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Modelling Agricultural Policies in the
CEE Accession Countries[1]

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Abstract
The present paper analyses sectoral impacts of the CEE integration with EU. Adopting a partial equilibrium model we explicitly model the agricultural sector in CEE. The underlying partial equilibrium model is based on the duality theory. The model captures all key CAP instruments, such as price support, area payments, animal premiums, quotas and set-aside premiums. The policy simulation analysis allows us to track how changes in the CAP affect the supply and demand behaviour of agricultural producers and consumers of food products. Our simulation results suggest that farm income in CEE will rise mainly due to area payments and animal premiums. The impact on consumer welfare is rather small, as decreasing prices for some food products are offset by increasing prices for other agricultural goods.
Keywords: Partial equilibrium model, CEE, CAP, policy modelling

1 Introduction

The integration of CEE with EU will significantly change, among others, their current agricultural policies. First, the level of support to agriculture will increase for the majority of CEECs, and secondly the composition of the policy instruments will be affected. One of the most hotly debated issues on enlargement is whether the CEECs should get access to full CAP support, in particular the direct payments. Yet, no matter what decision is taken, agricultural policy changes with accession are likely to change the income distribution and welfare in CEECs.

In the EU-15 it is feared that an implementation of the CAP's agricultural price and income support will boost CEEC's agricultural output and reduce their food demand. This could result in incompatibilities with the WTO commitments concerning the quantitative restrictions on subsidised exports. An alarming question for EU politicians is the potential burden for the EU budget arising from an implementation of the CAP in the CEECs.

The partial equilibrium model 'Central and Eastern European Countries Agricultural Simulation Model (CEEC-ASIM)' is used to address some of these questions. In particular, the impacts of a CAP

[1] The authors acknowledge helpful comments from Achim Fock as well as EAAE conference participants in Warsaw.

implementation on agricultural output, food demand and farm incomes in the potential accession countries and on the EU budget are analysed.

2 Theoretical framework

The theoretical framework of the present study is based on CEEC-ASIM, which is a partial equilibrium model with rational and perfectly informed economic agents and perfect markets (WAHL ET AL 2000). The key assumptions of the model are neo-classical. Producers are modelled as maximizing profit and consumers as that of utility. They have perfect knowledge about technical and market conditions. Transaction costs do not occur explicitly and exchange of goods is carried out frictionless and instantaneously. Markets are competitive, i.e. producers and consumers are price takers.

Agricultural commodities are homogenous. Hence, intra-industry trade is not captured in the model. In other words, the difference between supply and demand is considered to be traded internationally. In addition, the countries are modelled as being price takers on the world market. This reflects the assumption that they are too small to affect world market prices. This assumption is satisfied in the CEE data for most of the agricultural commodities.

The quantity of each output and input (netput) depends not only on its own price but also on all other netput prices and on a shift variable representing technological progress. The supply and input demand equations are derived from a Symmetric Generalised McFadden Profit Function (SGMPF), which belongs to the class of functional forms that are flexible up to the second order derivatives with respect to the prices. The supply system fulfils all theoretical conditions implied by the assumption of producers which maximise profits by producing multiple outputs using a bundle of inputs.

Consumer demand is a function of all retail prices and income. Demand is shifted by autonomous population growth. The demand functions are derived from a Normalised Quadratic Expenditure Function (NQEF), which belongs to the class of functional forms that are flexible up to the second order derivatives with respect to the prices. All theoretical conditions implied by the assumption of utility maximisation are fulfilled by the demand system.

Price transmission equations provide links between the various prices used in the model. To the latter belong those at the border, farm gate, and retail level. In addition, producer incentive prices are determined on which producers base their decisions. Due to the small-country-assumption made border prices are exogenous to the model. Also various agricultural policy variables enter the specification of the price transmission block like nominal protection rates, minimum prices and specific subsidies.

The model allows to assess how welfare of producers and consumers is affected by alternative policy scenarios. In addition, also the budgetary implications (government) of agricultural policies are estimated.

In the following, the different parts of the model are described in detail along with the underlying model assumptions.

2.1 Production

Supply and input demand are modelled on the basis of a system of output supply and input demand functions derived from a profit function. The profit function is a mathematical representation of the solution to an enterprise's optimisation problem (CHAMBERS 1988). From a set of feasible production plans T a combination of supply quantities and input demands QS is chosen that maximises profit π at given prices PS for N commodities:

$$\pi(\mathbf{PS}) = \max_{QS_s} \left\{ \sum_s PS_s QS_s \middle| QS_s \in T \quad \forall s \right\}; \quad s = 1,\dots,N$$

π	profit function
PS	producer incentive price
QS	supply (if QS>0) or input demand (if QS<0)
T	set of feasible production plans
s	index for output and input commodities
N	number of output and input commodities

(1)

The solution of the optimisation problem shown above leads to a profit function in which only prices are the determining variables. Quantities of netputs are at their optimal level and substituted for by prices. To be a profit function an algebraic representation must meet the following regularity conditions (VARIAN 1992): (i) continuity in output and input prices, (ii) non-decreasing in output prices and non-increasing input prices, (iii) homogeneity of degree 1 in prices, and (iv) convexity in prices.

As a functional form for the profit function CEEC-ASIM employs the Symmetric Generalised McFadden Profit Function (SGMPF) (see equation 2) described by DIEWERT and WALES (1987) in the context of cost minimisation.

$$\pi(\mathbf{PS}) = \sum_s \beta_s PS_s + \frac{1}{2} \frac{\sum_s \sum_t \zeta_{s,t} PS_s PS_t}{\sum_s \alpha_s PS_s} + \sum_s \Delta_s PS_s; \qquad s,t = 1,\dots,N$$

Δ	exogenous shift variable
α, β, ζ	parameters of the profit function

$$\zeta_{s,t} = \zeta_{t,s}; \quad \alpha_s \geq 0; \quad \sum_s \alpha_s PS_s > 0; \quad \sum_t \zeta_{s,t} PS_t = 0;$$

(2)

Regularity conditions (i) to (iii) are fulfilled by the SGMPF. Convexity in prices is imposed globally by restricting the matrix of the ζ parameters to be positive semi-definite. This is achieved using the Cholsky decomposition of this matrix.

DIEWERT and WALES (1987) show that the Symmetric Generalized McFadden is a flexible functional form in that it can approximate any unknown twice-continuously differentiable function representing an optimisation problem. In this sense it does not impose prior constraints on the economic effects: level of profit, the *N* derived supply and input demands and the *N(N+1)/2* derived supply and factor demand responses. Imposing convexity on the SGMPF does not destroy flexibility.
Applying Hotelling's Lemma (Chambers, 1988) one obtains the system of *N* output supplies and input demands as the first order partial derivatives of the SGMPF with respect to the prices:

$$\frac{\partial \pi(\mathbf{PS})}{\partial PS_s} = QS_s(\mathbf{PS}) = \beta_s + \frac{\sum_t \zeta_{s,t} PS_t}{\sum_s \alpha_s PS_s} - \frac{1}{2} \frac{\alpha_s \sum_s \sum_t \zeta_{s,t} PS_s PS_t}{\left(\sum_s \alpha_s PS_s\right)^2} + \Delta_s \tag{3}$$

The resulting supply and input demand functions are homogenous of degree 0. Therefore only relative prices matter in our model and there is no money illusion. Exogenous shifters Δ can move the supply and input demand functions in order to account for effects that are assumed to be independent of prices (e.g. technological progress).

2.2 Consumption

Demand is modelled based on the assumption that the consumer chooses a consumption bundle which maximises his utility at given prices subject to a budget constraint. This optimisation problem can be restated by an indirect utility function which gives the maximum utility achievable at given prices and income (VARIAN 1992). The system of demand functions is derived from an expenditure function E - the inverse of the indirect utility function -, which gives the minimum cost of achieving a fixed level of utility *U* at given retail prices *PD*:

$$\mathrm{E}(\mathbf{PD}, U(\mathbf{QDPHD})) = \min_{QDPHD_d} \left\{ \sum_d PD_d \, QDPHD_d \middle| U(QDPHD_d) \geq U \right\}; \quad d = 1,\ldots,M$$

E	expenditure function
PD	retail price
QDPHD	per-capita demand quantity
U	utility
d	index for consumer good
M	number of consumer goods

(4)

According to to VARIAN (1992), in order be an expenditure function an algebraic representation must meet the following regularity conditions: (i) continuity in prices, (ii) non-decreasing in prices, (iii) homogeneity of degree 1 in prices, and (iv) concavity in prices.
As a functional form for the expenditure function the CEEC-ASIM employs the Normalised Quadratic Expenditure Function (NQEF) described by DIEWERT and WALES (1988):

$$E(\mathbf{PD},U) = \sum_d a_d PD_d + \left[\sum_d b_d PD_d + \frac{1}{2} \frac{\sum_d \sum_e B_{d,e} PD_d PD_e}{\sum_d \alpha_d PD_d} \right] U; \quad d,e = 1, \ldots, M$$

where

$$\boldsymbol{\alpha}^T \mathbf{PD}_{basy} = 1; \; \boldsymbol{\alpha} = \frac{\mathbf{QDPHD}_{basy}}{Y_{basy}}; \; \mathbf{a}^T \mathbf{PD}_{basy} = 0; \; \mathbf{B} = \mathbf{B}^T; \; \mathbf{B}\,\mathbf{PD}_{basy} = 0; \; \mathbf{PD}^T{}_{basy}\mathbf{b} = 1$$

Y	per-capita total food expenditure	
α, a, b, B	parameters of the expenditure function	
basy	base year of projection	(5)

Regularity conditions (i) to (iii) are fulfilled by the NQEF. Concavity in prices can be imposed globally by restricting the matrix of B-parameters to be negative semi-definite (DIEWERT and WALES 1988). This is achieved using the Cholesky decomposition of this matrix.

The NQEF is a flexible functional form in that it can approximate any twice-continuously differentiable expenditure function (DIEWERT and WALES 1988). This means, that the NQEF can show *½(M+1)(M+2)* independent effects for a given price-income[2] situation without a-priori constraints on income and price elasticities (DIEWERT 1974). Furthermore, since 'local money metric utility scaling' with reference to base period prices[3] holds one can measure utility in nominal income terms. An advantage of the 'local money metric scaling' is that imposing concavity in prices will not destroy the flexibility property.

Applying Shepard's Lemma to the expenditure function one obtains the system of the consumer's compensated (Hicksian) demand functions as the first order partial derivatives of the expenditure function with respect to the consumer prices (VARIAN 1992). These functions determine the expenditure-minimising demand bundle given the level of utility (real income) as a function of prices.

$$\frac{\partial E(\mathbf{PD},U)}{\partial PD_d} = h_d(PD,U) = a_d + \left[b_d + \frac{\sum_e B_{d,e} PD_e}{\sum_d \alpha_d PD_d} - \frac{1}{2} \frac{\alpha_d \sum_d \sum_e B_{d,e} PD_d PD_e}{\left(\sum_d \alpha_d PD_d \right)^2} \right] U$$

h_d(**PD**, *U)*	Hicksian demand function for consumer good d	(6)

Solving the expenditure function for the utility consistent with a given nominal expenditure and substituting the resulting indirect utility function into the system of compensated demand functions, yields

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2 The terms 'expenditure' and 'income' are used interchangeable.

3 A more detailed description of the money metric scaling see DIEWERT and WALES (1988) or MCKENZIE (1985).

the system of uncompensated (Marshallian) demand functions. This system determines the utility maximising demand bundle at given prices for given nominal income.
The system of uncompensated demand functions derived from the NQEF by using Roy's identity has the following form (DIEWERT and WALES 1988):

(a) $$QDPHD_d = a_d + \left[b_d + \frac{\sum_e B_{d,e} V_e}{\sum_d \alpha_d V_d} - \frac{1}{2} \frac{\alpha_d \sum_d \sum_e B_{d,e} V_d V_e}{\left(\sum_d \alpha_d V_d \right)^2} \right] \cdot \frac{1 - \sum_d a_d V_d}{\sum_d b_d V_d + \frac{1}{2} \frac{\sum_d \sum_e B_{d,e} V_d V_e}{\sum_d \alpha_d V_d}}$$

where

$$V_d = PD_d / Y$$

(b) $$QD_d = QDPHD_d POP$$

QDPHD	per-capita demand quantity
Y	per-capita total food expenditure (exogenously determined)
QD	demand quantity
POP	population (exogenously determined)

(7)

The demand functions are homogenous of degree 0 in prices and income, which means that only relative income normalised retail prices *V* matter.
The NQEF has an important disadvantage in terms of model assumptions. The Engel curves derived from it are linear in income (DIEWERT and WALES 1988). RYAN and WALES (1996) describe a Normalised Quadratic – Quadratic Expenditure System (NQ-QES) with Engel curves quadratic in income and with the NQEF and its linear Engel curves nested as a special case.

2.3 Prices

CEEC-ASIM links prices at different levels, i.e. border prices, farm gate prices, producer incentive prices and consumer prices.[4]
We assume that foreign demand absorbs any surplus and that foreign supply meets any deficit in the commodity balances of the CEECs at given international prices. This so-called small country assumption is justified if the shares of the country in international agricultural trade are low. The border prices can then be treated as exogenous model variables. The appropriateness of this assumption is, however, questionable for some commodities in some CIS countries.
In the absence of policy interventions border prices could be seen as the relevant incentives on which agricultural enterprises base their decision on input demand and output supply. However, governments intervening on agricultural markets establish wedges between border prices and farm gate prices.

[4] All prices are in national currencies.

The nominal protection rate (NPR) is a measure for the policy induced gap between farm gate and border prices. It can be an exogenous or endogenous variable depending on the type of market intervention the government pursues. For example, in a system with fixed administered prices the NPR rate is viewed as being endogenously determined. On the other hand, with ad-valorem-import-tariffs changes in border prices are transmitted onto the domestic market, the NPR would be an exogenous policy variable reflecting the level of border protection.

The price transmission equations employed in the CEEC-ASIM allow to combine both types of market and trade policies Hence, the price transmission equations allow to switch from scenarios with import tariffs to options with minimum prices (e.g. intervention prices) or to any combination of the two.[5]

$$PFG_s = MAX\left(PW_s \cdot \left(NPR\_D_s + 1\right); PFG\_M_s\right)$$

PFG	farm gate price
PW	border price (exogenously determined)
NPR_D	desired nominal protection rate (exogenously determined)
PFG_M	minimum farm gate price (exogenously determined)

(8)

The costs of processing, wholesale and retail services are assumed to be perfectly inelastic with respect to demand for these services. Therefore, the margins between prices at producer and consumer level are exogenous to the model. The price transmission between producer and consumer level is given by the following equation:

$$PD_d = PFG_d + RM_d$$

PFG	farm gate price
RM	retail margin (exogenously determined)
PD	retail price

(9)

In the absence of subsidies farm gate prices would be the relevant incentives for the producers' decisions on output supply and input demand. However, there are agricultural policy measures that do not influence market prices but nevertheless distort production incentives. OECD's statistics on producer subsidy/support equivalents provide a grouping of these non market support subsidies according to which CEEC-ASIM distinguishes between direct payments, reduction of input costs and general services. In order to capture the impact of these subsidies on production decisions we have defined in

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[5]: For example, if no politically desired minimum farm gate price exists (*PFG_M = 0)*, the farm gate price *PFG* equals the border price *PW* times a desired nominal protection factor (*NPR_D + 1)* kept up by policy interventions as for example ad-valorem import tariffs. Under a policy aiming at ensuring a certain minimum farm gate price (*PFG_M > 0)* the realised *PFG* would equal *PW* if the latter is at least as high as the *PFG_M*. The realised *NPR* would be an endogenous model variable in this case. With both, a politically desired nominal protection

CEEC-ASIM so-called producer incentive prices *PS.* These take into account the farm gate prices plus some fractions of direct payments, input subsidies and general services (see equation 10) which are assumed to influence producers' decisions. Also quota rents enter the definition of the incentive prices if applicable.

$$PS_s = PFG_s + mult^D PSE_s^D + mult^I PSE_s^I + mult^G PSE_s^G - PQUOTA_s$$

PS	producer incentive price	
PFG	farm gate price	
PQUOTA	supply quota rent	
PSE	producer subsidy/support equivalent per quantity unit (exog. determined)	
mult	incentive fraction of PSE (exogenously determined)	
Superscripts:	*I*	input subsidies
	D	direct subsidies
	G	general subsidies

(10)

2.5 Welfare

The CEEC-ASIM allows to assess welfare implications of different policy regimes implemented by the government, hence they have affect producer and consumer decisions on supply, input demand and final demand for agricultural commodities. These changes influence the welfare position of the economic actors including the government's budget and thus total welfare.

Producer welfare is measured by net revenue including market income and subsidies:

$$NETREV = \sum_s \left(PFG_s + PSE_s^D + PSE_s^I\right) QS_s + SETAP * SETALE$$

NETREV		net revenue
PFG		farm gate price of output or purchase price of input
PSE		producer subsidy/support equivalent per quantity unit
QS		supply or input demand quantity
SETAP		set-aside premium per hectare
SETALE		area set aside
Superscripts:	*I*	input subsidies
	D	direct subsidies

(11)

The consumer welfare calculations follow the concept of the money metric indirect utility functions (MMIUF) (VARIAN 1992). The MMIUF determines the minimum income necessary at base year prices PD_{basy} to be as well off as facing (current) prices *PD*. Since the MMIUF is a monotonic transformation of the indirect utility function (see equation 11) it can be shown that it is a theoretically consistent welfare measure (DIEWERT 1988).

rate and a minimum farm gate price given, the farm gate price would be no lower than the minimum price but equal the border price times the desired nominal protection factor if this is higher than the minimum price.

$$m\left(\mathbf{PD}_{basy};\mathbf{PD},Y\right)=E\left(\mathbf{PD}_{basy},\upsilon\left(\mathbf{PD},Y\right)\right)$$

m	money metric indirect utility function
E	expenditure function
υ	indirect utility function
PD	vector of retail prices
Y	Per capita total food expenditure
basy	index for base year of projection

(12)

The indirect utility function corresponding to the NQEF and its money metric are then:

$$U=\upsilon\left(\mathbf{V}\right)=\frac{\left(1-\sum_{d}a_{d}V_{d}\right)}{\sum_{d}b_{d}V_{d}+\frac{1}{2}\frac{\sum_{d}\sum_{e}B_{d,e}V_{d}V_{e}}{\sum_{d}\alpha_{d}V_{d}}}$$

$$m=POP\left[\left(\sum_{d}a_{d}\cdot V_{d,basy}\right)+\left(\sum_{d}b_{d}V_{d,basy}+\frac{1}{2}\frac{\sum_{d}\sum_{e}B_{d,e}V_{d,basy}V_{e,basy}}{\sum_{d}\alpha_{d}V_{d,basy}}\right)U_{basy}\right]U$$

where $V_d=PD_d/Y$

U	utility
POP	population
α, a, b, B	parameters of the expenditure function

(13)

The new utility level of consumers at an alternative price vector is expressed in income/expenditure terms necessary to attain this new utility level at base year prices. This corresponds with the value of the expenditure function at the new utility level. One can compare now the impact of different policies to the consumers welfare position by calculating the equivalent variation. This measure asks what income change at base year prices would be equivalent to the change in utility:[6]

$$EV=m-Y_{basy}*POP$$

EV	equivalent variation

(14)

Finally the governments' budget expenditures are computed. The components of the budgets are in our case export subsidies, direct payments, input subsidies, and general services[7].

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[6] For more details see MACKENZIE (1985).

[7] For direct payments, input subsidies, and general services we use the definition of the OECD.

The budgetary expenditure for direct payments, input subsidies, and general services is obtained by multiplying the payments per quantity unit with the quantities produced. For direct payments also the payments for set aside are taken into account. In CEEC-ASIM exports are implicitly set off against imports (net trade). Therefore its results on budgetary expenditure on export or import subsidies (if negative sign) or revenues from export and import tariff (if positive sign) have to be interpreted with some care: these positions are simply the gap between farm gate and border prices multiplied with net trade quantities. The sum over all components and commodities gives the total budget expenditures or revenues:

$$SUMBUD = \sum_{oup}\left(\left(PSE^{D}_{oup} + PSE^{I}_{oup} + PSE^{G}_{oup}\right)QS_{oup} + NX_{oup}\left(PFG_{oup} - PW_{oup}\right)\right)$$
$$+ SETAP * SETALE$$

where $NX_{oup} = QS_{oup} - QS_{oup,feed} - QD_{oup}$

SUMBUD		governement budget expenditure
NX		net trade
PFG		farm gate price
PW		border price
PSE		producer subsidy/support equivalent per quantity unit
QS		supply quantity
SETAP		set-aside premium per hectare
SETALE		area set aside
oup		index for agricultural output
oup,feed		index for feed input item mapped to output oup
Superscripts:	*I*	input subsidies
	D	direct subsidies
	G	general subsidies

(15)

Adding producer and consumer welfare as well as budget expenditure leads to the total welfare. The impact of a policy variation is analysed by changes in the welfare components.

3 Policy scenarios

We study three policy scenarios: base run, EU accession and market liberalisation. More precisely, we compare the EU accession scenario under full application of the EU market regulations is with the base run of unchanged national agricultural policies. In addition, a scenario of complete liberalisation of agricultural policies is a second point of reference with which the EU accession scenario is contrasted.

3.1 Base run (BR)

The base run serves as a reference for comparison assuming that the national agricultural policies in the CEEC-10 observed for the base year 1997 do not change until 2007.

The *nominal rates of protection* are defined as the policy induced percentage gaps between farm gate and border prices. These rates are assumed to be those observed for 1997. The changes in border prices between 1997 and 2007 are exogenous and are based on world market price projections of FAPRI (1999). Any other support like direct subsidies, input subsidies and general subsidies are kept at their 1997 levels per unit of output.

Assumptions on autonomous *technical progress* are derived from European Commission (1998) and reflect per-hectare-yield changes and per-animal-output changes respectively. The annual growth rates of technical progress are mainly in the range of 1 to 3 %. Retail margins in absolute real values per quantity unit are kept at their base year levels. Population and income growth are based on FAPRI (1999) projections.

The parameters of the supply and demand equations are calibrated so as to reproduce the base year 1997 (see Annex 3). The calibration procedures start from initial elasticity sets borrowed from expert knowledge or specialised econometric studies. The initial sets must not be consistent with micro-economic theory but indicate to the magnitude of supply and demand reaction on changing prices and income. During the calibration they are adjusted in order to make them comply with theory, i.e. to ensure that the matrices of second order derivatives of the profit and expenditure functions with respect to prices are symmetric and fulfil the curvature conditions. The micro-economic constraints are implemented within a non-linear programming approach, which minimises the squared relative deviations of the final elasticity sets from the initial ones. The strong foundation of the model on duality theory is an advantage for modelling agricultural policy impacts in CEECs where long and reliable statistical time series are lacking and where it is difficult to refer to historical experience and informal analyses. Into the calibration approach for the model's supply side also information on technical relationships can be taken into account. For example, the objective function to be minimised is expanded by terms for the squared deviations between aggregated animal output elasticities and aggregated feed input elasticities. This ensure that animal output changes are reflected properly in feed input changes.

3.2 EU accession scenario: Agenda 2000 (AS)

In the EU accession scenario we assume that by 2007 the CEEC-10 have fully implemented the CAP market regulations as reformed by the Agenda 2000 decisions of the European Council (European Commission, 1999) and that economic adjustments to these policy changes are completed.

For *farm gate prices* of cereals, sugar, beef and milk we assume that policy induced price gaps between the accessing countries and the EU are abolished. The price cuts of the Agenda 2000 of 15 % for cereals and milk and 20 % for beef are taken into account. If the farm gate prices calculated according to these assumptions are lower than the border prices, the latter are used as farm gate prices. This implies that negative protection is not allowed. For all other products no border protection is in effect after EU accession (zero nominal protection rates).

The *area payments* for cereals amount to 63 Euro/t. The reference yields used to calculate the payments per hectare are the average expected yields for wheat and coarse grains in 2001. For oilseeds and set-aside the same premium is received. Farmers are obliged to *set aside* 10 % of the area. This rate is modified to a lower effective one to reflect the small producer regulation exempting non professional producers from the obligation. E.g., for Poland the 10 % obligatory set-aside reduces to an effective one of 2 %.

For the accession scenario production *quotas on sugar* are implemented. Sugar production is not allowed to exceed the 1997 output levels augmented by the expected rise up to 2001 of per-hectare-yields.

The *premium in the beef sector* is equivalent to Euro 290 per slaughtered male adult cattle (special premium plus slaughter premium). The upper limit for the number of eligible animals is assumed to correspond to the base year's number of animals.

The *quotas for milk production* are equivalent to the 1997 output levels plus an additional amount reflecting the expected rise up to 2001 of per-cow-yields as well as the 1.5 % increase of the Agenda 2000 decisions. For *milk,* a premium of Euro 17.24 per ton is paid. This premium is tied to the quota rights.

All national subsidies of the base run are abolished. The assumptions on border prices, technical progress, retail margins, income and population growth of the BR are maintained in the AS. Thus, only those accession impacts attributed to agricultural policy are examined.

3.3 Liberalisation scenario (LS)

A scenario in which any agricultural protection is dismantled serves as a second point of reference with which the EU accession scenario is compared.

In this scenario border protection is abolished, i.e. the nominal rates of protection are set to zero value. Also domestic support is cut. This leads to a change in the ratios between the producer incentive prices for the different commodities. It is further assumed that a global dismantling of protection leading to lower surpluses for agricultural commodities in the developed market economies would increase world market prices for all agricultural products by 10 % against the BR. The latter assumption induces a further change in the price ratios between output and input commodities. The assumptions on technical progress, retail margins, income and population growth of the BR are maintained in the LS.

3.4 Scenario implementation in the model

In this section we briefly describe how different agricultural and rural development policy measures of AS and LS scenarios are introduced into the model is.

3.4.1 Market price and other support

Market price support can be implemented into a simulation by setting values for the desired nominal protection rates and for the minimum farm gate prices in the price transmission equation (8).

The level of direct payments, input subsidies and general services per unit of output can be exogenously set as scenario assumption and enter equation (10).

Since the model is used also in the context of EU accession, we have introduced specific measures of the CAP into the model: production quotas, area payments, animal premiums, and area set-aside.
Production quotas are implemented as upper bounds on the output quantities in the system of supply and input demand equations, which means that output quantities are not allowed to exceed the quota but may be below the quota (equation 16). If the quota becomes binding, the model computes the rent for the quota PQUOTA, which enters the equation determining the producer incentive prices (equation 10). By that the incentive prices for all those products for which a quota is binding are adjusted downwards. This is necessary because the incentive prices determine the allocation of the inputs and the output mix. If this adjustment were not done the model results would be distorted.

(a) Quota: $QS_s \leq SQUOTA_s$ and $PQUOTA_s \geq 0$

(b) Non-quota: $PQUOTA_s = 0$

QS supply quantity
SQUOTA supply quota
PQUOTA quota rent (16)

3.4.2 Area payments

Area payments of the CAP for 'grandes cultures'8 are part of 'direct subsidies'. In CEEC-ASIM they are treated separately from other direct payments since their amount per quantity unit depends on output quantities and is therefore not set exogenously.
EU regulations specify that area payments for 'grandes cultures' and the set-aside is not to exceed a certain amount corresponding to a predetermined area under 'grandes cultures' and set-aside, called base area. This requirement is specified at regional or national level but not for individual farms at which the decisions on land allocation are made. If farmers apply for area payments for more than this base area, area payments per hectare will be reduced.
The payment per hectare is influenced by three policy instruments: the payment per tonne of reference yield, the reference yield and the base area.

8 Cereals, oilseeds and pulses.

(a) $$PSECST_g = PSER_g RYIELD_g$$

(b) $$LEVLP_g = PSECST_g REDGRAN; \quad 0 \le REDGRAN \le 1$$
$$SETAP = LEVLP_{WHEAT}$$

(c) $$MAXPAYGRAN = BASEAREA \frac{\sum_g PSECST_g LEVL_{g,basy}}{\sum_g LEVL_{g,basy}}$$

(d) $$LPAYGRAN = 1 - \frac{\sum_g LEVL_g LEVLP_g - SETALE * SETAP}{MAXPAYGRAN}; \quad 0 \le LPAYGRAN \le 1$$
$$LEVL_g = QS_g / YIELD_g; \quad YIELD_g = \left(1 + GRTP_g\right)^{(cury-basy)} \cdot YIELD_{g,basy}$$

(e) $$PSE_g^C = LEVLP_g / YIELD_g$$

PSECST	initial value (full amount) of area payment per hectare
PSER	area payment per ton of reference yield (exogenously determined)
RYIELD	reference yield (exogenously determined)
LEVLP	area payment per hectare
SETAP	set-aside premium per hectare
REDGRAN	reduction factor for area payment per hectare
BASEAREA	base area (exogenously determined)
MAXPAYGRAN	maximum budget amount available for area payments
LPAYGRAN	relative loss of area payments
SETALE	area set aside
LEVL	area cultivated with specific crop
YIELD	output per-hectare
GRTP	annual rate of technical progress (exogenously determined)
PSE^C	area payment per quantity unit
basy	base year of projection
cury	current year of projection
g	index for grandes cultures commodities

(17)

The regulation specifies that the payments per hectare are reduced proportionally to the percentage the base area is exceeded. Since the payment per hectare is not increased if applications for payments are below the base area, the equation for the area payments per hectare would be discontinuous in the allocation of land to 'grandes cultures' crops and set-aside. Implementing a discontinuous function is possible, creates, however, additional computational difficulties. Therefore area payments actually transferred are calculated in a way that dampens the effects of discontinuity.

The payments per tonne of reference yield PSER (exogenously given as scenario assumption) are multiplied with the reference yields RYIELD (exogenously given as scenario assumption) resulting in an initial value PSECST for the payment per hectare (see equation 17a). The maximum budget amount available for area payments MAXPAYGRAN is calculated from the base area BRSEAREA (exogenously given as scenario assumption) and PSECST (see equation 17c) assuming that the agricultural sector will not receive area payments for more than the base area.

PSECST corresponds to the financial transfer per hectare if the base area is not exceeded by actual area under 'grandes cultures' and set-aside. In our model a reduction factor REDGRAN links PSECST to the area payments per hectare LEVLP (see equation 17b). This factor is an endogenously determined variable and it is bound to take values between zero and one, with the latter serving as a starting value.

The model also computes the relative 'loss' of area payments LPAYPGRAN (see equation 17d). If this variable takes a value of zero actual payments equal MAXPAYGRAN. If it takes a value of one, farmers do not receive payments. If it would be below zero MAYPAYGRAN would be exceeded. If the result LPAYPGRAN<0 is obtained, the reduction factor REDGRAN is reduced by a very small amount and the model is solved again. This is repeated until a solution is achieved where MAXPAYGRAN is not exceeded by actual payments. Thus area payments per hectare cannot be higher than PSECST but may be lower. This makes the area payment per hectare to be actually an endogenous variable in the model.

The area payment per hectare is recalculated to a payment per quantity unit PSEC, which – after aggregation with other directs subsidies – enters equation (10) determining the incentive prices.

3.4.3 Beef premiums

The beef premiums of the CAP are part of the 'direct subsidies'. In CEEC-ASIM they are treated separately from other direct payments since their amount per output quantity is not set exogenously. They are paid only up to a certain number of animals, the so-called national envelope.

The initial (full) premium per animal *PSECST* and the number of eligible animals *LIMCOMP* are exogenously set as part of the policy scenario. The maximum budget available for the premiums *MAXPAYNGRA* is calculated by multiplying *PSECST* with *LIMCOMP* (see equation 18a). This means that the agricultural sector will not receive payments for an amount higher than the one based on the national envelopes.

PSECST corresponds to the financial transfer per animal if *LIMCOMP* is not exceeded by the actual herd size *LEVL*. The model computes a value for the relative 'loss' of premiums *LPAYPNGRA* (see equation 18b). If this variable takes a value of zero actual payments equal *MAXPAYNGRA*. If it takes a value of one farmers receive no payments. If it would be below zero *MAYPAYNGRA* would be exceeded. If the result *LPAYPNGRA*<0 is obtained, the average premium per animal *LEVLP* (which has been given a starting value equal to *PSECST)* is reduced by a small amount and the model is solved again. This is repeated until a solution is obtained for which *MAXPAYNGRA* is not exceeded by actual payments. Thus the premium per animal cannot be higher than *PSECST* but may be lower. This makes the premium per animal to be actually an endogenous variable in the model. The average premium per animal is recalculated to a payment per quantity unit PSE^C, which – after aggregation with other directs subsidies – enters equation (10) determining the incentive prices.

(a) $$MAXPAYNGRA_l = LIMCOMP_l * PSECST_l$$

(b) $$LPAYNGRA_l = 1 - \frac{LEVL_l LEVLP_l}{MAXPAYNGRA_l}; \quad 0 \le LPAYNGRA_l \le 1$$

$$LEVL_l = QS_l / YIELD_l; \qquad YIELD_l = (1 + GRTP_l)^{(cury-basy)} \cdot YIELD_{l,basy}$$

(c) $$PSE_l^C = LEVLP_l / YIELD_l$$

PSE^C	livestock premium per quantity unit
PSECST	initial (full amount of) premium per animal (exogenously determined)
LIMCOMP	maximum number of eligible animals (exogenously determined)
MAXPAYNGRA	maximum budget amount available for livestock premiums
LPAYNGRA	relative loss of livestock premiums
LEVLP	average premium per animal in the herd
LEVL	herd size
YIELD	output per animal
GRTP	annual rate of technical progress (exogenously determined)
basy	base year of projection
cury	current year of projection
l	index for livestock commodities

(18)

3.4.4 Set-aside premiums

The set-aside obligation concerns only the so-called professional producers. Since CEEC-ASIM does not distinguish farm types, the effective set-aside rate has to be set exogenously as part of the scenario. Set-aside is implemented as an additional shifter of the supply equations for grandes cultures. This implies that yield levels are not affected by the set-aside rate.

$$QSETA_g = \left[\beta_g + \frac{\sum_t \zeta_{g,t} PS_t}{\sum_s \alpha_s PS_s} - \frac{1}{2} \frac{\alpha_g \sum_g \sum_t \zeta_{g,t} PS_g PS_t}{\left(\sum_s \alpha_s PS_s \right)^2} + \Delta_g \right] \cdot [1 - SETA]$$

SETA	set-aside rate (exogenously determined)
QSETA	supply shifted by set aside requirement
s, t	indices for output and input commodities
g	index for "grandes cultures" commodities

(19)

In the above formula a set aside rate of SETA*100 percent means that per hundred hectares of actual produced 'grandes cultures' there must be SETA*100 hectares of area set aside. The set aside area is then:

$$SETALE = \sum_g \frac{QSETA_g}{YIELD_g} \frac{SETA}{1-SETA}$$

SETALE area set aside (20)

Introducing just an additional shifter into the supply equations cannot capture the impact of the set-aside on other product supplies and on input demand. Therefore implementing set-aside in a way similar to the one for quotas might be preferred. However, implementing set-aside via an upper bound on supply (as in the quota case) would not reflect EU regulations since these do not allow producing other crops on the area set aside[9]. For CEEC-ASIM we have therefore developed a two-step procedure. In the first step the supply system employing the supply shifter as depicted in equation (19) is solved. In a further step the supply system without set-aside shifters is solved, however, with the results obtained in the first step for each crop supply set as upper bounds. This way of modelling set-aside is comparable to the one in the quota-case: the model generates 'quota rents' for the crops entering the incentive price calculations. Hence, changing the set-aside requirement results in adjustments of the incentive prices for the crops and hence via the cross price terms in new input allocation and livestock output.

4 Simulation results

In this section we present the key simulation results. Given that according to the underlying theoretical framework all adjustments caused by policy shocks work through the relative prices, we start with price effects in the CEE agriculture.

We perform policy simulations for 10 CEE accession countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. As outlined in the Annex 2, our analysis covers supply of 12 primary agricultural commodities. In addition, the use of 5 intermediate inputs as well as labour input in agriculture is simulated.

4.1 Prices

Table 1 shows producer incentive prices relative to wheat for the base year 1997 and of the different scenarios for the year 2007. With unchanged national agricultural policies as assumed for the base run (BR) producer price ratios for the average of the CEEC-10 develop between 1997 and 2007 more favourable for meat production, whereas they decrease for crops and milk. Since in the BR nominal protection rates are assumed to stay at their 1997 levels, farm gate prices change between 1997 and 2007 with the same rate as world market prices.

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9 With the exception of limited possibilities to produce renewable resources, which, however, is omitted in the model.

Table 1: Relative producer incentive prices*, CEEC-10

	1997 (Wheat = 1)	Base run (BR) 2007 (Wheat = 1)	Liberalisation (LS) 2007 (Wheat = 1)	Agenda 2000 (AS) 2007 (Wheat = 1)
Wheat	1.000	1.000	1.000	1.000
Coarse grains	0.800	0.637	0.743	0.838
Potatoes	0.485	0.475	0.485	0.403
Oilseeds	1.546	1.386	1.407	1.532
Sugar beet	1.739	1.520	1.169	2.346
Vegetables	1.499	1.372	1.339	1.199
Milk	1.426	1.339	1.382	1.864
Beef	12.408	14.096	15.714	19.984
Pork	10.771	13.167	14.344	10.516
Eggs	10.197	9.400	7.654	6.262
Poultry	10.280	9.396	7.844	5.345
Rest of agric. Output	8.393	8.435	9.661	6.743
Fodder wheat	0.954	0.927	0.828	0.700
Fodder coarse grains	0.756	0.649	0.734	0.559
Fodder potatoes	0.330	0.320	0.326	0.247
Fertiliser	2.030	1.622	1.566	1.436
Rest of intermediate input	7.978	9.108	10.440	8.544
Labour	1.296	2.397	2.299	1.957

Notes: *In this table quota rents are no yet taken into account. Source: OECD, national statistics, own calculations carried out with CEEC-ASIM.

Implementing the CAP in the CEEC-10 (scenario AS) has impacts on the level and pattern of support. Farm gate prices for wheat, potatoes, oilseeds, vegetables, pork, eggs and poultry fall to border price levels or come close to them, whereas for sugar, milk and beef the gaps between domestic and border prices become higher due to EU price support. In addition, producers of cereals, oilseeds, beef and milk would receive direct subsidies in the form of area payments and livestock premiums. This leads to relative producer incentive prices turning less favourable for potatoes, vegetables, pork, eggs and poultry and becoming more favourable for coarse grains, oilseeds, sugar beet, milk and beef (see AS vs. BR in Table 1).

In comparing the AS with the scenario of completely liberalised agricultural policies (LS), the changes in the relative producer incentive prices show the same signs but different magnitudes than in comparing the AS with the BR. In particular for sugar there is a stronger increase in its relative producer incentive price. This is attributed to the fact that current national policies (BR) in CEECs often tend to mimicry the CAP and protect sugar producers. For beef, on the contrary, the increase in its relative price following a CAP implementation is smaller if compared with the LS than with the BR. This shows that national policies distort relative price incentives for beef production negatively. For white meats and eggs relative producer prices fall less for the AS compared with the LS than with the BR.

This is a result of the protection granted to producers of these products in the BR, but dismantled in the LS and in the AS.

4.2 Production and consumption

In the base run (BR) technical progress leads to growing output quantities for all products between 1997 and 2007 (see Table 2). Also in the EU accession scenario (AS) and in the liberalisation scenario (LS) this is the main reason for output growth. Due to different policies the output quantities differ, however, between the BR, AS and LS.

In the AS, the output of the key agricultural activities is restricted by the set aside requirement and the base area exceeding of which would reduce area payments. Within key agricultural activities wheat is substituted by coarse grains and oilseeds. Compared to the BR, wheat output is reduced by 7 %, whereas output of coarse grains and oilseeds fall by 1 % only. This substitution is caused by the increase in the price ratios for coarse grains and oilseeds vis-à-vis wheat. This also reflects the assumption of unchanged national policies in the BR under which wheat production is more heavily protected than coarse grains and oilseeds.

Although the relative price for sugar rises substantially under the CAP, production is lower than in the BR because of the quota system. Nevertheless, the CAP fosters sugar production. This becomes obvious when the LS is employed as a yardstick. Then the CAP increases sugar output by 5 % (AS vs. LS in Table 2).

Table 2: Production quantities*, CEEC-10

		Base run (BR)	Liberalisation (LS)	Agenda 2000 (AS)
	1997 (1000 t)	2007 (1000 t)	2007 (1000 t)	2007 (1000 t)
Wheat	26332.1	33713.0	36505.1	35107.6
Coarse grains	46123.2	52425.3	59960.2	51778.5
Potatoes	20732.6	25441.8	27587.6	23569.6
Oilseeds	3356.1	3958.2	4581.4	4144.9
Sugar beet	4093.0	4367.0	3896.5	4341.5
Vegetables	11125.8	11638.5	12911.8	12922.5
Milk	23450.9	26570.1	30977.6	24940.4
Beef	1139.0	1251.5	1230.7	1584.7
Pork	4167.4	4894.6	4774.6	4691.4
Eggs	1131.1	1395.0	1292.0	1388.6
Poultry	1643.3	1471.5	1391.2	1499.8
Rest of agricultural output	17422.2	21423.6	19608.9	18535.7

Notes: *Production is calculated net of waste and seed, for milk net of waste and feed use. In 1000 Euro at 1999 prices. Source: FAO, national statistics, own calculations carried out with CEEC-ASIM

In the accession scenario (AS) consumption of cereals and potatoes as fodder input declines compared to the base run (BR) because of lower livestock output (see Table 3). Wheat gains higher importance within the feed mix since its price ratio vis-à-vis coarse grains is reduced. The lower output levels also lead to reduced input use of fertiliser, other intermediate inputs and labour.

Table 3: Agricultural input use, CEEC-10

	1997 (1000 t)	Base run (BR) 2007 (1000 t)	Liberali-sation (LS) 2007 (1000 t)	Agenda 2000 (AS) 2007 (1000 t)
Fodder wheat	11258.5	9929.6	11550.0	11891.4
Fodder coarse grains	35469.2	42765.0	40519.8	43446.0
Fodder potatoes	10665.6	14151.5	11605.9	12284.6
Fertiliser	3275.0	2904.4	2876.8	2958.5
Rest of intermediate input*	20222.4	18715.2	16364.5	19140.8
Labour**	10081.8	8955.4	9277.7	9198.3

Notes: *in 1000 Euro at 1999 prices, **in 1000 employees. Source: Authors' calculations based on FAO, OECD and national statistics data.

The impact of EU accession on non-agricultural demand for crop products is modest. Only for sugar a strong drop in consumption is calculated (AS vs. BR in Table 4) which is due to the price increase. Effects with opposite sign are expected for pork, poultry and eggs for which the price cuts lead to higher consumption levels. Milk and beef consumption, on the other hand, strongly decline because of higher retail prices after CAP implementation. When interpreting these demand effects one has, however, to bear in mind that no attempt has been made in this analysis to capture the potential impacts of EU accession on consumer incomes as well as on the margins between prices at consumer and at farm gate level. Changes in these variables that are exogenous to the partial model would probably have impacts on the level and composition of food consumption. Therefore, the model re In the livestock sector the CAP's impacts on relative prices and the milk quotas lead to significant adjustments in production structures. Output of pork and poultry fall in the scenario AS when compared with the BR (Table 2). This is due to the fading out of price support for these products under the CAP. For beef this is different: with the EU's price support and the premiums beef output rises by 27 %. The growth in beef production would be even higher if no milk quota would exist: since milk and beef are partly joint in production the milk quota restricts also beef output. The higher beef production quantities in the LS than in the BR indicate that current national agricultural policies tend to discourage beef producers of the CEEC-10.

Table 4: Demand for agricultural products, CEEC-10*

	1997 (1000 t)	Base run (BR) 2007 (1000 t)	Liberali-sation (LS) 2007 (1000 t)	Agenda 2000 (AS) 2007 (1000 t)
Wheat	14631.1	12951.8	14372.8	14444.1
Coarse grains	5692.5	7038.4	6406.3	6696.3
Potatoes	11867.0	11089.0	12312.5	10701.9
Oilseeds	4319.7	4971.5	4512.4	5376.8
Sugar	3264.0	4026.0	3942.8	2911.1
Vegetables	10270.1	11208.1	11662.0	11663.2
Milk	27176.6	30879.2	25852.0	23807.8
Beef	1237.5	1242.6	1063.8	771.6
Pork	3671.7	4398.8	4143.0	4418.0
Eggs	1311.2	1508.0	1507.2	1571.3
Poultry	1533.1	1901.1	2126.1	2350.3
Rest of food**	29690.8	44156.2	40517.4	39553.8

Notes: *human consumption, processing and industrial use, **in 1000 Euro at 1999 prices. Source: Authors' calculations based on FAO, OECD and national statistics data.

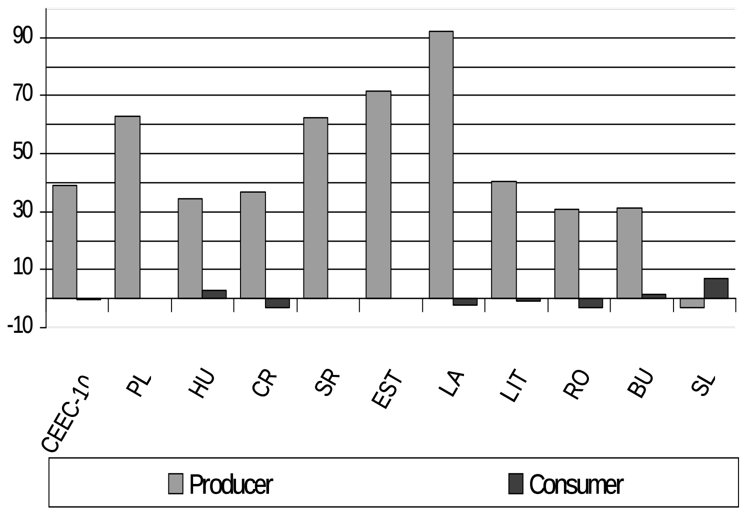
Price support and direct subsidies of the CAP are incentives also for milk producers to increase output. But the milk quota has a dampening impact on production. This becomes clear when we look at the results of the LS in which no milk quotas are in effect. In this scenario milk production is higher than in the AS even though the relative milk price is much lower.
paribus conditions concerning the processing and retailing sectors and the general economic situation of the countries.
The adjustments in output, agricultural input use and demand quantities described above lead to changes in the product balances. After implementation of the CAP net exports of the CEEC-10 as a whole rise for coarse grains, sugar, milk and beef compared to the base run. For wheat and pork net exports would be reduced. For poultry and eggs a greater import potential opens additional export chances for current EU Member States.

4.3 Welfare effects

In the EU accession scenario price support and direct subsidies increase real income from agricultural activity by 39 % for the aggregate of the ten Central and Eastern European Countries (Figure 1). Only Slovenia's farms are worse off since protection is lower after accession. The gains in producer welfare for the other countries are in the range of 31 % for Romania and 92 % for Latvia.
Negative impacts of the CAP on consumers resulting from price increases for sugar, milk and beef are balanced by price cuts for pork, poultry and eggs. The total (relative) impact on consumer welfare, which is measured by the equivalent variation, is small compared to the change in producer welfare. This is also due to the low value share of agricultural products in food retail prices and the re-

orientation of the CAP from price support towards direct subsidies. In some countries consumers are even better off with the CAP. This is the case in Slovenia where price support under the national agricultural policy is higher than under the CAP. In Hungary the price reductions for pork, poultry and eggs more than outweigh the negative impacts on consumer welfare of price increases for the other commodities.

Figure 1: Producer and consumer welfare, CEEC-10 (AS vs. BR, in %)



The gains in producer incomes mainly stem from transfers financed by the EU. The model estimates these additional budgetary costs at Euro 7.5 billion at prices of 1999, of which Euro 6.6 billion is direct payments for the key agricultural activities, set aside and livestock premiums. Expenditure on export subsidies amounts to Euro 0.9 billion. The largest share of these export subsidies is paid to the beef and milk sector, where the gaps between domestic and international prices remain substantial also after the Agenda 2000 reform.[10]

5 Conclusions

Implementing the EU market regulations in the CEEC-10 will change their levels and patterns of agricultural protection. In most of these countries higher protection would raise farm incomes. On the consumer side, a low value share of agricultural products in retail prices and the further re-orientation of the CAP from market price support towards direct income support reduce negative welfare impacts. The main source for producer welfare gains is direct subsidies financed by the EU. Total welfare in the

[10] For a more detailed analysis of the budgetary implications see European Commission (1999).

CEEC-10 increases provided that by far the greatest share of the budgetary burden is paid by the old Member States. In particular for milk and beef EU surpluses would become higher by an enlargement to the East.

Our simulation results suggest that a CAP implementation is attractive for the CEEC-10 since it is a vehicle for financial transfers from the EU without co-financing. This is not to say that this is an efficient way to support them in their efforts to attain standards of living in their rural areas comparable to those in the EU. The budgetary burden for the EU to pay the reformed direct subsidies also to the farmers of the CEEC-10 is high. Therefore it is questionable whether the EU Member States will agree to grant farmers of the accession countries the same level of support. However, is it politically feasible and economically sound to establish further distortions of the competitive environment across the agricultural sectors of an enlarged Union? The quantitative implications of this are difficult to analyse without a model also representing the EU agricultural sector. The extension of CEEC-ASIM by an EU component or its linked use with an existing EU model is therefore one option for further work on the model.

It would also be desirable to look at international trade of the CEECs not only in terms of net trade but to distinguish between exports by destination and imports by origin. Diversification of agricultural production into domestic sales and exports to different destinations (e.g. EU Member States, other CEECs, the Western Balkans) can become an important component of a strategy to overcome the CEECs' weaknesses in competitiveness. A development of the model into this direction could improve the model's capability to analyse trade policies. Together with the analysis at EU-15 level this could provide helpful insight into the implications of enlargement for the EU's WTO commitments. Moreover, it would allow to calculate the budgetary effects of EU enlargement with more detail and higher accuracy. Revenues from imports and exports could be treated separately whereas in the current version of the model exports are implicitly set off against imports before calculating expenditure on exports subsidies or revenues from import tariffs.

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Annex 1: Data

All country models of CEEC-ASIM have the same structure as regards the equations of the models. The country models differ only by data and parameters. The model can deal with any base year provided that the data set for this year is complete. A short description of the data domains of the model is given following. The data are available in spreadsheet format.

Most of the agricultural output items of the model (see also list of commodities in Table 5 in Annex 2) are represented in terms of raw product. However, whole milk equivalents stand for milk and refined sugar for sugar beets. Output volumes of the explicit output items are measured in quantity units (1000 tons). The residual item 'rest of agricultural output' comprises all agricultural output not covered by the explicit ones. It is measured in currency units at constant prices (million national currencies) and calculated by subtracting the output values for the explicit output items from the total agricultural output (gross agricultural output) .

Output is defined as gross production minus seed use and waste (net production). For those products for which feed use is not explicitly covered by the model (e.g. milk) also the quantities fed are deducted from gross production figures. Intermediate input quantities measured in quantity units (1000 tons) except for the item 'rest of intermediate input'. The latter is a residual derived from figures on total intermediate input use. It is expressed in currency units at constant prices (million national currencies). Labour input is given in 1000 man-years.

The model can easily accommodate other definitions of the commodity items. For example, output figures for oilseeds may also be defined in terms of oil. It is then, however, important that the price data reflect oil and not oilseeds.

An exhaustive description of the data sources used is not presented in this documentation since there is no unique database for all countries and items. Output and input quantities are mainly taken from the FAOSTAT data base. This is supplemented by data from OECD and national statistical offices and ministries. Nevertheless, missing data elements have often to be estimated by using related time series, overlaying with data from different sources, aggregating data items or calculating residuals. This task is supported by a data preparation module. This module is, however, subject to frequent revisions because of changes in the statistical sources and shall therefore not be a subject of this documentation.

These are data on the areas under each of the crops (in 1000 ha) and on the number of animals. For milk the production activity level is defined as the number of cows (in 1000 heads). For pork, beef, and poultry it is the number of slaughtered animals (in 1000 heads for beef and pork and in million heads for poultry) and for eggs the number of laying hens (in million heads). The main source for these figures is FAOSTAT.

Demand contains final domestic consumption of agricultural and food products (not including seed use, feed use and waste). Demand volumes are expressed in quantity units (1000 tons) for all products (see commodity list in Table 5 in Annex 2) except for the item 'rest of food expenditure' which is measured in currency units at constant prices (million national currencies). This residual item comprises all food expenditure not covered by the explicit food commodities of the model. It is calculated by subtracting expenditure for the explicit food items from total food expenditure. The main source for these data is FAOSTAT supplemented by national statistics.

Output prices should be defined as prices 'at the farm gate' received by agricultural enterprises for selling their products. When collecting and compiling these data attention should be paid to the level of processing. For example, if production of sugar is defined as refined sugar, the refined sugar price cannot be used directly as 'farm gate price' since it already covers processing costs. Instead, one has to deduct the value added share of processing from the refined sugar price to arrive at a 'farm gate price' for sugar. Alternatively, one can also use sugar beet prices and use processing coefficients to express sugar beet prices in terms of refined sugar. The main source for price data is national statistics.

Data on domestic support per output unit of the different products is needed to compile the so-called producer incentive prices. Domestic support data used in the model follow the definitions of the OECD concerning the measurement of producer subsidy/support equivalents (PSE). They are broken down into direct subsidies, input subsidies and general subsidies.

Consumer prices in absolute values as needed by the model are often difficult to obtain from official statistics. They should reflect the retail level. For wheat, for example, retail prices of flour can be used to represent 'retail prices' for wheat. In this case the consumer price of wheat already includes costs for transport, for the first processing level (e.g. milling) and for retailing but not the costs for the second level (e.g. bread and pasta making) and further processing activities. These additional processing costs have to be included in the residual item 'rest of food expenditure'. A similar procedure has to be adopted for other products like sugar, oilseeds and milk

World market prices for the model should be defined as border prices in national currency units. Since CEEC-ASIM looks at net-trade flows only and not on intra-industrial trade, it is often difficult to decide whether to use import or export prices or some average of these prices. Often this decision depends on data availability.

The nominal protection coefficients (NPR) express the percentage gaps between farm gate prices and world market prices. To compile these figures the OECD's PSE statistics on market support is useful. For countries for which this information is not available data on tariffs and trade subsidies might be used to establish the figures on NPRs. However, to compile NPRs from this information can easily become a difficult and time-consuming task since tariffs are often differentiated deeply according to tariff nomenclatures and origin.

Annex 2: Sectoral disaggregation

Table 5: Commodities of CEEC-ASIM

Production	**Consumption**
Outputs	
Wheat	Wheat
Coarse grains	Coarse grains
Potatoes	Potatoes
Oilseeds	Oilseeds
Sugar	Sugar
Vegetables	Vegetables
Milk	Milk
Beef	Beef
Pork	Pork
Poultry	Poultry
Eggs	Eggs
Rest of agricultural output	Rest of food expenditure
Inputs	
Fodder wheat	
Fodder coarse grains	
Fodder potatoes	
Fertiliser	
Rest of intermediate input	
Labour	

Annex 3: Calibration of Supply and Demand Parameters

Since there is a lack of time series data in all CEECs, it is still difficult to estimate the necessary parameters of the profit function and of the expenditure function completely by econometric methods. Therefore calibration procedures have been developed that determine the parameters of these functions as to reproduce the base year quantities at base year prices taking into account all of the theoretical constraints described above and using expert knowledge on plausible ranges for supply and demand elasticities.

For the calibration of the profit and expenditure functions initial sets of supply/input demand elasticities and demand elasticities have to be determined based on expert knowledge. These initial sets can be drawn also from econometric studies if available in literature or from other research activities. Initial elasticity sets need not be consistent with micro-economic theory but should give some indication of the magnitude of the supply and input demand reaction to changing prices and of the food demand reaction to changing prices and income.

The calibration procedures adjust the initial elasticities in order to make them comply with micro-economic theory. This means that the matrix of the second order derivatives of the profit function with respect to the prices (Hessian Matrix) is symmetric and positive semi-definite and that the supply and input demand function are homogenous of degree zero. On the demand side compliance with micro-economic theory means that the matrix of the second order derivatives of the expenditure function with respect to the prices is symmetric and negative semi-definite, the uncompensated (or Marshallian) demand functions are homogenous of degree zero and the expenditure shares for the commodities ad-up to one.

All these constraints are implemented within a non-linear programming approach, which seeks to minimise the deviations of the final calibrated elasticity sets from the initial parameters.