAPMAT). These studies provide a natural yardstick for simulation exercises with MFSS99 testing the modelling performance of this new system. Because the focus of the current simulations is methodological in nature, we did not update the assumptions to more recent information, for example regarding the $/Euro exchange rate or the current developments on the beef market. Doing so would have interfered with comparability of results.

5.1 Scenario assumptions: reference run

The reference run is based on the assumption that no further reform steps beyond the 1992 CAP reform will be undertaken. A number of crucial policy parameters and detailed exogenous assumptions are reproduced in table 1 below, but a few additional explanations will be useful here.

- Producer *prices* for *cereals, beef and raw milk* would fall somewhat compared to the base period 1993/95, as the price reductions from the 1992 reform will be fully implemented. *Oilseeds* prices are assumed to fall as well, due to rather weak international markets according to the 1999 "WATSIM" simulations (Henrichsmeyer, Lampe, Möllmann, 1999, Lampe 1999). For a number of agricultural products (olives, wine, industrial crops, other crops, other animals) and for non feed inputs, prices are simply linked to inflation, assumed to be 2.1% per year or 26% over the whole projection period. Other producer prices (inter alia for fruits, vegetables, potatoes, pork, mutton, veal, eggs and poultry) are resulting from market clearing on the EU level or on the member state level (fodder, calves), as explained in section 4.8 above.
- *Shift factors* for yields, exogenous demand components (industrial use) and exogenous activity levels (e.g. olives, wine, industrial crops, grassland) have been derived using trend estimations based on data after 1984 as explained above. Continuous improvements of feed efficiency are expected to reduce feed demand by 0.5% per year, all else equal. For total expenditure a nominal increase of 4.5% per year is assumed which stimulates consumer demand according to demand elasticities. In addition, we introduced exogenous taste shifts for meat and milk products to bring the reference run projections on these markets somewhat in line with assumptions by DG Agri market experts, as presented in European Commission (1999). Acknowledging the ad hoc nature of this procedure does not imply that it is unreasonable. The existence of long run taste shifts in consumer demand will be beyond doubt and in any "serious" application of MFSS99, detailed knowledge from market experts will be injected into the simulations as well.
- Per-hectare *premia* for cereals, pulses and oilseeds, the set-aside premia and premia for cattle and sheep are rising somewhat compared to the base year as the 1992 reform is fully implemented (see table 1). For *other subsidies* and *taxes linked to production* it is assumed that during the projection period their value for the entire sector remains the same as in the base period.
- The obligatory *set-aside* rate for professional producers is assumed to increase to 17.5 %, to slow down the accumulation of stocks (see table 1).
- Production *quotas* for sugar will not change at all. Guaranteed quantities for milk are rising compared to the 1993/95 average because quotas were increased somewhat in those years, particularly in southern Europe (see table 1).

Table 1: Policy parameters and important exogenous assumptions for the simulations

	Base 1993/95	Reference run 2005	Reference - Base	Agenda 2000 run 2005	Agenda - Reference
Crop sector					
Cereal intervention price	135	123	*-8,9%*	105	*-15,0%*
International price (per 100kg.) of:					
Soft wheat	99	112	*12,1%*		
Barley	70	70	*-0,4%*		
Maize	92	100	*7,8%*		
Rape seed	200	196	*-2,0%*		
Sunflower	220	192	*-12,9%*		
Soya	192	176	*-8,3%*		
Premia per ha for					
Soft wheat	214	281	*31,3%*	329	*17,3%*
Durum wheat	447	506	*13,3%*	539	*6,4%*
Barley	170	238	*39,6%*	283	*19,2%*
Maize	206	268	*29,9%*	340	*26,9%*
Rape seed	485	538	*10,9%*	345	*-35,8%*
Sunflower	434	468	*7,7%*	231	*-50,6%*
Soya/other oilseeds	429	496	*15,7%*	269	*-45,8%*
Set aside rate	13,2%	17,5%		10,0%	
Animal sector					
Administered price floor (per 1000 kg.) for:					
Beef	2989	2780	*-7,0%*	2220	*-20,1%*
Butter	3023	2954	*-2,3%*	2806	*-5,0%*
SMP	2069	2055	*-0,7%*	1952	*-5,0%*
International prices (per 1000 kg.) of:					
Beef	1175	1542	*31,3%*		
Butter	1550	1822	*17,6%*		
SMP	1442	1747	*21,2%*		
Total premia per head of					
Male cattle	71	138	*94,7%*	321	*132,4%*
Suckler Cows	126	159	*26,7%*	266	*67,2%*
Dairy				67	
Heifers				95	
Fattening of calves				33	
Milk quota	115754	117492	*1,5%*	119362	*1,6%*

5.2 Scenario assumptions: Agenda 2000 run

The Agenda 2000 run translates the Berlin summit decisions into scenario assumptions for MFSS99. The most crucial policy parameters are reproduced in table 1. In more detail this involves the following:

- Administered *prices* for *cereals, beef and raw milk* fall in accordance with the decision. Due to the projection year being 2005, this implies that only one third of the reform package for dairy will be implemented. For international prices, we neglected any repercussions of changing EU net exports and consequently took them to remain on the reference run level.

- All *shift factors* are kept the same as in the reference run.
- Per-hectare *premia* for cereals are rising to compensate for the decline in prices, with little change on the durum wheat premium. Special increases in Finland, Spain and Italy are also taken into account (see European Commission 2000, pp 33). Premia for pulses and oilseeds are declining due to the more or less complete unification with the cereal sector. The special male premium and the suckler cow premia are increased in line with the decision. National envelopes are assumed to top up the new slaughter premium. The dairy premium in introduced. Table 1 reproduces the total increase in premia per head for the cattle sector, taking into account that premia are scaled down in case of production exceeding the ceilings.
- The obligatory *set-aside* rate for professional producers is reduced to 10 %.
- Milk *quotas* are rising in line with the Berlin decisions.

5.3 Simulation results

This section will explain the simulation results both in the reference run as well as in the Agenda 2000 run for a number of key items on the EU level.

5.3.1 Activity levels

Crop Sector

Apart from the crucial influence of the obligatory set-aside rate, the development of areas is driven by the development of revenues per ha and input prices (section 4). For the cereals and oilseeds sector, changes in revenues are largely determined by the above assumptions on prices and premia. The reference run is crucially determined in addition by exogenous yield growth, which attains 16-17% on average for cereals but only around 3% for oilseeds from the base year 1994 to the projection year 2005 based on our trend estimations. This contributes to rather modest increases in revenues and reductions in areas for oilseeds compared to the base run which exceed those for cereals (table 2).

Table 2: Simulation results on activity levels and revenues for selected crops for EU-15

	Base 1993/95	Reference run 2005	Reference - Base	Agenda 2000 run 2005	Agenda - Reference
Cereals area	35377	32894	-7,0%	33340	1,4%
Wheat area	16020	15145	-5,5%	15348	1,3%
Soft wheat revenue	*1051*	*1175*	*11,8%*	*1121*	*-4,6%*
Soft wheat area	13024	12268	-5,8%	12425	1,3%
Durum wheat revenue	*883*	*957*	*8,3%*	*937*	*-2,1%*
Durum wheat area	2997	2877	-4,0%	2924	1,6%
Coarse grains area	19357	17749	-8,3%	17991	1,4%
Barley revenue	*713*	*813*	*14,1%*	*773*	*-5,0%*
Barley area	11072	9948	-10,2%	10180	2,3%
Maize revenue	*1458*	*1588*	*8,9%*	*1463*	*-7,9%*
Maize area	3840	3611	-6,0%	3541	-1,9%
Oil seeds area	5923	5240	-11,5%	5057	-3,5%
Rape seed revenue	*1023*	*1075*	*5,1%*	*883*	*-17,9%*
Rape seed area	2694	2428	-9,9%	2371	-2,3%
Sunflower revenue	*714*	*721*	*1,0%*	*486*	*-32,5%*
Sunflower area	2894	2498	-13,7%	2384	-4,6%
Soya/other revenue	*1153*	*1208*	*4,7%*	*981*	*-18,8%*
Soya/other area	336	315	-6,3%	303	-3,8%

The Agenda 2000 impacts are triggered by the combined changes in prices, premia and the reduction in the obligatory set aside rate from 17.5% to 10%. Price reductions are only about 12% for wheat because the wheat world market price is projected to be above the intervention price (section 5.2). Maize revenues are declining strongly because the share of (declining) market revenues in total revenues is higher. For all cereals except maize this combination leads to small increases in areas. Oilseed areas are projected to decline because the unification of premia implies a significant reduction in support for these crops.
The following table 3 compares these results to those reported in European Commission 2000 obtained with other modelling systems.

Table 3: Comparison of Agenda 2000 simulation results for EU-15 on activity levels for selected crops, year 2005

	Status quo	Agenda 2000				
	scenario	MFSS95	FAPRI - I*	FAPRI - II*	CAPMAT	MFSS99
Cereal area	100,0	102,4				101,4
Wheat	100,0	102,6	104,0	105,9		101,3
Soft wheat	100,0	102,5				101,3
Durum wheat	100,0	103,4				101,6
Coarse grains	100,0	102,2				101,4
Barley	100,0	102,2	102,6	105,0		102,3
Maize	100,0	104,6	100,8	103,5		98,1
Oilseed area	100,0	99,7	97,2	95.8**		96,5
Rapeseed	100,0	96,8	97,4	95,2		97,7
Soyabean	100,0	104,0	96,9	99,5		96,2
Sunflower	100,0	102,4	96,9			95,4

* FAPRI - I: FAPRI Missouri, set aside in status quo = 10%; FAPRI - II: FAPRI Iowa, set aside in status quo = 15%. ** Only rape seed and soya beans.

In the cereal sector, the overall response corresponds more or less to those with the precursor model operated at Eurostat, that is MFSS95. However when looking at the relative decline or expansion of maize compared to barley, the results of MFSS95 appear surprising and the new MFSS99 is more in line with the FAPRI results. Regarding oilseeds the aggregate reduction is again very close to FAPRI results. The differences between single oilseeds are probably to small for detailed comments but the resulting impacts according to MFSS95 are again more difficult to understand than those from MFSS99 (see table 2).

Animal Sector

The dairy herd is strongly declining in the reference run due to continuous increases in yields combined with milk quotas. This reduces the supply of young calves and drives up calves prices in spite of the decline of administered beef prices (table 1). Combined with an increase in premia (table 1) this makes for the suckler cow herd to expand with more than 10%. However the strength of this expansion is somewhat surprising, for example when compared with the 3% expansion according to the CAPRI model (Heckelei, Britz 2001, p. 289). Revenues of male adult cattle are rising, because unfavourable developments of prices are more than compensated by increases in slaughter weights and in the special male premium (table 1). Increases in slaughter weights have been determined simply on the basis of trends but an economic motivation is given by capacities not required by dairy anymore. If the activity level is nonetheless declining, this mainly reflects the operation of non-feed inputs which are rising by 26% with inflation over this period. This development corresponds well with the CAPRI projection of –5% for male adult cattle. Fattening of heifers is reduced even more because the decline in beef prices is not compensated by increasing premia.

Fattening of calves, pigs and poultry are treated differently from the adult cattle sector in two aspects. The first is that market prices are crucially determined by income driven human demand growth, which is assumed to favour poultry, with a mild bias against veal and pork, and a strong bias against beef (even before the current BSE crisis). This demand led growth in veal prices ultimately causes fattening of calves to expand to some degree in the reference run development. While the strength of this effect has to be scrutinised, the basic difference to beef will be considered reasonable. The second difference in our treatment of calves, pigs and poultry compared to the adult cattle sector is in the neglect of changes in slaughter weights. This was necessary to prevent unreasonable expansions of activity levels (section 4). It implies that the reported numbers on "heads" are expressed in base year slaughter weights and closely correspond to results on meat production (see below).

Table 4: Simulation results on activity levels and revenues for EU-15 of selected livestock activities

	Base 1993/95	Reference run 2005	Reference – Base	Agenda 2000 run 2005	Agenda – Reference
Dairy cows	23266	20420	-12,2%	20801	1,9%
Suckler cows: revenue	*440*	*497*	*12,9%*	*526*	*6,0%*
Suckler cows: hds	10848	11967	10,3%	12673	5,9%
Male adult cattle: revenue	*850*	*879*	*3,5%*	*920*	*4,6%*
Male adult cattle: hds	12453	11989	-3,7%	12331	2,9%
Heifers: revenue	*583*	*575*	*-1,3%*	*564*	*-1,9%*
Heifers: hds	4690	4375	-6,7%	4322	-1,2%
Calves for veal: revenues	*384*	*476*	*23,8%*	*456*	*-4,2%*
Calves for veal: hds	8041	8581	6,7%	9002	4,9%
Pork: revenue	*113*	*126*	*11,5%*	*120*	*-4,7%*
Pork: hds	197705	212657	7,6%	212072	-0,3%
Poultry: revenue	*2150*	*3010*	*40,0%*	*2916*	*-3,1%*
Poultry: hds	4627	5379	16,2%	5356	-0,4%

The Agenda 2000 package first implies a 2% increase in the dairy herd up to 2005. This increase is mainly caused by the rise of milk quotas under the Berlin decision. This contributes to declining prices of calves, apart from the reduction in administrative price support for beef. However, the 67% increase in premia (table 1) more than compensates for these price reductions, leading to a 6% increase in suckler cow revenues and in the suckler cow herd on the EU level. While being perfectly plausible in qualitative terms (comp. +2.8% in Heckelei, Britz 2001, p. 289) the magnitude of this expansion may be discussed. Our treatment of the suckler cow ceilings may have underestimated their constraining character. The scaling procedure may not correctly reflect the farm level disincentives of exceeding the ceilings, given that they are allocated to single farms. Furthermore we ignored the possibility of heifers qualifying for the suckler cow premia (up to 20% of the ceiling) which may reallocate premia from suckler cows to heifers. The strong, 132% increase in premia and, less important, declining prices of calves also explain why the level of male adult cattle is increasing in spite of the 20% drop in beef prices. Heifers for fattening receive considerably less premia than suckler cows and male adult cattle and consequently are stronger hit by the declining beef prices. The increase in the level of calves fattening may seem odd at first sight. The first problem, availability of young calves, is clarified by the composition of these additional calves of which 72% are female, not used in fattening of heifers anymore. The apparent contradiction of a 4.2% decline in revenues and the 4.9% increase in levels is due to composition effects on the EU level. In all the EU member states (but one) revenues and levels change in the same direction (positive in some countries, negative in others, depending on the changes in calves prices). Finally we may note that the expansion of calves fattening is in part also due to declining feed prices. Declining feed prices are crucial for pork and poultry markets where they stimulate supply. Demand, however, is declining because of substitution effects with beef which becomes clearly cheaper in the Agenda 2000 scenario. All these forces taken together cause pork and poultry prices to decline which has a corresponding effect on revenues and levels of these fattening activities.

5.3.2 Markets

Crop Sector

In the reference run, yield growth increases production in spite of declining areas for all cereals. Total domestic use of wheat is increasing by about 6%, mainly due to increases in human consumption. Our assumption on feed efficiency gains of 0.5% per year significantly curbs growth of feed demand and thus leads to a stagnating demand for coarse grains. Reducing or eliminating these efficiency gains would mainly impact of the surplus situation on cereal markets which would be characterised, with feed efficiency gains, by a total cereal excess supply of about 38 m t.

Table 5: Simulation results on cereal markets for EU-15

		Base 1993/95	Reference run 2005	Reference – Base	Agenda 2000 run 2005	Agenda - Reference
wheat	Production	85375	94531	10,7%	95694	1,2%
	Total domestic use	67616	71827	6,2%	72640	1,1%
	Excess supply	17759	22704	27,8%	23055	1,5%
soft wheat	*Producer price*	*138*	*125*	*-9,2%*	*111*	*-11,5%*
	Production	78000	86526	10,9%	87599	1,2%
	Total domestic use	61844	65501	5,9%	66259	1,2%
	Excess supply	16156	21026	30,1%	21340	1,5%
durum wheat	*Producer price*	*174*	*159*	*-8,4%*	*141*	*-11,5%*
	Production	7375	8005	8,5%	8095	1,1%
	Total domestic use	5772	6327	9,6%	6381	0,9%
	Excess supply	1603	1678	4,7%	1714	2,2%
coarse grains	Production	92273	99526	7,9%	100268	0,7%
	Total domestic use	83219	84186	1,2%	86922	3,2%
	Excess supply	9054	15340	69,4%	13347	-13,0%
barley	*Producer price*	*132*	*121*	*-8,5%*	*102*	*-15,1%*
	Production	44694	46607	4,3%	47586	2,1%
	Total domestic use	37081	36945	-0,4%	38209	3,4%
	Excess supply	7613	9662	26,9%	9377	-3,0%
maize	*Producer price*	*157*	*143*	*-9,0%*	*121*	*-15,3%*
	Production	30064	32839	9,2%	32224	-1,9%
	Total domestic use	30133	30631	1,7%	31635	3,3%
	Excess supply	-69	2208		589	-73,3%

In the Agenda 2000 run, the changes in levels from table 2 directly translate into changes in production, because yields are assumed exogenous, apart from composition effects on the EU level. Demand is rising following reductions of cereal prices. This demand growth is stronger for coarse grains than for wheat, because human demand price elasticities are lower than feed demand elasticities and because international price are assumed to be higher than Agenda 2000 intervention prices for wheat.
The following table 6 gives the comparison of these simulation results with those of other models.

Table 6: Comparison of Agenda 2000 simulation results on cereal markets for EU-15, year 2005

	Status quo	Agenda 2000				
	scenario	MFSS95	FAPRI - I*	FAPRI - II*	CAPMAT	MFSS99
Production						
Total cereals	100,0	102,4			101,6	101,0
Wheat	100,0	102,7	103,3	104,7		101,2
Soft wheat	100,0	102,5			103.0	101,2
Durum wheat	100,0	104,2			101.4	101,1
Coarse grains	100,0	102,2			100.2	100,7
Barley	100,0	101,7	101,9	105,0	100.9	102,1
Maize	100,0	104,6	100,3	100,9	98.4	98,1
Domestic use						
Total cereals	100,0	101,8				102,3
Wheat	100,0	101,4	100,1	100,0		101,1
Soft wheat	100,0	101,5				101,2
Durum wheat	100,0	100,5				100,9
Coarse grains	100,0	102,2				103,2
Barley	100,0	102,3	101,4	102,4		103,4
Maize	100,0	102,3	100,4	101,2		103,3
Excess supply						
Total cereals	100,0	105,6			101.9	95,7
Wheat	100,0	109,0	114,9**	135,5**	108.5	101,5
Soft wheat	100,0					101,5
Durum wheat	100,0					102,2
Coarse grains	100,0	102,0			88.0	87,0
Barley	100,0		109,0**	105,8**		97,0
Maize	100,0		100***	107,09***		26,7

* FAPRI - I: FAPRI Missouri; FAPRI - II: FAPRI Iowa. ** Net exports. *** Net imports

The comments regarding production essentially reiterate that on the comparison in table 3 above and note the close match with MFSS95 results except for maize. This table confirms the plausibility of MFSS99 results as it shows them to be also very close to CAPMAT results, especially on maize. However the expansion of soft wheat is smaller in MFSS99 than in the other models and will be investigated in more detail. Concerning domestic use, there is again a fairly close match with MFSS95, but apparently a somewhat higher feed responsiveness. On the response of excess supply the models differ more as small differences on the supply or demand side may have important effects for their difference. Nonetheless they may clearly be traced to the underlying differences: a relatively small expansion of wheat production causes excess supply to grow fairly slowly in MFSS99. On coarse grains at least CAPMAT and MFSS99 agree that excess supply will be curbed somewhat by the Agenda 2000 package.

Animal Sector

For beef, the reference run is strongly influenced by upward trending slaughter weights, reflecting the use of production capacities previously used for dairy. In spite of declining beef prices, demand is sluggish, because taste shifts are operating clearly against beef (even before BSE). Consequently the excess supply situation of the beef market is expected to deteriorate in the reference run. Veal production is increasing due to the expansion of calves fattened (table 4). As mentioned above, the increase in demand may seem somewhat strong compared to beef, but a loose relationship of veal and beef prices has been observed in the past as well. Excess supply is constant because this was our simple model assumption. More sophisticated information on export possibilities could be introduced, but has not been drawn upon for this modelling exercise. Pork and poultry markets are also cleared by endogenous prices which are rising most clearly for poultry.

Table 7: Simulation results on meat markets for EU-15

		Base 1993/95	Reference run 2005	Reference - Base	Agenda 2000 run 2005	Agenda - Reference
Beef	*consumer price*	*7221*	*6958*	*-3,6%*	*6397*	*-8,1%*
	production	7700	8096	5,2%	8268	2,1%
	total domestic use	6457	6384	-1,1%	6751	5,8%
	excess supply	1243	1712	37,8%	1517	-11,4%
Veal	*consumer price*	*16401*	*17446*	*6,4%*	*16526*	*-5,3%*
	production	852	899	5,5%	916	2,0%
	total domestic use	689	736	6,9%	754	2,4%
	excess supply	163	163	0,0%	163	0,0%
Pork	*consumer price*	*4465*	*4616*	*3,4%*	*4547*	*-1,5%*
	production	16579	17809	7,4%	17760	-0,3%
	total domestic use	15171	16401	8,1%	16352	-0,3%
	excess supply	1408	1408	0,0%	1408	0,0%
Poultry	*consumer price*	*3741*	*4318*	*15,4%*	*4262*	*-1,3%*
	production	7757	8969	15,6%	8930	-0,4%
	total domestic use	7022	8234	17,3%	8196	-0,5%
	excess supply	735	735	0,0%	735	0,0%

The Agenda 2000 measures further stimulate beef production according to MFSS99 because the rise in premia overcompensates the price drop. However, because demand is rising markedly following the price drop, excess supply is going down. The projected level is still grossly inconsistent with WTO obligations and thus requires huge intervention purchases of more than 1 m tons in 2005. Veal production rises considerably less than slaughtered animals because production happens to expand strongest in countries with small slaughter weights (UK, Ireland). This increase in supply as well as close substitution with beef drives down veal prices. The other meats also require declining prices to clear the markets but less than for veal or beef. As is evident from the excess supply line, we applied the same simple assumption of constant net exports to pork and poultry as well, even though these net exports would be

incompatible with WTO limits. More reasonable exogenous assumptions would have to be applied in refined simulations with greater policy relevance.
Again we may compare these Agenda 2000 simulation results with those of other models (table 8).

Table 8: Comparison of Agenda 2000 simulation results on meat markets for EU-15, year 2005

	Status quo	Agenda 2000				
	scenario	MFSS95	FAPRI - I*	FAPRI - II*	CAPMAT	MFSS99
Beef prices	100,0	80,0	87,9	87,1	80,0	79,9
Beef production	100,0	99,9	97,8	99,5	98,6	102,1
Beef consumption	100,0	101,8	102,8	103,1		105,8
Beef net exports	100,0		37,8	92,1	17.5***	88,6***
Pork prices	100,0	93,3	96,8	95,4		95,3
Pork production	100,0	99,7	99,5	100,3	100,1	99,7
Pork consumption	100,0	99,7	99,4	100,3		99,7
Pork exports	100,0		100,7			100,0***
Poultry prices	100,0	97,6	96,7	95,5		96,9
Poultry** production	100,0	98,8	99,5	100,5	100,6	99,6
Poultry consumption	100,0	98,8	99,4	100,3		99,5
Poultry exports	100,0		100,6			100,0***

* FAPRI - I: FAPRI Missouri; FAPRI - II: FAPRI Iowa. ** Broiler in FAPRI figures. *** Gross exportable surplus.

The main differences in the model results relate to the beef market. Whereas beef production declines somewhat according to FAPRI-I and CAPMAT (and CAPRI, Heckelei, Britz 2001, p. 289), and is essentially constant according to MFSS95 and FAPRI-II, according to MFSS99 there is a small increase, as explained above. On other meat markets the model results are more or less in line with each other.
Reference run results on markets for milk products are determined by the changes in quotas and intervention prices in the first years of the projection period (table 9). The quota increase determines the small aggregate increase in production of milk products. Given that human demand is expanding mostly for "other milk products" (including cheese) this increase in aggregate production is absorbed here whereas the production of intervention products declines to some extent. Nonetheless market prices are supported by intervention of butter and skimmed milk powder (SMP). Market prices for other milk products decline as well due to their technical link to the prices of fat and protein.

Table 9: Simulation results on milk markets for EU-15

		Base 1993/95	Reference run 2005	Reference – Base	Agenda 2000 run 2005	Agenda - Reference
Cow milk	Production	114110	115960	1,6%	117966	1,7%
	total domestic use	112510	114360	1,6%	116366	1,8%
	Excess supply	1600	1600	0,0%	1600	0,0%
Butter	*Consumer price*	*3023*	*2957*	*-2,2%*	*2815*	*-4,8%*
	Production	1871	1687	-9,9%	1737	3,0%
	total domestic use	1739	1542	-11,4%	1558	1,1%
	Excess supply	132	145	10,0%	179	23,6%
SMP	*Consumer price*	*2069*	*2056*	*-0,6%*	*1959*	*-4,7%*
	Production	1286	1119	-12,9%	1158	3,5%
	total domestic use	1067	1032	-3,3%	1041	0,9%
	Excess supply	219	87	-60,1%	117	34,0%
Other products	*Consumer price*	*651*	*643*	*-1,2%*	*620*	*-3,6%*
	Production	48272	51409	6,5%	52000	1,1%
	total domestic use	46636	49773	6,7%	50364	1,2%
	Excess supply	1636	1636	0,0%	1636	0,0%

With the Agenda 2000 package, this development is modified by a greater expansion of quota rights and the first reduction in intervention prices for butter and SMP (-5%). As unsubsidised exports of cheese are not considered, it appears that the price reductions were too small to balance the market such that excess supply for butter and SMP is rising again.

Again we may compare these Agenda 2000 simulation results with those of other models (table 10).

Table 10: Comparison of Agenda 2000 simulation results on milk markets for EU-15, year 2005

	Status quo	Agenda 2000				
	Scenario	MFSS95	FAPRI - I*	FAPRI - II*	CAPMAT	MFSS99
Milk production	100,0	101,6	101,1	101,2	101,3	101,7
Milk consumption	100,0	100,2				101,8
Milk prices	100,0	94,3	96,0	95,0	95,0	94,7
Cheese consumption	100,0		101,2	101,5		101,2
Cheese exports	100,0		102,0	102,9	118.0**	100,0**
Butter consumption	100,0		100,3	101,2		101,1
Butter exports	100,0		104,4	105,8	118.6**	123,6**
Butter ending stocks	100,0		102,3	103,4		
SMP consumption	100,0		100,4	103,4		100,9
SMP exports	100,0		100,0	104,5	111.4**	134,0**
SMP ending stocks	100,0		118,7	116,7		

* FAPRI - I: FAPRI Missouri; FAPRI - II: FAPRI Iowa. ** Gross exportable surplus. “Cheese” figures from MFSS99 refer to the aggregate of all other milk products except for butter and SMP

The models agree in the quota-determined expansion of raw milk production but differ slightly in the modest expansion of demand and in the development of net exports, in particular in the composition of these net exports. As MFSS99 fixed the exports of other milk products (including cheese), an increasing surplus is disposed of as net exports of butter and SMP. FAPRI and CAPMAT allowed cheese exports to increase to some extent as well which contributes to smaller increases of net exports in butter and SMP. To put it differently, MFSS99 results would have been even more in line with the “yardstick models”, if some increase of cheese exports had been allowed for.

5.3.3 Income

The income development in the reference run is crucially determined by yield growth, inflation, full implementation of the 1992 reform, and exogenous assumptions on some crucial variables such as total area, depreciation and the labour force, which have been specified for simplicity on the basis of statistical trends. Our recent trends on the labour force imply an overall outflow of labour of only 2% per year which is quite low by historical standards (Henrichsmeyer, Witzke 2000, p. 42). Consequently real net value added at factor costs per annual work unit (real NVAF per AWU) increases only by 15% up to 2005.

Table 11: Simulation results on income for EU-15

	Base 1993/95	Reference run 2005	Reference - Base	Agenda 2000 run 2005	Agenda – Reference	Agenda - Base
Gross value added at market price	109139	127068	16,4%	116857	-8,0%	7,1%
Subsidies	29151	32273	10,7%	38210	18,4%	31,1%
Taxes	3633	3633	0,0%	3633	0,0%	0,0%
Depreciation	31829	36953	16,1%	36953	0,0%	16,1%
Nominal net value added at factor costs	102828	118755	15,5%	114480	-3,6%	11,3%
Real net value added at factor costs	102828	94487	-8,1%	91085	-3,6%	-11,4%
Labour force	7461	5945	-20,3%	5945	0,0%	-20,3%
Real net value added at factor costs per annual work unit	13782	15894	15,3%	15322	-3,6%	11,2%

The Agenda 2000 package results in a decline in market income (GVAM) which is not completely compensated for by the increase in subsidies (premia) such that NFAV declines by 3.6%.
These income results may again be compared with the results of our "yardstick models" (table 12).

Table 12: Comparison of Agenda 2000 simulation results on income for EU-15, year 2005

	Base period*	Status quo			Agenda 2000		
		MFSS95	CAPMAT	MFSS99	MFSS95	CAPMAT	MFSS99
Agricultural income (nominal)	100,0	113,7	114,8	115,5	110,6	111,7	111,3
Agricultural income (real)	100,0	90,2	103,9	91,9	87,8	101,1	88,6
Agricultural labour	100,0	65,7	80,8	79,7	65,7	79,5	79,7
Real agricultural income per capita	100,0	137,4	128,6	115,3	133,7	127,2	111,2

* 1992-1996 for MFSS95, 1995 for CAPMAT, 1993-95 for MFSS99

Table 12 reveals that a great deal of the differences is due to exogenous assumptions, in this case on inflation and on labour outflow. Results on nominal income are more or less in line with each other with MFSS99 being more pessimistic regarding the Agenda 2000 impacts (-3.6%) than both MFSS95 and CAPMAT (-2.7%). More detailed analysis would be required to identify the reason for somewhat higher income losses according to MFSS99, but this analysis is unlikely to modify the basic conclusion that these models agree to a large extent. The differences in real income results mainly stem from a rather low inflation expected in the CAPMAT framework. Real income per capita results are in addition determined by expectations on labour outflow. Here it should be mentioned that the low rate assumed above is due to our decision to proceed rather simple and does not imply that we put great confidence in it. However, to compile well informed projections on labour outflow is clearly beyond the framework of this application of MFSS99 which was motivated as a test of the model's performance capabilities.

6 Discussion and outlook

The last section showed that the MFSS99 is ready for CAP impact analyses with results comparable to other well known modelling frameworks. Nonetheless there are ample possibilities for improvements, some of which urgent for continuous use and already envisaged, others desirable improvements for the future. For the following discussion it should be kept in mind that the main objectives, that is transparency, user friendlyness and policy relevance remain valid. Thus we will not consider fundamental changes in the conceptual framework which are likely to be at odds with these objectives.

6.1 Database

The current base year of MFSS99 (average 1993/95) is in urgent need of updating. This is because the initial situation of simulations has become more and more detached from information about recent developments in policy and in markets which are most valuable for medium term projections. Furthermore the 1994 base year data do not reflect the recent changes in the EAA and thus cannot depict (exactly, see section 4.2) the data underlying current agricultural policy decisions. These aspects were sufficient to agree between Eurostat and EuroCARE on the necessity of an update in the near future.

Other critical issues in the current database (or even gaps requiring assumptions to fill them) have been mentioned in section 4.2 and hopefully will be solved as well in the course of the envisaged update:

- The database on milk products frequently required assumptions for the heterogeneous aggregate "other milk products". Because policy relevance also suggests to separate out at least cheese from this aggregate this will be undertaken in the revision of the database as well. A more thorough treatment of milk products would also suggest to intensify contacts to other research teams on this complex industry
- The data on trade in live animals among EU countries are fraught with inconsistencies or at least severe intransparencies as has been revealed again in the disaggregation of calves into male and female calves. While well known for a long time, this problem should be tackled as well in the revision of the database.
- Currently, the behaviour of stock changes is frequently unbelievable in the database, forcing us to fix them like an initial period error term. A thorough revision of their calculation is foreseen in the update.
- Base period consumer prices have been calculated according to an inherited MFSS95 disaggegation procedure on macroeconomic expenditure data which turned out to yield unsatisfactory results in a certain number of cases. A maximum entropy approach would probably yield significant improvements. At the very minimum however these consumer prices will be updated as other data as well.
- The disaggregation of feedingstuffs required additional disaggregated prices, for example on rape cake, soya cake and so forth. This requires essentially, similar to the approach for consumer prices, a disaggregation of EAA data on feed costs, which is currently obtained

using a number of ad hoc assumptions. Here again it may be hoped that the update provides the opportunity to replace some adhocery with a systematic procedure.

6.2 Userfriendlyness for policy analysis

Under this heading we may subsume a number of potential improvements which sometimes require only moderate additional programming effort but could greatly enhance the usefulness for policy makers or policy analysts.

- A number of exogenous inputs are currently specified directly in the core GAMS programs. This applies, for example, to the assumptions on inflation, income growth and exogenous trade volumes. Here it would be more useful to enter these from external files, just as the user surface permits to modify the assumptions on political variables or world market prices.
- The abolition or introduction of quotas is a serious challenge to the model solver at present, although the model should be able to handle this with the current shadow revenue specification. Whereas the abolition of milk quotas was not a relevant option in the last two years this might change during the Agenda 2000 mid term review. Additional technical testing should therefore begin already now.
- As mentioned in section 4.3, there are well known statistics for the detection of influential observations which may complement our ad hoc procedures against unreasonable projections.
- A major improvement would be year to year simulations with market balances and levels of private and public stocks. However, this would require ex post data (for example from DG Agri) on public stocks which have not been included in the MFSS99 database so far. Levels of stocks would provide additional consistency checks on the ex post stock changes. Furthermore, simulated public intervention stocks might be bounded with the constraints being political instruments. Given the evident usefulness of this improvement it has been envisaged for the next phase of model development.

6.3 Parameters

The parameters likely to benefit most from additional effort are supply side parameters, starting values of which have been derived from the elasticities in MFSS95. Several issues could be improved:

- The empirical base of the initial values for these elasticities dates back to the 80ies. The most straightforward solution to this would be a new econometric estimation, definitely a formidable task if undertaken for the complete list of products (see the Annex) and all EU member states.
- Due to difficult to understand differences in the elasticities of MFSS95 between member states (lacking the time to investigate them in detail), it was decided to specify an uniform EU elasticity to be applied to all countries. While acceptable as a first attempt, the specification should not stop here.
- For lifestock activities MFSS95 essentially worked with a diagonal elasticity matrix, which has been augmented by guestimates.
- Feed demand elasticities with respect to livestock activities have been derived based on the shaky feed allocation in the SPEL/EU-BS. However, this procedure might appear less dangerous with an improved and updated database. Furthermore, these elasticities do not necessarily reflect animal requirements, for example in terms of energy. It has been agreed that this issue receives focus in the next phase of model development.

- Due to severe time constraints the feed price elasticities have been derived starting from a uniform Allen elasticity of substitution between all pairs of feedingstuffs. Given that intuition would suggest some more complicated separability structure, improvements should be rather easy to implement here.
- The current calibration procedure does not fully exploit microeconomic consistency conditions in that the relationship of cost and profit function in (1) is not yet imposed and curvature conditions have been only checked up to the third order minors.

Some of these options can be realised rather easy, others would involve a self contained major project (system estimation for EU) and are likely to be postponed for a while.
Parameters on the demand side (elasticities, taste shifts) are not known with certainty either, but, given that a literature review has been undertaken quite recently, marginal revenues of additional effort will be much higher on the supply side.

6.4 Functional forms

At the moment essentially all behavioural functions are specified as double log functions. This has advantages in terms of simplicity and quick readability of the GAMS programs for moderately experienced researchers in agricultural sector modelling. Furthermore it is reassuring to know that elasticities will not take on undesired values while moving away from the starting point during simulations.
However, the double log form also has disadvantages. Elasticities remain constant while moving away from the base year situation, but microeconomic consistency is lost, as consistency is only is imposed at the point of approximation, that is in the initial situation. As mentioned in section 3.2 a globally convex profit function could remedy this point. Furthermore zero or negative revenues provide a problem for the double log form which could arise, for example, for cattle activities, where revenues $REV_{m,j}$ are revenues net of the cost for young calves. Another special problem is the land constraint which has been imposed (see section 3.2) with the scaling factor $CFAC_m$. This is not very pleasant because its interpretation is far from straightforward. It might be more attractive to use a functional form imposing the land constraint by construction (for example using a multinomial logit form for the land shares) or by an endogenous rental price for land with a clear interpretation. Finally there is the problem to integrate feed requirements in the feed demand functions, solved elsewhere with more complicated functional forms (Folmer et al. 1995, p.167). At least the latter issue, feed demand, will be tackled in the next step of model development.
Finally we may note that consumer demand has not been expressed on a per capita basis so far. This will be improved in connection with the update of the database which requires a recalibration of demand side parameters as well.

6.5 Additional components

Model components not absolutely required for MFSS99 to run were postponed to the future in the initial specification of the model. It is already foreseen to amend the system with some of these.
An easy to supplement accounting tool would calculate a consumer welfare measure from the demand system and simulated price changes. The simplest measure would be consumer surplus as has been done for simulations with MFSS95 as well (Henrichsmeyer, Witzke 1998).

A component which easily can grow into a full scale project is the completion by a budget component. In a simplified form this has been envisaged and temporarily realised for MFSS95 as well and is a standard feature of many other sector models as well. A budget component only collecting the easy to calculate information on required export subsidies and premia could be added rather quickly, but difficulties rise considerably if storage costs are to be modelled based on information on stock levels. On this issue progress is likely to be made in several steps only.

Finally it will be noted that MFSS99 currently has a demand for exogenous information on trade variables (prices or volumes). The model shares this demand with MFSS95 and a number of other models. It implies that the model is not designed for a “stand alone” application but requires some information provided by trade models like WATSIM or FAPRI. A major point of improvement would thus be to incorporate a simplified trade component, a step also foreseen for the next future.

7 Summary

The aim of this research project can be summarised as to develop a new, transparent and user-friendly tool for medium term projections for the agricultural sectors of EU member states and impact of alternative CAP scenarios. The resulting new Medium-term Forecast and Simulation System (MFSS99) has been developed in a relatively short period. To meet the criterion of transparency, the technical infrastructure of the old SPEL/EU-MFSS model (MFSS95) has been thoroughly revised. Most importantly, the majority of data preparation, model simulation and evaluation steps are now written in GAMS instead of Fortran. This change not only increased the chances for communication and critical discussion with experts, but also facilitated the application of efficient model solvers.

The MFSS99-model is a purely comparative static modelling tool with behavioural functions driven by a set of synthetic elasticities. The behavioural functions are completed with a number of accounting identities to form a complete set of market balances for agricultural products. Market clearing currently occurs either by exogenous information on EU prices (determined by policy or world markets) yielding trade as endogenous variable or by exogenous trade volumes determining endogenous prices. Within this simple framework most CAP instruments could be incorporated.

To assess the performance of the MFSS99 an analysis of the Agenda 2000 CAP reform impacts has been carried out. The results of this analysis are then compared with the results of similar analysis carried out by several independent research teams on behalf of DG-AGRI. These research teams and the agricultural sector models used are MFSS95 (SPEL-group in Bonn), FAPRI-I (Missouri), FAPRI-II (Iowa) and CAPMAT (SOW-VU Amsterdam). In the analysis part the report is concentrating on production levels, product markets and income. The selected crop products, which are taken into account, are cereals and oilseeds. For the animal products the emphasis lies on meat and milk.

Overall the simulations showed MFSS99 results to be usually fairly close to those of other models with a longer tradition. Because MFSS99 is the result of a rather short research effort there are still many possibilities for improvements, some of which urgent for continuous use and already envisaged, others desirable improvements for the future. These options have been discussed in detail, identifying priorities for future work. Most important will be the update of the 1994 base year which will permit to resolve a number of other problems as well. Other envisaged improvements relate to user friendlyness, the specification of parameters, to functional forms and additional model components for consumer welfare, budget impacts and international trade interactions.

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9 Appendix: variables in MFSS99

The following two tables give the complete list of variables in the MFSS99 tables. In part they are more disaggregated than the variables mentioned in Section 3 above because this facilitated our use of the existing SPEL/EU infrastructure. In these cases, however, further differentiation is done after the simulations in a purely mechanical way. For example, feed demand has been split up into feed use on farm ("FEEP" below) and feed from the market ("PFEE" below) according to the composition in the base period.

Table 1: Columns (activities and other items) of MFSS99 tables for ex-post data

MFSS99	In MFSS95 corresponding to:	Explanation
Production activities *Crops*		
SWHE	SWHE	Soft wheat
DWHE	DWHE	Durum wheat
BARL	BARL	Barley
MAIZ	MAIZ	Maize
OCER	RYE, OATS, OCER, PARI	Other cereals
PULS	PULS	Pulses
POTA	POTA	Potatoes
SUGB	SUGB	Sugar beet
RAPE	RAPE	Rape and turnip rape
SUNF	SUNF	Sunflower seed
SOTH	SOYA, OOIL	Soya beans and other oilseeds
OLIV	OLIV	Olives for oil
INDU	FLAX,TOBA,OIND	Industrial crops
VEGE	CAUL,TOMA,OVEG, TABO	Vegetable
FRUI	APPL,OFRU,CITR,TAGR	Fruits
WINE	TWIN,OWIN	Wine
OCRO	NURS,FLOW,OCRO	Other final crop products
OFOD	OROO, SILA	Other fodder
GRAS	GRAS	Grass/Grazing

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MFSS99	In MFSS95 corresponding to:	Explanation
Set-aside and uncompensated fallow		
FALL	FALL	Fallow land
Cattle activities		
DCOW	MILK	Dairy cows
SCOW	CALV	Other cows
BULL	BEEF	Bulls fattening
HEIF	HEIF	Heifers
FCAM	CALF	Male calves fattening
FCAF	CALF	Female calves fattening
Other animals		
PORK	PORK,PIGL	Pig fattening
SHEE	MUTM,MUTT	Sheep and goat fattening
HENS	EGGS	Laying hens (only code changed)
POUL	POUL	Poultry fattening
OANI	OANI	Other animals
Farm balance		
PROP	PROP	Gross interactions (production/input)
FEEP	FEEP	Animal feed
SEEP	SEEP	Seed
PCOF	PCOF	Human consumption
PLOF	PLOF	Losses
PCSF	PCSF	Changes in stocks
TRAP	TRAP	Sales/purchasing
Import and export		
PIMT	PIMT	Imports, total
PEXE	PEXE	Exports, EUR-12
MAPR	MAPR	Marketable production
Market balance		
PFEE	PFEE	Feed, market
PSEE	PSEE	Seed, market
PIND	PIND	Industrial use
PPRO	PPRO	Processing
PCOM	PCOM	Human consumption, market
PLOS	PLOS	Losses, market
PCSM	PCSM	Change in stocks, market
PCSP	New	Change in stocks, public (intervention)

MFSS99	In MFSS95 corresponding to:	Explanation
Prices		
PRIC	PRIC	Farm gate price
UVAL	UVAL	Unit value (equal to PRIC if available)
CPRI	CPRI	Consumer prices
Old EAA		
PEAV	PEAV	Final production, old EAA (current prices)
PEAC	PEAC	Final production, old EAA (const. Prices - 1985)
PROV	PROV	Gross interactions (current prices)
PROC	PROC	Gross interactions (constant prices - 1985)
Other variables		
NAGG	NAGG	national aggregates
INHA	INHA	Inhabitants
EXPE	EXPE	Expenditure

Table 2: Rows (products and other items) of MFSS99 tables for ex-post data

MFSS99	In MFSS95 corresponding to:	Explanation
Outputs *Crops*		
SWHE	SWHE	Soft wheat
DWHE	DWHE	Durum wheat
BARL	BARL	Barley
MAIZ	MAIZ	Maize
OCER	RYE, OATS, OCER, PARI	Other cereals
PULS	PULS	Pulses
POTA	POTA	Potatoes
SUGB	SUGB	Sugar beet
RAPE	RAPE	Rape and turnip rape
SUNF	SUNF	Sunflower seed
SOTH	SOYA, OOIL	Soya beans and other oilseeds
OLIV	OLIV	Olives for oil
INDU	FLAX,TOBA,OIND	Industrial crops
VEGE	CAUL,TOMA,OVEG, TABO	Vegetables
FRUI	APPL,OFRU,CITR,TAGR	Fruits

INDEX

MFSS99	In MFSS95 corresponding to:	Explanation
WINE	TWIN,OWIN	Wine
OCRO	NURS,FLOW,OCRO	Other final crop products
OFOD	OROO, SILA	Other fodder
GRAS	GRAS	Grass/Grazing
Cattle		
MILK.	MILK	Raw milk
BEEF	BEEF	Beef
VEAL	VEAL	Veal
YCAM	CALV (disaggregated)	Young calves male
YCAF	CALV (disaggregated)	Young calves female
Other animals		
PORK	PORK	Pork
EGMI	MUTM	Sheep and goat milk
MUTT	MUTT	Sheep and goat meat
EGGS	EGGS	Eggs
POUL	POUL	Poultry
OANI	OANI	Other animal products
Services		
COWO	COWO	contract work on other services
Inputs *General inputs*		
IGEN	IPHA,PLOF,REPV,ENEV, WATV,INPV,REPO,ENEO, INPO	General cost items
Specific plant related cost items		
IPLA	NITF,PHOF,POTF,CAOF, PLAP, SEEP	Fertiliser and other inputs specific for plant production
Specific animal related cost items(for elasticity calibration)		
FCER	FCER	Fodder: cereals (incl. Rice)
FPRI	FPRO (redefined)	Fodder: rich protein
FENI	FENE (redefined)	Fodder: rich energy
FMIL	FMIL	Fodder: milk and milk products
FDRY	FDRY	Fodder: dried (not marketable)
FFSI	FFSI	Fodder: fresh or ensilaged (not marketable)
FOTI	FOTH (redefined)	Fodder: other
ICAL	ICAL (redefined)	Input calves

INDEX

MFSS99	In MFSS95 corresponding to:	Explanation
EAA		
DEPB.	DEPB	Depreciation buildings
DEPM	DEPM	Depreciation machines
Income Indicators		
PROV	PROV	Gross production
TOIN	TOIN	Total intermediate input
SUBS	SUBS	Subsidies
TAXE	TAXE	Taxes linked to production
GVAM	GVAM	Gross value added at market prices
GVAF	GVAF	Gross value added at factor costs
NVAF	NVAF	Net value added at factor costs
Activity level		
LEVL	LEVL	Levels of main activities
Derived products		
RICE.	RICE	Rice equiv. milled rice
MOLA	MOLA	Molasses
STAR	STAR	Potato starch
SUGA	SUGA	Sugar
RAPO	RAPO	Vegetable fats and oils - rape
SUNO	SUNO	Vegetable fats and oils - sunflower
SOYO	SOYO,OTHO	Vegetable fats and oils - soya/other oil seeds
OLIO	OLIO	Vegetable fats and oils - olives
RAPC	RAPC	Oilcakes - rape
SUNC	SUNC	Oilcakes - sunflower
SOYC	SOYC,OTHC	Oilcakes - soya
OLIC	OLIC	Oilcakes - olives
BUTT	BUTT	Butter
MIPO	MIPO	Skimmed milk powder
OMPR	OMPR	Other products of milk
Other variables		
LABO	LABO	Total labour in AWU (annual work unit)
NAGG	NAGG	National aggregates