THE ECONOMIC CONSEQUENCES OF AGRICULTURAL SUPPORT: A SURVEY

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INTRODUCTION

This survey is directed towards the single question, simple to pose but difficult to answer: "What are the effects of OECD countries' agricultural policies on their economic well-being?" It presents a number of estimates and arguments from the official and academic literatures and assesses their merits. The discussion covers both aggregate economic welfare – real income – and various other dimensions of the "willingness to pay" for agricultural support, such as national security and the distribution of income, but concentrates on the long-run effects of policy, leaving short-run and transitional issues to another occasion. The article's broad conclusion is that while there is strong evidence of the direction and orders of magnitude of the effects – large negative effects on income with relatively small pay-offs in other dimensions – there is still considerable scope for argument about the precise numbers.

In view of the imprecision of the current estimates, the article also examines certain methodological issues surrounding the measurement of the costs of agricultural support. It concludes that, to date, insufficient effort has been devoted to the general equilibrium modelling of agriculture. A general equilibrium treatment is necessary because distortions in agriculture affect other sectors of the economy via factor markets, product markets, the balance of payments and the level of national income. Agriculture, industry and services compete for the same factors of production. Thus, if agriculture is stimulated in a world of reasonably full employment, other sectors almost certainly contract. Moreover, if agriculture is encouraged to adopt particularly capital-intensive modes of production, it can drive down wages and/or employment throughout the economy for, by attracting capital disproportionately out of industry and services, it drives down labour productivity there. The balance-of-payments connection is similar. In the long run the balance of trade is determined largely by the amount that a country wishes or is able to borrow or lend abroad. Thus, if net exports of agriculture expand, net exports of other tradeables – typically manufactures – must contract. Finally, if agricultural intervention wastes resources, the level of real expenditure within the economy must be lowered, thus reducing the demand for output in the non-farm sector.

Parts I and II deal with these aggregate and broad sectoral issues, starting in Part I with the methodological issues. The latter introduces the simple partial equilibrium analysis of a distorted market, examines the assumptions necessary to render this model's estimates of the costs of agricultural protection accurate and discusses the consequences of relaxing these assumptions. Part II presents various empirical estimates of the effects of agricultural policy, ranging from studies of single small sectors, e.g. the market for eggs, through to complex multi-country, multi-commodity, general equilibrium models. It presents only a small sample of the many single sector studies extant but attempts to be comprehensive among the latter, more sophisticated, group. Throughout these sections the emphasis is on the maximization of (appropriately measured) national welfare.

Part III of the article switches attention to the other side of the ledger – the objectives and perceived benefits of agricultural support. These include its implications for the distribution of income, rural population levels, national security and the environment.

The article concerns the economic consequences of agricultural intervention, and *so* it uses only economic criteria as measuring rods. This is not to deny the legitimacy of non-economic objectives for agricultural policy, but merely to stress that rational governments must recognize the concommitant economic consequences of their policies. Thus they must assess both the effectiveness of agricultural policy in achieving non-economic goals and the costs or benefits of such policy in terms of society's total economic well-being.

I. AGGREGATE ECONOMIC WELFARE

A. The conceptual framework

Although it is very simple, the partial equilibrium analysis of a distortion in a perfect market provides a useful starting point for the present task. Moreover, although much of the succeeding text is devoted to generalizing it, the qualitative results of that analysis prove remarkably robust.

Figure 1 summarizes the effects of imposing a tariff on imports of a single good, X. Under free trade, at price P, domestic production and consumption are Q and R respectively and imports $M = (R - Q)$. When the tariff $t\,(= VP/OP)$ is imposed, the internal price rises to V, domestic production and consumption become U and T respectively and imports fall to $M' = (T - U)$. The welfare

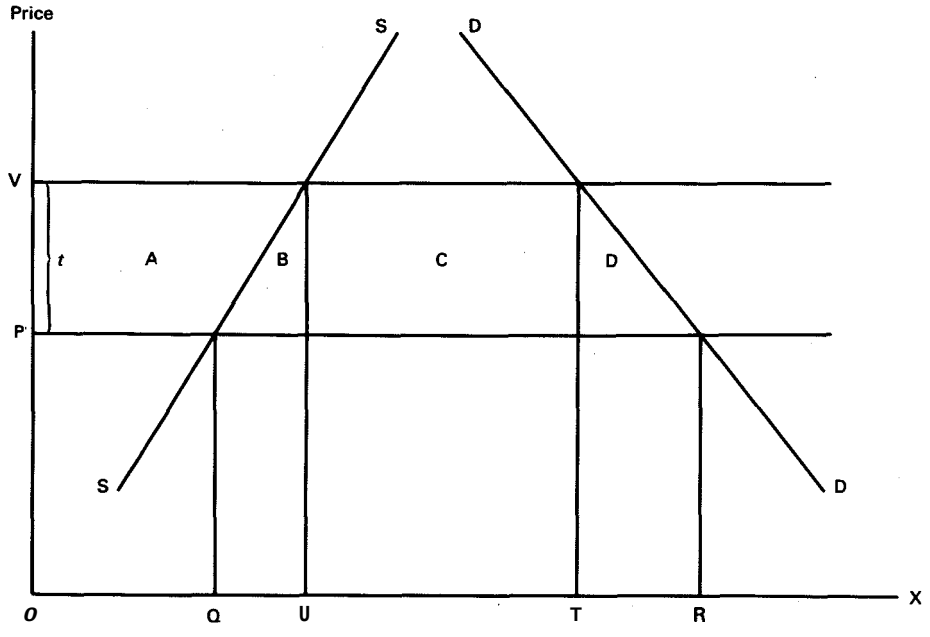
implications of this are as follows: consumer surplus falls by (A + B + C + D), producer surplus rises by A and government revenue rises by C (i.e. $M'*t$). The net effect is a social loss of (B + D), which is referred to in this survey as the deadweight loss'.

Even without generalization, this simple model provides some valuable insights. First, the deadweight loss from the tariff is quite distinct from the change in the government's revenue. This example entails deadweight loss but budgetary gain. While the effects of agricultural policy on the government budget may have some economic significance, this survey will concentrate on the much more important macro-economic issue of their overall economic cost. It will be assumed that, in order to neutralize the effects of changes in agricultural policy on the government's fiscal stance, compensating changes are made in taxes on expenditure, and that these have only second-order effects on resource allocation.

Second, policy is almost inevitably redistributive; in this case, the losses are concentrated on the consumers of X, while taxpayers and producers gain. The distributive effects of agricultural policy are discussed in Part III of this article; the

FIGURE 1

THE EFFECTS OF A TARIFF ON IMPORTS



bulk of the analysis in Parts I and II will concern society's total economic costs and benefits, implicitly assuming that governments can tackie redistribution by other means.

Third, the deadweight losses increase in proportion to the square of the tariff rate: tariffs of 20 per cent are four times as costly as tariffs of 10 per cent. Fourth, the deadweight loss is proportional to the elasticity of demand for imports, which is itself a function of the elasticities of supply and demand. Thus, the costs of taxing inelastic goods are lower than those of taxing more elastic goods, because the distortions – the changes in quantities – are smaller[2]. Fifth, similar analyses can be applied to other agricultural policies, including export subsidies, deficiency payments, and production quotas. All such interventions appear economically costly relative to the optimum of free trade.

The remainder of this section explores the assumptions necessary to justify the calculations just made, and considers how relaxing them affects both the outcome and the methodology of measuring the costs of agricultural protection.

B. Perfect competition

The partial equilibrium analysis presupposes that all domestic markets are perfectly competitive with respect to production, consumption and trading, and that the only distortion is the tariff under consideration. Under these circumstances, price equals both marginal cost and the marginal utility of consuming X in money terms, and tariffs and quotas are equivalent in the sense that a quota yielding implicit tariff t has the same effects as an explicit tariff of t. In most OECD countries agricultural production, consumption and trade are broadly competitive, so it does not seem necessary to pursue the issue of market power in agriculture further; distortions in other sectors of the economy, on the other hand, are important and are discussed below.

C. Infinitely elastic supplies of imports

These are reflected in Figure 1 by the horizontal supply curve for imports. They imply that the country is small and can buy or sell any amount of X without affecting its world price. This assumption is both significant to the analysis and frequently violated. With an upward-sloping foreign supply curve, cutting imports drives down their price, thus improving the importer's terms of trade and, possibly, more than offsetting the distortionary internal costs of the tariff. Similar arguments pertain to exporters. A country supplying a large proportion of world imports of X may face a downward-sloping demand curve; this grants it monopoly power which may render

export taxes beneficial from a nationalist point of view. Many OECD countries find themselves with such market power and could apparently benefit, at least in the medium term, from restricting international trade.

In assessing the effects of agricultural policy, the generalization to include large countries requires at the minimum the specification of the parameters of the world export demand and import supply functions. However, since these functions reflect the interaction of demand and supply in *all* other countries of the world, a number of researchers model these phenomena directly in a multi-country framework. The advantages of doing *so* are that the direction of international trade, as well as its totals, may be calculated, and that other countries' policy reactions to the target country's policy may be dealt with explicitly.

D. The fixity of other goods' prices

This is implicit in the demand and supply curves of Figure 1. Consumers allocate expenditure among alternative uses according to relative prices and producers select their activities in response to relative returns. Thus, to examine demand and supply in own-price/quantity space requires that other prices be constant.

The substitutions between goods and activities can occur at any level, ranging from broad aggregates (e.g. between agriculture and industry or services) to very fine commodity distinctions (e.g. between different varieties of rice). They raise two methodological difficulties. First, they may generate exogenous shocks to the market for X complicating the identification of the effects of policy in that market. Second, and more important, they cause other markets to react endogenously to changes in the market for X. For example, cutting price support for barley may increase the excess supply of wheat, causing its price to fall and thus shifting the partial equilibrium supply and demand curves for barley. In practical terms, the important issue is the quantitative significance of these interactions. Many of them will be small enough to ignore, but not necessarily all of them.

To date, research has concentrated much more on the lower-level substitutions within agriculture than on the agriculture/industry/services divide. Many models of agricultural policy distinguish several commodities: some model their interactions explicitly, while others do *so* in an adhoc fashion by adjusting the own-price elasticities to allow for spill-overs into and out of other markets. Nearly all, however, assume that the links between agriculture and other sectors are negligibly small.

"Other goods" also figure in the analysis as inputs into agricultural production functions and as arguments in their supply functions. Thus, the markets for inputs may also need to be modelled: and not only those for agricultural produce,

e.g. feed-stuffs as inputs into livestock farming, but also those for industrial goods such as fertilizers, pesticides and machinery.

E. The constant marginal utility of income

This assumption is the analytical linch-pin of Marshallian consumer surplus. It is required in order that the pound spent (or not spent) on X at *R* be worth the same as, and hence be aggregatable with, the pound spent (or not spent) at T. Strictly speaking, this requirement can never be satisfied along the Marshallian (constant money income) demand curve; the money saved by buying *T* units of X rather than R will be spent on other goods, hence increasing consumption of those goods and reducing the utility derived from the marginal units. However, if X accounts for only a small part of consumers' budgets, these spill-overs will be small enough to ignore. Hence, while, say, the tomato sector may be small enough to permit this approximation, any study of agricultural policy in its entirety is likely to encounter serious problems with it. These will be compounded if the prices of other goods change endogenously, for then not only does the marginal utility of income change along the demand curve, but the demand curve itself shifts.

Economists have long been aware of these problems, and for nearly fifty years have known of theoretically superior methods of welfare measurement – ***compensating*** and ***equivalent variations*** (*CV* and *EV* respectively)[3]. Only recently, however, have these measures been operationalized, making use of dual cost or expenditure functions.

Two approaches exist, both based on Roy's Identity, which defines the relationship between any Marshallian demand system satisfying minimal regularity conditions and the well-behaved cost function that must lie behind it. First, Vartia (1981) and McKenzie and Ulph (forthcoming), among others, have derived numerical algorithms to calculate CV or *EV* for arbitrary shocks to arbitrary demand systems. However, while these calculations are now feasible, they are still relatively difficult and expensive to implement, and do still require the regularity properties mentioned. This has led other researchers to adopt a second approach. For a limited number of simple demand systems, both the cost function and the associated Marshallian demand curves may be written in explicit form using the same parameters. If one works with one of these systems, rather than with arbitrary demand equations, the cost function, and hence CV and EV, follow immediately once the parameters of the demand system are known. Popular demand systems such as the Linear Expenditure System, Constant Elasticity of Substitution Utility Function and the Almost Ideal Demand System are amenable to this treatment, and while the choice is limited it is broad enough to capture most of the forms of demand

behaviour that are identifiable from our imperfect data. Thus, at least in the sphere of modelling agricultural policy, the use of explicit cost functions probably represents the best way forward.

Similar comments apply to the calculation of producer surpluses. Dual profit functions may be defined relating the surplus from profit-maximizing levels of output to input and output prices; from these the consequences of simultaneous changes in several input and output prices may be calculated analogously (see, for example, McFadden, 1978).

Equivalent and compensating variations are also used to calculate the costs of protection in general equilibrium. Given a numeraire, it is possible to calculate the income equivalent of the changes in utility implied by a particular policy change. It is not necessary to value producer effects directly in full general equilibrium because they are captured in the reduced consumption of other goods, although they are still relevant if the costs of protection are to be attributed to particular groups or activities.

F. Processing industries

The preceding discussion implicitly assumes that all demand is final, but that is manifestly untrue for many agricultural goods. If the effects of policy on the sector purchasing X are not of direct interest, and if that sector satisfies all the assumptions required of the X-sector, then the manipulation of the intermediate demand curve as above will generate the correct conclusions about economic welfare.

The response of agricultural model-builders to this difficulty has been mixed. Within agriculture, production links are often reflected in great detail, but between agriculture and processing industries the treatment is somewhat patchy. Some researchers have modelled food processing industries explicitly, but more have either ignored them (working only with raw products), or aggregated them with primary agriculture. Finally, in certain sectoral studies, production is related to the rate of effective protection offered to producers: that is, the protection offered to primary factors in the X-sector after allowing for taxes or subsidies on the material inputs.

G. Factor prices

Factor prices are also assumed to be fixed in the simple partial equilibrium analysis, for if they are not, the supply curve will shift and the simple calculation of producer surplus will be biased. This assumption implies that the X-sector faces an infinitely elastic supply schedule for factors; for capital this may be legitimate, but for

labour it has been hotly contested. In the long run, labour mobility out of agriculture may be very high, but in the short term it may not be so. Moreover, even with perfect mobility the elasticity of labour supply is infinite only if the X-sector is small. If the rate of agricultural depopulation affects returns to labour in other sectors, agricultural policy may feed back onto the agricultural supply curve via those other sectors. This difficulty will be greatest when agricultural policy as a whole is being assessed.

Land prices are certainly not fixed with respect to agricultural policy, but in fact this does not cause great difficulties for the simple analysis of Figure 1. In *so* far as agricultural land has no alternative use, its return is pure economic rent. Then the supply curve should be defined by the supply price excluding rent, i.e. the value of marginal inputs having alternative uses, and rent to landowners absorbs part or all of the producers' surplus.

Non-land factor prices represent one of the crucial links between agriculture and the rest of the economy, i.e. in the broad economic consequences of agricultural policy. The stimulation of a significant agricultural sector will have material effects on the rest of the economy and feed back into agriculture itself. Moreover, the effects are not always obvious intuitively. For example, if agriculture is capital-intensive relative to the rest of the economy, policies designed to stimulate agriculture could lower wages throughout the economy, or cause unemployment if wages were rigid. This occurs because agriculture absorbs factors in different proportions from those in which they are released by other sectors. Suppose that the stimulation of agriculture led to the transfer of one unit of capital from industry to agriculture. With its relatively capital-intensive technology, agriculture would require fewer workers to operate that capital than did industry, and would thus absorb fewer new workers than those sectors laid off. These "surplus" workers would either drive down wages for all labour (the so-called Stolper-Samuelson result of international trade theory) or become unemployed.

If one is interested in the rest of the economy, or in aggregate indicators such as GNP or aggregate unemployment, these factor-market effects must be addressed by means of explicit general equilibrium modelling. If, alternatively, one is interested in the effects of agricultural policy only on agriculture itself, they may be captured by non-horizontal factor supply curves, although care must be taken to treat the interactions between factors correctly.

H. Balance-of-payments constraints and the exchange rate

These enter Figure 1 implicitly. For a genuinely small sector, the exchange rate may be taken as exogenous and the balance of payments ignored. Where the

X-sector is significant, however, and especially when efforts are being made to model the agriculture/industry/services interface, external balance becomes much more significant. Through its effects on external balance, agricultural policy may change relative prices either between tradeables and non-tradeables or within the tradeable sector. Either could shift the supply and demand schedules of Figure 1 endogenously.

I. Distortions

If present in either the *X*- or the other sectors of the economy, distortions represent, perhaps, the greatest challenge to the free trade prescription derived from Figure 1. Implicit in all the normative calculations is the presumption that the supply and demand curves represent the true social value of the good in question. This is frequently challenged on a number of fronts, and a satisfactory assessment of the costs of agricultural protection must meet these challenges. Examples of distortions include the following.

Where several policies affect a sector, the consideration of one of them in isolation could be misleading. For example, the separate assessment of milk quotas and of high milk support prices would suggest that quotas were advantageous because they reduce the degree of artificial over-production. But if both policies are taken as parts of the same distortionary package, then quotas are seen to be pernicious because, by alleviating the budgetary consequences of price support, they perpetuate its existence.

Non-uniform taxes or subsidies to factor use in agriculture also undermine the welfare calculations of Figure 1. By disturbing input proportions, they induce inefficient technologies and cause the supply curve to misrepresent (under-state in the case of subsidies) the social costs of production.

If all other activities bear taxes, the supply curve for untaxed agriculture will be artificially pushed out and at free-trade prices domestic output will be excessive. In many OECD countries, agriculture does receive relatively favourable tax treatment, e.g. income tax concessions, *so* welfare calculations based on private net-of-tax supply curves tend to understate the costs of protection relative to truly undistorted trade.

Another distortion often quoted in support of market intervention is the absence of insurance markets: if moral hazard prevents farmers from being able to insure against poor harvests, it is argued that governments may have to compensate for the missing market by stabilizing producer prices or incomes. While there is some basis to this argument, Dixit (1986) suggests that it is far from watertight. In an admittedly simple model he shows that government intervention is desirable only

when moral hazard completely closes the insurance market. Even in these cases, the first-best policy is the public provision of insurance, and if a tariff must be used, the optimal rate may be negative. The basic argument is that moral hazard complicates not only the provision of insurance, but also the provision of any alternative policy attempting to substitute for it.

Rural unemployment and under-employment have also been advanced as reasons for agricultural support. In these circumstances, supply curves valuing labour at actual wages will overstate the social marginal costs of agricultural output and hence overstate the benefits of free trade. The social costs of rural depopulation, the positive externalities of a thriving countryside and any strategic advantages of food self-sufficiency could also lead to the same conclusions, as could a social desire to eradicate rural poverty. In all of these examples, however, one needs first to establish that farm policy actually improves the situation, which turns out to be quite difficult (see Part III below).

So far as the author is aware, no study attempts to integrate these various externalities into a strict quantification of the advantages of agricultural intervention; it is simply too difficult to do. Thus, model-builders tend to ignore them, appealing to the insignificance of distortions in other sectors and treating the external objectives as independant phenomena to be weighed against the calculable economic costs of agricultural policy. While this seems rather unsatisfactory, there is no plausible alternative *so* this approach is adopted below.

II. ESTIMATES OF THE DEADWEIGHT COST OF AGRICULTURAL SUPPORT

The taxonomy of Part I provides a basis for assessing the empirical literature on the deadweight costs of agricultural policy. As the requirements become more complex in terms of the number of markets and phenomena to be modelled, the literature becomes thinner, and since there is more interest in the more complex models, only a sample of the simpler exercises are described in the initial stages. The works surveyed are summarized in Table I. Obviously, only the briefest description can be given for each study. For detailed results and methodology – and the way one affects the other – the original references must be consulted.

The wide range of approaches to assessing the costs of protection reflects mainly the range of emphases among researchers. Thus the partial equilibrium approach allows detailed data collection and intra-sectoral modelling at the expense

Table 1. Summary of estimates of the cost of agricultural support[a]

Study	Country	Year[b]	Commodity	Policy[c]	Deadweight loss	
					Absolute	Relative
Single Sector Studies						
Harling and Thompson (1985)	Canada	1975-77	Poultry and eggs	All	US$51 million	0.03% of GDP
	Germany	1975-77			US$25 million	0.03% of GDP
	UK	1975-77			US$4 million	*
Anderson (1985)	USA	1964-79	Cheeses	Import quotas	US$71 million	49% of expenditure or controlled cheeses
Otsuka and Hayami (1985)	Japan	1980	Rice	Price support	Y1 444 billion	0.7% of GDP
				Price support and acreage controls	Y663 billion	0.3% of GDP
Schiff (1985)	EEC	1960-80	Wheat	CAP	US$216 million	5% of EEC wheat output
Multi-sectoral Studies						
Bale and Lutz (1981)[d]	France	1976	Wheat, maize barley, sugar beef and rice	All	US$514 million	0.1% of GDP
	Germany	1976			US$776 million	0.2% of GDP
	UK	1976			US$78 million	0.03% of GDP
	Japan	1976			US$4 119 million	0.7% of GDP
Harling (1983)	Canada	1975-77	Wheat, barley oats, potatoes beef, rye, pork poultry. eggs	All		0%–7% of producer receipts
	Germany	1975-77				2%–105% of producer receipts
	UK	1975-77				0%–67% of producer receipts
Gardner (1986)	USA	1984-85	All	All	US$4.4 billion	0.1% of GDP
Australian Bureau of Agricultural Economics (1985)	EEC	1978	All CAP commodities	All	ECU 11 billion	0.5% of GDP
	EEC	1983	All CAP commodities	All	ECU 8 billion	0.3% of GDP
inter-sectoral Studies						
Buckwell, Harvey, Thompson and Parton (1982)	EEC	1980	All CAP commodities	CAP	ECU 11.1 billion	0.5% of GDP
Tyers and Anderson (1986)[e]	EEC	1985	wheat, coarse grains, rice, beef and lamb, pork, and poultry, dairy, sugar	All	US$24 billion	0.8% of GDP
	EFTA	1985			US$4 billion	0.9% of GDP
	Japan	1985			US$27 billion	2.1% of GDP
	USA	1985			US$1 billion	0.03% of GDP

General Equilibrium Models						
Rosine and Helmberger (1974)	USA	1970	All	All	US$2.1 billion	0.2% of GDP
Parikh *et al.* (1985)	World	2000	All	All	Approx 0	
Trela, Whalley and Wigle (1986)	World	1980	Grains	Most	US$20 billion	6 % of world grain output
Spencer (1985)	EEC	1980	CAP commodities	CAP		Approx 1 % of GDP
Stoeckel (1985)	EEC	1980	CAP commodities	All	Up to 1 million jobs	
Brechling, Thorp and Stoeckel (1987)	EEC	1983	CAP commodities	All	Up to 1 million jobs	
Burniaux and Waelbroeck (1985)	EEC	1985	CAP commodities	All		2.1% of GNP

a) This summary should not be read in isolation from the text; it does no justice to the details or caveats of the original studies.
b) Years for which policy is assessed. Many studies use data from other years at some stage.
c) For studies covering the EEC, 'CAP denotes that only the effects of Community policy (mostly price guarantees) are measured, while 'all' denotes that member states' national policies are included in addition.
d) High elasticity estimates (see Table 2).
e) Deadweight losses are measured in 1980 prices.
• Less than 0.01% of GDP.

of crudity in its inter-sectoral effects. The general equilibrium model, on the other hand, offers the opposite combination. The results of the two approaches cannot be compared very precisely, but it is notable below that both approaches and all those in between suggest very substantial deadweight losses from agricultural intervention.

A. Single-sector studies

The simplest assessments of agricultural policy are those of single sectors, e.g. Harling and Thompson (1985) on poultry and eggs in Canada, **UK** and West Germany, Anderson (1985) on cheese in the USA, and Otsuka and Hayami (1985) on rice in Japan.

Harling and Thompson relate producer effects to effective rather than nomimal protection coefficients, but otherwise follow the simple analysis above precisely. They devote great care to their data and to understanding the industrial processes in the sectors they study, but little to estimating the parameters of economic behaviour. Their deadweight losses are rather small because most of their domestic demand and supply elasticities (which they take from other studies) are small, never exceeding unity in absolute value, and because, relative to other agricultural products, protection in the poultry and eggs sectors is fairly modest (30-40 per cent in Canada and Germany; 5-10 per cent in the **UK).** Overall they suggest losses in 1975-77 in these markets of about $50 million per annum for Canada, $25 million for West Germany and $4 million for the **UK.**

Anderson (1985), in a model of **US** cheese quotas, treats the market for cheese as entirely separable from other domestic markets, small relative to world supplies, and subject to fixed government support prices for all levels of domestic output. Using the Deaton-Muellbauer (1980) Almost Ideal Demand System to model the allocation of demand over heterogeneous varieties of cheese, he calculates the welfare costs (compensating variations) of restricting imports by means of country- and variety-specific quotas rather than by tariffs or not at all. He concludes that quotas cost some $20 million per *annum* relative to tariffs or $70 million relative to free trade (evaluated at mean prices and quantities, 1964-79). These costs represent 15 per cent and 50 per cent, respectively, of expenditure on the controlled items – a substantial effect by any standard.

Anderson's work represents a significant advance in estimating the effects of actual policy, for it is more firmly based than most estimates in actual data. On the other hand, there remain a number of concerns over his econometric estimation – see Anderson (1983) for details – not least the use of a demand system requiring endogenous quantities and exogenous prices, when reality requires the reverse.

The final single-sector study noted is Otsuka and Hayami's (1985) study of Japanese rice policies. This is unusual both in taking account of producers' consumption of their own output (up to 25 per cent of rice production may be consumed without coming to market) and in separating the effects of price support (government purchases behind rigid import quotas) from those of acreage reductions. Otsuka and Hayami's formulae are complicated on these scores, but are otherwise basically the simple partial equilibrium surplus calculations of Part I. They calculate the total deadweight loss of Japanese rice policy relative to free trade as Y 663 billion in 1980, of which about half is due to price support and half to the losses of output due to acreage control. This loss is approximately 20 per cent of annual expenditure on rice and 0.3 per cent of annual GDP.

The interaction of the two policies is also interesting. If price support is taken as given, acreage controls are found to be beneficial – to the tune of Y 781 billion[4]. This is a classic second-best result: price support causes each unit of rice to cost far above its social value, so any policy that curtails output will, at least initially, be beneficial. On the other hand, as the factor that makes price support feasible, acreage controls should be judged more negatively. In fact, Otsuka and Hayami may over-estimate even the second-best virtues of acreage controls, for they assume that production falls *pari passu* with acreage. If, as is likely, output actually fell less than proportionately, the costs of price support would fall less than proportionately, and the real costs of rice production would rise as farmers adopted inefficient methods, substituting other inputs for land. Nonetheless, this article is instructive in the detail it devotes to modelling government interventions.

A refinement of the single-sector model is to include several countries explicitly. This allows the world-wide effects of policy to be guaged, but more significantly, it also allows the small-country assumption to be relaxed. Among the many recent studies of this nature are Koester (1982), Schiff (1985) and Mitchell (1986) on wheat, and Zietz and Valdes (1985) on sugar and beef.

Schiff (1985) provides a good example of the multi-country approach. He models the world wheat market recognizing eight countries or geographical units. He imposes world market clearing and considers the effects of intervention in wheat markets on the value and volume of trade, the variability of world prices, the degree of adjustment to external shocks, and on economic welfare. He concludes that it was rigid and inappropriate policy that caused such over-reaction to Soviet purchases in the early 1970s, and that had free trade ruled, world prices would have been some 15 per cent higher and 40 per cent less variable. The abolition of the CAP alone, he states, would have changed the mean and standard deviation of world prices by +17 per cent and –25 per cent and would have saved Europe an average deadweight loss of $216 million *per annum* over 1960-80. The last figure

represents about 5per cent of annual average EEC wheat output over the period.

B. Multi-sectoral studies

The studies in this second set are conceptually identical to the first, but have generally attracted greater attention by virtue of their wider coverage. Typically they apply the simple partial equilibrium methodology to several sectors simultaneously, but without modelling explicitly the interactions between them. The additional coverage takes its toll in terms of the detail with which any particular sector can be treated. Its main pay-off in principle is the comparability between sectors and/or countries that it grants rather than its ability to assess agricultural policy overall. This is because, as most of the authors note, aggregating across commodities is a dubious practice both because of the interactions between sectors and because the small-sector assumption becomes less applicable.

Perhaps the most comprehensive multi-sector study is Bale and Lutz (1981). They estimate consumer, producer and government surplus effects, and the effects on foreign exchange receipts and rural employment, of policies in up to five sectors in nine countries. They calculate each on both high and low elasticity assumptions, and their results for four major OECD countries are summarised in Table 2. These estimates, which relate to 1976, encompass all policies, for they are based on nominal protection coefficients, $(Pd - Pw)/Pw$, where Pd and Pw are domestic and world prices respectively. They make explicit use of the small country assumption: Pw is assumed fixed quite independently of the policies under consideration.

Bale and Lutz's results were – and still are to some extent – quite startling. Dealing with a year which by today's standards had relatively undistorted trade, they find very significant effects from agricultural policy, especially under their high elasticity assumptions. The UK, still operating its transitional arrangements towards the **CAP,** has relatively modest costs from intervention in the markets covered, but France, Germany and especially Japan show heavy penalties. In the last case, up to 0.8 per cent of 1976 **GNP** may have been wasted by agricultural intervention – some 1.4 per cent of **GNP** being sacrificed by consumers to grant producers welfare increases of about 0.5 per cent. Thus, for every $1 gained by producers, nearly **$3** is lost by consumers.

The employment effects in Table 2 are based on rather crude marginal labour-output ratios. They suggest some gains in employment from agricultural policy, but nonetheless the costs per job saved are still significant. They range from $1 924 per job for Japan under high elasticity assumptions to $5 150 for Germany under low elasticity assumptions. In fact the employment effects are probably

	Consumer loss[b]	Producer gain[c]	Change in Government revenue	Deadweight loss	Loss as percentage of:		Effect on rural employment ('000 full-time workers)	Cost per job $/job
					GNP	Agricultural GNP		
	US $ millions				Per cent			
	(1)	(2)	(3)	(4) [(1)–(2)–(3)]	(5)	(6)	(7)	(8) [(4)/(7)]
				(A) HIGH ELASTICITY ESTIMATES				
France	2257	2437	–694	514	0.16	3.2	241.2	2 131
Germany	3453	2229	449	776	0.19	6.3	152.2	5 099
United Kingdom	983	452	453	78	0.04	1.3	23.5	3 319
Japan	7 089	2606	364	4 119	0.80	16.0	2 140.9	1 924
France	2 145	2 669	–694	160	0.05	1.0	79.5	2 013
Germany	3251	2 545	449	257	0.06	2.0	49.9	5 150
United Kingdom	951	472	453	26	0.01	0.3	7.8	3 333
Japan	6 870	5 133	364	2 194	0.43	8.6	713.5	3 075

overstated for, given the productivity differential between full-time employees on large farms and small and part-time farmers, the marginal labour-output ratio is probably less than the assumed 1.5 times the average ratio. This is particularly likely to be so given that the effect of policy abolition would be to reduce activity among less efficient farmers first. Thus, as a rural employment policy, agricultural intervention is probably more costly than these figures suggest.

Bale and Lutz argue that being based on econometric estimates, and therefore on rather short-run supply elasticities, their results tend to under-state the economic costs of protecting agriculture, a problem common to all the studies reported in this article. Since agriculture adjusts so slowly to external stimuli, econometric estimates are unlikely to reflect the full extent of long-run changes in response to policy, especially once one takes into account the effects of distortions on investment and R&D activity. On the other hand, it is probably true that partial elasticities over-state the responses of agriculture to simultaneous changes in several prices. Thus, the totals quoted in Table 2 may also be subject to some upward bias.

A similar study is provided by Harling (1983), who covers eight products in Canada, West Germany and the UK during the mid-1970s. Unlike Bale and Lutz, Harling relates supply responses to rates of effective rather than nominal protection,

although the former are built up from price differentials of the sort used by Bale and Lutz. Effective protection incorporates inter-sectoral links, but in a very rigid fashion. It is explicitly assumed that input combinations are independent of relative input prices; thus, in calculating supply responses and welfare implications, Harling's results take account of policy distortions on the inputs into each sector but not of the shifts in demand for inputs that such distortions entail. Harling presents the ranges of deadweight losses for the commodities he treats (wheat, rye, barley, oats, potatoes, beef, pork, poultry, eggs), but does not present totals. Like Bale and Lutz, however, he finds significant effects: in Canada, with relatively low distortions, losses amount to between 0 per cent (pork) and 6.6 per cent (poultry) of estimated producer receipts under free trade; in Germany, the range is 2.1 per cent (eggs) to 105.5 per cent (wheat), and in the UK 0.1 per cent (eggs) to 67.5 per cent (wheat).

Gardner (1986) provides a multi-sector study of US agricultural policy. In this case, the small-country assumption is plainly inappropriate. Moreover, since most US intervention relies on internal rather than border measures, US domestic and world prices are very close. This means that the degree of protection must be calculated other than via the nominal protection coefficients and also that many of the costs of US policy are borne abroad as the prices of her exports are driven up and those of her imports driven down. Gardner uses the simple partial equilibrium analysis although he states that wherever possible he has adjusted his own-price elasticities to take account of endogenous changes in the prices of other goods.

Gardner finds rather larger effects of policy than most other US commentators. Partly this reflects his concentration on 1985, but it also arises because he has taken account of the losses of rent entailed in idling land and the costs of storing surpluses. Gardner estimates the long-run domestic cost of US farm policies to comprise:

Table 3. The costs of US agricultural intervention
$ billions

	Consumer losses	Taxpayer losses	Producer gains	Deadweight losses
	(1)	(2)	(3)	[(1)+(2)–(3)]
(A) Gardner (1986) 1984-85	5.7	10.3	11.6	4.4
(B) Rosine and Helmberger (1974) 1970	0.2	4.6	2.7	2.1
(C) Tyers and Anderson (1986) 1980-82 (1980 prices)	16.8	2.4	20.4	–0.7

consumer and taxpayer losses of **$16.0** billion, and total deadweight losses of $4.4 billion (see Table **3).** In terms of transfers, the producer gains of **$11.6** billion account for about half of net farm income in **1983-85.**

The other major player on world agricultural markets is the EEC. Several studies of EEC policy exist, but among the best is that by the Australian Bureau for Agricultural Economics (BAE) **(1985).** This offers a detailed examination **of** the Common Agricultural Policy (CAP) in terms of both its institutions and its effects. Although it treats the EEC as a single market, it also includes the effects of certain national agricultural policies in its calculations. Like Gardner, it treats sectors individually and makes informal adjustments for the effects of policies on world prices, drawing on other studies. The separate treatment of sectors is particularly significant for Europe because the distortions vary *so* much over agricultural activities; the BAE argues that in ignoring these intra-agriculture distortions, it significantly understates the costs of the CAP. Further understatement arises, it argues, because it ignores the misallocation of infra-structural investment and R&D expenditure, rent-seeking and lobbying, and the employment costs of agricultural intervention.

According to the BAE, the peak year for CAP costs was **1978.** More typical perhaps was **1983** in which the deadweight loss of agricultural intervention was about ECU **8** billion, or **0.32** per cent of GDP. The results for **1983** are summarized in Section (A) of Table 4. They imply significant costs: a typical family of four pays

Table 4. The costs of the EEC agricultural intervention[a]

	Consumer losses	Taxpayer losses	Producer gains	Deadweight losses
	(1)	(2)	(3)	[(1)+(2)–(3)]
(A) Australian Bureau of Agricultural Economics (1985) 1983, EC-10				
ECU billion (1982 prices)	30.6	24.9	41.5	8.0
% of GDP	1.2	1.0	1.9	0.3
ECU per person	112.0	90.0	113.0	29.0
(B) Buckwell, Harvey, Thornson and Parton (1982) 1980, EC-9				
ECU billions	24.8	8.3	22.0	11.1
(C) Tyers and Anderson (1986) 1985, EC-10				
$ billions (1980 prices)	49.0	2.2	21.2	24.1

a) Buckwell, Harvey, Thomson and Parton assess only the costs of Community policy (the CAP proper): the Bureau for Agricultural Economics and Tyers and Anderson also include certain of the member states' national agricultural policies.

ECU 450 *per annum* through higher prices, and a further ECU 360 *per annum* as taxpayers! Moreover, all this is to support a sector producing only about 4 per cent of total GDP. Of total value-added in EEC agriculture, around 60 per cent is transferred directly from consumers and taxpayers to producers.

While the BAE study has some obvious and admitted methodological defects, it is among the most thorough analyses of a single country or group's agricultural policy available. Moreover, given its fairly conservative assumptions, it is unlikely to over-estimate the costs of policy.

C. Inter-sectoral studies

This section examines the inter-sectoral studies in which the relationships between agricultural sectors are explicitly modelled, taking as given the overall demand for agricultural output. The two studies quoted are also multi-country studies, so they are substantially more complex than the models described above.

Among the most widely quoted works on the CAP is Buckwell, Harvey, Thomson and Parton (1982) (referred to below as BHTP). This models the CAP, distinguishing each member country and a residual "rest of the world". The latter is represented by supply and demand functions with finite – actually rather small – elasticities, reflecting the EEC's considerable size. The inter-sectoral aspect of the BHTP model is represented by the use of explicit cross-elasticities of demand and supply for the goods modelled. While this is simple and precludes the explicit calculation of intra-agricultural flows, it is sufficient to warrant classifying the study as intersectoral. An important element of the model which is not explored here is the inter-member transfers generated by the CAP. BHTP use simple Marshallian surpluses to calculate their economic costs and benefits.

The aggregate results of BHTP's work are reported in Section (B) of Table 4. They imply rather larger deadweight losses than do the BAE for either 1982 or 1980 (which are not reported here). The principal reason is that BHTP take account of intra-agriculture distortions, while BAE do not. BHTP also find that the abolition of the CAP would reduce average real prices for agriculture by 32 per cent and cut average self-sufficiency from an actual value of 112 per cent in the base run to 82 per cent. It is perhaps comforting that two such methodologically diverse projects as BAE and BHTP should reach such broadly comparable conclusions.

Probably the most sophisticated model of agricultural policy is that of Tyers, e.g. Tyers and Chisholm (1982), Anderson and Tyers (1984), Tyers (1985), and Tyers and Anderson (1986). This model has several attractive features and the references above trace its evolution through time. The results reported here are

taken from Tyers and Anderson (1986) which under-pinned much of the analysis of industrial countries in the World Bank's World ***Development Report 1986.***

The **1986** version incorporates seven temperate commodities – wheat, coarse grains, rice, beef and lamb, pork and poultry, dairy products and sugar – and thirty countries or regions. Most of the latter are modelled in considerable detail, although in some cases data shortages precluded complete treatment. The principal object of Tyers and Anderson's work is to model inter-commodity and inter-country relationships in detail. Only by so doing, they argue, can even a single country's policy stance be properly assessed. The model is based on data for the period **1980-82.** Considerable attention is paid to collecting data on nominal protection coefficients and a significant number of important relationships are estimated econometrically. .

The inter-sectoral aspects are again captured by cross-elasticities in both supply and demand. In addition, stock-building is modelled explicitly, combining the behaviour of government agents, whose responses are conditioned on quantity signals alone, with that of risk-neutral private speculators who predict prices one year ahead. In the long run, however, stocks are presumed to be proportional to consumption or production flows[5].

Government policy is also modelled explicitly. While doing ***so*** is contentious, it is largely unavoidable in the context of large models. The small-country assumption permits one to ignore the rest of the world's policy responses to one country's liberalization; a two-country model might allow those responses to be treated parametrically; but in a thirty-country model, automatic rules must be used. Tyers and Anderson adopt two. For the short run, they estimate for each country and commodity "price transmission elasticities" which determine what proportion of a world price shock is passed through to domestic producers and consumers, and what proportion is absorbed by the government. For the CAP, for example, if intervention prices are fixed, transmission elasticities are approximately zero. In the long run – for which results are reported below – transmission elasticities are set at unity, i.e. those countries whose policy is not under investigation are assumed to aim for a constant ratio of internal to border prices. Both the short- and long-run treatments are arbitrary, but it is difficult to think of better alternatives.

Tyers and Anderson report a mass of results on various packages of agricultural liberalization. Tables 5 and 6 repeat some of the more interesting. The former reports the "own" effects of liberalizing each industrial country's agricultural policy in isolation. These are rather larger than those reported above for the EEC and Japan. Partly, of course, this reflects commodity coverage, but it also reflects differences over the effects of policy on the rest of the world. Not reported in the table is the fact that in both cases, and also for EFTA, the rest of the world loses

Table 5. The annual domestic costs of food price distortions in selected OECD countries, 1985

Billions of 1980 dollars

	Consumer cost	Taxpayer cost	Gross cost	Producer benefit	Deadweight loss[a]	Transfer ratio[b]
	(1)	(2)	(3) [(1)+(2)]	(4)	(5) [(3)–(4)]	(6) [(3)/(4)]
Australia	0.6	–0.1[c]	0.5	0.4	0.2	1.4
Canada	1.9	1.0	2.9	2.4	0.5	1.2
EC-10	49.0	2.2	51.2	27.2	24.1	1.9
EFTA-5	9.0	1.1	10.0	6.1	4.0	1.7
Japan	44.2	–4.5[c]	39.7	12.4	27.4	3.2
United States	16.8	2.4	19.2	20.4	-0.7	0.9

a) Column(3) minus column (4) minus stock profits That is, it does not include costs of raising and dispersing government tax revenue and of lobbying by farm groups, nor does it include the costs to the rest of the world.
b) Ratio of gross costs to producer benefits, that is, the average cost in dollars to consumers/taxpayers per dollar transferred to producers
c) Government revenues from distortions exceed government payments to producers
Source Tyers and Anderson (1986).

Table 6. The gains and losses from agricultural trade liberalization[a]

Billions of 1980 dollars

Country group	Industrial-country liberalisation	Developing-country liberalisation	Industrial- and developing-country liberalisation
Developing countries	–11.8	28.2	18.3
Industrial market economies	48.5	–10.2	45.9
East European non-market economies	–11.1	–13.1	–23.1
Worldwide	25.6	4.9	41.1

a) Data are based on the removal of the rates of protection in effect in 1980-82. Deadweight gains and losses.
Source: World Bank (1986), based on Tyers and Anderson (1986).

from trade liberalization. That is, Tyers and Anderson suggest that OECD countries' current agricultural policies benefit countries other than themselves.

The figures for the US are even further removed from previous estimates. According to Tyers and Anderson, US policy slightly benefits both the US itself – due to its favourable terms of trade effects – and the rest of the world. The latter conclusion may be explained by the theory of second-best. Tyers and Anderson consider relaxing each country's policies, given the maintainance of existing policies elsewhere in the world. Thus the price-increasing effects of US grain and beef

policies help to offset the deleterious effects of Japanese and European price-depressing policies. Under general free trade, any terms of trade benefits that the US could extract by curtailing its output would be more than balanced by welfare losses elsewhere.

Table 6 reports Tyers and Anderson's estimates of the consequences of the complete liberalization of industrial country agriculture, complete developing country liberalization and finally, "global" liberalization. In each case country groups benefit from their own liberalization and suffer from other groups'; Eastern Europe loses from both. The $48.5 billion that OECD countries would gain from their own liberalization comprises gains to consumers and taxpayers of over $100 billion offset by losses to producers of a little over $50 billion.

Tyers and Anderson also show that trade liberalization could reduce the variance of world commodity prices considerably, by allowing shortages and gluts to be smoothed over much larger numbers of agents. Current levels of variability discourage agricultural production significantly. Thus, OECD liberalization could well stimulate developing country agriculture sufficiently to reverse the adverse effects reported in Table 6 (Tyers and Anderson do not relate countries output to price variability in the model). Such an outcome looks more plausible when one takes account of the expansion that could arise as political uncertainty was removed from agricultural markets, as R&D was redirected towards developing rather than industrial country agriculture, as higher world prices encouraged rural infra-structure investment in developing countries, and if more commodities than just the seven temperate products covered by Tyers and Anderson were liberalized. Part III of this article deals with instability in more detail.

Several other inter-sectoral models exist which have the potential to estimate deadweight losses, but which have not so far been used for that purpose, e.g. Munk (1985) and OECD (1987).

D. General equilibrium models

The distinguishing feature of general equilibrium models is their representation of non-agricultural sectors. Ideally this entails modelling all factor markets, with explicit economy-wide supply functions for each factor, and also a foreign balance constraint. Since this is the approach most pertinent to the question in hand – the macroeconomic and intersectoral consequences of agricultural policy – this section is as comprehensive as possible. Its thinness is sufficient evidence of the need for further research in this direction.

An early step towards general equilibrium modelling of agriculture is Rosine and Helmberger (1974). Treating US agriculture as a single sector and ignoring foreign

trade, these authors estimate a seven-equation model. It comprises a Cobb-Douglas supply function, four input demand equations (labour, land, capital, and material inputs), a demand equation and a labour supply function. While capital and material inputs are assumed to have infinitely elastic supply and land earns only economic rent, the supply curve of labour to agriculture is upward-sloping. At least implicitly this reflects increasing losses of industrial output as additional labour is transferred into agriculture or as the labour outflow from agriculture to that sector slows down. Simulating the abolition of US farm policies in 1970, Rosine and Helmberger find consumer and taxpayer losses of $4.8 billion and producer benefits of $2.7 billion; net deadweight losses are, therefore, about $2.1 billion [Table 3, Section (B)]. In their own words, "for every $1 of benefits engendered by farm programmes, 92 cents of which accrued to land-owners, society incurred a loss in economic efficiency amounting to 80 cents".

The most ambitious and comprehensive general equilibrium study of agricultural policy is that undertaken by the International Institute for Applied Systems Analysis (IIASA) – IIASA (1985) and Parikh (1985). This models agriculture in as much detail as, for example, Tyers and Anderson (1986), but in addition includes a non-agricultural sector. IIASA distinguish twenty countries or regions plus a residual "all other". Each country is represented by a model which determines its excess supply of each of ten commodities at any world price vector. Prices are measured in terms of the single non-agricultural numeraire good and protection is estimated by means of nominal protection coefficients, as in Bale and Lutz (1981). The model is solved over real time from 1984 to 2000 and incorporates some dynamics. Policy liberalization is examined by comparing the solution path under liberalization with that under a "current policy" base-run. Some policy endogeneity is permitted even in the base-run, for policy is represented by transmission elasticities which vary according to, inter *alia,* self-sufficiency indices.

Unlike any other model described in this article, the IIASA model solves agricultural input-output relationships by means of a non-linear programming model. Such a direct approach has many attractions, but it runs a severe danger of producing "bang-bang" solutions by which input-output coefficients exhibit huge and implausible sensitivity to the precise details of a simulation run, and spend much of their time constrained at exogenous and often arbitrary maximum and minimum values. In other words, optimizing, rather than behavioural, models do not represent very well the inertia of real economies. It is not clear that IIASA have adequately solved this problem.

The general equilibrium closure of the IIASA model is through fixed primary factor supplies (excluding capital, for investment is endogenous), and through a link from factor rewards to incomes. There are no non-traded goods – a potentially

serious omission. IIASA quote several indices of welfare with which to judge trade liberalization, including the equivalent variation – which is easy to calculate because consumption is modelled with the Linear Expenditure System, which has an explicit cost function – and calorie intake ***per capita.*** They find that, while free trade may be potentially Pareto superior to protection, a number of countries – especially developing countries – lose from it. Thus, they argue, international redistributive measures would need to accompany any liberalization.

The IIASA project is highly complex and its conclusions were not thoroughly documented when this survey was prepared. Thus, it is sometimes rather difficult to assess the quality and implications of its results – especially those that are counter-intuitive. While this is a brave and laudable effort, its current recommendations for policy must be treated with caution.

If computable general equilibrium (CGE) modelling has a guru, he is surely John Whalley. We look next, therefore, at Whalley's only explicit contribution to agricultural modelling, Trela, Whalley and Wigle (1986) (referred to below as TWW). This starts by discussing agricultural policy in the EEC, the USA and Japan, stressing the ways in which all interventions ultimately affect trade flows; it then considers issues in the negotiation of agricultural liberalization in the coming GATT round. Finally it offers a simple general equilibrium simulation of the benefits of liberalizing world grain trade. It suggests that these alone could outweigh the gains from completely liberalizing manufactured trade among industrial countries.

The TWW model distinguishes nine regions, each with a Constant Elasticity of Substitution production possibility frontier defined over grains and a single aggregate non-grains. Consumers, similarly, have Constant Elasticity of Substitution utility functions. In each case, the same Elasticity of Substitution is used for all countries. Producer, consumer and world prices can all differ in the presence of policy, and all protection is represented by these price differentials. Parameters and data, which refer to **1980,** are taken from other secondary sources, e.g. Tyers and Chisholm **(1982).** Trade balance is explicitly imposed and, along with Walras' law, this renders expenditure equal to factor incomes. Unlike Whalley's previous studies, both goods are assumed to be homogeneous across countries.

The model is calibrated to actual **1980** data and then re-solved with producer and consumer prices set equal to world prices. Such liberalization results in significant welfare gains for the EEC and Japan as the most distorted countries in **1980, $4.8** billion and **$1** 1 billion respectively. In each case, about one-third of the gain reflects improvements in consumption efficiency and the remainder those in production allocative efficiency. North America gains **$3.8** billion, while other regions record very small gains and losses which net out to zero overall[6]. These figures, of course, refer directly to deadweight losses. Thus, the world total gain

from liberalizing just grain amounts to very nearly $20 billion per *annum* – about 6 per cent of the value of total grain output – and, for several reasons noted above, this is probably an under-estimate.

Elegant though the TWW calculation is, it amounts to little more than a back-of-the-envelope illustration. It is certainly correct in identifying large gains to liberalizing grain trade, but in its present form it can hardly be taken as even the crudest basis of policy-making or negotiation.

A second two-sector general equilibrium model is Spencer's **(1985, 1986),** which is used to investigate the EEC's Common Agricultural Policy. Spencer separates agriculture from non-agriculture and pursues a more traditional CGE approach. Both goods are distinguished by place of production and consumers have two-level "Armingtonian" preferences[7]. At the lower level, the elasticity of substitution between different varieties of agriculture is **3,** and similarly for non-agriculture, while at the upper level the elasticity between agriculture and non-agriculture in aggregate is **0.1.** Thus, one would expect to find non-neglible optimum tariff effects in consumption. Production is represented by Cobb-Douglas productionfunctions and requires two factors, labour and capital, which are fixed in supply, inter-sectorally mobile, but internationally immobile. Factor markets clear to ensure full employment, and trade is balanced. Spencer focuses on intra-EEC relations; he models the eight pre-**1981** members explicitly (Belgium-Luxembourg combined) plus a rest of the world. The model is calibrated to **1980** data.

Spencer **(1985)** considers a number of simulations, the most relevant of which permits free trade but maintains **1980** rates of VAT[8]. Relative to the actual position in **1980,** free trade involves welfare losses of **0.6** per cent and **0.8** per cent of national income for Ireland and the rest of the world respectively, and gains for all other countries ranging from 0.6 per cent (Denmark) to **1.6** per cent (Belgium-Luxembourg). While the distribution of gains clearly depends on the CAP-induced transfers, the CAP entails deadweight losses of around 1 per cent of EEC aggregate real income. These results are not fundamentally different from those of BHTP.

Spencer **(1986)** extends these results to consider the effects of moving to global free trade in both agriculture and non-agriculture. This entails increases in the prices and output of manufactures within Europe, and the opposite elsewhere. It also implies, however, that the rest of the world loses from liberalization. While this outcome is conceivable given the terms-of-trade effects implied by Spencer's low elasticities of substitution, it more probably reflects the aggregate and imprecise nature of his rest of the world data.

Spencer's model is rather more detailed than Trela, Whalley and Wigle's, especially in its treatment of intra-EEC transfers, but it is still very simple. The level of aggregation excludes many of the most interesting features of general equilibrium

results, and the uniform elasticities of substitution and treatment of agriculture and non-agriculture limit the model's applicability.

A more convincing CGE treatment of agriculture is provided by Stoeckel (1985), and Breckling, Thorpe and Stoeckel (1986 and 1987). Related to the BAE's work on the CAP, these studies deal exclusively with the EEC. They use data from only the four largest EEC economies, treating the EEC as one unit in the earlier study but as four separate countries in the later work. Stoeckel and his colleagues distinguish four sectors: agriculture, food processing, manufactures and services, with the first split into large and small-scale agriculture – an important distinction given the stated intention of the CAP of preserving rural communities and easing the burdens of small farmers.

Stoeckel (1985) distinguishes five factors: small-scale and large-scale land, capital, labour, and specific labour for large farms. All goods are produced by combining primary factors and intermediate inputs, but with relatively high degrees of substitution between them. Imported and domestic varieties of a good are differentiated and are combined into an "effective" aggregate of the good concerned with Constant Elasticity of Substitution aggregators. Primary factors are fixed in supply and, except for labour, kept fully employed by varying their rewards. In some experiments labour is assumed to have a rigid real wage and, in consequence, to be liable to unemployment.

Consumers maximize utility over the five goods measured in "effective" units. The rest of the world is represented by import supply and export demand equations. These are upward and downward sloping respectively and admit a role for tariffs and subsidies as well as for prices proper. No quantitative constraints are modelled directly. External balance is imposed in terms of world prices and brought about by changes in the real exchange rate.

The model is rather non-linear, but Stoeckel linearizes it in terms of logarithmic first differences. This is useful computationally, but when dealing with large changes such as the abolition of the CAP, this linearization may not always provide a good approximation, for it does not preserve all the theoretical properties that models ideally should have. Parameter estimates are taken from other studies.

Stoeckel's approach to calibration is somewhat unusual. First he constructs a free-trade version of the model; then he introduces a set of export subsidies, import tariffs and production taxes that just induces the actual changes in EEC agricultural trade between 1973 – which is implicitly assumed wholly liberalized – and 1983. These are financed by a small general tax on other sectors. The model containing these "plausible" policies is then taken as "actual" or "base", and the liberalization exercise conducted relative to it.

Stoeckel's model is basically a realization of the standard Heckscher-Ohlin-Samuelson model of international trade. It admits significant differences between sectors' labour/capital ratios, and shows clearly that the protection of agriculture is equivalent to the taxation of other sectors. Moreover, because the other sectors vary in their openness, the burdens of promoting agriculture fall disproportionally on manufacturing. Stoeckel correctly draws strong parallels with the "Dutch Disease" literature, e.g. Corden and Neary (1982), in which a boom in tradeable sector A, stimulates output in the non-tradeable sector through its demand effects, but curtails output in tradeable sector B because the balance of trade must balance.

Table 7. The sectoral effects of EEC agricultural policy[a]

Percentage

A) EFFECTS UNDER FLEXIBLE WAGES

Sector	Domestic output	Exports	Imports	Real prices[b]		Use of labour	Use of capital
				Consumer	Producer		
Agriculture							
– small-scale	0.9	37.4	–31.1	5.5	1.9	3.2	2.8
– large-scale	4.8					0.0	10.4
Food, beverages and tobacco	2.8	36.7	–15.0	3.1	2.2	5.4	5.1
Manufacturing	–1.5	–4.0	4.7	–1.0	4 . 4	–1.5	–1.8
Services	0.2	–17.0	6.0	–0.2	-0.2	0.4	0.1

Variable	% Change
Aggregate employment	–1.0
Return to capital	–0.1
Exchange rate	4.4

a) Change due to policy as a percentage of policy-free value.
b) Relative to a constant producer price index.
Source: Stoeckel (1985).

Table 7 reports Stoeckel's main results (A) with flexible wages and full employment, and (B) with rigid wages and unemployment. The story – most clearly seen in (A) – is quite simple. Agriculture receives export subsidies of 25 per cent, import taxes of 40 per cent (22 per cent for food processing) and a production subsidy of 4 per cent. This drives up relative prices in agriculture, cuts demand, stimulates production, cuts the import deficit dramatically, turns the terms of trade

against the EEC and diverts factors into agriculture – mostly the large-scale sector. Manufacturing output falls and its trade balance declines. Services experience a greater proportionate decline in the trade balance, but output and employment increase slightly. These results reflect increasing consumption of non-agricultural goods in response to relative price changes. In the manufacturing sector, the extra demand is met from abroad, but for the non-tradeable component of services it must be produced domestically and thus increases service output.

Because agriculture is relatively capital-intensive, raising its output increases the returns to capital while reducing those of labour. If wages are reduced to maintain overall employment, employment in manufacturing falls by 1.5 per cent – about 400 000 workers – as a result of farm support. This drop will tend to be concentrated in those sectors where trade balances are most flexible, i.e. where imports are not controlled quantitatively and where export markets are highly competitive[g]. If, on the other hand, real wages are rigid, the burden of adjustment is thrown onto quantities, with a loss of jobs of approximately one million, spread throughout the non-agricultural sectors. Note that unless wages are rigid for ever, these results strictly refer only to short and medium runs rather than the long run, for which other results are quoted. Suprisingly, for neither the fixed nor the flexible wage exercise does Stoeckel quote the aggregate deadweight losses of policy, but there can be little doubt of their sign.

Breckling, Thorpe and Stoeckel (1987) offers a number of changes to Stoeckel (1985). It treats the large-scale/small-scale dichotomy differently, distinguishes four countries, models inter-country transfers, and uses 1979 as the (supposedly undistorted) base year. Non-agricultural products are differentiated by country of origin, but agriculture is assumed homogeneous and subject only to common EEC policies. Factors do not move between member states.

Using the same method of calibration as Stoeckel (1985), Breckling, Thorpe and Stoeckel explain the shifts in trade between 1979 and 1983 by means of a 12 per cent agricultural production subsidy, 80 per cent subsidies on agricultural and processed food exports, 40 per cent tariffs on imports of those goods and a 0.75 per cent tax on all consumption in the EEC. Additionally, the authors reflect the CAP-induced distortion of R&D activity by assuming a 5 per cent improvement in total factor productivity in large farms and a 5 per cent regress for small farms. The initial results suggest that the net costs of Europe's agricultural policies fall most heavily on the UK, where agricultural output rises by 54 per cent, and that of manufacturing and services decline by 2.5 per cent and 3 per cent respectively. Total real income falls by 0.6 per cent while returns to large-scale land rise by 130 per cent; unemployment rises by 16 per cent. Similar but less extreme results afflict Germany, while France and Italy appear to gain from the CAP. Qualitatively the

results are not very different from those of Stoeckel **(1985).** While this is encouraging, it is too early to accept the new results as definitive, for to date, neither a full specification of the model nor any sensitivity tests have been published.

Stoeckel's two models treat the large/small scale agriculture dichotomy differently. In the earlier work the two sectors are assumed to produce different goods. In the later one they have identical outputs but different technologies, large-scale agriculture having a specific factor – large-scale land – and small-scale agriculture being much more labour-intensive. The later treatment represents a considerable improvement, although there is still room for further research on this issue. Two facets of the shifting nature of agriculture must be distinguished. First, a secular trend against small farming. Breckling, Thorpe and Stoeckel represent this by their differential technology movements, but it might equally well be due to biased policy change such as capital investment allowances or increasing labour costs. In the present circumstances, however, the cause is less important than the fact that it is assumed to carry on independently of anything else over the timescale used in these models.

The second phenomenon is both more interesting and more contentious. Stoeckel's articles imply that price support policies applied equally to large- and small-scale agriculture boost the former and may cause the latter to contract even though prices appear to rise by more than any factor reward in the long run. The economic basis of this result appears to be Traill's **(1982)** investigation of factor inputs in UK agriculture. Traill found that price support initially raised both capital and labour inputs into agriculture, but that in the long run, capital inputs expanded *so* much as to displace labour and eventually cut employment. The most plausible explanation of this lies in income tax distortions. Income re-invested in new land or in farm machinery is free of tax in the UK. Hence, in good years farmers can invest on their farms liquid funds whose opportunity costs are very low because they attract high income tax in other uses. Technology may be such that the injections of capital and land *so* increase labour and capital productivity, that labour requirements actually fall. If borrowing for such investment purposes is expensive or impossible because of credit rationing, farm support can ratchet up farm sizes and capital intensity and cut agricultural employment. These effects may be exacerbated if farm incomes fluctuate. When prices fall, small farmers on the margin are squeezed out. When prices rise, small farmers benefit, but by less (absolutely) than large ones, and so become vulnerable to take-over.

Alternatively, there may be fixed nominal thresholds for certain types of behaviour. For example, a uniform percentage increase in agricultural prices or subsidies will raise the value of a given piece of land by the same proportion for both large and small farmers. Thus, it should not alter the proportionate incentive to

transfer the land. If, however, there is a fixed cost to selling up, or if small farmers require a fixed return before selling (e.g. a lump sum giving an annuity equal to the average industrial wage), then a general price rise might take transactors over the threshold and permit transfers that had previously appeared unattractive.

The problem is not with the plausibility of these arguments, but with deducing how a simple homogeneous model such as Stoeckel's can induce such an outcome. Presumably this will become clear as more details of the model are published.

Stoeckel's results are important and represent a major contribution to the modelling of agricultural policy; they identify very large orders of magnitude for the costs of agricultural intervention and show that unemployment as well as income loss can result from it. While there may be certain areas where the models require elucidation and improvement, and others where genuine uncertainty exists over the values of key parameters, it is unlikely that Stoeckel's conclusions are qualitatively misleading. By promoting agriculture, EEC countries waste resources, cut wages and/or employment and curtail manufacturing.

Another assessment of the CAP is offered by the RUNS model – Burniaux (1984) and Burniaux and Waelbroeck (1985). This has CGE models for each of nine world regions, distinguishing rural and urban economies. The former have thirteen goods and the latter five. Input-output relations are recognized and value-added is generated by constant elasticity of substitution (CES) functions; labour and capital are intersectorally mobile. Manufactured goods are differentiated internationally, but agricultural goods are homogeneous, each having a single world price. Tariff equivalents represent the only form of protection, but they are partly endogenised through transmission elasticities. Real urban wages have an exogenous lower bound, and unemployment is possible. Hence agricultural price support can be costly through its effects on food prices and real wages. The model is calibrated to the World Bank's projections for 1995 reported in World ***Development Report 1983.***

Burniaux and Waelbroeck report the effects of abolishing the CAP on incomes in 1995. Real incomes rise in every region, except for the (non-EEC) Mediterranean region which records a very small fall. The largest gains are recorded by oil exporters and certain middle-income developing countries; it appears that dismantling the CAP reduces the real price of industrial goods which benefits the major net importers of manufactures most. The EEC itself gains 2.7 per cent on its real income in 1995.

The model also reports the rural/urban split of the benefits. As may be expected, rural GNP in the EEC falls from abolishing the CAP (although wages and rates of return do not necessarily do *so),* but rural GNP rises in all other regions. The EEC urban sector records real income gains of 5.5 per cent, but elsewhere urban gains are small and even negative in low-income Asia and the Mediterranean region.

These results seem quite plausible, but somewhat larger than those reported elsewhere. Two possible reasons for this are, first, that real wage rigidity hinders the adjustment to and mitigation of shocks, and second, that the treatment of agricultural goods as homogeneous entails smaller estimated terms-of-trade benefits of the CAP and larger changes in specialization from its abolition.

Finally, mention should be made of a general equilibrium model that has not, to date, been used to quantify the effects of OECD countries' agricultural protection, but which, at least in principle, could be so used. Gerken (1986) uses a CGE model to assess the determinants of EEC agricultural trade interference; as with Spencer and BHTP, he is particularly interested in intra-EEC income distribution.

Gerken's model follows the ORANI pattern (Dixon, Parmenter, Sutton and Vincent, 1982). Domestic and imported varieties of goods are aggregated by CES functions into effective units, which then enter utility functions and production functions. The latter use a Leontief technology at the highest level, allowing no substitution between various intermediates and an aggregate of primary factors.

The model distinguishes six commodities – five agricultural and one industrial – and four EEC countries – France, Germany, Italy, and the Rest. The non-EEC world is represented by export demand and import supply curves; the former are downward-sloping, the latter infinitely elastic. The EEC countries take common decisions about the CAP which in turn imply particular transfers between them. Agricultural goods are assumed homogeneous within the EEC, but different from foreign agriculture; industrial goods are all differentiated. Labour, capital and land (which includes durable capital) are distinguished. The first two are inter-sectorally mobile, the last is fixed. Wages and rentals are variable, incomes and expenditures are equal and trade is balanced. Agricultural policy enters through import taxes, export subsidies, and quantitative restrictions.

Gerken's model is calibrated to 1982. It is log-linearized and is solved over five years in "real time", assuming the continuation of various exogenous trends. The baseline is contrasted with various runs involving different patterns of protection. Unfortunately, farmers' incomes are the variables of most interest to Gerken, and few results are reported on other dimensions. Among those that are available, however, is the observation that if prices and production quotas are manipulated to maintain the incomes of Italian farmers at 1982 levels for five years, increases of up to 10 per cent in the general price level would result. With balanced trade and with exchange rates fixed at unity, such price rises translate approximately into 10 per cent declines in real incomes.

III. DISTRIBUTION, STABILITY AND SECURITY

The previous section has presented a wide body of evidence that agricultural intervention is costly in terms of aggregate unweighted economic welfare. This alone is not sufficient to condemn it, however, for if something worthwhile were gained in return, society may still feel itself better off as a result of intervention. This Part, therefore, looks at the objectives of agricultural policy and the benefits that are said to spring from it. In considering them, three questions are of relevance:

- Does existing agricultural policy achieve its objectives?
- Could other policies achieve them more cheaply?
- Does one country's policy affect another's welfare?

Most attention is devoted to the first aspect, and the conclusion is that, in fact, current policy achieves very little. This Part is less comprehensive than Parts I and II, because several other excellent surveys already exist, e.g. Howarth (1985), World Bank (1986), and OECD (1987a).

The first section of Part III deals with the distribution of income both within the farming community and between consumers, and also with the related issues of part-time working and rural de-population which reflect dimensions of the income differences. Subsequent sections examine the implications of agricultural policy for price and income stability, national security and the environment.

A. Income distribution

Perhaps the most common justification for supporting agricultural prices is to defend or raise farm incomes – the incomes of farmers, their families and their labourers. Since World War II it has been widely accepted that all members of a society have the right to some share of its prosperity, and that if markets cannot bring this about governments should intervene. This view is particularly influential in the face of potential cuts in real incomes – the so-called "Conservative Social Welfare Function" (Corden, 1974) – and is compounded in the case of agriculture by a general sympathy for the farmer[10].

While it is difficult to collect precise data, all the indications are that price support does not offer long-term protection to farmers' incomes – particularly those of poorer farmers. In the first place, economic theory suggests that price support can do little about wages and returns to capital in agriculture alone, because in the longer run capital and labour are mobile between sectors. A relative increase in agricultural

prices encourages agricultural production and increases the demand for all factors of production in that sector. Agriculture is small compared to the rest of the economy in nearly all OECD countries, so proportionately large additions of labour and capital can be attracted with little increase in their remuneration. Not so with land, however; land is basically fixed in supply and so its price is bid up by increases in output prices[11]. In the long run, the benefits of price support accrue not to labour or capital but to people owning land at the time that farm policies were introduced or extended. Some farmers, of course, own their land and benefit accordingly, but many do not; the latter end up paying higher rents and gaining almost nothing from price support. Even among land-owners the benefits are proportional to land holdings and so the estate-owner receives absolutely more than the small-holder.

There is significant empirical support for these theoretical predictions. For example, Howarth (1985) shows that, despite massive increases in support since 1970, UK farmers' incomes have not increased relative to those elsewhere in the economy, while land prices increased more than six-fold between 1970 and 1982. Traill (1980) and Phipps (1985) have shown for the UK and USA respectively that increasing price support since 1950 has raised land prices but not the rate of return to agricultural land. World Bank (1986) shows that the degree of agricultural support and the relative incomes of farm and non-farm workers are negatively correlated[12]. It also argues that support has not stemmed the rate of farm bankruptcy in the USA since 1981, where farmers in supported sectors have fared no better than those in unsupported sectors.

A number of other factors increase the bias towards larger and richer farm-owners. First, in Europe the selection of commodities for higher levels of support has probably imparted some bias, e.g. sugar beet and cereals are now largely the preserve of large units. Second, at least in some commodities, costs are lower for large farms than for small. Thus, prices fixed according to the latter's costs offer the former considerable surplus. (Cost comparisons such as these must be treated with caution, however, because of the difficulties of valuing non-traded inputs such as home-grown feed-stuff and the farmer's time.) Third, large farms, with their more sophisticated machinery and greater division of labour, are probably able to expand output more strongly in response to higher prices. Fourth, credit rationing certainly favours larger farmers.

Fifth, in many countries tax incentives for investments are related to marginal tax rates. Thus, they lower the effective price (opportunity cost) of investment for a rich farmer relative to that for a poor one[13]. Evidence of the effects of some of these biases is provided by the BAE (1985), which estimates that in the early 1980s about one-quarter of farmers received about three-quarters of the assistance offered by

the CAP. Similarly, the Council of Economic Advisors (1986) shows the largest 5 per cent (30 per cent) of US farms receive 31 per cent (89 per cent) of direct government payments to agriculture, while Gardner and Hoover (1975) demonstrate that support tended to increase the income inequalities between farmers.

Closely related but not equivalent to the advantages of size are the rapid increases in the ratios of capital and land to labour in agriculture in most OECD countries. In the United States, for example, while average farm acreage has more than doubled since 1930, average labour per farm has remained constant (Kislev and Peterson, 1982). In Japan, on the other hand, farm size has been relatively constant, but labour inputs have fallen as more farms are worked only part-time (World Bank, 1986).

Of course, one would expect to observe some decrease in the labour intensity of agriculture in line with that elsewhere in the economy. As labour productivity increases outside agriculture, so it must within agriculture in order to maintain the real income relativities between sectors'[4]. But the process has been encouraged in agriculture by the increasing amounts of social legislation, investment incentives and rapid technical advance in the capital goods industries that have increased the cost of labour relative to capital. Traill (1982) documents this for the United Kingdom, while Kislev and Peterson (1982), who do so for the United States, argue that these factors alone account for all the change in the ratios of capital and land to labour since 1930. Moreover, as argued in Part I, the asymmetries that arise from the interaction of credit rationing and tax legislation mean that even price support itself could increase the rate of capital intensification'[5].

An alternative response to rising wages outside agriculture has been to turn to part-time farming: in Japan, only 13 per cent of all farms were operated by full-time labour in 1984, and 71 per cent of farm households received more than half their income from non-farm sources. Moreover, average income per household member in these latter households was about 25 per cent higher than in full-time farming households in 1983. In the United States, only 15 per cent of farms are in size classes for which farm income exceeds non-farm income (CEA, 1986), and in Europe over one-quarter of farmers have other sources of earned income themselves (i.e. in addition to those of other earners in their families and investment income) (Hill, 1982).

While part-time farming represents a rational response to the declining rewards of farming relative to industry, it also weakens the case for general agricultural support. First, part-timers' costs are generally above those of full-time farmers; prices that just cover the former's costs provide the latter with handsome profits.

Hence, if price support were reduced such that the part-timers could no longer

farm commercially, one would observe lower average costs in agriculture but a much less than proportionate reduction in output[16]. Second, while part-time farming obviously contributes to a family's total income, if the family is self-sufficient in food – and many part-time farming families do not produce much more than they eat – its welfare can remain unaffected by change in food prices. That is, if price support were reduced, the beneficial income effects via the family's consumption could offset the negative ones via production.

The differences between individual farmers are also reflected in differences between regions. In part these arise from inherent geographical variations – some areas are better able to exploit the high support prices than others. Just as with individual farmers, however, it is frequently the strongest which gain the most. Furthermore, geographical discrepancies can also reflect the government's choice of commodities to protect. For example, the CAP favours temperate crops and dairying over Mediterranean products, such as fruit and vegetables, and thus exacerbates the regional divisions of the enlarged EEC. The result has been that while poor regions remain poor, the favoured regions become over-exploited.

While in the short term all factors of production may benefit from farm price support, it is difficult to avoid the conclusion that in the long run agricultural intervention has done little to maintain the incomes of farmers and farm workers. Rather it has transferred income and wealth to land-owners, and probably more than in proportion to their holdings of land. While the benefits of higher prices are roughly proportional to output, other policies, such as input subsidies and tax-breaks, bias factor demands away from labour, inducing downward pressure on wages and adding to the benefits of price support accruing to large-scale farmers.

The labour mobility, which prevents agricultural price support from raising the long-run returns to labour, also establishes a link between intervention and rural population levels. Simple price support would almost certainly reduce the rate of rural de-population, by allowing more people to be employed at the standard wage. The other elements of farm policy, however, frequently have the contrary effect. Investment incentives and input subsidies, for example, reduce the demand for labour, encouraging part-time working or emigration from rural areas: so possibly do economy-wide factors such as tax law and credit rationing, as was argued in Part I. Thus, in *toto,* government policy may not support rural population levels[17].

Not only does current agricultural policy favour rich land-owners over poor ones and over farm labourers, it also favours them over consumers. The total consumer costs of intervention were discussed above, but we note here that they fall disproportionately on poor consumers. First, the poor spend a higher proportion of their income on food, and second, there is some evidence that the implicit taxes are higher on the goods consumed most intensively by the poor. Dilnot and Morris

(1982) estimate that the burden of the CAP is equivalent to a 6 per cent income tax on poor British families, but to a tax of only 3 per cent on the richest group of families.

On distributional grounds then, agricultural intervention has not been a success; but what could have been better? Economic theory shows that if a society's objective is to increase incomes or employment, then direct income supplements or employment subsidies are the most efficient policies to adopt (e.g. Corden, 1974). For example, if society's objective is to increase the incomes of small farmers without stimulating infra-marginal farmers' output or taxing food consumers, welfare payments to poor farmers and farm labourers coupled with free trade and uncontrolled prices would be the appropriate policy[18]. If, on the other hand, concern were really focused on rural population levels, residence subsidies or enhanced infra-structural spending would be better. In either case, the important requirement is that additional agricultural output beyond that profitable at world prices is not rewarded, and thus that the production and consumption deadweight losses associated with current policies are avoided.

B. Stability

Among most governments' stated objectives for agricultural policy is that of stabilizing farm incomes. In the absence of insurance markets, some intervention may be desirable to maximize national economic welfare, although Dixit (1986) has suggested severe constraints on this argument. However, for several reasons, it is not clear that extra stability and security for farmers have resulted from current policies.

First, stabilizing prices does not necessarily stabilize incomes. If either outputs or input costs vary more because of intervention, the effects of stable prices on net incomes could be offset. The greater use of purchased inputs to increase yields may raise farmers' exposure to exchange rate or general price fluctuations, and there is some evidence of recent increases in the variability of output (Hazell, 1984). However, it seems unlikely that these factors entirely offset the stability induced by fixed prices.

Second, government policies to reduce risk are often thought merely to encourage farmers to increase their private risk. That is, farmers use the government-provided insurance to increase expected returns at their original level of risk. Gabriel and Baker (1980) present evidence of the trade-off between financial and business risk among US farmers, while Gardner has estimated that for every ton of wheat stored by the US government, private stock-holders reduce their stocks by three-quarters of a ton (quoted in World Bank, 1986).

Third, while price-fixing may suppress market risks, it replaces them with political uncertainty. Thus, instead of facing economic risks whose probability distributions might be reasonably well understood, farmers face political uncertainty which could be every bit as debilitating. The rapid increases in land values in most OECD countries during the 1970s and 1980s owed much to official price supports and farmers' beliefs that they were permanent. Acting on these beliefs, many farmers increased their borrowing far beyond the levels they would have chosen in the absence of intervention. Thus in many cases the immediate cause of bankruptcy in recent years was the actual and prospective slower growth of support prices, i.e. a political decision. Moreover, while the effects of weather and pestilence might average out world-wide, no such averaging is likely in the political dimension because only a few major governments have significant influence on agricultural markets.

Fourth, most OECD countries' policies restrict the transmission of economic signals between the domestic and international markets. Thus, adjustment to any particular agricultural shock is concentrated in the segment of the world market in which it originates, and is thus proportionately more severe than it would be if adjustment were world-wide. This is particularly true of commodities in which only a small, residual proportion of transactions lying outside the scope of managed trade passes through the world market, e.g. sugar. Not only do unadjusted contemporary data on world prices exaggerate the degree of instability that would exist in the absence of market intervention, but the increased variability induced by intervention can also lead to a vicious cycle of restriction leading to instability leading to further "countervailing" restriction.

It is conceivable that a country which experienced very few domestic shocks could improve its stability through isolation, but this is almost bound to be at the expense of increasing instability elsewhere[9]. Moreover, given the extent to which international trade can accomodate local shocks, such an outcome is as improbable in theory as it is unproven in practice. In the simplest case of n identical countries with linear supply and demand curves, the variance of prices under free trade is one-nth of that experienced under autarchy. Johnson and Sumner (1976) calculate that the grain buffer-stock required to stabilize prices by a particular amount is one-eighth as large under free trade as if the world comprised fourteen closed regions. Schiff (1983) and Tyers and Anderson (1986) have shown that freeing agricultural trade could reduce the variance of world prices by factors of up to one-half.

Suppose, however, that current policies do actually reduce risk; such an outcome is not dependent on their also raising mean prices. Countries could avoid much of the deadweight loss by stabilizing prices about world levels rather than

about levels substantially above them. Indeed, if stabilizing prices is feasible, it will encourage agricultural output, so governments should aim at lower mean prices than would apply without stabilization.

As in the previous section, it is also the case here that policy should be more closely tailored to its precise objective. For example, if the latter is to guarantee farmers a particular minimum income level, subsidized insurance would be preferable to price support and may itself be dominated by the establishment of fuller forward and futures markets.

The effect of **OECD** countries' current policy on fluctuations in world prices also raises questions of international equity. There is no doubt that the current excessive fluctuations and gross political uncertainty about prices and market access are a considerable burden to developing countries. They reduce agricultural output, threaten macro-economic stability, encourage governments to intervene in markets far beyond their ability to do so efficiently, and absorb valuable skilled manpower in the constant monitoring and negotiation of **OECD** countries' policies.

C. National security

Another aspect of risk often associated with agricultural policy is the security of food supplies. Food satisfies man's most basic needs and there is naturally great anxiety that a country's citizens should have sufficient to eat at all times. This need is often invoked to justify self-sufficiency in food but rarely is the justification objectively analysed.

It is easy to over-estimate the rigidity of the demand for food. The substitutability between types of food is quite high; hence the welfare costs of large rises in the prices of a few particular foods are not necessarily very great. There is also flexibility in the total volume of food required to maintain a population. Well before there is any question of dietary shortfalls, considerable economies may be made in the use of food by, for example, consuming a greater proportion of each animal slaughtered, preparing food differently, or substituting crops for meat. There is no reason to treat economies or substitutions in food consumption as qualitatively different from those within other parts of consumers' budgets.

No OECD country need fear critical food shortages in the regular course of economic events; each is affluent enough to buy all it needs on world markets even at the height of the strongest boom. Thus, the case for "economic food security" rests on relative costs rather than on biological imperatives, and it is not difficult to deduce that paying low prices usually and high prices occasionally dominates paying fairly high prices (resource costs) all the time.

"Strategic security" is a different issue. This involves maintaining access to food supplies in even the worst political crisis. If it alienated the world, a food importer might face a food embargo – much as the USSR did after invading Afghanistan; but, as in that case, there are sufficient food producers in the world to make any embargo largely ineffective. A country pursuing food self-sufficiency through protection, on the other hand, would, under the same circumstances, surely face an embargo of oil and fertilizer. With few suppliers, this is far more likely to be effective and, given the over-exploitation of the land that current prices encourage, domestic yields would plummet if farms were starved of material inputs. Indeed, they would fall below the levels that would be obtainable from newly ploughed land in the absence of such inputs. Thus, even if one expected prolonged periods of total embargo, it would seem better to maintain strategic reserves of food, fallow land and farming equipment than to squeeze every ounce of production out of the land every year[20].

A final perversity of any proposed national security justification for OECD countries' farm policies is evident in Table 6 above. This suggests that Eastern Europe benefits from current policy by about **$23** billion per *annum*.

D. The environment

A justifiable concern of every affluent country is its environment. This covers a range of features from facilities for rural recreation and wildlife preservation to the prevention of poisoned rivers and soil erosion. High agricultural prices encourage intensive cultivation resulting, at least occasionally, in wind erosion, the destruction of hedgerows and wild-life habitats, nitrate concentrations, unsightly and exhausting mono-culture and the closure of land to the public. Such outcomes are particularly likely if farmers are uncertain about future levels of farm Support because, under those circumstances, it makes sense to 'make hay while the sun shines'. The reduction of farm support would not leave the countryside entirely untended, but it would probably ease the intensity of land use, and in some areas even shrink the margin of cultivation somewhat. Thus, on balance, current agricultural policy seems as likely to harm as to preserve the environment[21].

CONCLUSIONS

This article has presented two sets of evidence on agricultural policy in OECD countries. The first and major set comprised estimates of the deadweight losses of national unweighted economic welfare that current policies entail. It showed that these losses can be measured in a number of ways of differing sophistication, ranging from simple partial equilibrium modelling of a single sector through to complex general equilibrium modelling of the whole economy. The attraction of the former is the detail that can be devoted to collecting and interpreting data and to representing the processes of the sector concerned. That of the latter is its comprehensiveness – its ability to reflect the connections between agriculture and the resources it absorbs (labour, capital, land, foreign exchange) and other parts of the economy.

While every approach to measuring the welfare costs of agricultural policy is subject to reservations, certain qualitative conclusions emerged from nearly every study surveyed above. OECD agricultural support:

- increases food prices to OECD consumers;
- wastes resources by over-expanding agricultural output in high-cost areas and curtailing it in low-cost ones;
- diverts resources from industry and services;
- reduces OECD countries' competitiveness in manufactures.

A number of other conclusions were also noted, which while not having the force of repeated replication are nevertheless well enough justified to be taken very seriously. OECD agricultural support:

- can reduce aggregate employment;
- transfers substantial resources to Eastern Europe;
- discourages developing countries' agriculture by reducing world prices and making them more volatile.

The quantification of the deadweight losses of agricultural intervention is still relatively imprecise, but assuming that observed prices and rewards reflect social values, losses of up to 1 per cent of GNP look plausible in Europe, with even greater losses in Japan. One estimate suggests that consumers and taxpayers in industrial countries are some $100 billion worse off because of agricultural intervention. Of this, about half is transferred to producers – mostly to the owners of land – while the rest – roughly equivalent to Denmark's national income – is lost in economic inefficiency. Moreover, by ignoring the instabilities and uncertainties that policies

entail, the wasteful lobbying they give rise to, the environmental dangers of over-cropping and the distortions in investment and R&D that they produce, these estimates probably significantly understate the costs of current interventions. While it is impossible to quantify the degree of understatement, these additional components of costs will almost certainly grow for so long as the distortions to OECD agriculture remain uncorrected.

Part III of this article considered the other side of the agricultural policy ledger: specifically, what countries might hope to achieve in return for the lost $50 billion. The evidence suggests relatively little. The principal beneficiaries of farm support are the land owners – in proportion, or possibly more than in proportion, to their land holdings. Poor farmers and farm labourers appear to gain little and maybe even lose. There is some possibility that farm policy stabilizes farm incomes, but even that is not unambiguous. Finally, the studies surveyed in Part II suggest that **OECD** countries' farm policies penalize poor consumers, do nothing to enhance national security or the environment, and may be harmful to developing countries.

All told, therefore, the evidence suggests considerable advantages to the reform of agricultural policy. It is true that this would entail substantial change in certain **OECD** economies; however, the associated costs may be minimized by adopting a multilateral programme of liberalization and their effects ameliorated by offering non-distortionary compensation to the affected parties. The details of transitory arrangements are not the subject for this article, but it should be noted that adjustment costs are temporary and that, given the large long-run savings to be made by rationalizing agriculture, compensation could be very generous. While there may be significant political difficulties to undertaking it, the economic returns to reforming agricultural policy look substantial compared with those available from almost any other area of governmental activity.

NOTES

1. Provided the demand and supply curves are approximately linear, the losses may be estimated as $\frac{1}{2}et^2M$ if, without loss of generality, we set $P = 7$, and where e is the elasticity of demand for imports,

2. By contrast, if imports are controlled directly by quota, the costs are approximately $\frac{1}{2}(dM)^2/Me$, where dM is the enforced cut in imports. The difference arises because under quotas a lower elasticity associates a larger change in price (implicit tariff) with a given enforced change in imports. Obviously, given the same (implicit) tariff and change in imports, the cost of protection will be identical for the two methods of protection.

3. Compensating variation is the increase in income that a consumer requires after a change in prices to allow him just to reattain his former level of welfare; equivalent variation is the increase in income he would need before the change in prices to allow him to reach the welfare level he actually achieves after the change. The definitions are most clearly seen using cost (or expenditure) functions which define the minimum expenditure (income) necessary to achieve a particular level of utility, given the vector of prices. Thus, to achieve the free-trade utility level, $u(f)$, given free-trade prices, $p(f)$, one requires, say, income level $C[u(f);p(f)]$. Now imagine that tariffs are imposed, changing prices to $p(t)$; the income required to maintain $u(f)$ is $C[u(f);p(t)]$. Compensating variation is the difference between that amount and actual income under tariffs:

   $$CV = C[u(f);p(t)] - C[u(t);p(t)]$$

   Equivalent variation may be similarly defined, but at original free trade prices:

   $$EV = C[u(t);p(f)] - C[u(f);p(f)]$$

4. That is, in the absence of quotas, price support would impose social costs of Y 1 441 billion or 0.7 per cent of GDP.

5. Modelling stocks is an innovative step, but it is also a contentious one, for stock functions must be subject to the so-called Lucas critique. This states that the estimated parameters of economic behaviour depend crucially on the ruling policy regime, so that estimates made under one regime may not be used to predict behaviour in another. Thus if the nature of government intervention changed dramatically, speculation functions based on past data would be very suspect, especially if, as Tyers and Anderson argue, trade liberalization stabilized world food prices.

6. Because of aggregation, the developing country regions report only minor distortions in 1980, e.g. in the South Asian country group, food subsidies in India are offset by food taxes in Pakistan. Thus, for developing countries TWW understate the gains from liberalization.

7. "Armingtonian prefences" denotes that consumers behave as if they first allocated their expenditure across broad groups of goods, e.g. food, housing, etc, and then allocated each groups' expenditure over the goods in that group independently of anything happening in other groups. The assumption has fairly strong implications for the way in which consumers can react to price changes (Armington, 1969).

8. The VAT receipts are implicitly returned to the public through the income identity, but VAT positions matter because rates and the treatment of food vary by country.

9. Stoeckel is not necessarily correct in arguing that the consequences will be concentrated on the unprotected parts of manufacturing.

10. See Winters (1986) for a discussion of the role of these attitudes in the formation and perpetuation of agricultural policy.

11. Even on the rural-urban margin, the supply of land to agriculture is largely fixed because zoning laws restrict changes in use.

12. Clearly this correlation cannot reflect causation, but it is hardly indicative of successful redistributive policy.

13. The majority of farmers are taxed as self-employed individuals, not as owners of incorporated businesses. If the latter dominated, the effects would be rather different.

14. This is just the same 'mobile labour' argument used above to explain why price support would not raise wages.

15. OECD (1986) quotes further studies reaching this conclusion.

16. Large farms already account for the vast bulk of output – and produce it profitably. Thus, if only a fraction of smallholdings were consolidated into larger farms, overall output levels could be maintained.

17. This discussion illustrates the important practical fact that agriculture is affected by several different authorities whose actions may not be perfectly co-ordinated. While price support and material input subsidies fall under one ministry, investment incentives generally fall under another and the tax system under a third. In the EEC, this is further complicated by the division between Community and national policies.

18. It is sometimes objected that such schemes would make proud men live on charity and that society would not sanction the massive direct transfers involved. But the present system is no more than inefficient, covert charity.

19. Conversely, isolationary policies which do not increase world instability are almost bound to increase it at home.

20. As an argument about the efficient response to the threat of war, this point is quite independent of the subjective probability of war.

21. Some commentators argue that cutting output prices would increase the intensity of farming as farmers sought to increase output to maintain their incomes. This implies that society could have more food for less money than at present – a strong indictment of agriculture's present inefficiency. But the balance of econometric evidence suggests that over anything but the very short run, agricultural supply curves slope upwards.

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