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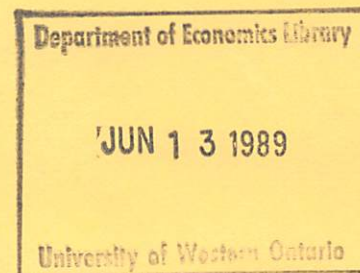
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THE COMMON AGRICULTURAL POLICY
OF THE EUROPEAN COMMUNITIES

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This paper contains preliminary findings from research work still in progress
and should not be quoted without prior approval of the authors.

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THE COMMON AGRICULTURAL POLICY OF THE EUROPEAN COMMUNITIES

by

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1. THE ISSUES

The Common Agricultural Policy (CAP) of the European Communities (EC) is widely regarded as a costly "sacred cow". It is deemed to be sacred because it represents the major "success" of the EC in terms of political efforts to harmonize economic policy across diverse countries. It is also central to the continued cohesion of the EC as an expanding customs union. The evolution of the CAP has largely been a story of its use as a vehicle for effecting heavy "side payments" to certain countries in order to maintain a greater harmony. As such, the costs of the CAP may be viewed as the price that the EC has paid in order to achieve something that is more valuable to its membership (perhaps for geo-political reasons).

Notwithstanding this judgment, many argue that the CAP may have outlived its value, at least in the present form. Criticisms of the CAP range from the severe budgetary cost to the EC membership, the hidden redistributive effects of the CAP within the EC, the efficiency costs on production and consumption, and the possibility that it may engender retaliatory agricultural trade wars [see Hathaway (1987) for a recent review]. We provide a quantitative evaluation of some of these costs and effects using a numerical general equilibrium model of the EC.

In Section 2 we discuss the CAP from an analytical perspective, arguing that it has certain features that cannot be properly modelled with fixed *ad valorem* taxes or subsidies. There is an essential open-ended feature of the CAP that must be understood if one is to account for the astounding growth in CAP expenditures in the last decade. This open-endedness is the combined use of *endogenous* tariffs, production subsidies, intervention storage purchases, export subsidies, and financing to support relative prices for agricultural goods that are fixed above market-clearing levels.

In Section 3 we introduce a numerical general equilibrium (GE) model designed to evaluate the major costs of the CAP. Although our model is relatively aggregated in terms of sectors, it does identify each of the major members of the EC during the 1970's. Moreover, it is capable of addressing each of the open-ended features of the CAP discussed in Section 2.

We adopt two different time horizons in our evaluation of the consequences of eliminating the CAP. First, it is well known that Europe has a much higher level of unemployment than virtually any other industrialized region: averaging a persistent 11% in the mid-1980's. This problem is claimed to have long hampered the efforts of the Commission to liberalize its interventionist activities in agriculture. The Commission has explicitly and repeatedly argued that general unemployment makes it difficult to reform the CAP:

"Today the economic scene has changed considerably. Given a total unemployment level of some 17 million persons in EUR 12, ... the redundant farm worker is now more likely to be found among the ranks of the unemployed."
[Commission of the EC (1987; para.121)]

Similarly, the Commissioner for Agriculture in the EC is reported as saying in 1987 that it

"... is my conviction that if we allowed the market to operate, we would lose millions of farmers and the economy would be charged with the burden of supporting them." [quoted in Breckling, Thorpe, and Stoeckel (1987; p.3)].

We follow Stoeckel (1985), Breckling, Thorpe, and Stoeckel (1987), the Commission of the EC (1985) (1986), and Harrison and Rutherford (1989) by treating this unemployment as due to a downward rigidity of real wages.¹ In this setting, which we call our "short-run" case, we also allow Capital to be sector-specific, unable to adjust to equalize rates of return within the time period in question.

Second, in our "long-run" case, we consider the removal of agricultural support policies assuming that there is no unemployment and that Labor and Capital are able to move intersectorally to equalize their rates of return.

In Section 4 we make counterfactual calculations evaluating the effects of liberalizing European agriculture in both the short-run and over a longer time horizon. We introduce a new technique that permits us to determine whether it would be *potentially* Pareto-improving to eliminate the CAP programs. That is, we find whether there exist transfers within the EC

¹ We do not want to dismiss the alternative explanations for persistent unemployment that have been proffered [see Beckerman (1986) for a review]. Rather, we only seek to model unemployment in a simple way that is consistent with one plausible "story". It is possible to model certain alternative labor market formulations with our general modelling system and this may be an interesting direction for future research.

such that, if the transfers were indeed made, all member countries would benefit from an end to the CAP. Using our time-series database, we determine the changing distribution of benefits from the agricultural policies over the period 1974-1985. We also discuss the importance of CAP elimination relative to another aspect of trade liberalization on the agenda of the EC: the completion of the market.

2. MODELLING THE COMMON AGRICULTURAL POLICY

Despite the many intricacies of the operation of the CAP, the essential features are reasonably simple from an analytical point of view. We decompose our "model-equivalent" interpretation of the CAP into five related aspects: the setting of target prices, selection of a variable import levy, intervention purchases of any domestic excess supply, the subsidized disposal of intervention purchases on foreign markets, and the financing of the CAP's activities. Although each of these facets of the CAP is jointly determined in an equilibrium of our model, it is heuristically natural to consider them as operating sequentially. More importantly, we also indicate aspects of our model that are deliberate simplifications adopted to maintain tractability.

2A. *Exogenous Target Prices*

The *target price (TP)* for an agricultural good is a fixed domestic price which the EC would like to achieve. It need bear no relation to any market-clearing price, and is understandably a focus of much squabbling within the EC. Typically it is set on an annual basis.²

Once the target price is set two other prices get determined. The *threshold price*, which is set slightly below the *TP*, is the minimum price at which imports are allowed to enter the EC such that, once they bear the further cost of transport, the price of imports equals the target price. The difference between world prices for the good and the threshold price

² It can vary from EC member to EC member depending on transportation costs relative to the "official port of entry"; we ignore these variations.

determines the *variable import levy*, or tariff. This tariff may be changed on a daily basis, depending on current world prices. In 1984-85, for example, the average *TP* for durum wheat was 357.7 ECU per tonne whereas the average threshold price was 352.7 ECU per tonne.

Given the possibility of excess domestic supply in the face of a rigid *TP* the EC also defines an *intervention price (IP)* at which it stands ready to support the market with endogenous purchases. The *IP* ranges from 10 to 20 percent below the *TP*, although this interval is also subject to much internal EC squabbling from year to year. In 1984-85 the average *IP* for durum wheat was 312.1 ECU per tonne, some 15% below the *TP*.³

For our immediate purposes the important feature of CAP policy involved here is the *exogenous* determination of the producer price of agricultural output. We do not enquire here into the political economy of particular *TP* levels, although our later simulations may imply something about those forces.

2B. Endogenous Tariffs

We assume that there is no difference between the *TP* and the threshold price applying to imports from outside the EC. We therefore endogenously determine the tariff on agricultural imports from the exogenous *TP* and the endogenous world price.

2C. Endogenous Intervention Purchases

In order to maintain the *IP* in the face of domestic excess supply, the EC engages in three kinds of intervention activities. The first of these activities is delicately, if somewhat euphemistically, termed "market guidance". This consists of *price subsidies* and premia, which are intended to "... keep consumer prices lower than producer prices and to enable community products to compete with those imported from non-member countries" [EC (1987a; p. 48)]. In

³ In our model goods are distinguished by region of origin. For this reason, changes in the *IP* and *TP* produce incomplete adjustment between domestic and foreign supplies; that is, demand for domestic output does not fall to zero when imports become relatively cheaper. The Armington assumption results in different outcomes than is observed in a model with homogeneous goods, such as Sampson and Snape (1980).

1985 these intervention expenditures amounted to 7.7 billion ECU (US \$9.6 billion), 39.3% of all EAGGF appropriations.⁴

The second type of intervention activity is the purchase of goods for *storage*. At the end of 1985 the EC valued the products in storage at just over 10.5 billion ECU. Expenditures on storage (and related market withdrawals) amounted to 5.2 billion ECU (US \$6.4 billion), some 26.9% of all EAGGF appropriations.

The final type of intervention activity is the provision of *export subsidies* to dispose of domestic excess supplies on non-member markets. These subsidies are "... intended to cover the difference between internal prices and world prices" [EC (1987a; p. 48)]. They have been increasing rapidly in the last ten years, reaching the 6.6 billion ECU (US \$8.2 billion) mark in 1985, or 33.8% of all EAGGF appropriations.

Figure 1 illustrates our treatment of the intervention activities of the CAP. For simplicity, we represent world prices as being fixed at p^w (in the model itself the world supply function is not perfectly elastic). Imports are subject to the variable import level (tariff), raising their price on the domestic market to the threshold price, drawn as equal to the target price (TP). Let p^* denote the elusive domestic-market-clearing price while IP is the (higher) intervention price. This generates domestic excess supply of AB . As discussed above, this intervention price is supported by a variety of means. Price subsidies would shift the domestic demand curve to the right while export subsidies would have to equal the difference between IP and p^w .

2D. Endogenous Export Subsidies

The EC does two things with the agricultural goods that it purchases. The first is to simply put them into storage, generating "mountains of butter and cheese and lakes of wine". The second is to export them to non-EC markets, along with hefty subsidies to make them "marketable". At the risk of some slight simplification, we model these two outlets for

⁴ EAGGF is the English acronym for European Agricultural Guidance and Guarantee Fund, frequently referred to as FEOGA using the French acronym.

intervention purchases as joint outputs of an "intervention production activity". The export subsidy is determined endogenously such that the quantity which the EC wants to export is purchased by foreigners. The remaining goods are "eaten" by the EC government agents.

Figure 2 illustrates that each of the three major types of CAP expenditure are roughly equal in importance, and that the largesse of the CAP is spread over several agricultural goods.

2E. Endogenous Financing

The financing of CAP activities is effectively the story of the financing of the EC activities as a whole, since the CAP is such a large proportion of the whole (70% in 1985) and because it is easily the most volatile component. Figure 3 charts the astounding real expansion in CAP expenditures over the last decade. Since 1975 all agricultural import levies and all customs duties from EC members were to be paid to the EC. In recent years these revenues have constituted slightly less than a third of total EC revenue.

The vast bulk of EC revenue currently (1988) derives the *value-added tax* (VAT) "own resources" rate applying to each EC member. This rate refers to the percentage of VAT collections that each member would transfer to the EC. It was intended that this rate would be uniform across all members, so that the size of contributions would be roughly proportioned to GDP *and* tax revenues actually received by members themselves. Apart from a budgetary crisis in 1986, these contribution rates have been effectively uniform across all members.

One contentious feature of the VAT rates is their "ceiling" value. Originally set at 1.0%, these ceilings have been forced to rise to meet EC expenditures arising from the CAP. In 1982 the uniform rate was 0.92%, and in 1983-1985 it reached the maximum allowed of 1.0%. In 1986 the maximum was allowed to rise to 1.4%, and a uniform rate of 1.25% was adopted in the initial 1986 budget. However, after bitter disputes over the 1986 budget the VAT rate was set to the maximum allowed 1.39996% for all except Germany (1.33697%) and the United Kingdom (0.67663%). These dispensations from the uniform rate are not regarded as long term. In 1987 it is anticipated that the uniform rate will be 1.3694%, with lower rates

again from Germany (1.3153%) and the United Kingdom (0.8033%). The crucial point is that current budgetary projections suggest that a ceiling of 1.4% will soon be inadequate:

"Comparisons of requirements and resources shows that the resources available within the 1.4% VAT limit will no longer be sufficient from 1988 onwards."
[EC (1987b; p. 63)].

We could interpret this method of financing of the CAP (and the EC as a whole) as including an endogenous VAT contribution rate. This rate would be assumed to be uniform across all members, notwithstanding the temporary dispensations of 1986 and 1987. The rate then adjusts so that the EC is in budgetary balance. Apart from this endogenous rate, the EC receives all revenues from all tariffs.⁵

In the basic version of the model we have instead opted for an alternative that is in many respects more realistic: each EC member contributes a *fixed share* of whatever funds are necessary to finance the expenditures of the EC. These "fixed key scales" for national contributions were indeed the formal method used in the EC until 1975 (in fact they were the formal method used until 1979, due to delays in harmonizing the VAT systems of EC members). Moreover, there is much informal speculation that GDP-based shares will again become the basis for financing the EC. We therefore assume that each member contributes according to predetermined shares. In certain years, one or two countries (specifically, Ireland and Denmark) are *net recipients* of EC funds. These flows are represented as fixed lump-sum transfers in the model. We simultaneously set funding shares for the recipient country to zero.

Table 1 presents the available data on EC budget contributions during the 1970's. For each of the years from 1973 to 1980 we employ the revenue shares listed when determining how much of the EC budget each country must finance. For later years we employ the average shares for 1973-1980 as shown. Similarly, we allocate EC expenditures across countries in accordance with the expenditure shares listed; for 1976-1980 we adopt the observed shares, and for all other years we adopt the average observed shares.

⁵ In practice each country retains 10% of these revenues to cover administrative costs.

We therefore assume that, on average, Germany is a heavy net contributor to the finances of the EC. The United Kingdom is also a heavy net contributor in 1978-1980, but is not so heavy a contributor on average. All other countries are, on average, net beneficiaries in terms of these direct financial transfers.

3. AN EMPIRICAL GENERAL EQUILIBRIUM MODEL

We now describe a static general equilibrium trade model designed to calculate the welfare consequences of the CAP on members of the EC. The structure of the model may be summarized as follows: traded commodities produced in different regions are imperfect substitutes; factors of production may be sector-specific or mobile within regions but are immobile between regions; and government policies include production subsidies, trade and value-added taxes. Special attention is, of course, devoted to the treatment of commodities falling under the CAP. For these goods, the EC enforces threshold price constraints through variable levies and supports target prices through intervention purchases linked to export subsidies. In the case of CU member countries, tariffs and export subsidies are discriminatory: tariffs on trade within the CU are zero and there are commodity-specific CETs. Non-tariff barriers to trade are represented as fixed *ad-valorem* price wedges with associated rents captured by the importing country.

Let the set of traded goods be denoted X and be indexed by x and y . Non-traded goods are represented implicitly. Within X , we distinguish goods which are covered by the CAP as $x \in \text{CAP}$. Let K be the set of primary factors indexed by k , and let J be the set of regions indexed by i and j . Sets C and N are disjoint subsets of J referring to CU member and non-member (extra-union) countries, respectively.

3A. Export Markets

Following Armington (1968), commodities are distinguished by type and by region of origin. π_x^j denotes the buyer price of domestically produced commodity x in region j . This

TABLE 1
EC BUDGET: CONTRIBUTION SHARES

Total Revenues									
BILLIONS OF EUA (1973-1977) OR ECU (1978-1980)									
Year	Total Revenues	Percentage of Total							
		GER	FRA	ITA	NET	BEL	UKI	DEN	IRE
1973	4.584	29.0	24.8	19.0	9.4	7.4	8.8	1.1	0.3
1974	4.972	28.5	24.0	18.4	9.1	7.1	11.0	1.4	0.3
1975	5.893	28.1	22.8	17.5	9.0	6.7	13.6	1.7	0.4
1976	7.710	27.3	21.4	17.1	8.8	6.5	16.2	2.1	0.5
1977	8.200	25.8	20.3	16.7	8.6	6.3	19.2	2.4	0.6
1978	12.004	29.4	18.2	13.8	9.9	6.2	19.4	2.3	0.7
1979	14.372	29.5	19.0	11.8	9.0	6.4	21.1	2.4	0.7
1980	15.263	29.6	19.2	12.6	8.3	6.2	20.8	2.3	0.9
Average	-	28.4	21.2	15.9	9.0	6.6	16.3	2.0	0.6

Total Expenditures									
BILLIONS OF EUA (1976-1977) OR ECU (1978-1980)									
Year	Total Expenditure	Percentage of Total							
		GER	FRA	ITA	NET	BEL	UKI	DEN	IRE
1976	6.579	16.5	23.5	17.4	11.9	5.9	15.1	6.1	3.5
1977	7.817	17.6	19.7	15.2	10.5	5.8	19.1	6.0	6.0
1978	10.804	25.1	15.7	18.6	11.3	6.0	13.7	5.6	3.8
1979	12.847	21.4	20.6	16.9	12.0	6.6	12.6	5.5	4.9
1980	14.592	20.1	23.1	17.9	11.4	4.6	12.4	4.7	5.7
Average	-	20.1	20.5	17.2	11.4	5.8	14.6	5.6	4.8

Source: Statistical Office of the EC, *Eurostat Review 1971-1980*, 1982.

price is inclusive of any producer subsidy. π_x^j adjusts so that supply equals aggregate demand.

The market clearance condition is:

$$Y_x^j = \sum_{i \in J} M_x^{ij} \quad (1)$$

Y_x^j represents production of good x in region j , M_x^{ij} represents import demand for good x (for both intermediate and final use) from region j in region i , and M_x^{jj} is the demand for commodity x produced domestically in region j .

Equation (1) is modified when a commodity is included in the CAP. When $x \in \text{CAP}$ and $j \in C$, we have

$$Y_x^j = \sum_{i \in C} M_x^{ij} + G_x^j + VX_x^j \quad (2)$$

where G_x^j represents government intervention purchases and VX_x^j represents voluntary exports to non-member countries.

The existence of a CU implies discriminatory import tariffs and export subsidies. There is "free trade" in all commodities between member countries, but export subsidies and import tariffs apply on trade with and between non-member countries.⁶ This means that buyer prices in region $i \in N$ of commodity x from region j will typically differ from π_x^j which apply in region $j \in C$.

Let Π_x^{ij} denote the buyer price of commodity x from region j in region i . All consumers in region i pay this price. Π_x^{ij} is determined by the relationship between regions i and j . First, $\Pi_x^{jj} = \pi_x^j \forall x \in X$ and $j \in J$. Next, when *both* i and j are in the CU we have $\Pi_x^{ij} = \pi_x^j(1 + \eta_x^i \theta^n)$, where η_x^i is the basic rate of non-tariff protection on good x in region i , and θ^n is the proportion factor for non-tariff protection applied to member *vis-a-vis* non-member countries. When *neither* i nor j is a CU member, then $\Pi_x^{ij} = (1 - s_x^j)(1 + t_x^i + \eta_x^i) \pi_x^j$, where s_x^j is the rate of subsidy on commodity x exports from region j and t_x^i is the tariff rate on commodity x imports imposed by region i . If j is a member and i is a non-member, then s_x^j is replaced by s_x^* , the common subsidy rate in the CU. If, on the other hand, i is a member and j is a

⁶ Non-tariff barriers may apply to trade within the union.

nonmember then t_x^i is replaced by t_x^* , the CET on good x . Table 2 summarizes these relationships between tariff distortions and import prices.

TABLE 2

Π_x^{ij}	Exporting Country j	
	Importing Country i	
	$j \in C$	$j \in N$
$i \in C$	$(1+\eta_x^i \theta^n) \pi_x^j$	$(1-s_x^j)(1+t_x^* + \eta_x^i) \pi_x^j$
$i \in N$	$(1-s_x^*) (1+t_x^i + \eta_x^i) \pi_x^j$	$(1-s_x^j)(1+t_x^i + \eta_x^i) \pi_x^j$

In the expressions for Π_x^{ij} subsidies are paid first and tariffs then apply on the subsidy-inclusive price. For example, the tariff revenue collected per unit commodity x flow between two non-member countries is given by $(1-s_x^j) t_x^i \pi_x^j$ per unit.

3B. The Common Agricultural Policy

When $x \in \text{CAP}$ the producer price is supported by a lower bound in real terms.⁷ This "intervention price constraint" is written

$$\pi_i^j \geq \bar{\pi}_x \lambda \quad (3)$$

where $\bar{\pi}_x$ is the nominal target price and λ is the numeraire price index for CAP constraints (typically the consumer price index in a large member country). The intervention price constraint is accommodated through the level of government purchases, G_x^j .

⁷ This formulation differs from the treatment of the CAP adopted in Spencer (1985; p.128) (1986; p.134) in which export subsidies are endogenously determined such that EC agricultural output stays at the benchmark level. Grais (1986; p.147) criticizes this way of formalizing the CAP, encouraging an approach like our own that is more in keeping with the way the CAP actually works. Stoeckel (1985; p.54) and Breckling, Thorpe, and Stoeckel (1987; p.12) model the CAP as an exogenous set of tariffs on imports, subsidies on exports, subsidies on domestic production, and changes in factor productivity in agriculture. In our model the first two of these are endogenously determined, which seems more in keeping with the way the CAP works. (Of course, if these exogenous values happen to equal the endogenous solution values that are implied by administered CAP prices then the final GE solution should, *ceteris paribus*, be the same.)

The export subsidy rate for CAP commodities is determined endogenously through market demand and the level of intervention purchases. A scalar parameter κ_x determines the share of government purchases which are released to world markets. The portion entering stockpiles is therefore $(1 - \kappa_x)$. The export market for CAP goods is then:

$$\bar{X}_x^j + \kappa_x(G_x^j - \bar{X}_x^j) + VX_x^j \geq \sum_{i \in N} M_x^{ij} \quad (4)$$

where \bar{X}_x^j represents the reference export level. By setting $\kappa_x = 0$, export volume can become exogenous. The voluntary export activity, $VX_x^j \geq 0$, assures that the domestic producer price for CAP commodities remains above the world market export price of those goods. When $VX_x^j > 0$, the two prices are equal.

Import prices of CAP goods are fixed in real terms. This means that the CET on $x \in \text{CAP}$, t_x^* , is replaced by an endogenous discriminatory tariff, τ_x^j , which adjusts to accommodate the target price constraint:

$$\pi_x^j (1 - s_x^j)(1 + \tau_x^j) = \pi_x^T \lambda \quad x \in \text{CAP}, j \in N \quad (5)$$

in which π_x^T is the target price defined in terms of the numeraire commodity price λ .

3C. Import Markets

There is a market for commodity x inputs in region j . The input price p_x^j is the tariff-inclusive price of the commodity x aggregate in region j . This price adjusts so that imports plus retained domestic production satisfies intermediate and final demand. This constraint is:

$$g(M) = \sum_{y \in X} Y_y^i a_{xy}^i + c_x^i \quad (6)$$

In this expression:

c_x^i represents final demand for commodity x in region i which arises from budget-constrained income maximization.

$Y_y^i a_{xy}^i$ represents intermediate demand for commodity x in commodity y production in region i . Production functions are linearly homogeneous, so a_{xy}^i is determined by prices and is independent of the level of output.

$g(\cdot)$ represents a two-level CES aggregate. In this aggregation, tariffs are levied on imports. Cost-minimization determines the composition of import demand. We assume a two-stage budgeting process. Domestic product (M_x^{ii}) trades off at the top level against an aggregate of imported commodities, and imports from different trading partners ($M_x^{ij}, i \neq j$) substitute at the second level.

Due to considerations of dimensionality and data availability, this formulation does not distinguish between the import composition of, and degree of substitution in, intermediate and final demand.

3D. Factor Markets in the Long Run

Factors of production are allocated through competitive markets. A price w_k^i applies for factor k in region i . Factor prices freely adjust so that supply satisfies production and final demands. Market clearance requires

$$V_k^i = \sum_{x \in X} Y_k^i b_{kx}^i \quad (7)$$

where V_k^i is the inelastic supply of factor k held by region i and b_{kx}^i represents a price-responsive unit-input coefficient for factor k in commodity x production in region i .

3E. Factor Markets in the Short Run

The long-run version of our model assumes that the relative wage of Labor in each region is perfectly flexible, and that the benchmark equilibrium is characterized by the full employment of all available factors. In a variant of the model presented in Harrison and Rutherford (1989) we introduce a constraint that real wages not be allowed to fall from their benchmark value. Specifically, we assume $w_1^i \geq \bar{w}^i$ where w_1^i refers to the price of Labor in region i , \bar{w}^i is the exogenous lower bound, and ω^i is the *numeraire* price index for wages in region i . (That is, ω^i is the price of a unit of region i 's utility.) Thus we are, in effect,

assuming that the wage is downwardly rigid in terms of a region-specific (and hence taste-specific) bundle.^{8 9}

This constraint does not change any of the calibration procedures for the model. In the benchmark GE the wage is still unity, as required. All that is changed is the ability of the wage to change in some counter-factual simulation. The rigid wage constraint is accommodated by changes in the unemployment rate in each region. Assume for the moment that benchmark unemployment is zero. If the wage constraint is slack then unemployment stays at zero; if the wage constraint is binding then unemployment rises and the employed labor supply declines until that constrained wage is in a GE.

We also allow for the *existence* in the benchmark GE of some positive unemployment in each region. In 1985 the unemployment rates were actually 8.6%, 10.1%, 10.5%, 10.6%, 11.2%, 11.3%, 7.3%, and 17.4% for Germany, France, Italy, the Netherlands, Belgium, the United Kingdom, Denmark, and Ireland, respectively.¹⁰ Denote these rates, in fractional form, as μ^i for region i . To allow for *existing* unemployment in the benchmark GE we augment the reported supply of *employed* labor, V_1^i , by the ratio $1/(1 - \mu^i)$. Thus if unemployment in a region were 11% we would increase the observed labor supply by $1/(1 - 0.11) = 1.1236$ to allow for the unobserved endowment of labor that was unemployed. In our benchmark GE the solution value of μ^i is precisely this assumed (positive) value, thus the *employed* labor supply in our benchmark GE is exactly as it was when we assumed zero initial unemployment.

⁸ An alternative formulation adopted by Whalley (1985; Ch.13) is to state the rigidity in real wages in terms of the wage-rental ratio. Harrison and Rutherford (1989) compare this formulation with the one adopted here, and find that it leads to much smaller welfare impacts for most of the policies considered there. The intuition for this result is simple enough: if the labor *and* capital markets are both able to adjust to ensure full employment of the existing (employed) labor force we are more likely to observe no change in unemployment than when *only* labor markets are able to adjust, as in our formulation.

⁹ We could easily adopt a common numeraire price index for all EC regions, but this makes very little sense intuitively: why should British workers, or unions, care if the wage they receive is constrained not to fall below the benchmark value in terms of what Frenchmen like to eat?

¹⁰ These rates were taken from Table 2.20, "Standardized Unemployment Rates", of the OECD (1987) for all countries except Denmark and Ireland, for which we used Table 2.15, "Unemployment as a Percentage of Total Labour Force". In contrast with the EC, the 1985 rates for Japan and the United States were only 2.6% and 7.1%, respectively.

However, it is then possible in some *counterfactual* GE solution for the employed labor supply to be augmented by a reduction in unemployment.

The short run may also be characterized by the inability of sectoral capital stocks to adjust in order to equalize any differences in rates of return that might have been induced by our policy change. We assume that in the initial benchmark equilibrium that domestic capital markets are in equilibrium.

3F. Production Functions

All commodities are produced using nested CES functions $f_x^i(\cdot)$ which exhibit constant returns to scale in factor and commodity inputs. Vectors a_x^i and b_x^i represent vectors of commodity and primary factor unit inputs in the production of commodity x in region i . These input coefficients are determined by cost minimizing producers who take market prices and value added taxes as given. The producer problem is

$$\min_{a,b} \left\{ \sum_{y \in X} p_y^i a_{yx}^i + (1 + v_x^i) \sum_{k \in K} w_k^i b_{kx}^i \right\} \quad (8)$$

subject to: $f_x^i(a,b) = 1$.

Two forms of intervention apply to commodity production. A production subsidy σ_x^i applies to output and the value-added tax v_x^i applies to primary factor inputs. In CU-member countries, the production subsidy is paid by a central authority while the VAT revenue is returned lump-sum to consumers. In non-member countries, both flows are associated with national income. These exogenous tax rates appear in the associated zero-profit condition:

$$\pi_x^i \leq (1 - \sigma_x^i) \sum_{y \in X} p_y^i a_{yx}^i + (1 + v_x^i) \sum_{k \in K} w_k^i b_{kx}^i \quad (9)$$

Consistent with the assumption of constant returns to scale, this constraint ensures that the domestic buyer price inclusive of production subsidy be sufficient to cover the cost of commodity inputs, factor inputs, and value-added taxes.

3G. Final Demand

A country-specific nested-CES utility function defined over commodities characterizes each region's preferences. In order to generate scenarios for a short-run to medium-term period, we avoid explicit characterization of savings and investment behaviour. This may also be interpreted as assuming an identical commodity composition of final demand and investment. Under this assumption each region's budget is exhausted by demands for traded commodities.

We now describe sources of income for each country. Primary factor income is $PFI^i = \sum_{k \in K} w_k^i V_k^i$. Each country independently collects value-added taxes on primary inputs:

$$VAT^i = \sum_{x \in X} v_x^i Y_x^i \left[\sum_{k \in K} b_{kx}^i w_k^i \right] \quad (10)$$

Let TAX^i represent net revenue from production subsidies, export subsidies, and import tariffs. The calculation of this value for current and acceding CU countries is detailed in the following subsection. Non-member countries administer their own taxes, and the net value of region i revenue is given by:

$$TAX^i = - \sum_{x \in X} \left\{ \sigma_x^i Y_x^i \pi_x^i - \sum_{i \neq j} M_x^{ij} s_x^i \pi_x^i + \sum_{i \neq j} M_x^{ij} t_x^i \pi_x^j (1 - s_x^j) \right\} \quad (11)$$

In this calculation the export subsidy s_x^j applies directly on the output price π_x^j while the import tariff applies on the price inclusive of subsidy but net of rents from non-tariff barriers. These rents are given by:

$$NTB^i = \sum_{x \in X} \left\{ \sum_{i \neq j} M_x^{ij} \eta_x^i \pi_x^j (1 - s_x^j) \right\}.$$

With a given level of income, final demand in each region is selected to maximize aggregate utility, solving the following optimization problem:

$$\max_{c^i} U^i(c^i) \quad (12)$$

subject to:

$$\sum_{x \in X} p_x^i c_x^i \leq PFI^i + VAT^i + TAX^i + NTB^i$$

in which c^i represents a vector of final demands for commodities. The optimal choices which arise out of this subproblem are demand functions c_x^i in (4).

3H. Funding of CU Subsidies

We adopt a stylized representation of CU financial policy. Each CU member forfeits tariff revenues to a non-profit central authority which pays all export and production subsidies. Assuming the cost of subsidies exceeds tariff revenues, the member country pays a *fixed share* of the net operating costs of the central authority. That is, if subsidy payments less tariff revenues equal S , then member region i pays $C^i = \phi^i S$. ϕ^i is an exogenous parameter and S is determined by trading equilibrium.¹¹ In equilibrium, if the value of tariff revenue exceeds subsidy payments (i.e., $S < 0$) then these same shares determine the division of net revenue.

The cost of operating the union involves a number of outlays and collections in member and acceding countries. The following expression summarizes these income flows:

$$\begin{aligned} S = & \sum_{x \in \text{CAP}} \left\{ \sigma_x \pi_x^i Y_x^i + s_x^* \pi_x^i \left[\sum_{j \in N} M_x^{ji} \right] - t_x^* \left[\sum_{j \in N} \pi_x^j (1-s_x^j) M_x^{ij} \right] \right\} \\ & + \sum_{x \in \text{CAP}} \left\{ \sum_{j \in C} \pi_x^j \left\{ (1-\kappa_x) G_x^j - (1-s_x^j) [\bar{X}_x^j + \kappa_x (G_x^j - \bar{X}_x^j)] \right\} - \sum_{j \in N} \tau_x^j (1-s_x^j) \pi_x^j \left\{ \sum_{i \in C} M_x^{ij} \right\} \right\} \end{aligned} \quad (13)$$

3I. Endogenous Pareto-Equivalent Funding

The basic version of our model employs fixed funding shares for member countries. In a given counterfactual experiment there will be differential impacts on the members. When EC expenditures rise, some countries (those receiving subsidies) will be helped, and other member countries (those contributing proportionately more than they receive) will be hurt. Almost invariably a change in EC policy helps some members and hurts others. We would

¹¹ Values of ϕ^i are determined from benchmark contributions, \bar{C}^i . By microconsistency, $\sum \bar{C}^i = \bar{S}$, the benchmark union expenditure. Let $\bar{C}^{j+} = \max(\bar{C}^j, 0)$. Then $\phi^i = \bar{C}^{i+} / \sum \bar{C}^{j+}$. This ensures $\phi^i \geq 0$, $\forall i$ and $\sum \phi^i = 1$. $\sum \bar{C}^{j+}$ exceeds \bar{S} by an amount equal to the lump-sum transfers.

like, however, to distinguish those policy changes that are *potentially* beneficial to all member countries with appropriate adjustments in contribution rates. The simple approach would be to sum the equivalent variations for member countries and reach a conclusion based on whether the sum is positive or negative. Such a method fails to capture the general-equilibrium effects that result from the implied redistribution of income between agents. To avoid these inconsistencies, we have developed an extension of the standard GE model in which intra-EC lump-sum redistribution is determined endogenously so as to *equalize the welfare impact on member countries*.

The equalization of welfare involves expanding the equilibrium problem to incorporate variables C_j representing the contribution level for member country j . C_j has an associated constraint:

$$U_j \leq W, \quad j \in C \quad (14)$$

that relates U_j , the linearly homogeneous utility index for j , and W , a variable representing the Pareto-equalizing welfare level for member countries. W has an associated constraint:

$$\sum_{j \in C} C_j \leq S \quad (15)$$

in which S is defined by (13). Intuitively, it can be seen that these conditions have the appropriate properties: a decrease in S leads to an increase in W ; while an increase in U_j relative to W produces an off-setting increase in C_j .

We use this extension to distinguish potentially welfare-improving policies from those that are not. In the process, the equilibrium adjustments in contribution rates provide insights into the nature of gains and losses from policy changes.

3K. Empirical Implementation

Harrison, Rutherford, and Wooton (1989a) describe an extensive microconsistent database developed to empirically calibrate this model. They also describe the procedures used to calibrate a "generic" version of this model to a benchmark equilibrium for a given year. Once benchmarked, the model will replicate the observed economy in terms of

expenditure patterns, production patterns, and trade flows, *inter alia*. The current version is "non-generic" because of the inclusion of the CAP and the allowance for unemployment.

The basic database spans each of the years from 1973 to 1985. Our benchmark calibration procedure applies for any representative year in this sequence and does not impose intertemporal consistency in any sense. The general procedures for calibrating to a given year are quite standard; all that is different here is that we have a number of years, in sequence, that we may calibrate to. It is important to realize that when we report results of some simulation over a number of years we are solving a *distinctly calibrated* model for each of those years, rather than solving a single model for a dynamic solution path.

Our model has eleven regions and six goods per region. The goods are: (1) Agriculture, Forestry, and Fishing (AGR); (2) Food, Beverages, and Tobacco (FOO); (3) Energy and Mining (E&M); (4) Manufacturing (MAN); (5) Trade and Transport (T&T); and (6) Services (SER). The first two goods are subject to the CAP in our model. The regions are Germany (GER), France (FRA), Italy (ITA), The Netherlands (NET), Belgium (BEL), the United Kingdom (UKI), Denmark (DEN), Ireland (IRE), the United States (USA), Japan (JAP), and a residual Rest-of-World region (ROW). We do not model Luxembourg, Greece, Spain, and Portugal, all current members of the EC, since we did not have data available for them.¹²

There are three primary factors of production: Labor, Capital, and Land. No factor is internationally mobile. Labor and Capital are employed in all sectors, whereas Land is specific to the (first) Agricultural sector. As noted earlier, we have two alternative formulations of the Labor market in each region: one in which the real wage is downwardly rigid and there is (classical) unemployment in the benchmark; the other in which Labor is freely mobile between sectors. Each of these formulations of the Labor market is accompanied by an assumption regarding Capital mobility. In the former, short-run scenario,

¹² See Harrison, Rutherford, and Wooton (1989a) for further discussion of the data requirements.

Capital is unable to move between sectors; while in the latter, long-run case Capital is freely mobile across the sectors of each country.

3J. Computational Considerations

Our model is solved using Rutherford's (1988) general-purpose modelling system, MPS/GE, which implements Matheisen's (1985) sequential complementarity algorithm. In this formulation the model is represented by a system of inequalities corresponding to exhaustion of product conditions for all production and trade sectors, market clearance conditions for all goods and factors, and budget constraints for each of the regions.¹³ The model represents roughly 400 equations. A typical counter-factual calculation takes about 90 seconds on a VAX 6330, 6 minutes on a 16MHz 80386 PC, or 65 minutes on a 4.77MHz 8086 PC laptop.^{14 15}

4. RESULTS

Our basic simulation results are presented in Tables 3, 4, and 5, each reflecting different assumptions regarding time horizon and factor mobility (the welfare changes being expressed in terms of equivalent variations). Tables 6 and 7 report more detailed results for the year 1985. Apart from our "base" replication of the benchmark GE, we report two counter-factual simulations.

¹³ The choice of solution algorithm can have implications for the results of an analysis. Grais (1986; p.147-8) suggests that the algorithm used by Spencer (1986) may have influenced his indirect treatment of administered prices in the CAP. Much more seriously, however, the use of "linearization" solution techniques in Stoeckel (1985) and Breckling, Thorpe, and Stoeckel (1987) can lead to completely erroneous conclusions. Indeed, they (p.21) explicitly note that "... the linearisation errors in the current application are substantial, especially for trade variables" since they study "large" changes in exogenous variables. We treat the explicit *non-linear* system, so linearization errors are avoided.

¹⁴ The Pareto-equivalent calculations are considerably more CPU-time intensive, taking about 8 minutes to solve on a VAX 6330.

¹⁵ An Appendix (available on request) documents the software that has been developed to generate the database for various aggregations of regions and sectors, construct a benchmark equilibrium for a given year, generate the model and MPS/GE input file for various counter-factual cases, and produce an easily interpreted report of the model results after the model has been solved by MPS/GE. We will gladly make this software available to anybody wishing to replicate, extend, or criticize our simulation results.

The first counterfactual simulation refers to the complete removal of all agricultural support programs in the EC under the stylized representation of EC financial policy detailed in Section 3H (above). For those goods subject to the CAP, we set all export subsidies, import tariffs, and production subsidies to zero. The government does not support the *TP* or *IP*. We do not allow for the effects of disbursing existing stocks in the CAP, preferring to focus attention on the static effects of the removal of the CAP.

The second counterfactual simulation determines the maximum welfare gain (or minimum loss) that can be equally shared by member nations of the EC when CAP support is eliminated. Thus member-country contributions are endogenously adjusted in order that their welfare indices are equalized at the biggest possible common level.

4A. Long-run Welfare Effects

The long-run impact of eliminating the CAP is reported in Table 3. In each year, from 1974 to 1985, we calculate the effects on each country (or region) of the EC discontinuing its agricultural support programs. In the second column of the table we list the maximum welfare benefit that can be shared by members of the EC. These numbers are also illustrated in Figure 4.

It is evident that the overall welfare cost of the CAP to the EC as a whole has grown substantially. The rising loss seems to follow closely the expansion in expenditure on the CAP, shown in Figure 3. In addition, across the period, the distribution of the burden of the CAP has changed. Initially the CAP favored Germany, Belgium, and the United Kingdom at the expense of The Netherlands, Denmark, and Ireland. By 1985 the tables had turned and the first three countries had become losers from the CAP, with the latter group its major beneficiaries. France, however, has always lost from the CAP, while Italy had a brief period of benefit from the CAP. As the CAP has expanded, countries outside the EC have generally benefited from it, largely due to the CAP's maintenance of low world prices for imported agricultural and food products.

TABLE 3

IMPACT OF ELIMINATION OF THE CAP: LONG-RUN MODEL

PERCENTAGE CHANGE IN WELFARE

Year	Pareto	GER	FRA	ITA	NET	BEL	UKI	DEN	IRE	USA	JAP	ROW
1974	-0.04	-0.23	0.07	0.02	0.38	-0.09	-0.10	0.11	0.80	0.05	-0.10	0.06
1975	0.04	-0.09	0.15	0.09	0.17	-0.08	0.02	-0.10	0.40	0.06	-0.08	0.02
1976	0.08	0.05	0.11	0.13	0.02	-0.07	0.13	-0.11	0.32	0.02	-0.07	0.02
1977	0.10	0.07	0.16	0.19	-0.05	-0.10	0.12	-0.22	0.24	-0.02	-0.06	0.01
1978	0.18	0.13	0.32	-0.01	-0.04	-0.04	0.43	-0.32	0.14	-0.03	-0.05	-0.01
1979	0.16	0.30	0.13	-0.10	-0.30	-0.09	0.58	-0.51	-0.12	-0.04	-0.13	-0.01
1980	0.18	0.40	0.02	-0.11	-0.24	0.23	0.60	-0.46	-0.23	-0.04	-0.13	-0.02
1981	0.13	0.28	0.16	0.07	-0.17	-0.01	0.18	-0.29	-0.05	-0.02	-0.08	-0.01
1982	0.10	0.27	0.13	0.05	-0.23	-0.01	0.12	-0.31	-0.09	-0.01	-0.06	-0.01
1983	0.13	0.31	0.16	0.07	-0.25	0.04	0.18	-0.42	-0.22	-0.03	-0.05	0.00
1984	0.15	0.33	0.17	0.07	-0.22	0.06	0.17	-0.38	-0.18	-0.05	-0.03	0.00
1985	0.15	0.34	0.16	0.06	-0.24	0.08	0.18	-0.38	-0.21	-0.04	-0.02	0.00

TABLE 4

IMPACT OF ELIMINATION OF THE CAP: SHORT-RUN MODEL, CAPITAL MOBILE

PERCENTAGE CHANGE IN WELFARE

Year	Pareto	GER	FRA	ITA	NET	BEL	UKI	DEN	IRE	USA	JAP	ROW
1974	0.00	-0.36	0.24	0.06	0.97	0.08	-0.15	0.51	1.87	0.10	-0.25	0.13
1975	-0.04	0.29	0.22	0.00	0.50	0.00	-0.13	0.02	1.07	0.10	-0.22	0.06
1976	0.01	-0.12	0.13	0.04	0.18	-0.06	-0.03	-0.07	0.85	-0.02	-0.23	0.03
1977	-0.05	-0.17	0.10	0.04	-0.05	-0.15	-0.14	-0.35	0.64	-0.12	-0.24	-0.02
1978	0.00	0.12	0.28	-0.28	-0.15	-0.12	0.27	-0.57	0.40	-0.15	-0.23	-0.07
1979	-0.22	-0.05	-0.19	-0.58	-0.69	-0.35	0.26	-1.09	-0.20	-0.21	-0.36	-0.12
1980	-0.13	0.14	-0.29	-0.56	-0.53	0.09	0.34	-0.94	-0.36	-0.22	-0.37	-0.14
1981	-0.06	0.12	0.01	-0.18	-0.33	-0.11	-0.09	-0.56	-0.02	-0.13	-0.26	-0.09
1982	-0.13	0.06	-0.04	-0.23	-0.50	-0.16	-0.21	-0.69	-0.14	-0.11	-0.21	-0.06
1983	-0.16	0.06	-0.08	-0.29	-0.61	-0.14	-0.21	-0.96	-0.41	-0.12	-0.18	-0.06
1984	-0.12	0.11	-0.03	-0.24	-0.57	-0.10	-0.19	-0.86	-0.31	-0.15	-0.16	-0.04
1985	-0.14	0.11	-0.07	-0.27	-0.62	-0.10	-0.19	-0.89	-0.37	-0.14	-0.14	-0.04

4B. Short-run Welfare Effects

Our results are quite different when unemployment of Labor is taken into account. Table 4 reports the effects of capital elimination when Capital is assumed to be intersectorally mobile, while Table 5 lists the results under the assumption of sector-specificity of Capital. The potential Pareto effects are illustrated in Figure 5.

Consider first the case in which Capital is assumed to be mobile. The startling result is that, as the size of the CAP has grown over the years, so too has the cost of eliminating the programs. The difference from the long-run case is that the contraction of the agricultural sector no longer releases a stock of Labor to productive employment in the other sectors of the economy. There already is a substantial level of unemployment in each of the European nations and the elimination of the CAP adds to this surplus.

The distribution of the burden of the CAP over the years is much like that for the long-run case. Germany is an early beneficiary of the CAP, but eventually becomes the major (in fact, the only) loser in later years. The United Kingdom's fortunes differ in that for 1981-1985 it reverts to being a beneficiary of the agricultural programs.

Consider now the short-run case in which Capital is assumed to be sector specific. Now when the CAP is eliminated, Capital and Land remain locked in agriculture and disparities in rates of return to capital appear between sectors of the economy. As a result, Labor unemployment is not as great and hence the costs of eliminating the CAP are diminished, such that for all but 1983 there is a potential Pareto gain from ending agricultural support.¹⁶ These gains have diminished over time, as the size of the CAP has expanded and the costs from rising unemployment have increased.

What has arisen is an incarnation of the familiar Theory of the Second Best. There are several distortions in the EC (for example, the CAP and unemployment) and the removal of one (the CAP) does not guarantee a welfare improvement. The existence of yet another

¹⁶ For 1976, removal of the CAP yields, even without any special redistributive measures, a welfare gain to all members of the EC.

TABLE 5

IMPACT OF ELIMINATION OF THE CAP: SHORT-RUN MODEL, CAPITAL FIXED
 PERCENTAGE CHANGE IN WELFARE

Year	Pareto	GER	FRA	ITA	NET	BEL	UKI	DEN	IRE	USA	JAP	ROW
1974	0.09	-0.27	0.33	0.10	1.11	0.14	-0.06	0.73	1.94	0.08	-0.26	0.11
1975	0.10	-0.17	0.37	0.09	0.72	0.08	0.02	0.35	1.24	0.08	-0.22	0.04
1976	0.15	0.01	0.28	0.13	0.43	0.03	0.15	0.28	1.04	-0.03	-0.24	0.02
1977	0.11	-0.03	0.28	0.15	0.23	-0.07	0.06	0.04	0.88	-0.13	-0.24	-0.03
1978	0.20	0.03	0.50	-0.16	0.21	-0.03	0.53	-0.09	0.70	-0.16	-0.23	-0.08
1979	0.01	0.12	0.05	-0.43	-0.30	-0.25	0.53	-0.58	0.14	-0.22	-0.35	-0.12
1980	0.06	0.28	-0.08	-0.42	-0.22	0.18	0.55	-0.52	-0.02	-0.22	-0.35	-0.14
1981	0.08	0.22	0.17	-0.08	-0.10	-0.06	0.06	-0.24	0.21	-0.13	-0.25	-0.09
1982	0.01	0.18	0.11	-0.13	-0.25	-0.10	-0.04	-0.36	0.09	-0.11	-0.20	-0.06
1983	-0.01	0.19	0.09	-0.18	-0.33	-0.07	-0.01	-0.59	-0.15	-0.13	-0.17	-0.06
1984	0.03	0.24	0.13	-0.14	-0.30	-0.04	0.00	-0.51	-0.07	-0.16	-0.16	-0.04
1985	0.01	0.24	0.09	-0.17	-0.35	-0.04	0.00	-0.55	-0.12	-0.15	-0.13	-0.04

TABLE 6

IMPACT ON PRODUCTION OF ELIMINATION OF THE CAP, 1985
 PERCENTAGE CHANGE IN OUTPUT

A. Long-Run Effects

Good	GER	FRA	ITA	NET	BEL	UKI	DEN	IRE	USA	JAP	ROW
AGR	-2.2	-1.3	-1.4	-2.4	-3.0	-2.3	-1.5	-0.7	0.0	+0.1	+0.1
FOO	-5.5	-4.2	-3.6	-5.7	-9.5	-5.5	-4.6	-3.7	+1.6	+0.5	+0.5
E+M	+0.4	+0.7	+0.7	+0.8	+0.7	0.0	+1.4	+0.9	0.0	-0.2	-0.1
MAN	+1.0	+0.7	+0.8	+1.8	+1.0	+0.7	+1.4	+1.2	-0.1	0.0	-0.1
T+T	0.0	0.0	+0.1	-0.4	0.0	0.0	-0.7	-0.8	0.0	0.0	0.0
SER	+0.3	+0.4	0.0	-0.2	+0.2	+0.4	-0.3	-0.1	0.0	0.0	0.0

B. Short-Run Effects, Capital Mobile

Good	GER	FRA	ITA	NET	BEL	UKI	DEN	IRE	USA	JAP	ROW
AGR	-2.2	-1.5	-1.6	-2.4	-3.2	-2.7	-2.0	-0.7	0.0	+0.1	0.0
FOO	-5.8	-4.4	-3.8	-6.3	-9.6	-5.7	-5.2	-4.0	+0.8	+0.5	+0.5
E+M	0.0	0.0	0.0	+0.6	+0.7	0.0	+0.7	+0.7	0.0	-0.2	-0.1
MAN	+0.5	+0.7	0.0	+0.7	+0.8	0.0	+0.7	+0.9	-0.1	-0.4	-0.1
T+T	0.0	0.0	-0.1	-0.8	0.0	-1.0	-1.4	-0.8	-0.2	0.0	0.0
SER	0.0	0.0	-0.6	-0.5	0.0	0.0	-0.7	-0.4	-0.1	0.0	0.0

distortion (sector-specificity of capital) has however ameliorated the losses from eliminating the agricultural support programs.

4C. A Comparison

As an indication of the relative importance of the elimination of the CAP, for comparison we calculate the welfare impact of "completion of the market". This experiment, discussed in detail in Harrison and Rutherford (1989), calculates the effects of removing all the non-tariff barriers to trade within the EC. In the short run (with mobile capital), the EC faces a Pareto welfare gain of 7.9%, largely arising from the near eradication of unemployment in the community. Market completion potentially yields a common gain in the long run (assuming zero unemployment) of 1.8%, roughly ten times greater than that for the termination of agricultural support..

4D. Production and Employment Effects

In order to obtain some understanding of the processes at work when the CAP is eliminated, we focus on the results of a particular year (1985) and examine the changes that would occur in each country or region as a result of the policy change. The results are summarized in Tables 6 and 7.

We find that the elimination of the agriculture programs has a clear effect on production. By maintaining high agricultural prices in the EC, and simultaneously depressing these prices outside Europe, the CAP biased production towards Agriculture and Food in the EC and away from these commodity groups elsewhere. With the removal of the price and other distortions, Agricultural and Food production falls in all of the member countries of the EC, while it generally increases in the remaining regions of the world. These changes are substantial: for example, the fall in Belgium's Food production is 9.5% of the benchmark production level. The countries of the EC increase their production of Energy & Mining and Manufacturing while production of these commodities in the other regions declines or remains at the same level. Within the EC, the effects on output of Trade & Transport and Services are

TABLE 7**IMPACT ON UNEMPLOYMENT OF ELIMINATION OF THE CAP, 1985****PERCENTAGE OF LABOUR FORCE UNEMPLOYED**

Case	GER	FRA	ITA	NET	BEL	UKI	DEN	IRE	USA	JAP	ROW
Benchmark Level	8.6	10.1	10.5	10.6	11.2	11.3	7.3	17.4	7.10	2.60	7.61
Capital Mobile	8.9	10.4	11.0	11.2	11.4	11.8	8.2	17.6	7.26	2.79	7.67
CapitalFixed	8.7	10.2	10.9	10.9	11.3	11.6	7.7	17.3	7.27	2.78	7.67

relatively small and have no clear pattern; beyond the EC, there is no change in the production of these commodities.

In the short run, with intersectorally mobile capital, the effects on Agricultural and Food production within the EC are even more pronounced. Capital that is released from employment in these sectors is able to be used in production of other goods, whereas the binding minimum wage prevents this for workers who lose their jobs. The ranks of the unemployed swell in all parts of the EC while the short-run growth of industrial production is significantly smaller than in the long run. Table 7 reports the changes in unemployment levels.

When sector-specific capital is considered, we find the output responses to lie between those of the long run and the short run with mobile capital. In this case, capital is not able to respond to intersectoral differences in rates of return. There cannot be the same opportunity to substitute cheaper capital (as a result of the elimination of the CAP) for fixed-price labour. Food and Agricultural production does not decline as much, nor do the other industries expand to the same degree.

5. SUMMARY AND CONCLUSIONS

The Common Agricultural Policy is a cornerstone of the European economic alliance. In this paper we have developed a general equilibrium framework designed to provide a quantitative evaluation of the costs and effectiveness of the CAP programs for the member countries, the community as a whole, and their trading partners. This has led us to introduce several new developments to the theory and practice of numerical general-equilibrium modeling.

First, contrary to previous work on the CAP, we do not model the agricultural support program by fixed *ad-valorem* taxes and subsidies. In their stead, we incorporate endogenous tariffs, production subsidies, intervention storage purchases, export subsidies, and financing for

price supports. This not only makes the model more "realistic" but allows for more complex *endogenous* economic reactions to the experiment of liberalizing agricultural trade.

Second, we make use of a time-series database for the EC that spans the period from 1974 to 1985. We use counterfactual calculations to determine the consequences of complete removal of all of the EC's agricultural support programs in each year of our database. This has two significant benefits: our results are not dependent on the choice of some arbitrary base year; and we can compare the results of our simulations over time to determine the relative historical importance of the CAP as well as the shifting distribution of benefits and losses between EC members.

Third, international trade theorists continually propose the implementation of policies that are "potentially Pareto-improving", in that the gains are sufficiently large that, with the appropriate redistribution, all agents in the economy can experience some benefits. Almost invariably, some countries in a customs union will gain from a change in industrial policy and some others will lose. We introduce a technique that not only determines whether the elimination of the CAP is potentially Pareto-improving for the EC, but actually calculates the size of the maximum shared benefit and the pattern of redistribution necessary to support it.

Fourth, we conduct our experiments under two different assumptions regarding factor markets. We examine the results of discontinuing agricultural support both in the long run, once markets have adjusted fully to changes, and also in the short run, in the presence of general unemployment and sector-specificity of capital. This unemployment results from a downward rigidity of real wages and reduces the ability of the labor market to adjust to contractions in labour-intensive sectors, such as Agriculture.

Our long-run calculations indicate a substantial growth in the overall welfare cost of the CAP to the EC, with a significant change in the distribution of the burden of the CAP amongst the member countries. In particular, The Netherlands, Denmark, and Ireland have turned from being early losers from the CAP to become substantial gainers from its programs while the reverse is true for Germany, Belgium, and the United Kingdom. As the CAP has expanded,

countries outside of the EC have generally benefited from it. Eliminating the CAP is potentially Pareto-improving for the EC, yielding a 0.15% shared increase in welfare for 1985.

When labour is unemployed, as in our short-run model, the results are quite different. When capital is assumed to be mobile, the cost of eliminating the CAP has grown over the years, along with the program itself. The contraction of the agricultural sector releases Labor, not to productive activity in other sectors of the countries' economies, but to further increase the level of unemployment. Assuming capital to be sector-specific results in disparities in its rates of return within each country and consequently a smaller impact on unemployment as the CAP is eliminated. As a result, for most years, there is a potential Pareto gain from ending agricultural support.

This asymmetry of results for the short run and the long run presents an interesting problem for European policymakers. There are clear risks in the short run that, without the correct sidepayments to particular EC countries, there would be losers from the reform of the CAP. These risks are not so severe in the long run. Given that any major reform of the CAP would require a unanimous vote from all members of the EC, it is clearly important to have an explicit set of short-run sidepayments computed. On the other hand, these sidepayments are not the same ones needed in the long run to ensure a potential Pareto gain for all EC countries. The policy implication is that the *quid pro quo* for agreeing to reform the CAP must distinguish between temporary and long-run compensation in order for there to be any expectation of a Pareto gain for the EC.

Elimination of agricultural programs has a clear effect on production, leading to sizeable declines in the Agricultural and Food sectors of the member nations of the EC and, when labour is fully employed, complementary increases in the outputs of Energy & Mining and Manufacturing.

While our experiments show long-run benefits from eliminating the CAP, it is worthwhile to place these potential gains in some perspective. We estimate some of the

consequences of the completion of the market by calculating the impact of removing non-tariff barriers to intra-EC trade. Such a policy yields shared welfare gains in the order of 1.8%, roughly ten times that of moving to free trade in agriculture.

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