POLICY ANALYSIS OF THE EUROPEAN
COMMUNITY FOOD AND AGRICULTURE
MODEL

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ABSTRACT

Conducting a "policy analysis" of a model is not a well defined task. In this case it refers to an approach whereby a number of policy instruments are selected and their simulation by the model in question evaluated.

This paper is composed of three parts. The first section describes the European Community (EC) model's purpose and structure. This description is presented in order to clarify the level of detail required by the model. The second section contains an overview of EC agricultural problems and objectives, leading into a determination of relevant policy instruments. In the third part EC model simulation of these policy instruments is analyzed.

Comments and criticisms fall into three categories. The first refers to the model description of the policy instruments. As several variables representing relevant policy instruments are not included in the model, suggestions are made concerning how this might be accomplished. The second type of comment concerns the model simulation of the policy instruments. Difficulties in this sphere are due primarily to the model's level of aggregation; structural and social policies cannot easily be simulated. The third category contains criticisms of the verbal description of the model. Since the model is not yet complete, many questions remain unanswered. However, even those areas that have been developed lack clarity on certain points. This work, it is hoped, will serve as a basis for revision and clarification of both the model and model description.

CONTENTS

1. INTRODUCTION

Under the auspices of the Food and Agriculture Program (FAP), a model of the European Community (EC)* is being developed. Although not complete, the model is being subjected to review and revision. This report, it is hoped, will contribute towards the model's refinement by recommending improvements in the model itself and in the model description. Towards this end, a set of relevant policy instruments were selected and their representation by the model evaluated.

The work proceeds as follows:

- a. Short review of the purpose and structure of the
     EC model,

- b. Discussion of EC problems and objectives,

- c. Determination of relevant policy instruments,

- d. Evaluation of the model simulation of these
     instruments

- e. Conclusion.

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*The EC currently has nine member nations: France, West Germany, Luxembourg, Belgium, Netherlands, Italy, Great Britain, Denmark and Ireland.

2. PURPOSE OF THE EUROPEAN COMMUNITY MODEL

The EC model is being developed as one part of a larger effort in global modeling conducted by FAP. "The central objectives of the program are to contribute to

- the evaluation of the <u>nature</u> and dimensions of the world food situation,

- identification of the underlying factors,

- investigation of <u>alternative</u> courses of <u>policy action</u> at the national, regional, and global level that may alleviate existing and emerging food problems in years ahead". [1]

In order to realize these objectives, national policy models focusing on the agricultural sector are being developed. The national level was chosen since "Nations are the highest units within which the problems appear in their full complexity."[6] Importance as a producer or consumer of agricultural produce was the criterion for choosing which nations to model.

Although the EC is a group of nations, the national policy models for this region are aggregated. The rationale for using this approach is that "One set of major policy measures (agricultural price and trade policy) is currently commonly controlled".[8] In addition, the EC's eventual objective is to have common economic and monetary policies. While the EC level was chosen, the model structure does distinguish between nations.

The purpose of this model, then, is to describe the ramifications of both current EC agricultural policy as well as probable future policy on the world food situation. In addition, although the model is not being developed under official EC auspices, it does have the potential to affect EC decision makers, if they can be convinced of its validy.

3. DESCRIPTION OF THE MODEL STRUCTURE

The EC model is a descriptive model focusing on food and agriculture. It is a dynamic simulation model that is primarily deterministic but includes a stochastic input representing weather uncertainties. In the first version of the model it is assumed that weather effects cancel out over a three-year period. Hence, no stochastic variable will be included.

Each time period corresponds to one year and the total period of simulation is 1976-2000. The model parameters are estimated using a data base from 1961-1973. One of the criteria for model validation is its ex-post forecasting ability. This is a test for the 1974-1976 period.

As mentioned earlier, the level of aggregation is national. The model is divided into two parts: a "real world" model and a "think" model. The latter describes the policy decision-making process at the EC level, in other words, the EC governing body. Its decisions are represented by changes in policy instruments. This model is still under development. The "real world" model simulates the physical aspects of the agricultural system.

This "real world" model contains two sectors: agricultural and non-agricultural. The non-agricultural sector produces only one homogeneous good, while the agricultural sector produces 19 commodities, including both crops and livestock (see Appendix A). Within each sector an average producer is modeled. In addition to being divided across sectoral lines, the model contains a number of subcomponents. "Subcomponents within the real world model are related to Population, Inputs, Production, and Expenditure including National Accounts." [6] Thus far modeling activity has concentrated on the production subcomponent.
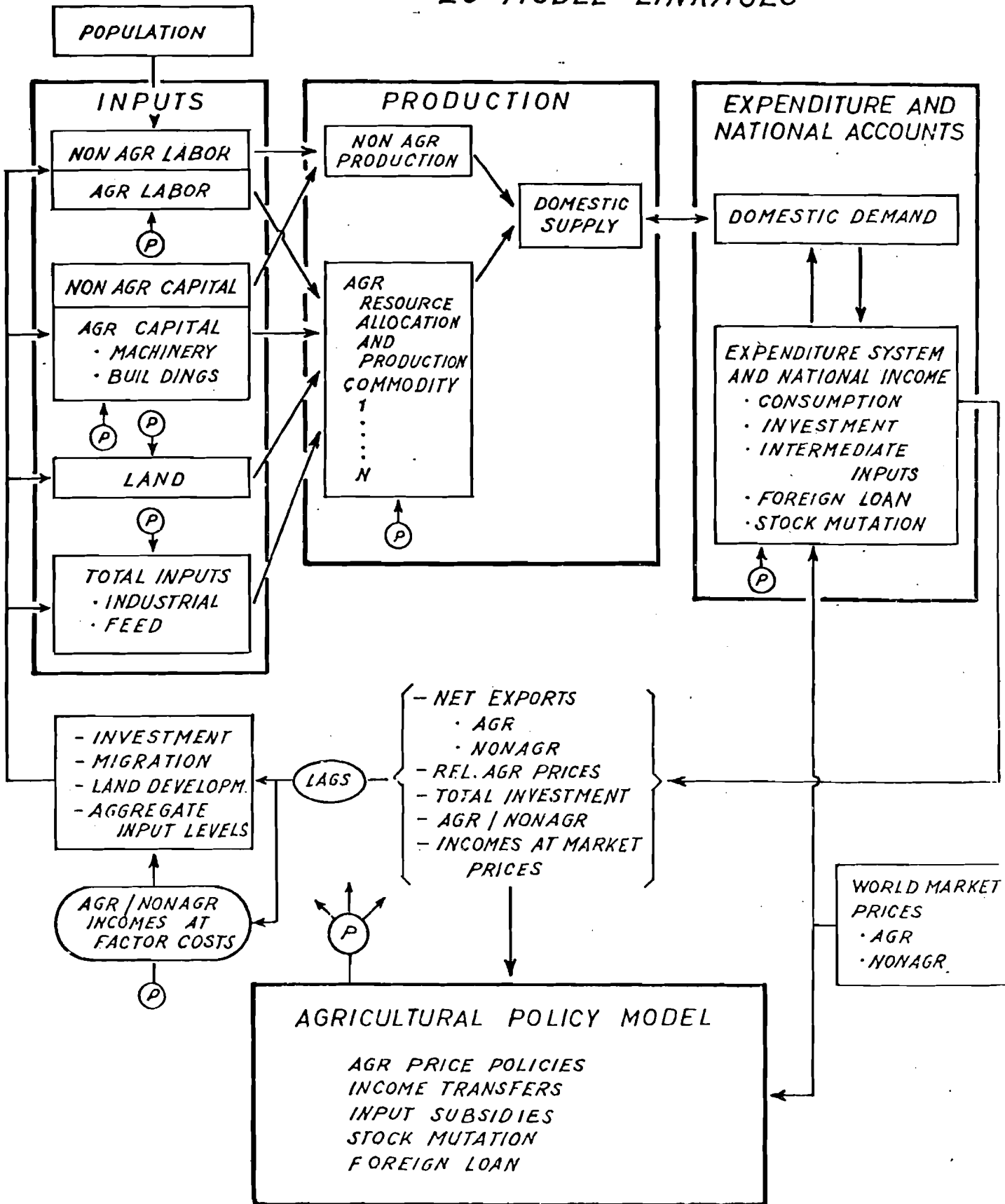
concentrated on the production subcomponent, which in essence is
an allocation model.

Inputs include labor, capital and land as well as agricultural
and non-agricultural intermediate products. They are allocated
to production in two stages. First, they are divided between the
two sectors. No formal decision process at the farm level is
assumed. Labor is a function of population which, in turn, is
exogeneously given. Other input levels are determined by lagged
prices, the previous period's income, and some additional vari-
ables divided between the two sectors. Since it is a full-
employment economy, those labor resources not employed by the agri-
cultural sector are used by the non-agricultural sector.

In the second stage the fixed quantity of resources is al-
located among the various agricultural commodities so as to maxi-
mize profit given expected commodity prices, input costs and ex-
pected yield. Input prices or costs are determined by scenario
settings. Actual or final commodity prices differ from the ex-
pected level as the model includes random weather changes and a
time difference between when production decisions are made and
the product is sold. Each commodity has a yield function in-
fluenced by technological change over time.

The supply module is recursive with respect to the demand
module. In other words, supply at time t is used to meet demand
at time t + 1. The resulting price at t + 1 is then used as
"information" for farmers deciding how much, and what, to produce
at t + 1. Demand consists of consumption, investment, stocks
and international trade. Consumption is determined by a dynamic
non-linear expenditure system.

SCHEMATIC BLOC DIAGRAM OF THE [6]
EC MODEL LINKAGES

POPULATION

INPUTS

NON AGR LABOR

AGR LABOR

(P)

NON AGR CAPITAL

AGR CAPITAL
· MACHINERY
· BUILDINGS

(P) (P)

LAND

(P)

TOTAL INPUTS
· INDUSTRIAL
· FEED

PRODUCTION

NON AGR
PRODUCTION

DOMESTIC
SUPPLY

AGR
RESOURCE
ALLOCATION
AND
PRODUCTION
COMMODITY
1
·
·
·
N

(P)

EXPENDITURE AND
NATIONAL ACCOUNTS

DOMESTIC DEMAND

EXPENDITURE SYSTEM
AND NATIONAL INCOME
· CONSUMPTION
· INVESTMENT
· INTERMEDIATE
      INPUTS
· FOREIGN LOAN
· STOCK MUTATION

(P)

- INVESTMENT
- MIGRATION
- LAND DEVELOPM.
- AGGREGATE
     INPUT LEVELS

LAGS

- NET EXPORTS
    · AGR
    · NONAGR
- REL. AGR PRICES
- TOTAL INVESTMENT
- AGR / NONAGR
- INCOMES AT MARKET
     PRICES

AGR / NONAGR
INCOMES AT
FACTOR COSTS

(P)

(P)

WORLD MARKET
PRICES
· AGR
· NONAGR

AGRICULTURAL POLICY MODEL

AGR PRICE POLICIES
INCOME TRANSFERS
INPUT SUBSIDIES
STOCK MUTATION
FOREIGN LOAN

Supply and demand are then equated in order to determine trade and stock levels needed to achieve domestic equilibrium. The precise amounts of commodities allocated to each of these uses are also influenced directly or indirectly by the outcome of the "think" model, i.e., through policy decisions (e.g., through quotas, levies, etc.

A schematic representation of the model follows. For a presentation in greater depth, see <u>Modelling the EC Agricultural Sector: Problem Assessment, Policy Scenarios and Model Outline</u>.[6]

4. EUROPEAN COMMUNITY PROBLEMS

The EC faces a number of problems in the agricultural sector, which agricultural policies attempt to solve. They include: (1) income disparities between the agricultural and non-agricultural sectors; (2) income disparities within the sector; (3) inadequate structures, and (4) imbalances between demand and supply. [8]

While production has increased in the agricultural sector, demand has not kept pace. This has caused prices in real terms to fall in several cases and surpluses to develop in others. While incomes have grown, a smaller percentage of that increase has gone towards agricultural products. "In all EC member states a diminishing proportion of private household expenditures is allotted to food products, beverages and tobacco."[8] Since at the same time the population has not grown it cannot serve as a source of increasing demand. The long-run impact would be a worsening of intersectoral income disparities if no changes in supply and/or the structure of the farming sector occur.

The distribution of land is the primary cause of income disparities within the agricultural sector. In the EC Six* in 1970

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* France, West Germany, Luxembourg, Belgium, Netherlands and Italy.

farms of 5 hectares or less constituted slightly less than 50% (46%) of the total, while those over 50 hectares accounted for 4%.[5] Intrasectoral disparities also exist between different types of farms, farms in different regions, etc.

Another contributing factor to intrasectoral disparity is the large number of hired laborers required in production. Their wages and hence standard of living tend to be lower than those of land-owners, as well as those of persons with equivalent skills working in other sectors.

In addition to the distribution of land and labor within the agricultural sector, 'agricultural structure' refers to the agricultural infrastructure, regional distinctions as well as the working populations' skill and age distribution. Not only is the agricultural structure characterized by an uneven distribution of land and regional productivity, it also contains an aging population. In 1975, 64% of the farmers were over 50 years of age.[5] For these reasons, the EC agricultural structure is regarded as inadequate.

Supply and demand imbalances are a recurring phenomenon in agriculture. The primary cause is EC price support policies, which result in the development of high surplus stocks.

In spite of the concerns articulated by the EC in the statement of its objectives which follows, the actions taken seem to indicate a greater interest in the welfare of producers than consumers. However, as problems left untended generally grow, a discussion of EC problems and objectives provides a basis for predicting possible future EC policies and action.

5. EUROPEAN COMMUNITY OBJECTIVES

The EC was formed to eliminate trade barriers between neighboring countries and to promote European political unity. The agreement,

The Treaty of Rome, establishing the EC, was signed in 1957 by six member nations*, and became effective in 1958. It set up Common Agricultural Policy (CAP) and also tried to streamline non-agricultural policies of its members. Currently the CAP is the most unifying institution within the EC. [4]

The objectives of the CAP are set out in Article 39 of The Treaty of Rome. There it states that "the objectives of the common agricultural policy shall be:

- to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilisation of the factors of production, in particular, labor;

- thus to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture;

- to stabilize markets;

- to assure the availability of supplies;

- to ensure that supplies reach consumers at reasonable prices."[8]

The first objective calls for growth in productivity. "Productivity" means output per input, for example, wheat per hectare. Inputs include items such as land, labor, capital, water, etc., employed in production. Most commonly output per worker is used. In a perfectly competitive economy, output per worker is proportional to wages. Increasing productivity then results in increased wages.

Several strategies are called for in order to achieve this increase in productivity. They are: (1) promoting "technical progress" and (2) ensuring "rational development and optimal utilization of factors of production".

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*France, West Germany, Luxembourg, Belgium, Netherlands and Italy.

Technical progress can be achieved in two ways.
Either it can be biological, such as creating new strains of
wheat that increase yields, and/or it can be mechanical. An example
of this latter case is the transition from horses to tractors.

Attainment of the second sub-goal is less easily evaluated.
The "optimum use of factor inputs" refers to the manner in which
resources are allocated to agricultural production. If the
farmers' objective is profit maximization, then an optimal use of
factor inputs will be one which achieves this end subject to
factor prices and farmers' budget, or expenditure, constraints
with given technologies.

However, the use of inputs must not only be optimal but also
rational. In order to fulfill this second criterion, the alloca-
tion of inputs must be made within political and social boundaries as
well as within technical and economic constraints.

The second objective, that of providing a "fair standard of
living to persons in the agricultural sector" is the primary con-
cern of the EC.* This is due in part to the conspicuousness of
the issue as well as its political salience for EC officials.
As mentioned, the average wage of the agricultural population
falls below that of the national average. This "income gap", as
it is called, is due to several factors.

Agricultural production has been rising faster than consump-
tion. "The volume of production in the Common Market area of

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*"The drive to increase income and improve the standard of living
 for the agricultural population is so widespread that it must be
 considered as the predominant aim of agricultural policies."
 (OECD, *Trends in Agricultural Policies since 1955*.[9])

the "Six" increased with an average annual growth rate of 3-4% between 1963 and 1970, while consumption increased by 2-3% yearly".[13] As a result, a surplus has developed. Under a no-price-support system, the prices, and consequently agricultural incomes, would fall. As it is, intervention agencies purchase the surpluses of certain commodities. Even this intervention may represent a decline from former pre-surplus prices, and hence a drop in income.

Were factors such as labor or land to move from agriculture to other sectors, incomes could be held constant or increased. However, "agricultural resources--particularly labor--are said to be immobile. A small relative decline in farm product prices is not sufficient to bring about a rapid adjustment in agricultural production and resource use...."[9] Hence even if prices do fall this does not ensure the migration of inputs. As a result, agricultural incomes fall. Allowing commodity prices to fall substantially, instead of intervening, is not politically feasible.

The third objective is "market stability" or stable prices. Prices of most agricultural goods generally fluctuate over the year; during harvest time they are low, rising at other periods. The increased cost is attributable both to a diminished supply and storage costs.

At the same time, sudden and unexpected changes in production conditions can also affect prices. Weather is the most commonly thought of uncertainty. However, government treaties and policies can also affect both the feasibility of production as well as factor input prices. For example, a government subsidy of oil prices can change produce prices.

Within the agricultural sector there is a lagged response to such price changes. In other words, if the price of tomatoes falls, due to a large harvest, it will be one harvest period before producers can respond by reducing tomato production. The tendency will be to over-respond. Thus the movement towards an equilibrium (supply of tomatoes equals demand) will not be smooth. Unless the system is stable, it will not move towards an equilibrium. On the following page the "cobweb model" depicts a stable system (see Figure 1).

Supply stability is not an unrelated objective. In a market economy, provision of a stable supply, given no changes in consumer preferences, income or input prices and supplies will result in stable prices. However, no such situation exists. Therefore the two objectives are considered separately.

Part of the concern expressed by this objective is that EC consumers face sudden unexpected shortages, such as that occurring as a result of the Russian wheat deal. A second aspect of supply stability is that supplies be made available to all consumers, even in remote areas.

Supply instability may be due to several of the factors mentioned above, including weather vagaries, price fluctuations and input availability. In addition, depending upon the degree of self-sufficiency, the level of imports from other countries will affect these objectives. Infrastructure quality and the level of communication with supply centers will influence market accessibility.

The final objective of reasonable prices is also consumer-oriented. The meaning of this objective is clear. However, how to achieve it is not as easily determined. Within the EC the
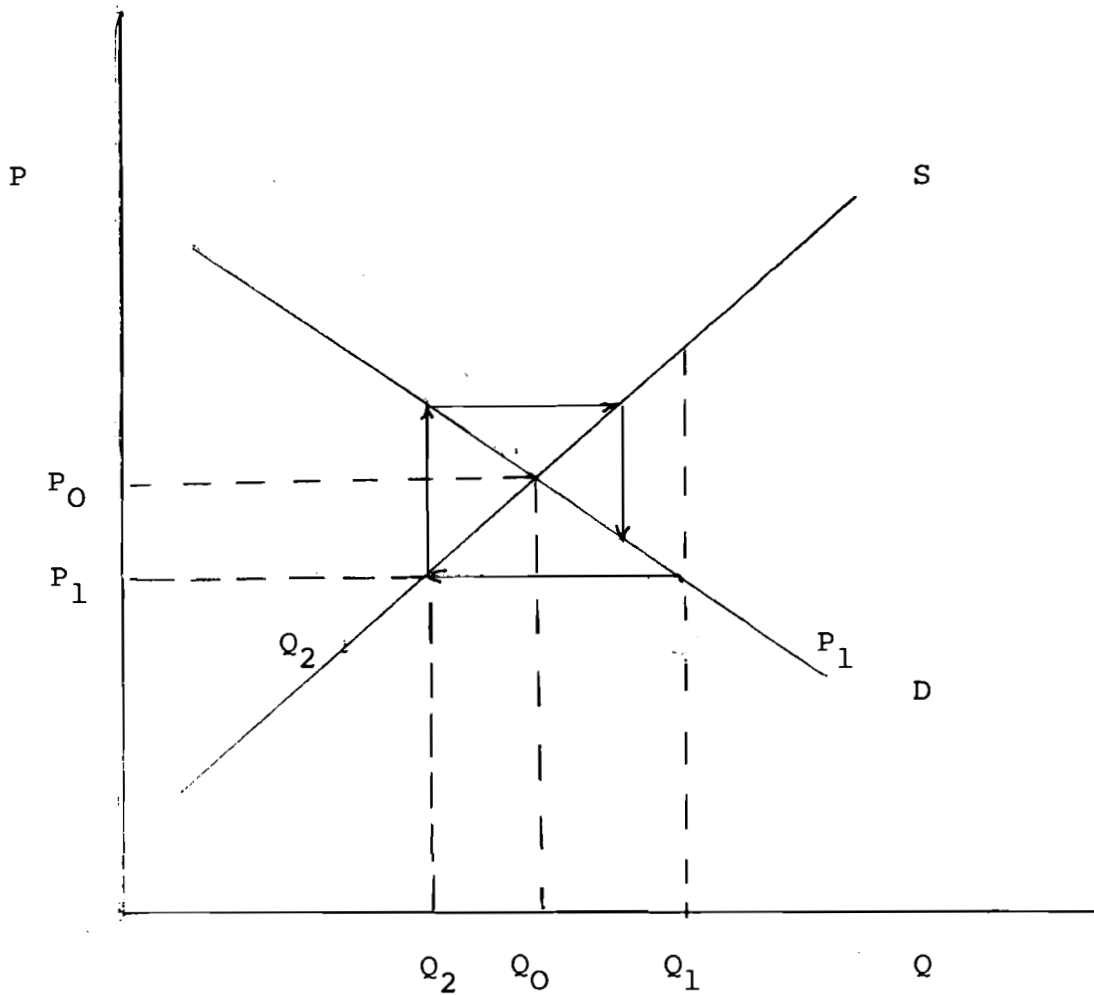
Stable cobweb model

Equilibrium: (Q_0, P_0)

Supply increases to Q_1, due to a good crop.

At Q_1, demand causes price to fall to P_1, producers then cut back production to Q_2, etc.

Figure 1

definition of "reasonable price" varies between nations, due to differing standards of living. As a result, agreement on specific policies and support levels is difficult.

Up to this point objectives explicitly stated by the EC have been discussed. However, based on its behavior, there appear to be several others not as clearly articulated.

The first is a desire by the EC to maintain a high degree of agricultural self-sufficiency. In case of blockades, major famines or other unexpected calamities, the EC wishes to be pre-pared. Dependency on imported input supplies hinders attain-ment of this objective. Since the objective is not explicit, the exact level of self-sufficienty is not determined.

Trade results in general welfare gains and encourages specialization. This in turn leads to a greater dependency upon trading partners and possible disaster if that partner decides to terminate the relationship. While trading may be economically sound, politically it entails high risks.

A second implicit objective is that of rectifying regional and class inequities. In fact, programs are currently being ad-ministered by the EC to deal with these problems. However, since social, structural and regional policies are not officially under EC jurisdictions, these concerns are not included in the state-ment of objectives.

The primary difficulty in realizing the objectives is that many of them conflict. For example, in order to provide pro-ducers with "fair incomes" without using direct income supports, a politically suspect policy, commodity prices must be increased. However, this causes consumer prices to be "unreasonable". Since all of the objectives cannot be simultaneously optimally achieved, sub-optimization is necessary.

6. POLICY OPTIONS

Policy instruments for achieving these objectives may be placed in the following categories:

- (a) producer-oriented,

- (b) consumer-oriented,

- (c) producer- and consumer-oriented.

Only mass changes in production or consumption will affect the world food situation. For that reason, policies are divided into the three categories listed above. Other taxonomies are available. E.R. Swanson, for instance, groups policies into those affecting factor or production markets, directly or indirectly. [11]

As mentioned earlier, the policies either help, hinder or do nothing for attainment of the objectives. Table 1 (p.15), is a matrix illustrating this relationship. A plus (+) means that the policy promotes attainment of the objectives, a minus (-) that it hinders attainment, and a blank that it has little or no effect.

Within each of the categories a large number of policy options are available (see Appendix B). A list of those relevant to the EC, together with their effects on different objectives, is given in Table 2 (p.16). "Relevant" policy instruments were chosen with the help of Dr. Frohberg and Dr. Tangermann. teria. Feasibility refers to whether the policies are:

- (a) at least moderately politically acceptable,

- (b) technically capable of being implemented,

- (c) economically reasonable,

- (d) legal.

Table 1. Effects of Policies on Different Objectives

OBJECTIVES / POLICIES	Increase in productivity (per labor)	Economic efficiency	Equity-intersectoral	Stable Prices	Stable Supply	Reasonable prices
Producer-Oriented Policies						
I. Input Usage						
A. Acreage Controls	—	—	+			—
B. Farm Production Inputs	—/+		+			—/+
C. Labor	+	+	—			—
D. Credit	+/—	+/—	—/+			+/—
E. Research and Development	+	+	+			+
II. Infrastructure Development	+	+	+		+	+
III. Marketing and Production Control	—	—	+		+	—
IV. Price Incentives	+/—	—	+	+	—	—/+
V. Income Policies	—	—	+			—
Producer- and Consumer-Oriented Policies						
I. Trade						
A. Tariffs						
B. Import Controls	—	—	+	+	+	—
C. Export Encouragement						
II. Aid (objective relative to nations providing aid)						
A. Concessional Trade						
B. Grants		—	+		—	—
C. Technical Assistance						
III. Reserves						
A. Commodity			+	+	+	+
B. Non-Commodity						
Consumer-Oriented Policies						
I. Price Control						
A. Taxation	—	—	+/—	+		+
B. Price Subsidies	+	+/—	+	+		+
C. Fixing	—	+/—	—	+		+
II. Food Distribution						
A. Commodity Transfer	—		+/—	—	—	—
B. Income Subsidy	+		+	—	—	—

Meaning of symbols:
+ : promoting attainment of the objective
- : hindering attainment of the objective
blank : no or little effect on the objective

Table 2. Effects of Policies relevant to the EC on Different Objectives

RELEVANT POLICIES / OBJECTIVES		Increase in productivity	Intersectoral equity	Stable prices & supply	Reasonable prices
A. 1. Land subsidy/tax	c	-/+	+/-	+	-/+
2. Investment subsidy/tax	c	-/+	+/-	+	-/+
3. Early retirement Labor mobility subsidy Training programs	c	+	-		-
4. R. & D.	u	+	-		+
5. Quota	u	-	+	+	-
6. Commodity specific price support	u	-	+	+	-
7. No price support + income subsidy	c	+	+	-	+
B. 1. Tariff	u	+	+	+/-	-
2. Variable import levy	u	+	+	+	-
3. Import quota	u	+	+	+	-
4. Standard and regulation	u	+	+	+/-	-
5. Export subsidy	u	+	+	+	-
6. Aid	u	+	+		-
7. Reserve/bufferstock	c		+	+	+/-
C. 1. Food price subsidy	c		-	+	+
2. Food transfer	c		+	-/+	-
3. Income subsidy	c		+	-/+	-

Meaning of symbols:
+ : promoting attainment of the objective
- : hindering attainment of the objective
blank : no or little effect on the objective
u : policy currently part of CAP
c : policy under consideration for implementation

Included in the list are policies currently part of CAP, denoted by u, as well as several others under consideration, denoted by c.

7. ANALYSIS OF POLICY INSTRUMENTS

The relevant policy instruments are presented in the following format:

(1) description of the policy,

(2) impact of the policy focusing on the model's representation.

In the course of this analysis the same problem or difficulty may be encountered more than once. When that occurs a reference to the initial mention will be made so as to minimize repetition.

7.1 FINANCING

Except when stated otherwise, financing is carried out as follows: Member countries contribute a set fee to the European Agricultural Guidance and Guarantee Fund (EAGGF) each year. These contributions are raised from income and value-added taxes. They limit EC activity. Eventually, the EAGGF hopes to become "self-sufficient", dependent only on value-added taxes.

Income taxes are a percentage tax, increasing with income. A value-added tax is a tax on the total value of sales from one firm or farm per time period, less the value of inputs purchased from other firms or farms.[9] Neither of these taxes is included in the model as it currently stands. The sole tax that is represented is applied to specific inputs in one sector and paid for by the other. It is discussed later.

While the value-added tax can rather easily be included in the model, the income tax cannot. "Personal income distribution is not analyzed at all in the model.... This is done under the assumption that the distribution in the EC, although certainly not even and subject to political controversy, at the given level of income is not critical w.r.t. nutrition and the availability of other basic human needs."[6]

In response to an income tax, consumption patterns will change. Exactly how this occurs is currently not specified this part of the model has not yet been constructed. However, it will be represented by utility maximization. A value-added tax on the other hand affects production patterns.

7.2 PRODUCER-ORIENTED POLICIES

7.2.1 Land Subsidy

1. Description

This is a subsidy or tax placed on land to control production. It may be employed in a number of ways: (1) as as a tax on the use of land; (2) as a subsidy to farmers owning but not using the land, and (3) as a subsidy that can be varied in order to bring land in and out of production. Also, a subsidy can be used to promote farms with growth potential and to discourage those lacking potential

In the model the first three options are represented by T_A. T_A is taxed from the non-agricultural sector and provided to the agricultural sector or vice versa. It affects the allocation of land between the two sectors. In order to represent the fourth possibility properly, the model

must distinguish farms with growth potential from those without. Since it does not, this latter policy cannot be represented explicitly. Instead, it might be assumed that a certain percentage of farms have growth potential.

2. Impact

A tax on agricultural land makes it more expensive to farm. In response, production patterns will change and some farmers may migrate from the agricultural sector. The result will be expansion of the average farm size. This process will take time. During the transition imports may rise as domestic production falls. At the same time, an even stronger effect will be the increase in food prices since farm gate prices will rise.[4]

Taxes collected from this policy can be used in any number of social programs for either sector. In the model the taxes only move from one sector to the other. Consideration should be given to modification of this approach.

In order to employ the second option, that of subsidizing persons not using agricultural land, a whole administrative network of enforcement officers is required. The success of such a program is not guaranteed, since it can easily be violated. However, its overall impact will be to encourage the sale of agricultural land to the nonagricultural sector and hence to diminish production. The subsidy can also be applied to the production of specific crops. Once the likelihood of response is included in farmers' behavior functions, the model describes the policy's impact.

A variable subsidy is just an expansion of the previous policy. It will cause agricultural land to move between the two sectors or to go in and out of production. Whether the lagged response time included in the model is adequate is not clear.

7.2.2 Investment Subsidy

1. Description

This policy very much resembles the land subsidy. Again all four variants may be considered. As in the previous case the transfer is T_K. This subsidy may either be spent on building or machinery capital.

2. Impact

Again the impact will be similar; production will shrink or expand in response to the policy employed after a one-period lag.

7.2.3 Policy

Early Retirement Scheme

Labor Mobility Subsidy

Training Programs

1. Description

An early retirement scheme is an age-tied subsidy provided to farmers who retire from the profession early. Labor mobility subsidies are used to enable and encourage farmers to move into the non-agricultural sector. Finally, training programs teach farmers skills enabling them to obtain lucrative employment in the non-agricultural sector. These policies may be implemented individually or in conjunction with one another.

They are represented in the model by T_L. This is a transfer to agricultural labor from the non-agricultural sector. It affects the size of the working population in each sector.

2. Impact

The early retirement scheme and labor mobility subsidy are both programs using financial incentives to achieve their end goal, that of reducing the agricultural population so as to increase labor productivity. Their degree of effectiveness depends upon labor-responsiveness.

In order to model the first scheme, an age limit must be chosen by the policy model. Although not mentioned, the population subcomponent makes an age distinction. [4] Thus the two policies can be represented as follows: The labor mobility subsidy as mentioned above is T_L and the retirement subsidy is T_R where T_R is only available when age exceeds some predetermined value.

In response to either subsidy, labor migrates. Since the model has been defined as a full-employment economy, labor leaving the agricultural sector is immediately employed by the non-agricultural sector. In the model problems of unemployment are not encountered; this should be substantiated. Since the migration of labor causes total agricultural labor supply to fall, the labor constraint is amended. Resources are then reallocated under the new constraint.

According to the model, when labor migrates, the land it was formerly working is freed for purchase or renting by

other farmers. If the land is used by the agricultural sector, the model shows an increase in the average farm size. However, the extent and manner in which this actually occurs may be quite different. It depends upon the distribution of land.

As farms of different sizes are not represented by the model, the purchase of land by one farmer is represented as an increase in average farm size. This may result in poor predictions of productivity and production levels. If larger farms are less productive than smaller ones, then the level of production predicted using average farm size will not equal that using different-sized farms.

Training programs present quite different modeling problems. They affect the quality and skill of labor. Since the quality of average labor is homogeneous, this cannot be explicitly represented by the model. However, it is not clear that, per expenditure unit, training programs have a substantially different effect on migration than labor mobility subsidies. If there is no difference, then T_L can also represent training programs. This must be examined.

All three policies affect returns to labor and hence farmers' incomes. They may cause a change in consumption patterns. However, as mentioned earlier, income elasticity of food consumption is low. Therefore the expected net result is a relative increase in non-agricultural consumption.

7.2.4 Research and Development

1. Description

Investments in R & D frequently result in new technologies which increase productivity. Two types of R & D can be distinguished in agriculture: biological and mechanical, as described earlier.

Each is represented differently in the model. Mechanical progress is described in the "mechanization function" in two ways. It may either be non-neutral (in the Hicksian sense) or cause the initial allocation of inputs to produce more outputs (i.e., neutral). This is represented for both animal and plant production. Whether the progress is non-neutral and, if so, which of the factors it is saving, is tested empirically.

Biological technical progress is an indirect determinant of yield per animal unit, and crop yield per hectare. In the latter case, yield is a function of time over which biological technical progress occurs, by extrapolation.

2. Impact

In order to conduct an R & D program, investments must be made. Even if large expenditures are made the development of successful technology is not guaranteed. In fact, current efforts are being stymied by biological limits. Also, once a technology is developed, its adoption by farmers is not necessarily immediate.

Although the model includes technological progress, only mechanical technical progress is a function of investment. In addition, lagged acceptance of a new technology

does not appear to occur in the model. Following its intro-
duction it is immediately accepted. One can argue that only
the innovation is modeled, but not the invention.

In response to technology acceptance, production will
rise, thereby causing prices to fall. In order to maintain
income parity, labor should be encouraged to migrate. For
this reason R & D is generally employed in conjunction with
labor mobility policies.

7.2.5 Production/Marketing Quota

1. Description

Under the production/marketing quota, the EC guarantees
to purchase predetermined quantities $Q_1^!, Q_2^!$, of good χ at
varying support price levels (see Figure 2). Any amount ex-
ceeding that level will be purchased at world prices. Cur-
rently this policy is applied to sugar beets.

Model

The model description contained a constraint on the
amount of land used to grow sugar beets.[6] However, this
has since been updated and is represented in the following
form:

$$P_1 \text{ for } Q_1^s \leq Q_1^!$$

$$P_2 \text{ for } Q_2^! \leq Q_2^s \leq Q_2^!$$

$$P_3 \text{ for } Q_2 \leq Q_3^s$$

where $\quad Q_1^!, Q_2^!$ are quotas

$\quad\quad\quad\quad P_1, P_2, P_3$ support prices

and $\quad\quad Q_1^s + Q_2^s + Q_3^s$ is farmers' total production.
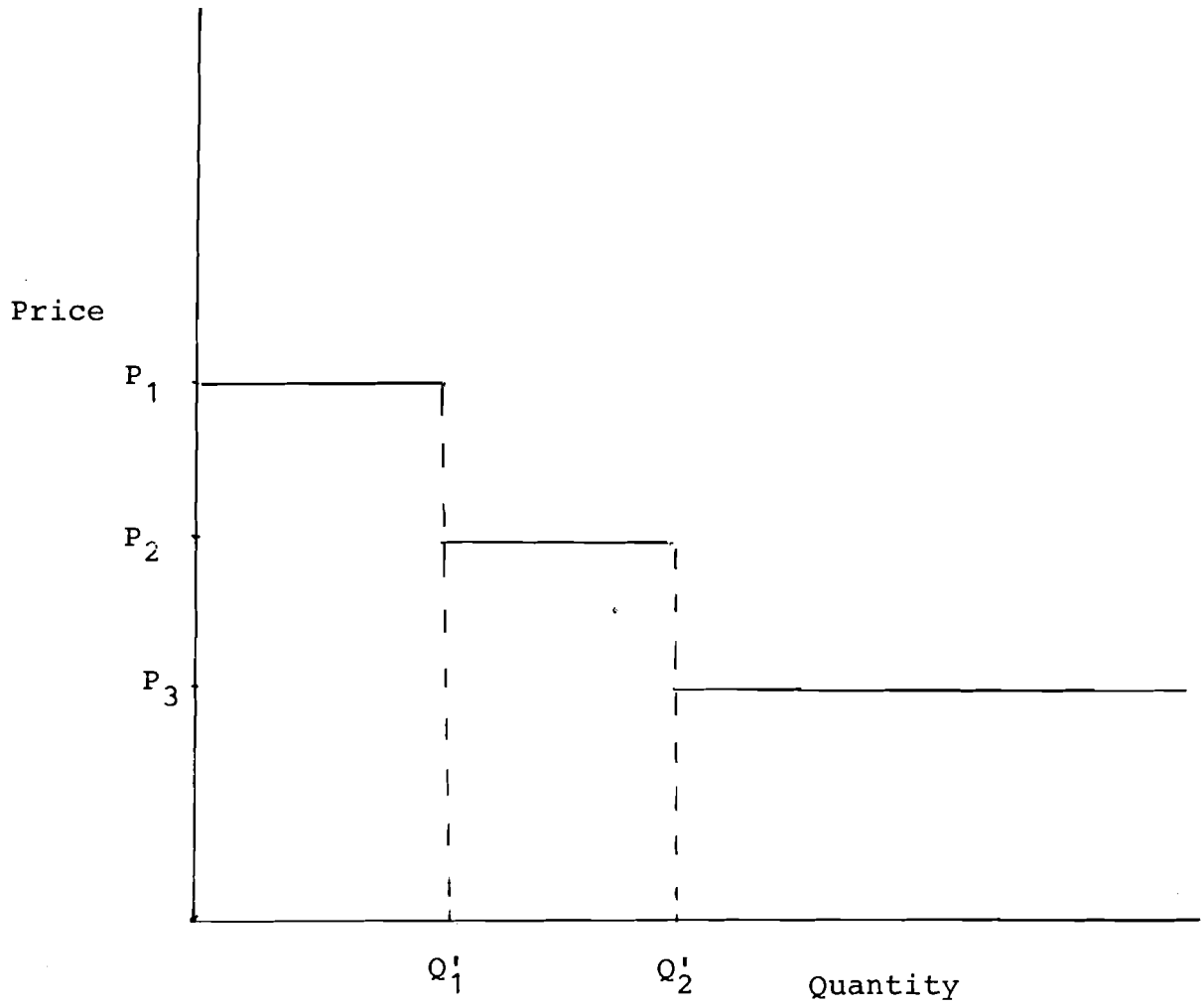
Figure 2

In the model none of the good is purchased at the
world price. Instead, by definition, it is all sold to
the EC. This is done to facilitate calculation of an
optimum.

2. Impact

Imposition of this policy will affect the allocation
function and in the long run reduce the supply of com-
modity χ. The degree to which supply is reduced depends
upon the differences between the support price, world prices
and production costs. The support price level as well as
the quota size may be varied by the policy model depending
upon the objectives emphasized. In response to the policy,
prices may increase and input usage will change. The model
adequately represents these processes.

7.2.6 Price Support

1. Description

Commodity-specific price supports provide a minimum
guaranteed price to agricultural producers. If world prices
fall below that level, intervention agencies funded by the
EC are authorized to step in and purchase the commodity
from farmers at this price. In order to implement this
policy successfully, imports must be restricted. If they are
not, consumers will purchase the lower-priced imports, thereby
obliging the EC to acquire all of the domestic produce, and
possibly even more. According to the model formulation $\bar{P}^P_{at}$,
the vector of agricultural commodity prices may be set by
the policy model.

2. <u>Impact</u>

As the price is increased above its former "competitive" world price level, domestic production increases and consumption falls. The model represents this process. If the world price is lower than the "intervention" price, the model estimates demand and supply at the "intervention" price. The difference between demand and supply is then purchased by the intervention agency.

Holding domestic prices above world prices affects the cost of inputs. In order to expand production, more inputs are needed. Since the supply of inputs is finite, agricultural producers must acquire inputs from the non-agricultural sector or other farmers. In order to tempt them out of their current employ, input prices are bid up. As input prices rise, producers will tend to rely more on imported inputs. Over time, the supply of domestically produced inputs will rise. The input market is not represented by the model. As mentioned earlier, scenarios are used instead. One scenario is: let input prices move in the future as they did in the past. In other words, a time extrapolation is used.[4]

Changing input prices affects factor incomes. Depending upon the production processes used, demand for one factor may change more than for another. This affects their relative returns. Since no distinction is made by the model between workers, capitalists and landowners, the impact that this policy has on that structure is not represented.

Finally, reliance on a price support policy results in the creation of a commodity surplus. The EC is then obliged to decide what to do with it.

7.2.7 No Price Support + Income Guarantee

1. Description

Eliminating price supports is equivalent to setting domestic prices equal to world prices (i.e., $\bar{P}^p_{at} = \bar{P}^w_{at}$). At the same time, an income supplement is provided in order to promote the income objective. The income support is F, a transfer from the non-agricultural to the agricultural sector.

2. Impact

The effect of eliminating price supports will depend upon the level and degree of detail used to represent the current CAP. In response to the no-price support policy, the prices of those commodities supported above world prices, such as milk products, will fall. Consequently, demand will rise, domestic production will fall after the suitable lag period and if domestic supplies do not meet demand, imports will increase.

As domestic production falls, inputs are freed. Their prices in turn fall and a reallocation occurs. Land that is freed will be picked up by the agricultural sector, causing farm size to grow. In actuality, "land is a non-transportable good and...structural change is a slow-going continuous process in which larger farms buy or rent the land offered by outgoing farmers only within a rather small area".[13] Regional and locational distinctions of this

type are not made by the model. This simplification, while impairing the predictive accuracy of domestic structural policies, does not significantly affect the world market. However, this assumption should be justified by the modelers.

A second structural impact of this policy is that it may prompt inefficient farmers to leave the sector. Not all farms operate efficiently. Part of the rationale for eliminating price supports is to eliminate inefficient farms and encourage efficient ones. Since the model makes no distinction of this kind, this impact also cannot be simulated. The model cannot describe which farms will be vacated.

Income supports are also part of this policy. The object of income support is to help farmers survive the burden of price changes. Hence it is provided to farmers who produced under the old CAP, but not to new farmers. Since the model has the potential to distinguish between "old" and "new" farmers, this policy may be represented.

Emphasis must be placed on the fact that such a support is <u>not</u> to affect production, since increasing production would drive down prices. Enforcement of this provision may be cumbersome, and its success is not guaranteed. This uncertainty may be included in the model.

Financing for this scheme may be provided by a price tax on the "freed" commodities, which is slowly reduced

as farmers retire. Since it is assumed that income support
funds are raised by applying a non-agricultural income tax,
a new tax variable must be formulated. Each of these changes
is possible to include in the model.

8.1 PRODUCER- AND CONSUMER-ORIENTED POLICIES
8.1.1 Tariff, and Variable Import Levy

1. Definition

Although these are two distinct policies and cannot be
applied to the same commodities concurrently, they are con-
sidered together because their impacts are similar. Vari-
able levies and tariffs restrict supply by increasing the
price of imports. A variable import levy is calculated by
subtracting the difference between the "threshold" price
and the world price. This difference or levy is then added
to the price of the commodity. The "threshold" price level
is set by the EC.

A tariff resembles a sales tax. It increases the price
per unit of imported item by a set amount or percentage,
which does not vary with the world price.

The model contains no explicit representation of either
policy. They will be considered in the "think" model.
However, both are easily included as increases in world
prices. For the tariff $P^{W'} = P^W + t$ where P^W is the world
price and t the tariff. For the levy $P^{W'} = P^W + t^\ell$ where
$t^\ell = P^{Th} - P^W$, $t\ell$ is the variable levy, and P^{Th} the threshold
price.

2. Impact

The primary impact of this policy is the reduction of imports. Restricting imports in either manner enables the EC to control domestic prices. As described earlier, net exports and stocks are the residual used to make demand equal supply at expected prices. When the price of imports rises, imports will not be purchased until the domestic price attains this level.

As a result of the levy or tariff, the EC receives an increased income. Since the model is purely commodity-oriented, the returns are not collected explicitly.·

8.1.2 Quota

1. Import Quota

Imports can be restricted directly through the imposition of an import quota. The quota sets a limit on the amount of the restricted commodity that can be imported. This policy is represented in the model by imposing a constraint $M \leq M^Q$, where M equals the import level and M^Q the import quota. Actual imports may be equal to or less than the quota level.   .

In the model net exports/imports are calculated as the difference between demand and supply at the domestic price level. Only when net excess demand exceeds the quota will the domestic situation be affected. Up to that point, the gap will be filled by imports. However, once the quota is reached no more is imported, which causes the domestic price to rise. The model represents this process.

8.1.3 Standards and Regulations

1. Description

An indirect way to control imports is through the imposition of standards and regulations. Any commodity not of standard quality cannot be imported. The stringency of the standards then determines the quantity and quality of imports.

No model simulation of this policy is possible as it requires making a qualitative distinction between commodities. However, a simplified representation can be constructed. A probability distribution of quality which changes over time in response to technological change may be developed. The policy is then represented as a constraint; any good of better quality can be imported, while any good of worse quality cannot.

2. Impact

The short-run impact of this policy is much the same as the quota; it restricts imports and hence total supply. As a result, domestic prices may be maintained above world prices, at least temporarily.

However, the long-run impact of this policy is less predictable. If quality of imports rises, either the standard will have to be raised or domestic prices increased in order to hold imports at the same level. However, if the objective is to raise produce quality, nothing needs to be done.

Secondly, administering the policy is costly as it requires the recruitment of a large number of inspectors.

Costs of this type are not explicitly included in the model. Once the policy is adequately described in the model, the ensuing impacts are simulated.

8.1.4 Export Subsidy

1. Description

An export subsidy helps control domestic supply. In order to encourage exporting, exporters after they sell a commodity on the world market are reimbursed by an amount equalling the difference between the domestic price paid and the world price received times the amount sold. If the subsidy were not provided, exporters could not afford to carry out this activity. According to the model's notation this subsidy is

$$(P^p_{ati} - P^w_{ati})X_{ati}.$$

Since the model contains no representative "middlemen" an export subsidy is equivalent to having the EC export the goods themselves at world prices, after having purchased them at domestic prices. It is a welfare transfer by the EC to the importing country.

2. Impact

The primary impact of this policy is to reduce domestic stocks developing when domestic prices are too high to equalize demand and supply. In additon, the policy helps maintain this price discrepancy. When these two prices are equal, the policy need not be employed.

Exports should increase in the model in response to the policy. Since exporters are not included as a distinct group, the model cannot represent the impact of the policy on their behavior.

8.1.5 Aid

1. Description

Aid is the provision of commodities to another country at low or no cost (i.e., as grants or concessional trade). Since little or no monetary returns are received in return for aid, the returns are primarily political; aid is distinct from exports. Therefore it should be represented as a separate policy variable, A_i^d.

2. Impact

In addition to yielding political benefits, providing aid to needy countries reduces EC commodity stocks. Choosing the amount to allocate is a decision left to the policy model.

The domestic impact of aid depends upon the manner in which it is collected. It may be acquired under a price support or quota policy. The effect of both of these has already been discussed. A third possibility is direct purchase from the market by the EC. In this case, because demand is increased, a new equilibrium is reached, if imports are restricted. Otherwise imports increase.

Once the decision to provide aid is made, it is difficult to rescind. The recipient country becomes dependent on the donor over time. Hence as the relationship continues it becomes more difficult for the donor country to vary the amount so as to control domestic supply and prices. Representing these political constraints in the model is difficult, if not impossible. Nevertheless, it should be considered.

8.1.6 Bufferstocks/Reserves

1. Description

Bufferstocks are commodity stocks collected by the EC to minimize price and supply perturbations. Generally, the goods are purchased when the price is low and sold when it rises. These upper and lower bounds are predetermined. In the model $\overline{ST}_a$ represents the stocks.

In actuality, storage capacity is limited both in volume and time. These may both be extended through the development of new technologies. In the model description no mention is made of such constraints. It is recommended that some be developed.

2. Impact

As noted above, stocks can be used to minimize short- and long-run fluctuations in price and supply. When prices rise above a certain predetermined level, the EC can step in and sell its stocks in the domestic market. Prices will fall in response.

In the model the stock mutation variable is one component of demand and as such affects the commodity price. While the model adequately represents bufferstock policies in the medium and long runs (i.e., those occurring over a period of several years), it cannot model short-run policies since one time period in the model is a year. This lack is not crucial, however, since short-run fluctuations tend to average out in the long run and since the focus of the model is long-run.

A related policy decision concerns the quantity of commodities put into reserves to cover the EC in case of blockade, or major crop disaster. However, as the EC is approximately 98% self-sufficient in food it has no need to develop a large reserve.[4] This decision is left to the policy model.

Finally, it is possible to stockpile inputs. This is an indirect way of controlling price and supply fluctuations. Consequently it is less reliable. In order to represent this policy a more explicit input market representation is needed.

9.1 CONSUMER-ORIENTED POLICIES

9.1.1 Food Transfer, Income Transfer

These two policies are not being considered as a group. However, as they have similar effects, they will be evaluated concurrently.

1. Description

An income subsidy is a supplement to incomes of poor persons enabling them to purchase necessities. A food transfer or food stamp is a commodity or monetary transfer good only for food purchases by low-income persons. The model has an income subsidy variable F; this, however, is not income-tied.

2. Impact

An income transfer will increase income. The extent to which demand will rise in response is a function of income elasticity and the size of the subsidy. This former

variable determines the percentage of the increase to be
spent on additional food purchases.

When the consumer receives a food consumption subsidy
a similar process occurs. He will substitute this subsidy
for all or part of his current food consumption. This then
frees that amount of income formerly spent on food for ex-
penditure on other items. The extent to which his consump-
tion of food rises depends both on his income elasticity
and preference structure. Currently, how a consumer chooses
to allocate his income among agricultural and non-agricultural
goods is not well developed in the model. In the model's
final version, the consumer will allocate his income accord-
ing to a utility maximization objective. Hence in the
optimum $\frac{\partial u}{\partial y_a} = \frac{\partial u}{\partial y_n}$ *. Financing may be carried out as
described initially.

As mentioned above, the effect of these two policies
cannot be modeled unless a distinction is made among income
classes. In the current model either policy will be repre-
sented as an increase in average income. Income elasticity
of food consumption changes over income. The extent to
which this occurs in the EC should be examined. Only if a
subsidy of either type significantly changes inter-income
class demand patterns should consideration be given to its
inclusion.

9.1.2 Food Price Support

1. Description

A food price support is a subsidy on certain selected
food items enabling consumers to purchase them at lower than

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* $\frac{\partial u}{\partial y_i}$ is the marginal utility of good i; a refers to agriculture
and n to nonagriculture.

usual prices. In order to accomplish this, either a monetary

subsidy can be provided to the marketing bodies or the EC can

use its own reserves to maintain a selected price level.

Either of these approaches changes the price to consumers,

$\overline{P}_{at}$.

A second related policy is one currently in use by the

EC, that of dumping stocks on the domestic market at various

times of the year. This helps regulate the stock size. It

is currently used with respect to butter. However, this policy cannot

easily be represented by the model since the impact is short-

term.

2. Impact

Unless the first policy is implemented concurrently with

a price support program, it will cause producers to cut back

production since prices will fall. This low price level is

maintained either by selling reserves or subsidizing imports.

If the domestic price is less than world prices, exports must

be restricted. However, if the domestic price level exceeds

world prices at any point in time, unrestricted trading

should be initiated. The objective is to help consumers.

If the EC insists that prices be kept low even after the

reserves are depleted, shopkeepers will find it in their

interest to sell regulated food items on the black market. The

model represents this whole process; when demand exceeds

supply, prices will rise.

10. CONCLUSION

The criticisms presented in this report fall into one of three categories: (1) model description of the policy instrument, (2) model simulation of the policy instrument, and (3) verbal description of the model. Each category is discussed and the criticisms made concerning each reviewed.

In order to rectify problems of the first type, either (a) a definition is developed, or where this is not feasible, (b) verbal recommendations and directions are provided. Included in the former group are: the representation of the early retirement scheme and a variable notation for aid. Policy instruments or characteristics falling into group (b) include: training programs, standards and regulations, R & D investments as well as bufferstock quantity and time constraints. Since the first two policy instruments in the above list affect quality, of labor and of products, which the model does not include, they cannot be explicitly simulated.

Criticisms of the second type are due primarily to the model's level of aggregation. In these cases the policy instruments under discussion affect units smaller than or different from those described in the model. For example, an income tax is best represented when incomes are differentiated. The unit, income, is not divided into smaller subgroups in the model. Rectification of such problems requires either: (1) complication of the model by disaggregating the relevant variable or (2) discussion explaining why representation at that level of detail is unnecessary.

These criticisms primarily apply to representations of the general economic structure and the farm structure. No distinction is made between income classes or among owners of input resources (i.e., capitalists, workers and landlords). As a result, simulating policy instruments that attempt to influence the food and agriculture situation through structural modifications is not easily achieved. Instruments in this category include food and income subsidies to low-income persons as well as policies affecting production such as taxes and subsidies on land, investment and labor. Similarly, as no distinction is made between farms of different sizes, from different regions, with different growth potential or of different levels of efficiency, simulation of relevant policy measures affecting these characteristics cannot be represented. Instruments falling into this group include subsidies and taxes on production and inputs tied to any of these characteristics.

The third category contains fewer items. It is recommended that the written description of the model's representation of the input market and taxes be elaborated. In addition, since the policy instruments used to conduct this analysis are not evaluated with respect to specific commodities, the choice of commodity groupings was not examined. However, as there are some groupings which may inhibit accurate simulation of the CAP (e.g. coarse grain as well as wine and fruits) the reasoning behind their aggregation should be provided. Processed food items have not yet been included in the model.

Finally, there are several additional comments not made during the analysis. The first if the problem of environmental

degradation. Nowhere in the model is it discussed. In the long run certain agricultural practices may have adverse environmental effects. This may be modeled as a factor that changes over time and affects agricultural productivity. Secondly, EC politics are not part of the model; it focuses solely on economic relationships. However, in actuality, policy choices are not based on purely economic criteria. This will have to be discussed in the description of the "think" model.

Model evaluation, criticism and revision is never complete; the situation is always changing. For example, if Greece, Portugal and Spain join the EC, intra-EC labor migration will become an important factor. In order to facilitate this undating process, it is recommended that model simulation of probable future events as well as sets of policy instruments be evaluated. Possible future events include greater or lesser EC cooperation, new members, wars*, sudden input shortages, etc. Policy sets should be developed with EC objectives in mind. While the relevant policy instruments have been examined individually, interactions between them may further complicate their simulation. In conclusion, it is important to recall, when evaluating models, that while models can always be improved, they are never as accurate as the real world.

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*Wars may be simulated only through the secondary effects that they cause, such as: increased deaths of young males, greater armament expenditures, termination of trade agreements with/ between waring parties, etc.

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Appendix A

Commodity List [3]

1. Wheat and wheat products
2. Rice
3. Coarse Grains
4. Animal fats and oils
5. Protein feeds
6. Sugar beets
7. Bovine and ovine meats
8. Pork
9. Poultry and eggs
10. Dairy products
11. Fruits, nuts and wine
12. Vegetables and potatoes
13. Processed vegetables, potatoes, fruits and nuts
14. Fish and fishery products
15. Coffee
16. Cocoa, tea and their products
17. Alcoholic beverages
18. Clothing fibers
19. Industrial crops
20. Rest of national production

Appendix B

Policy List

Producer-Oriented Policies

I. Input

A. Acreage

    1. Acreage controls or allotments

    2. Government licencing of growing rights

    3. Whole farm retirement

    4. Government purchase and/or renting of farm land

    5. Regulation of land inheritance system

    6. Farm land taxation scheme

    7. Crop land diversion payments

B. Crop Inputs (i.e., fertilizer, water, etc.)

    1. Price control

    2. Control of supply of inputs

    3. Taxes

C. Labor

    1. Labor mobility subsidy

    2. Provision of training programs

    3. Increased employment in other sectors

D. Credit

    1. Control of interest rate

    2. Collateral requirements

E. Research and Development

    1. Training programs to improve farming and management skills

II. Infrastructure Development

A. Direct Development

B. Subsidized Development

III. Marketing and Production Control

A. Production and/or Marketing Quotas

B. Farmers' Marketing Collectives

C. Government Crop Insurance

IV. Price Incentives

A. Commodity Specific

B. Supplemental or Deficiency Payments

C. Minimum Prices and Loans

D. Incentive or Compliance Payments

E. Guaranteed Prices

F. Direct Payments and Subsidies

G. Open Buying and Selling by Intervention Agencies

H. Free Market.

Appendix B (continued)

Policy List

V. Distribution

A. Income

    1. Insured

        (a) Crop insurance

    2. Guaranteed income

    3. (a) Social security

Producer- and Consumer-Oriented Policies

I. Trade

A. Tariffs

    1. Ad valorem

    2. Per unit

    3. General system of preferences

    4. Exchange rate

B. Non-tariffs

    1. Imports

        (a) Variable levies

        (b) Supplementary levies

        (c) Minimum import price

        (d) Quotas

        (3) Licencing of importers

        (f) Health safety and sanitary regulations

        (g) Voluntary agreements

        (h) Special internal tax for imported items only

        (i) Customs valuations practices

        (j) State Trading

    2. Exports

        (a) Credit programs

        (b) Embargoes

        (c) Subsidies

        (d) State Trading

        (e) Bilateral and multilateral agreements

        (f) Administrative guidance

        (g) Tax programs

C. Exchange Rate Regulation

Appendix B (continued)

Policy List

II. Aid (to other nations)
  A. Concessional Trade
      1. Minimum import price
      2. Preferential agreements
      3. Common price support fund
      4. Compensatory financing schemes
      5. Sales in local currency
      6. Barter and exchange
  B. Grants
      1. Commodity transfers
      2. Farm production inputs
      3. Investment funds
      4. Debt moratorium
  C. Technical Assistance
      1. Research assistance and training
      2. Extension assistance and training
III. Reserves
  A. Commodity
      1. Private stocks
      2. Private stocks with government assistance
      3. National stocks
      4. International/regional stocks
  B. Non-commodity
      1. Export earning stabilization schemes

Consumer-Oriented Policies
  I. Price Control
  A. Taxation
      1. Excise tax
      2. Export tax
      3. Processor payments
  B. Subsidies
      1. Price concessions on surplus food products
      2. Denaturing premium
  C. Fixing
      1. Two-price plan
      2. Government pricing