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THE IIASA FOOD AND AGRICULTURE MODEL FOR THE EC: AN OVERVIEW

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June 1984

WP-84-50

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FOREWORD

Understanding the nature and dimensions of the world food population and the policies available to alleviate it has been the focal point of the IIASA Food and Agriculture Program since it began in 1977.

National food systems are highly interdependent, and yet the major policy options exist at the national level. Therefore, to explore these options, it is necessary both to develop policy models for national economies and to link them together by trade and capital transfers. For greater realism the models in this scheme are kept descriptive, rather than normative.

Over the years models of some twenty countries, which together account for nearly 80 percent of important agricultural attributes such as area, production, population, exports, imports and so on, have been linked together to constitute what we call the basic linked system (BLS) of national models. One of the models is a model European Community treated as one nation.

For analyzing a number of interesting policy issues we need a detailed model of European Community where the EC member countries are modeled separately. These national models first interact among themselves under the rules of the Common Agricultural Policies (CAP) of EC, and then interact with the models of other nations. This detailed model of EC can be used to replace the aggregated EC model in the BLS.

In this paper Uwe Färber, Klaus Frohberg, Erik Geyskens, Costas Meghir and Pierpaolo Pierani present an overview of the detailed model developed for the countries of the European Community. Work on this model was begun at the University of Göttingen in 1977 with partial support from IIASA. Since 1982 the work is being carried out at IIASA supported by a grant from the Center for World Food Studies of The Netherlands.

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Food and Agriculture Program

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THE IIASA FOOD AND AGRICULTURE MODEL FOR THE EC: AN OVERVIEW*

1. INTRODUCTION

The Common Agriculture Policy (CAP) of the European Community most prominently seeks to ensure a fair standard of living for the agricultural population, mainly through regulation of agricultural markets. Over the past years this policy has been subject to growing criticism, both from member countries and the outside world. The internal debate appears to revolve about the increasing costs of market intervention on the one hand and the inequal distribution of these costs over member countries on the other hand. For example, one frequently mentions that

*This paper is a revised version of a paper presented at the FAP Workshop "Interdependence of national agricultural policies; impact of agricultural trade liberalization", Laxenburg, January 11-13, 1984.

The EC modeling work was initiated at the Institute of Agricultural Economics at the University of Göttingen, FRG, in 1978. At that time it was financially supported by the Volkswagen Foundation in Germany. Since 1982 the work has been continued at IIASA's Food and Agriculture Program (FAP) and is financed by a grant of the Dutch Government to the Centre for World Food Studies, Amsterdam. The authors would like to thank the Advisory Committee members: Prof. M. de Benedictis, Naples, Prof. J.-M. Boussard, Paris, Prof. D. Colman, Manchester, Prof. H. de Haen, Göttingen, Prof. J. de Hoogh, Wageningen, Prof. F. Polverini, Naples, and Prof. S. Tangermann, Göttingen, both for their steady and helpful suggestions and constructive criticism and comments. Many others who are too numerous to mention also contributed to the work; however, the contribution of M. Keyzer is too substantial not to be singled out here.

there is an income transfer in the current system from the net importing to the net exporting countries.

The criticism coming from non-EC countries can be summarized as follows. Developing countries complain that the protectionism implied by the CAP makes it very difficult or even impossible to get a fair market share within the EC for their products, which hinders the development of their agricultural sectors. The developed countries claim that the EC dumps its surplus on the world market and thereby reduces their opportunities to export. In addition, it is claimed that the CAP has a destabilizing effect on world market prices.

Many studies have appeared on the subject referring to a number of these problems in either a partial or a qualitative way. However, the national food and agriculture sectors are tightly interconnected and policy decisions, whether domestically or trade-oriented, can have an immediate and significant effect on both member countries and the rest-of-the-world. Furthermore, structural changes in the agriculture system and links between the agricultural and nonagricultural sectors are such that ignoring them would mean missing an important component of the direct and indirect policy effects. To evaluate alternative policies we need to account for the interdependence of policies and the structural changes in agricultural production, consumption and trade brought about by policy alterations in a consistent way. For this we need a model which describes the economies of the member countries, with special emphasis on the agriculture sectors, as constituent parts of the common market.

The EC model developed at the IIASA Food and Agriculture Program (FAP) serves this purpose. Alternative policies about the CAP which can be explored are, for example: removal of Monetary Compensatory Amounts (MCA's) at a greater speed, lowering protection levels while simultaneously providing farmers with direct income support, minimizing the costs of surplus disposal, etc.

In terms of both imports and exports the EC has a substantial share of total world trade in agricultural products. Hence, the world market prices which are an important determinant of the cost of the CAP are influenced by the EC policy itself.

To take this influence into account in the analysis the EC model is constructed as part of a system of linked national agricultural policy analysis models, covering the world food and agricultural system, which is being developed at IIASA/FAP.

Running the EC model in the FAP model system allows one to evaluate additional policy options such as: oligopolistic strategies with respect to surplus disposal on the world market, concessional trade of third countries with the EC, participation in international stabilization schemes, sharing the burden of holding food reserves for emergency food aid, etc.

This paper presents an overview of the EC model, followed by a description of the FAP model system. The paper concludes with possible policy scenarios for simulation.

2. AN OVERVIEW OF THE EC MODEL

In its present form the EC model includes all EC countries but Greece, which joined the EC when the modeling work was already advanced. Belgium and Luxembourg are taken to be one individual country. The EC model is of a general equilibrium type suitable for policy analysis in a medium-term time horizon. It works on a 15-commodity list with 14 agricultural commodities and one nonagricultural commodity to cover the whole economy (see Table 1).

Since the introduction of common price and trade policies in the EC, the exchange of commodities between producers and consumers no longer takes place on separate national markets. The common policies establish a common market where total EC demand meets total EC supply and exchange takes place. Accordingly, the EC model has only one exchange component. The policy instruments affecting exchange are defined by the policy module which represents the decision process with regard to the CAP.

We now briefly discuss the different country-specific models, illustrate the functioning of the EC exchange component, and then describe the EC policy module. Figure 1 gives a diagrammatic picture of the model's operation.

2.1. The Country-Specific Modules

For each country there is an agricultural supply component, a private demand component, and a macrocomponent. Although the functional forms used for a particular module are similar for all countries, it is important to note that these country-specific modules are estimated separately and thus may reflect the sometimes considerable differences between countries.

With respect to agricultural supply it is hypothesized that the numerous decisions made by farmers during a year to determine output can be reduced to only two decision stages. Based on expected prices farmers in the first step decide on the aggregate output of livestock and crop sectors and on the input of such factors as labor, buildings and machinery, and land. This is followed by a decision on the allocation of these factors and other inputs (fertilizer, feed), and thereby farmers determine the output of the various individual commodities.

Private demand is described by a complete demand system, including the demand for the nonagricultural commodity. The specification used is the Linear Expenditure System (LES).

The macro-component currently defines, among other things, exogenously nonagricultural supply, government consumption, nonagricultural investment.

2.2. The exchange component

Under the CAP the EC nations first interact with each other and together then trade with other nations at the world market. Their interaction on the internal market is described in the exchange component. In this module EC prices, demand and trade flows adjust, given total supplies from the different member countries and given world

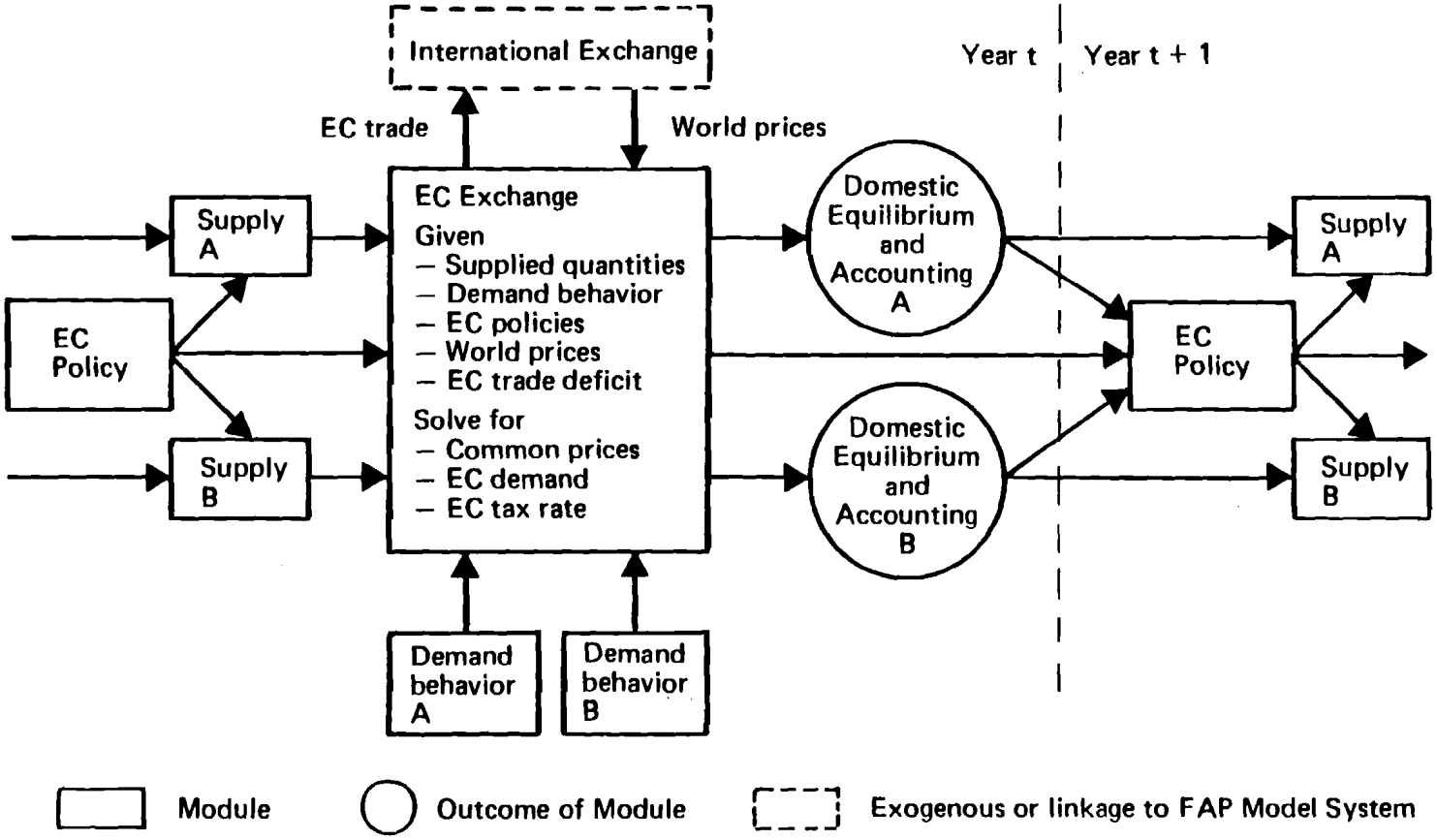

Figure 1. A Schematic Outline of the EC Model (Simplified for two countries).

market prices, until all EC markets are cleared. The outcome of this process is affected by the policy instruments as defined by the policy component. The CAP is financed by an endogenously determined tax on EC value-added. Thus the model ensures common prices and common financing within the Common Market, and it also ensures that the EC member countries trade with third countries as one unit with respect to trade policies.

The solution of the EC exchange component implies domestic equilibrium for each of the member countries; national accounts, supply balance sheets and prices are then calculated.

The information for setting next year's EC policy instruments is obtained from these different domestic equilibria. The policy instruments related to production become effective at various stages of next year's supply module of each country.

2.3. The EC Policy Module

We now turn to a more detailed discussion of the EC policy module, which characterizes the way in which the various policy instruments are set.

Under the present working of CAP the EC Council and Commission set for most commodities threshold and intervention prices. The EC regulations are such that the market price cannot fall below the intervention price nor rise above the threshold price. These price bounds are defined in the policy module, taking specific market regulations into account. In determining policy prices for the different commodities, the model uses a two-step approach.

In the first step a normative increase of CAP prices at EC level is determined. Assuming that the Council's principle objective to maintain the relative income position of the agricultural population is more or less bounded by the EC budget, a normative increase of the common price level could be determined as a function of

- the difference in the increase in the costs of agricultural production and productivity (the "objective method" is mainly based on this aspect)
- the income parity between the agricultural and the nonagricultural sector
- the situation on the world market
- the EC budget situation.

In the second step the differentiation of the normative price increase across commodities takes place. To what extent this normative price increase will actually be applied in the price decisions on the various commodities depends on the structures of the different market regimes and on the characteristics of the respective commodity markets. The general assumption is that for any CAP commodity this normative price increase is the maximum possible policy price increase, which for commodity-specific reasons will not always be applied fully. These commodity-specific elements are modeled in the EC policy module according to the individual market regulations like quota systems, co-responsibility levies, intervention policies, world market influences,

stockholding policies, etc. with a built-in flexibility for major changes in policy.

Moreover, the policy component derives green rates from given market exchange rates and calculates MCA's based on the divergence of the two. Thereby the policy module can provide policy prices for each country separately in national currencies.

To explain how these policies have been implemented in the model, we describe them for a single commodity. Figure 2 illustrates the variable import/export levy and refund policy of the EC. Independently of current world market prices, the EC sets the prices at which the member countries will trade with the rest of the world: for imports the upper price $\bar{p}$ has to be paid and for exports the lower price $\underline{p}$. Only if the trade of the EC with the rest of the world is zero may the price lie between the lower bound $\underline{p}$ and the upper bound $\bar{p}$, the equilibrium price will then depend on the position of the EC net demand curve.

The example above can be looked at as if realization of trade targets is given a higher priority than realization of price targets. The price first adjusts to defend a trade target and only when the price hits a bound is trade allowed to adjust. If a single commodity is subject to more than one policy instrument – for example, the combination of the variable import/export levy and refund policy with a stock policy – there will be a chain of priorities. In this case, the price first adjusts to defend a stock target, and then stock adjusts, the price remaining at its reached bound. Next, price adjusts again between the previously reached bound and a wider bound to defend the trade target, stock remaining at one of its bounds. Finally, trade adjusts.

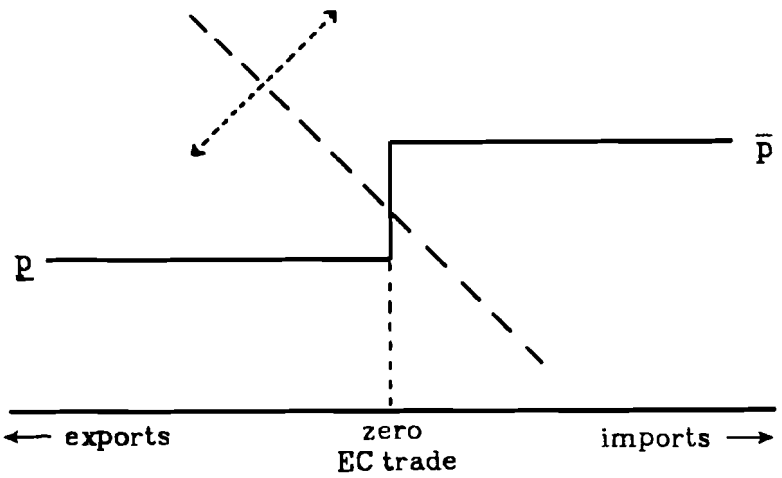

Figure 2. The variable import/export levy and refund policy.

The policy model has been flexibly structured and can therefore easily accommodate changes in policy rules. Special attention has been given to the interface of the EC with the world market. Here the implementation allows EC prices to become partially or completely dependent on world market prices.

3. THE FAP MODEL SYSTEM

The FAP model system consists of national and regional models which have the same structure as the EC model. They interact with one another through trade and capital flows, and respond to national government policies and to international agreements, as well. Examples of the latter are the introduction of a buffer stock agency, compensatory financing agreements, barter trade agreements and economic unions. The FAP model system solves for world market prices that clear the world market.

The countries included in FAP's model system are listed in Table 2.

Together they make up about 80 percent of the world's population, agricultural production, land area and exports and imports of food. The system is closed by including an aggregate model for the "rest-of-the-world". At the international level the model distinguishes between eight agricultural food commodities, one nonfood agricultural commodity and one aggregate nonagricultural commodity, thus covering the whole economy (see Table 1).

In the description of the EC model it was assumed that the world market prices were given. This assumption can be dropped once the model is linked with the FAP system. In this way the EC policies can be analyzed in a global context. It becomes possible to take into account policy impacts both on other countries and on world markets and, vice versa, to assess to what extent EC markets and policies are influenced by the global food situation.

Table 1. Commodities in EC Model and in FAP Model System

	EC Commodity List		IIASA/FAP Commodity List
1.	wheat	1.	wheat
2.	coarse grain	2.	coarse grain
3.	rice	3.	rice
4.	bovine + ovine meat	4.	bovine + ovine meat
5.	dairy	5.	dairy
6.	pork, poultry, eggs	6.	other animals
7.	fish		
8.	protein feed	7.	protein feed
9.	oilseeds	8.	other food + beverages
10.	sugar		
11.	fruit		
12.	vegetables		
13.	beverages and resid. other food		
14.	nonfood agriculture	9.	nonfood agriculture
15.	nonagriculture	10.	nonagriculture

Table 2. Countries included in the FAP model system.

Country	Model	Country	Model
Egypt	*	Austria	▪
Kenya	*	EC	*
Nigeria	*		
		Belgium	
Bangladesh	▪	Denmark	
China	*	France	
India	*	FRG	
Indonesia	▪	Ireland	
Pakistan	*	Italy	
Thailand	▪	Netherlands	
Turkey	*	UK	
Argentina	*	Finland	▪
Brazil	*	Portugal	▪
Mexico	*	Sweden	▪
Australia	*	CMEA	*
Japan	*	Bulgaria	
New Zealand	*	Czechoslovakia	
Canada	*	GDR	
USA	▪	Hungary	
		Poland	
		Romania	
		USSR	

*Indicates that the model was developed at FAP.
▪Indicates that the model was developed elsewhere.

4. SIMULATION OF ALTERNATIVE POLICIES

The EC model is quite suitable for generating the information needed to evaluate different policy options in a sensible way. In any simulation run for each of the eight countries which together constitute the EC model and for each year of the simulation period supply-utilization accounts for the 15-commodity list as well as national accounts and consumer and producer prices are generated. At the EC level the costs of CAP are also calculated.

Some examples of policy options which can conceivably be simulated with the EC model are mentioned here:

- trade liberalization; with or without direct income support for the farmers; either differentiated by commodity or not
- removal of MCA's at greater speed or complete abolition of these
- policies which seek to dispose of surpluses at minimal cost, taking into account the trade-off between disposal on the internal market (e.g. through denaturation of food to feeds) and disposal on the world market
- stabilizing trade flows by using buffer stocks
- partial opening of the EC market in order to help absorb shocks from the outside world; internal prices would be allowed to follow price movements at the world market in a dampened way.
- preferential trade arrangements
- enlargement of the EC
- food aid policies
- EC's contribution to international stabilization schemes

As already mentioned before, the EC model can be run on its own or within the FAP model system. In the first case a set of world market prices has to be provided exogenously, whereas within the world-wide framework results are obtained with endogenous world market prices. Not all of the examples mentioned above can be run in a stand-alone mode, but some might if one is prepared to assume that the policy at hand will not affect world market prices noticeably. The examples are meant to give only a flavor of the variety in policies which can be simulated with the EC model within or outside of the FAP model system.

The EC model and the FAP model system are transferable, that is they can be implemented on other computers than that in use at IIASA. Other institutions are given the opportunity to use these models for policy analysis. The US Department of Agriculture, for example, continues developing the US model and uses a copy of the FAP model system as a tool for evaluating policy options.

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