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THE MACROECONOMICS OF EUROPEAN AGRICULTURE

by

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The Macroeconomics of European Agriculture

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Summary

This paper approaches the Common Agricultural Policy of the European Union from a macroeconomic perspective. This approach is based on recent empirical evidence from various sources indicating that the cost of present agricultural protection in Europe to consumers and taxpayers in terms of welfare lost and of output foregone is higher than has been commonly understood. This conclusion is supported by assessing the cost of farm protection by simple general equilibrium analysis that reflects the implicit discrimination involved against manufacturing, trade, and services in Europe. On the other hand, the costs imposed also on developing countries and on the emerging market economies of Central and Eastern Europe by denying their farm produce access to the European market are not taken into account. Whereas short-run partial equilibrium studies have generally indicated deadweight losses due to farm support equivalent to about 1% of GDP on average, long-run general equilibrium considerations are shown to raise the loss estimates to about 3% of GDP.

By lowering costs and prices, freer farm trade could deliver a substantial supply-side boost to the European economy and to the world economy as a whole in the long run, facilitating a noninflationary decrease in interest rates and unemployment in Western Europe and possibly also paving the way for export-led growth in Central and Eastern Europe in the years ahead. Even so, there may remain a cultural justification for continued public support for agriculture in Europe; if so, such support needs to be made more effective and more efficient than it is now.
The Macroeconomics of European Agriculture

1. The farm problem

Should Central Banks concern themselves with agricultural policies? Does Europe's Common Agricultural Policy matter for Central and Eastern Europe? Should Ministries of Agriculture be abolished—or perhaps be incorporated into Ministries of Environment or even Education and Culture?

The answers suggested in this paper are yes, yes, and yes. They are based on recent empirical evidence from various academic and institutional sources indicating that the cost to consumers and taxpayers of agricultural protection in Europe in terms of welfare lost and of output foregone is such that farm trade reform could possibly deliver a substantial supply-side impetus to the European economy and to the world economy as a whole in the long run. This conclusion is supported by assessing the cost of farm protection by simple general equilibrium analysis that reflects the implicit discrimination involved against manufacturing, trade, and services in Europe, even if the costs imposed also on developing countries and on the emerging market economies in Central and Eastern Europe by denying their farm produce access to the European market are not taken into account. Whereas short-run-oriented partial equilibrium studies have generally indicated deadweight losses due to farm protection equivalent to about 1% of Gross Domestic Product (GDP) on average, long-run general equilibrium considerations will be shown to raise the deadweight loss estimates to about 3% of GDP.

By lowering costs and prices, farm trade liberalization would facilitate a noninflationary decrease in interest rates and unemployment in Western
Europe, and could also pave the way for export-led growth in Central and Eastern Europe in the years ahead. Even so, agriculture is not so named for nothing: there may remain an important cultural justification for continued support for European agriculture from public funds. If so, however, such support needs to be made more effective, more efficient, and probably also more equitable than it is now.

1.1. History, technology, biology

Around 1870, a century after the commencement of the industrial revolution in England, the economies of Europe were still predominantly agricultural. In France, farming—including hunting, forestry, and fishing—was still by far the most common occupation, accounting for about a half of total employment. In the United Kingdom, by contrast, the proportion of the economically active population tilling the land had decreased to about 15% in 1870. The industrial revolution did not spread rapidly to the rest of Europe, not even to Ireland next door.

The 120 years or so that have passed since then have seen a slow but steady continuation of the decline in farm employment all over Europe. By 1960, employment in agriculture had decreased to 22% of civilian employment in the industrial countries as a whole, and to 7½% in 1990 (Appendix Table A1). The share of value added in agriculture as a percentage of GDP fell correspondingly from 7% to 2½% in the OECD area in the same thirty-year period (Appendix Table A2). This development continues. Output per worker in agriculture has increased slightly on average relative to GDP per worker in the OECD countries, or from 53% to 59% between 1960 and 1990, but these averages conceal substantial differences across countries (Appendix Table A3). All the same, the reader must be warned against interpreting these figures as precise
indicators of income or productivity differences between agriculture and other activity, because they do not include non-farm incomes earned by farm families, nor do they reflect accurately the labor input from part-time farm households (see Johnson, 1991, Chapter 11).

The dramatic decline of agriculture, once the mainstay of the economies of Europe and the chief livelihood of most Europeans, is a natural consequence of the interaction between technology and biology. Increased labor productivity through the replacement of animal power by mechanical power on the farms, improved chemical fertilization, and other types of technical progress and modernization reduces the number of working hands needed to feed a slowly growing population whose biological requirements are essentially confined to a fixed number of calories per person per day. As their incomes rise and their living standards improve, people generally require more and better housing, cars, and clothing, but their demand for food remains essentially unchanged in quantity if not in quality.

This is the bright side of Baumol's law: it still takes four to play a string quartet, and always will, but it takes fewer and fewer farmers to feed the rest of us, fortunately. At the time of the Franco-German war of 1870-71, the labor of every other Frenchman and German was required to feed the population of these countries. Today, with modern farming techniques, roughly the same job --indeed, a much better job!--is done by about ten to twenty times as few farmers, relatively. What happened to the others? They were released to work in other industries and thus contribute to the build-up of strong, diversified, modern economies based on industry, trade, and services.

Figure 1 highlights the relation between the decline of agriculture and economic growth in the world. The vertical axis shows the share of agriculture in GDP in 105 low-, middle-, and high-income economies and the horizontal
axis shows their real GDP per capita (see World Bank, 1993, Appendix Tables 1 and 3, and OECD, 1993a). With a correlation of -0.86, the general pattern is clear: poor countries are overwhelmingly agricultural, whereas rich countries derive their steadily increasing income and wealth essentially from having successfully transferred labor and other factors of production from agriculture to industry and, especially, to trade and services that have grown to become the source of almost two-thirds of GDP in the industrial (i.e., OECD) countries compared with about a half or so on average in middle-income countries, about 40% on average in low-income developing countries, and even less that that in most of the erstwhile planned economies of Central and Eastern Europe (World Bank, 1993). The saying “What is good for General Motors is good for America” has become a distant echo in an economy where artists now outnumber autoworkers five to one.

1.2. The case for agricultural protection

Even so, the massive transfer of labor from the farms that has taken place in Europe and elsewhere little by little over the years has created, or threatened to create, severe economic and social problems, especially for uprooted farmers and their families. This is the essence of the farm problem, and a prime justification for ambitious agricultural policies intended to resist the trend towards fewer, more efficient farms and to alleviate the burden of relocation from farm to city. This is not the sole source of the problem, however, because the biological inelasticity of the demand for food makes farm prices and incomes uncommonly sensitive to supply shocks. As a result, a technological innovation or a bumper crop can reduce farm prices and incomes drastically. Price and income stabilization is, therefore, another important objective of agricultural policies in a world with imperfect private insurance
markets. If farmers could insure themselves against adverse supply shocks in private markets, the case for government stabilization programs would be weaker. Moreover, farm protection is often regarded as an instrument of regional policy: agriculture is shielded from market forces to secure a desired distribution of the population across regions, and to protect certain rural areas from depopulation.

Specifically, according to the Treaty of Rome, the major goals of the Common Agricultural Policy (CAP) of the European Union are:

(a) To increase agricultural productivity;
(b) To insure a fair standard of living for the farm community;
(c) To stabilize farm product markets;
(d) To provide food security; and
(e) To secure supplies to consumers at reasonable prices.

These objectives are not mutually consistent in all respects, however. In particular, the aim to raise farm incomes may, and often does, conflict with the goals of securing low prices to consumers and of increasing agricultural productivity, the latter because the CAP, by protecting small and often inefficient farms, has stood in the way of scale economies in agriculture.

But why do governments generally try to resist the natural and inevitable trend towards fewer, more efficient farms? Do they resist the replacement of old coal mines by cleaner and more efficient sources of energy with similar fervor? The answer is actually yes. According to Radetzki (1993), coal production in France, Germany, Spain, and the United Kingdom is subsidized directly and indirectly at a cost of almost US$ 60,000 per job. But even so, unlike coal mining, agriculture has a special place in the hearts and minds of Europeans and many others—a place, indeed, that lies beyond the purview of pure economics. Unlike most coal miners, farmers—some farmers, at least—are, or are viewed as, artists.
Their contribution to society and to culture—by bringing us Brie and Gorgonzola, you name it, by keeping the countryside populated, green, and clean for us all to enjoy, and by preserving our common cultural heritage and our treasured links to the land—can be considered to generate external benefits that justify public financial support on similar grounds as arts and science. Parisians and most other city-dwellers are willing to pay for the preservation of agriculture because they think it enriches their lives, and especially if they feel that farming is in some way an endangered occupation. Unlike most coal mines or industrial plants, farms cannot be left entirely to the vagaries of the market because of the external benefits involved. Without support, there would simply be too few farmers. Agriculture, like art, has the character of a partly non-excludable public good.

Therefore, like many opera houses and other theaters, agriculture needs—and, most of us would agree, I think, deserves—to be protected against unfettered market forces, within reasonable limits, effectively, equitably, and by efficient means. This is an important part of the reason why every industrial country (with the recent exception of New Zealand) supports its farmers in some measure, in sharp contrast to many developing countries where agriculture is the main occupation and a major source of direct and indirect tax revenue to the government (see World Bank, 1986); indeed, the taxation of agriculture in developing countries—where poor farmers are commonly taxed, directly and indirectly, by about 30%—shows that farm subsidization is by no means the natural order of things (see Schiff and Valdés, 1992). Even so, the cultural argument can also be used to explain why many of those who would argue without hesitation for a total dismantling of coal subsidies in Europe would nevertheless want to see farm support continued to some extent at least.
As noted before, agriculture and arts are related by Baumol's law. Just as agriculture becomes steadily more expensive to maintain because of the interaction of rapid technical progress and inelastic demand, so the performing arts also need steadily more subsidies because of the interplay between highly elastic demand and stagnant productivity that causes a persistent increase in production costs relative to other industries where productivity rises over time (see Throsby, 1994). Thus, decreasing costs in agriculture and increasing costs in the arts have similar causes and effects: they tend to depress the incomes of farmers and artists and to generate steadily increasing demands for subsidy in both activities. It is thus not technical progress as such that depresses farm incomes over time, but rather its interaction with the biological inelasticity of the demand for food.

The cultural argument for farm support is clearly normative, and is therefore impossible to refute in its general form. It appears in many guises. Some OECD countries have counted the maintenance of healthy rural communities, the promotion of regional development, the preservation and encouragement of family farming, the protection of the environment, and even national security among the explicit objectives of their agricultural policy. These are commendable objectives. Yet, empirical evidence indicates that the Common Agricultural Policy is neither effective, efficient, nor equitable in reaching these goals. For example, capital subsidies under the CAP have encouraged excessive use of chemical fertilizers that appear to have polluted rather than preserved the environment (see Winters, 1989-90, and Anderson, 1992b). This indicates that less, not more, agriculture in Europe would be good for the countryside, and that the environmental part of the cultural argument for farm support suggested above begins to apply only after agriculture has contracted further. The CAP has not insured adequate incomes to small-scale farmers as intended,
nor has it preserved and encouraged family farming. Instead, it has generated windfall gains for more efficient large-scale farmers, especially by pushing up rents and land prices (see IMF, 1988, and Martin et al., 1989-90). The national security argument for agricultural protection, often heard in Russia and Japan among other places, is not convincing either, for not even during the Second World War were whole countries cut off from foreign food supplies. After all, most developing countries tax their agriculture, as noted before. Hong Kong and Singapore have no agriculture to speak of.

Moreover, the CAP has led to extensive and wasteful overproduction of farm goods at the expense of industry, trade, and services, thus calling for enormous public expenditure on agriculture at the expense of other wants. It has also distorted incentives by raising food prices in Europe and by thus imparting a stagflationary bias to the European economy and worsening the terms of trade of many food-exporting countries in the rest of the world, especially developing countries. These problems have been compounded by imperfect competition in agricultural markets in individual countries (compare the Dutch milk monopoly, for example). The result of all this has been substantial waste in terms of welfare lost and in terms of nonagricultural output foregone, as we shall see. So, if the argument for maintaining farm protection at present levels is primarily cultural in a broad sense, public outlays on agriculture directly and indirectly need to be compared fairly and squarely with other cultural outlays and with the external benefits they generate.

Such comparisons are difficult to make in practice, but they are likely to indicate a substantial overcommitment to agriculture, because farmers and landowners are a vocal and well-organized interest group in Europe and elsewhere in the industrial countries. Their influence in the political arena is often disproportionate to their numbers, independently of the merit of their case
for special protection (see Bohlin et al., 1984, and Gardner, 1992). In some
countries, farm regions are grossly overrepresented in national legislative
bodies; Japan, Norway, and Iceland are cases in point. Individuals with close
ties to agricultural interests are sometimes even chosen to head Ministries of
Agriculture. The ministries then tend to become guardians of special interests
against the public interest rather than the other way around. Russia, before and
after the revolution of 1991, is an extreme example of this tendency and its
macroeconomic consequences.

But why do special interests tend to prevail over the public interest in
agriculture in particular? Each farmer and landowner stands to gain much more
from protection than each consumer and taxpayer stands to lose, it is true (see
Sharker et al., 1993, and Anderson, 1994), but this is a general argument that
does not apply especially to agriculture. More likely, as agriculture accounts for
less than 3% of national income in the industrial countries on average, its
relative unimportance and its continuing decline on top of that may have
created a general impression that agricultural protection cannot be all that
costly. This impression may have been supported by inadequate data collection
and monitoring of agricultural policies by national authorities and international
organizations at least until the late 1980s. If so, this increases the urgency of
assessing the full costs of farm support and of making the general public and
policymakers aware of these costs.

1.3. The cost of agricultural protection

The main instrument of the CAP is price support maintained by
intervention purchases in addition to variable import levies, export
refunds (i.e., subsidies), deficiency payments, and production quotas. This
policy has two major implications in Europe: (a) it raises food prices for
consumers and (b) it imposes higher taxes on taxpayers. Consumers are thus deprived of access to less expensive imported agricultural products and taxpayers must accept reduced purchasing power because of the need to finance the fiscal part of the CAP. Until the early 1980s, this direct fiscal part of farm protection attracted most attention in empirical studies. More recently, however, attention has been drawn also to the even more important indirect cost of protection through the price support that has inflated food prices in Europe.

This is not all, however. Agricultural protection in Europe and elsewhere imposes two other types of potentially major costs: (a) on industry, trade, and services that are taxed implicitly by the favorable treatment of agriculture and (b) on the rest of the world, developing countries especially and, more recently, the countries of Central and Eastern Europe as we shall see, by denying them access for their agricultural products in the European market. To understand the full costs of farm protection, all these factors need to be taken into account.

So how large, then, is the current cost of agricultural protection in Europe and elsewhere in the OECD area?

In 1992, the total cost imposed on consumers and taxpayers amounted to more than US$ 350 billion according to the OECD (Table 1). This amount is larger than the combined GDP of Australia and New Zealand, and only slightly smaller than the combined GDP of Austria and Switzerland. Direct transfers from taxpayers have tended to be the favored method of farm protection in the United States, Canada, and Australia, whereas indirect transfers from consumers are relatively larger in Europe and, especially, in Japan where the domestic price of rice, the main staple food, has been five to seven times higher than the world market price in recent years, for example.
Table 1. Total transfers associated with agricultural policies in OECD countries, 1992

<table>
<thead>
<tr>
<th>In billions US dollars</th>
<th>Transfers from taxpayers</th>
<th>Transfers from consumers</th>
<th>Budget revenues</th>
<th>Total transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>1.1</td>
<td>0.4</td>
<td>0.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Austria</td>
<td>1.3</td>
<td>3.0</td>
<td>0.1</td>
<td>4.2</td>
</tr>
<tr>
<td>Canada</td>
<td>5.4</td>
<td>3.7</td>
<td>0.0</td>
<td>9.1</td>
</tr>
<tr>
<td>European Union</td>
<td>67.0</td>
<td>89.7</td>
<td>0.8</td>
<td>155.9</td>
</tr>
<tr>
<td>Finland</td>
<td>1.9</td>
<td>2.8</td>
<td>0.1</td>
<td>4.5</td>
</tr>
<tr>
<td>Japan</td>
<td>18.0</td>
<td>68.8</td>
<td>12.8</td>
<td>74.0</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Norway</td>
<td>2.2</td>
<td>2.1</td>
<td>0.1</td>
<td>4.1</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.6</td>
<td>2.9</td>
<td>0.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2.6</td>
<td>3.9</td>
<td>0.7</td>
<td>5.8</td>
</tr>
<tr>
<td>United States</td>
<td>63.4</td>
<td>28.6</td>
<td>0.9</td>
<td>91.1</td>
</tr>
<tr>
<td><strong>Total OECD</strong></td>
<td><strong>163.6</strong></td>
<td><strong>205.9</strong></td>
<td><strong>15.8</strong></td>
<td><strong>353.7</strong></td>
</tr>
</tbody>
</table>

Source: OECD, Agricultural Policies, Markets and Trade, Monitoring and Outlook 1993, Table II.15.

Note: For a detailed description of the methods by which these estimates were generated, including assumptions about demand and supply elasticities, wage rigidities, and the like, see OECD (1987) and OECD (1989-90).

The cost figures shown in the table are gross. To arrive at corresponding estimates of the net cost of agricultural protection, that is, of the deadweight or welfare loss, one needs to subtract the benefits received by farmers and landowners from the gross costs to consumers and taxpayers. As suggested by Johnson (1991, Chapter 3), however, it is not obvious that the net cost is a better measure of the burden at issue than the gross cost. To see this, consider a
scheme through which the poor are taxed lump-sum by 100 in order to subsidize the rich by the same amount. The true cost of the scheme is probably closer to the gross cost of 100 than to the net cost of zero because the poor are hurt much more by the tax than the rich gain from the subsidy. Now consider a scheme by which consumers and taxpayers are forced to pay 100 to subsidize farmers by 50 at a deadweight loss of 50 that includes the salaries of Agriculture Ministry officials, the cost of storing food surpluses, and so on. Clearly, the true cost here is not zero because bureaucrats, storage owners, and other nonfarmers at the receiving end would presumably find other worthy things to do if the scheme were dismantled. But if this applies to the bureaucrats and to other middlemen, why should it not also apply to the farmers and landowners?

A comparable preference for gross rather than net cost explains in part why white-collar crime is illegal. Because the main purpose of such crime is to redistribute wealth without violence, the net cost involved is probably near zero, but understandably the gross cost matters more to most people in this case.

Thus, it is not obvious that the benefits that farmers and landowners receive from agricultural protection should be subtracted from the costs imposed on consumers and taxpayers to arrive at the true cost of farm protection, not least in view of the fundamentally regressive nature of the transfers. For not only do inflated food prices fall most heavily on poor families, but in the long run the benefits of farm support accrue primarily to landowners, and then mostly to those who own the largest estates (see Winters, 1987, and Martin et al., 1989-90). This is not surprising: while price support raises rents because land is essentially fixed in supply, price support cannot be used to raise the return to farm labor because of the unrestricted potential entry of workers into agriculture from other industries, nor can price support be used to prevent the
inevitable emigration of labor out of agriculture in the long run. According to Johnson (1991, page 247), a sixth or at most a fifth of all farmers in the industrial countries are responsible for two-thirds to three-fourths of all farm sales, and receive support commensurately. In view of all this, both gross and net estimates of the cost of farm protection are presented below.

For the record, the OECD estimates of gross cost shown in Table 1 are based on elaborate computations of Producer Subsidy Equivalents (PSEs), defined as the decrease in the gross income of producers if farm protection was discontinued, and Consumer Subsidy Equivalents (CSEs) indicating the increase in consumer expenditures (net of transfers) if the protection was discontinued. In other words:

\[
\begin{align*}
\text{PSE} &= \text{quantity produced} \times \\
&\quad \text{difference between domestic producer price} \\
&\quad \text{and world market price} \\
&\quad \text{plus net transfers to agriculture,} \\
\text{CSE} &= \text{subsidies to consumers} \times \\
&\quad \text{quantity consumed} \times \\
&\quad \text{difference between domestic consumer price} \\
&\quad \text{and world market price.}
\end{align*}
\]

The OECD's assessment of total transfers draws upon and extends the estimates of PSEs and CSEs, essentially by incorporating additional budgetary payments and revenues (OECD, 1993b, pages 157-165).

In proportion to GDP, the total gross cost of agricultural support ranged from virtually nil in New Zealand, where transfers to agriculture have been dismantled in recent years as part of the country's radical and ultimately
successful economic transformation, to more than 4% in Finland (Table 2). All the members of the European Free Trade Association (EFTA) included in Table 1 except Sweden—that is, Austria, Finland, Norway, and Switzerland—spend considerably more on their agriculture relative to GDP than the European Union. Thus, the EFTA countries spend about 3% of their GDP on agriculture on average compared with about 2% of GDP in the European Union.

Table 2. Total agricultural transfers in OECD countries, 1992

<table>
<thead>
<tr>
<th>Country</th>
<th>Share in GDP (in percent)</th>
<th>US$ per head of population</th>
<th>US$ per full-time farmer</th>
<th>US$ per hectare of farmland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>0.5</td>
<td>89</td>
<td>4,200</td>
<td>3</td>
</tr>
<tr>
<td>Austria</td>
<td>2.3</td>
<td>530</td>
<td>16,400</td>
<td>1,210</td>
</tr>
<tr>
<td>Canada</td>
<td>1.6</td>
<td>330</td>
<td>20,400</td>
<td>123</td>
</tr>
<tr>
<td>European Union</td>
<td>2.0</td>
<td>450</td>
<td>17,700</td>
<td>1,120</td>
</tr>
<tr>
<td>Finland</td>
<td>4.1</td>
<td>910</td>
<td>31,300</td>
<td>1,780</td>
</tr>
<tr>
<td>Japan</td>
<td>2.0</td>
<td>600</td>
<td>24,000</td>
<td>14,120</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.1</td>
<td>15</td>
<td>400</td>
<td>4</td>
</tr>
<tr>
<td>Norway</td>
<td>3.7</td>
<td>970</td>
<td>39,600</td>
<td>4,240</td>
</tr>
<tr>
<td>Sweden</td>
<td>1.3</td>
<td>370</td>
<td>38,600</td>
<td>950</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2.4</td>
<td>840</td>
<td>29,300</td>
<td>2,850</td>
</tr>
<tr>
<td>United States</td>
<td>1.5</td>
<td>360</td>
<td>36,100</td>
<td>210</td>
</tr>
<tr>
<td>Total OECD</td>
<td>2.1</td>
<td>440</td>
<td>21,900</td>
<td>310</td>
</tr>
</tbody>
</table>


The table shows that the cost of farm protection is spread quite unevenly across countries. Averages, such as the 2% figure for the European Union, may
thus conceal substantial differences among individual countries. In fact, some countries may gain from farm protection (among EU members, for example, Denmark, Ireland, the Netherlands, and France are major food exporters). If so, the losses incurred by other countries included in the average in question must be correspondingly larger. Therefore, a wide range of gains and losses across countries and commodities does not necessarily weaken the case against protection, on the contrary.

Total agricultural transfers per head of population are highest in Norway, where, at US$ 970 per person, they exceeded the average for the European Union and for the OECD area by more than 100%. Total agricultural transfers per full-time farmer equivalent (FFE, defined as 2,200 hours of work in agriculture per year) are highest in Norway and Sweden where total transfers amount to almost US$ 40,000 per FFE, compared with US$ 17,700 in the European Union. Each full-time farmer thus costs consumers and taxpayers more than the median labor income of about US$ 12,000 in the European Union, and far more in some countries.

It is striking that agricultural protection per full-time farm worker in the United States is more than twice as large as in the European Union. Farm support in the United States has not declined in tandem with agricultural employment that is lower relative to total employment in the United States than anywhere in Europe except in the United Kingdom and Belgium (Appendix Table A1). Per hectare of farmland, however, total agricultural transfers are highest by far in Japan (US$ 14,000), followed by Norway and Switzerland.

In sum, then, the costs to consumers and taxpayers of protecting agriculture are substantial everywhere in the OECD area except in Australia and, especially, New Zealand. In Norway, the gross cost of farm protection exceeds the contribution of agriculture to GDP by almost 1% of GDP (compare Tables 2
and A2). The value added in Norwegian agriculture is thus negative in this sense. In Japan and the United States, the value added in agriculture (i.e., value added in production less the gross cost of protection) amounts to about 0.5% of GDP.

What if the benefits that accrue to farmers are subtracted from the gross cost figures reviewed above? The mean estimate of the deadweight loss incurred through the redistribution of incomes from consumers and taxpayers to farmers and landowners is about 1% of the European Union's GDP according to the IMF (1988), Demekas et al. (1988), and Winters (1987). This deadweight loss estimate implies a transfer ratio (that is, the ratio of the transfers from consumers and taxpayers to the benefits received by farmers and landowners) of about 2. This is by no means the end of the story, however, because of the discrimination involved against industry, trade, and services; because of wasteful rent-seeking, lobbying, investment distortions, and even fraud; and also because of the hardships imposed on innocent third parties in the rest of the world.

1.3.1. Other evidence

Table 3 gives an overview of several empirical studies of the cost of farm protection in Europe undertaken in the 1980s. The numbers in the table are net of the benefits received by farmers. The corresponding gross figures are considerably higher. For example, the net cost of the CAP equivalent to 0.3% of GDP reported by the Australian Bureau of Agricultural Economics conceals substantial consumer and taxpayer losses, equivalent to 1.2% and 1.0% of GDP.

The potential output gains from agricultural liberalization implied by the table involve employment gains as well. For example, the 3.3% output gain to West Germany reported by Dicke et al. (1988) is consistent with a decrease in unemployment by 4 percentage points. Similarly, based on a general
equilibrium model, Dicke et al. (1988) report a gain of two to four million jobs in Europe as a whole as a result of agricultural liberalization, depending on the degree of real wage flexibility. The deflationary impact of the CAP is primarily the consequence of domestic agricultural prices far above world market prices. The price differential in the European Community was about 50% on average during 1970-85 according to the IMF (1988), with the nominal rate of protection ranging from 11% for beef to 80% for sugar. Tyers and Anderson (1986b) report similar figures. By their calculations, producer-to-border price ratios were 1.6 and 2.2 on average in 1980-82 and 1988 in the European Community, compared with 1.9 and 3.2 in the EFTA countries, 2.4 and 3.8 in Japan, and 1.2 and 1.5 in the United States. By 1988-91, the nominal rate of protection had reached 84% in the EC, compared with 176% in the EFTA countries, 190% in Japan, and 33% in the United States according to the OECD (1992). The corresponding figures for Canada, Australia, and New Zealand in 1988-91 were 48%, 13%, and 6% (Anderson, 1994).

In the partial equilibrium studies reviewed in the table, the figures are intended to reflect deadweight losses as measured by Harberger triangles in farm product markets without regard to the implications of agricultural support for other parts of the economy. In the general equilibrium studies, on the other hand, including those in Stoeckel et al. (1989), an attempt has been made to incorporate the economywide long-run ramifications of agricultural protection without, however, taking the costs imposed on other countries into account. Unsurprisingly, the general equilibrium studies yield higher cost estimates than the partial equilibrium ones (see Buckwell and Medland, 1991). On average, the general equilibrium cost estimates are about three times as high as those obtained from partial equilibrium studies, or 2.2% versus 0.7% of GDP on average in the two types of model reviewed in the table. This is partly because
the long-run-oriented general equilibrium studies typically assume larger price elasticities of agricultural supply than the more short-run-oriented partial equilibrium studies (see, for example, Miller and Spencer, 1977, and Johnson, 1991, Chapter 6).

Table 3. The cost of agricultural support in the European Community in the 1980s: Overview of the evidence

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of model</th>
<th>Cost of CAP in % of GDP</th>
<th>Transfer ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morris (1980)</td>
<td>PE</td>
<td>0.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Thomson and Harvey (1981)</td>
<td>PE</td>
<td>...</td>
<td>1.8</td>
</tr>
<tr>
<td>Buckwell et al. (1982)</td>
<td>PE</td>
<td>0.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Bureau of Agr. Economics (1985)</td>
<td>PE</td>
<td>0.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Bureau of Agr. Economics (1985)</td>
<td>PE</td>
<td>0.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Burniaux and Waelbroeck (1985)</td>
<td>GE</td>
<td>2.7</td>
<td>...</td>
</tr>
<tr>
<td>Spencer (1985)</td>
<td>PE</td>
<td>0.9</td>
<td>...</td>
</tr>
<tr>
<td>Tyers (1985)</td>
<td>PE</td>
<td>1.1</td>
<td>3.2</td>
</tr>
<tr>
<td>Tyers and Anderson (1986a)</td>
<td>PE</td>
<td>1.3</td>
<td>1.9</td>
</tr>
<tr>
<td>OECD (1987)</td>
<td>PE</td>
<td>1.2³</td>
<td></td>
</tr>
<tr>
<td>Tyers and Anderson (1987)</td>
<td>PE</td>
<td>0.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Dicke et al. (1988)</td>
<td>GE</td>
<td>3.3</td>
<td>...</td>
</tr>
<tr>
<td>IMF (1988)</td>
<td>GE</td>
<td>3.5</td>
<td>...</td>
</tr>
<tr>
<td>Stoeckel and Breckling (1989)</td>
<td>GE</td>
<td>1.5</td>
<td>...</td>
</tr>
<tr>
<td>Martin et al. (1989-90)</td>
<td>GE</td>
<td>1.4</td>
<td>...</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td><strong>1.4</strong></td>
<td><strong>1.7</strong></td>
</tr>
</tbody>
</table>

1 PE = partial equilibrium. GE = general equilibrium.
2 The transfer ratio is defined as the cost, in ECU, of transferring 1 ECU from consumers and taxpayers to farmers. In other words, the transfer ratio measures the total transfers from consumers and taxpayers to farmers as a proportion of the transfers received by farmers.
3 This figure is obtained by taking the gross estimate reported, 2.8%, of the costs of transfers from consumers and taxpayers, and by converting it to a net figure by subtracting the transfers to farmers assuming the average transfer ratio of 1.7 shown in the bottom right corner of the table.
Broadly similar results have been reported in several other studies and for other countries. Bale and Lutz (1981) found, for example, that agricultural policy in the United Kingdom, France, Germany, and Japan cost consumers in these countries 0.5%, 0.7%, 0.9%, and 1.4% of their GNP in 1976. Otsuka and Hayami (1985) concluded that the net cost of Japanese rice policy alone during 1965-80 amounted to 0.3% to 0.7% of Japan's GDP. In Japan and Korea, agricultural liberalization would raise real wages by 3% and 6% according to Vincent (1989a, 1989b), while land prices would fall by 70% and 45%. Based on their general equilibrium computations, Martin et al. (1989-90) found in some of their runs that GDP in the EC would rise by about 3% to 6% following multilateral liberalization of agricultural support in the OECD countries, while agricultural output would fall by about 18%. Moreover, they report that the total costs of farm support per job saved in agriculture and food processing range from US$ 13,000 in Japan and US$ 20,000 in the EC and the United States to almost US$ 100,000 in Canada (at 1988 prices and exchange rates). Many more examples could be given.

1.3.2. The Uruguay round of the GATT

The cost of agricultural protection is scheduled to be reduced significantly over the next few years in accordance with the recently concluded Uruguay round of the General Agreement on Tariffs and Trade (GATT), both by reducing direct transfers to agriculture and by replacing nontariff trade barriers by more efficient and transparent tariffs that will then be reduced by 36% over a period of six years ending in 2001. That way, with high tariff rates on the table for everyone to see, the farm lobby will find it more difficult than before to dispute empirical estimates of the total cost of agricultural protection. This is an
important accomplishment, as is the extension of the GATT process to include farm products for the first time.

Even so, at the end of this six-year adjustment period, the costs to consumers and taxpayers of protecting agriculture will remain high. The farm problem thus remains unsolved to a considerable extent. Moreover, as Johnson (1991, pages 210-215) points out, a constant degree of protection is not enough to maintain farm incomes at a given level. This is because a price increase raises farm incomes once and for all. Therefore, a continuous increase in agricultural support is needed to enable farm incomes to keep pace with steadily increasing real incomes in the rest of the economy. The persistent tendency for farm support in Europe to increase over time is, therefore, no coincidence. On the contrary, it is a direct consequence of the productivity and demand growth differential between agriculture and other economic activity. The continuous transfer of labor and capital out of a declining industry such as agriculture depresses their returns in that industry compared with other activities.

These tendencies are borne out by experience. According to the OECD (1992), the nominal rate of agricultural protection in industrial countries rose persistently between 1979-81 and 1988-91: from 58% to 84% in the European Community, from 133% to 190% in Japan, from 19% to 33% in the United States, from 32% to 48% in Canada, and from 41% to 73% in the OECD as a whole. Looking further back, Gulbrandsen and Lindbeck (1973) estimated that the average nominal rate of agricultural protection in Western Europe increased from less than 30% in the 1930s to more than 60% in the late 1960s. In Japan, rice imports were free before 1904, but after a tariff was imposed in that year, the rate of rice protection rose to more than 60% by the late 1930s and further to more than 700% by the late 1980s (see Anderson, 1994, and Tyers and
Anderson, 1986b). The general intensification of agricultural protection has coincided with gradual liberalization of trade in industrial goods.

In this connection, it is interesting that many economists and politicians who advocate shock therapy as the best way of securing effective economic liberalization in Central and Eastern Europe seem nevertheless to favor a gradual approach to farm trade liberalization at home, even though several but perhaps not all of the standard arguments against gradualism would seem to apply to trade reform in general. In particular, many have argued forcefully that delayed adjustment in the former socialist economies only prolongs the pain and plays into the hands of special interest groups that gain time and opportunity to organize opposition and even sabotage against reforms. The macroeconomic consequences of the chosen gradual approach to farm policy reform and to agricultural trade liberalization need to be pondered in this light.

2. The macroeconomic implications of agricultural protection

The costs of agricultural protection were generally considered light, or at least were not a major political concern, as long as the European economies enjoyed full employment and healthy economic growth in the decades following the Second World War. In times of hardship, high and increasing unemployment, and sluggish growth, however, all available means of increasing macroeconomic efficiency and restoring full employment and rapid growth need to be considered. The scope for farm policy reform must, therefore, also be contemplated along with other options. As long as it costs consumers and taxpayers the equivalent of about 2% of Europe's GDP every year on average, and perhaps more as we shall see, agriculture is a major macroeconomic concern.
The case against agricultural protection is closely related to the case against protectionism in general. What is at issue here is not just the welfare losses and leakages involved in the redistribution of income from consumers and taxpayers to farmers and landowners. There is also a need to uproot the inefficiency involved in impeding agricultural markets and trade, and in the income and expenditure opportunities thus foregone at home and abroad. To do this, we need to go beyond the partial equilibrium measures of the cost of farm protection reviewed above, compare Tables 1 and 2.

2.1. Gains from trade

To see this clearly, imagine two sectors, agriculture and industry, where productive resources are fully, but inefficiently, employed initially and the relative price of industrial goods and agricultural goods is lower at home than in world markets. This means that agricultural produce is overpriced—by about 80% on average in Europe according to the OECD (1992). More resources are devoted to farm production at the prevailing distorted domestic prices than would be the case under free trade at world market prices. When all restrictions on farm trade are lifted, trade begins at undistorted world market prices. Agricultural output contracts without protection, at least to begin with, but industrial production expands and total output in the economy increases as intended (see Box 1). Therefore, there is scope for those who gain from the change to compensate those who lose. However, in view of the regressive nature of present farm protection in Europe, it is not clear that substantial compensation would be considered necessary.
Box 1. The anatomy of agricultural trade liberalization

In Figure 2, the initial full-employment equilibrium position is described by point E where the domestic relative price line is tangential to the production possibility frontier. At E, domestic production equals domestic consumption and no trade takes place because of a prohibitive tariff or its equivalent by assumption. The steeper line describes the ratio of the prices of the two goods in world markets. The intersection of this line through E and the horizontal axis gives total output (i.e., GDP) measured in industrial goods.

Suppose now that all restrictions on farm trade are lifted. Trade begins at undistorted world market prices. Agricultural output contracts. The economy moves downwards from E in the figure to a point such as J inside the production possibility frontier. Unemployment emerges. If the contraction of agricultural production spreads to industry, that is, if the decline in purchasing power in agriculture reduces the demand for industrial goods as well, industrial production first falls and then rises again on the way from E to J. Aggregate output is lower at J than at E. Sooner or later, however, the increase in the relative price of industrial goods will begin to be exploited by profit-seeking entrepreneurs. As resources are transferred from agriculture and idleness to industry, the economy begins to move to the right from the interior point J towards point F on the production possibility frontier.

One possible adjustment path is described by the locus EJHF. Along the segment EJ, output is lower than initially in both agriculture and industry. At J, industrial output is restored to its original level, but national output is still lower than initially. At H, national output has returned to its initial level, but full employment is not restored until the new equilibrium point F is reached. Gradual adjustment trajectories of this type involving unemployment of labor and other factors of production can be derived from optimal producer behavior if the adjustment itself is costly.

When point F on the production possibility frontier is reached, aggregate output measured in industrial goods has increased by an amount indicated by the thick segment MN of the horizontal axis in the figure. Domestic production of agricultural and industrial goods in the new equilibrium is described by
point F in the figure, and domestic consumption, by point G. The concavity of the production possibility frontier insures that agriculture does not disappear. Industrial goods are now exported in exchange for agricultural imports from the rest of the world. Exports GQ are equal to imports FQ at world market prices by construction of the trade triangle GQF. The current account is in equilibrium.

The welfare cost of the status quo is another matter. This cost is measured by the external transfer of resources that would be required at domestic prices without trade to lift the economy to the same level of social welfare as could be achieved by structural adjustment through free trade. The welfare cost in terms of industrial production is indicated by the horizontal distance between the domestic relative price line tangential to the production possibility frontier at point E and the parallel price line (not shown) tangential to the upper social indifference curve that goes through point G. Generally, this hypothetical welfare cost of the status quo is different from the output gain from structural adjustment denoted by the thick segment of the horizontal axis. For example, the imposition of an optimum tariff may increase welfare but decrease output in the long run.

Because of its weight in world markets, the European Union might be able to gain from less than full liberalization of farm trade. Partial liberalization from E to K in Figure 2 could result in more favorable terms of trade for Europe, reflected by the line segment connecting the production point K and the corresponding consumption point L. Then welfare at L under the optimum tariff would exceed welfare at G under free trade. For consistency, the price line though E, H, and M would then have to be redrawn steeper than the segment KL. Trade liberalization from E to F or K would then increase GDP in terms of industrial goods, but decrease it in terms of agricultural goods by raising their price in the world market.

The total output gain described thus far reflects only the intersectoral reallocation of resources, but not increased efficiency in the use of those
resources within each sector over time. As emphasized by Koester (1991), farm output may actually increase after a while following liberalization as farmers are encouraged to adopt new technology and as efficient farmers expand their operations to fill the void left by less efficient farmers that leave the land. This explains why total farm output in New Zealand has grown by 2% to 4% a year since farm protection was discontinued after 1984. The production of some commodities, such as wine, fruits, and nuts, has grown by leaps and bounds following the liberalization (see Box 2).

**Box 2. Farming without subsidies: The case of New Zealand**

In 1950, New Zealand was the third richest country in the world measured in national income per head. The country had no unemployment, no inflation to speak of, and almost no foreign debt. Gradually, its economy declined to 11th place in the rich-country club in 1960, 15th place in 1970, 20th place in 1980, and 23rd place in 1987 (see Crocombe, Enright, and Porter, 1991). Living standards worsened. Unemployment, inflation, and especially external debt rose to unprecedented levels.

This decline can be traced in part to reduced access of agricultural products from New Zealand to the United Kingdom after the latter’s entry into the European Economic Community in 1973, and partly also to extensive protectionism at home. For example, the nominal rate of pastoral agricultural protection in New Zealand reached a peak of 123% in 1982-83, the highest rate in the OECD. The withdrawal of farm subsidies in 1984 involved significant adjustment costs. About 800 farms, one in hundred, failed. Farmers leaving the land were given “exit grants” equivalent to about two-thirds of their annual income. Even so, by 1991 the number of full-time farm workers had recovered to its pre-1984 level. As farm commodity prices fell by 15% to 65% in real terms (Koester, 1991), real incomes on sheep and beef farms decreased by 40%, and real farmland values dropped similarly, but real incomes on dairy farms did not decline; “[o]n balance, agricultural reform has resulted in a stronger, more
Agriculture diversified and resilient agricultural sector” (OECD, 1991, page 63). Efficiency has improved through larger farms, new technology, and mechanization. New products and new markets have been developed. Land use and input use per acre have decreased in favor of more labor intensive production. The main losers have been landowners and banks whose assets had to be devalued to prevent the insolvency of many farms (Koester, 1991).

The improvement in efficiency is shown by the outward shift of the production possibility frontier from AB to AC in Figure 3, and by the change of the production pattern from F to G where farm output is higher than initially at E. Of the total increase in output, indicated by the thick line segment MQ on the horizontal axis in the figure, MN stems from the liberalization (as in Figure 2) and NQ from the resulting rise in productivity. In Leibenstein’s (1966) terminology, MN represents increased allocative efficiency and NQ, increased X-efficiency.

The output gain from free farm trade depends solely on the magnitude of the initial trade distortion, the response of technology to trade as reflected by the outward shift of the production possibility frontier in Figure 3 (in Box 2), and, at last, the flexibility of production as reflected by the curvature of the production possibility frontier in Figure 2 (in Box 1). As shown in Appendix A, the expansion of output is approximately proportional to the square of the original trade distortion:

\[
\text{Expansion} = \text{mc}^2
\]  

(3)

where \( m \) is a multiplicative factor that reflects the shape and shift of the production possibility frontier and \( c \) is a measure of the constant initial trade distortion shown by the angle between the domestic and world market price lines in Figures 2 and 3. This formula shows the output gain in general
equilibrium by taking the expansion of industry resulting from the liberalization of farm trade into full account, and by including the potential efficiency gains that result from the liberalization. The same formula is obtained when total output is measured in terms of a consumer price index, defined as a weighted average of agricultural and industrial prices, rather than in units of industrial output as above.

This simple formula for output gain is a variation on a well-known theme in welfare economics. The welfare gain from removing a single distortion (a tax or a tariff, for instance) is proportional to the square of the initial distortion (Harberger, 1964). In partial equilibrium analysis, the square of the distortion enters the formula because the welfare gain is measured by an area enclosed by a right triangle whose short sides are both proportional to the tax or tariff rate.

2.2. Partial versus general equilibrium

The simple formula (3) can now be used to approximate the potential output gains from farm trade liberalization. As shown in Appendix A, the parameter m in the formula is a multiple of the share of industry (i.e., manufacturing, communications, trade, and services) in total output after the structural adjustment has been completed, I/Y; of the elasticity of industrial production with respect to its relative price, b; and of the response of agricultural productivity change to the trade liberalization, k. Specifically, we have $m = \frac{1}{2}(I/Y)b(1+k^2)$. The distortion parameter c in the formula is defined as one less the inverse of one plus the nominal rate of protection, i.e., $c = 1 - \pi/\pi^*$, where $\pi$ and $\pi^*$ are the relative prices of industrial and agricultural goods at home and abroad. Therefore, if domestic farm commodity prices are kept at 80% above world market prices, a seemingly reasonable figure for the European Union (see OECD, 1992, and Anderson, 1994), and if the price of industrial
goods is the same at home and abroad, then it follows that \( \pi/\pi^* = 1/1.8 = 0.56 \)
so that \( c = 0.44 \). By the same token, if the domestic/foreign price ratio is 1.5 or
1.2, the distortion parameter is 0.33 or 0.17.

Table 4. Static output gains from farm trade liberalization as a function
of agricultural protection and the elasticity of industrial supply

<table>
<thead>
<tr>
<th>( I/Y = 0.95 )</th>
<th>( b = 0.05 )</th>
<th>( b = 0.1 )</th>
<th>( b = 0.2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( k = 0.7 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( c = 0.17 )</td>
<td>( g = 0.1% )</td>
<td>( g = 0.2% )</td>
<td>( g = 0.4% )</td>
</tr>
<tr>
<td>(20% protection)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( c = 0.33 )</td>
<td>( g = 0.4% )</td>
<td>( g = 0.8% )</td>
<td>( g = 1.6% )</td>
</tr>
<tr>
<td>(50% protection)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( c = 0.44 )</td>
<td>( g = 0.7% )</td>
<td>( g = 1.4% )</td>
<td>( g = 2.8%* )</td>
</tr>
<tr>
<td>(80% protection)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Author's computations based on equation (3).

Note: \( I/Y \) = share of industry in GDP. \( b \) = price elasticity of industrial production. \( c \) = one less the inverse of one plus the nominal rate of protection [i.e., the nominal rate of protection is \( \pi^*/\pi - 1 = c/(1-c) \)]. \( k \) = response of agricultural productivity to trade liberalization (i.e., productivity rises by \( k \) times \( c \) or by 31\% if \( k = 0.7 \) and \( c = 0.44 \)). \( g \) = static output gain in percent.

Given this range of protection, from 20\% to 80\%, and assuming (a) industry in a broad sense (i.e., all except agriculture) to account for 95\% of total output, (b) the elasticity of industrial production with respect to its relative price to range from 0.05 to 0.2 (which means that the long-run price elasticity of farm production ranges from 1 to 4, a plausible range compared with the various estimates reviewed by Johnson, 1991, Chapter 6), and (c) the response of farm productivity to the liberalization to be reflected—arbitrarily, it is true, because no empirical evidence is available on this—in \( k = 0.7 \), so that the withdrawal of 80\% protection increases productivity by about 30\% (see equation (A15) in
Appendix A), we obtain the approximate estimates of the output gains from agricultural liberalization shown in Table 4. If the long-run price elasticity is 0.2, and if the nominal rate of protection is 80%, the potential output gain amounts to almost 3% of GNP, compare the starred entry in the bottom right corner of the table. This estimate is net: it reflects both the gains to industry and the losses to agriculture following liberalization. Higher elasticity estimates, greater productivity effects, and more severe price distortions initially yield even larger potential output gains. Moreover, the net gains shown in the table are smaller than the corresponding gross gains as before. For comparison, the estimate of the permanent static output gain expected to emerge gradually from the market unification of Europe in 1992 is about 4% to 5% according to Cecchini (1988).

The above general equilibrium estimate is about three times as large as the mean estimate of the deadweight loss from farm protection in partial equilibrium analysis according to the surveys of the IMF (1988) and Winters (1987). To see this clearly, the partial equilibrium estimates can be approximated by Harberger's law that expresses the welfare loss from a trade distortion \( t \) as a multiple \( v \) of the square of the distortion:

\[
\text{Loss} = vt^2. \tag{4}
\]

The loss is expressed as a fraction of total output. The constant \( v \) equals a half of the multiple of the import demand and export supply elasticities involved, \( d \) and \( s \), divided by their sum, times the share of agriculture in total output, \( A/Y \). Thus, the loss is \( \frac{1}{2}[ds/(d+s)](A/Y)t^2 \). If, for example, \( d = 1, s = 2, A/Y = 0.05 \), and \( t = 0.8 \), the formula implies a loss of about 1% of output. This figure reflects the loss of consumer surplus in excess of the gain in producer surplus in agriculture resulting from inflated farm prices through protection. It does not,
however, reflect the other side of the coin: namely, the loss of producer surplus and the gain in consumer surplus in industry resulting from depressed industrial prices relative to agriculture (see Harberger, 1974, pages 10-11). Doubling the price elasticity estimates from 1 and 2 in the short run to 2 and 4 in the long run also doubles the estimate of the welfare loss, from 1% to 2% of total output.

And this, roughly, is how Harberger (1959) concluded that Chile's trade restrictions, being equivalent to a tariff of 50% in the 1950s, involved a welfare loss equivalent to at most 2½% of the national income. In this case, the partial equilibrium formula implies a loss of \( \frac{1}{2}[ds/(d+s)](X/Y)t^2 \) where \( X/Y \) is the ratio of exports to output and \( t \) is the trade distortion as before. With \( d = s = 4, \ X/Y = 0.1, \) and \( t = \frac{1}{2} \), the welfare loss is 2½% of GNP. Lower elasticities imply a smaller loss.

The beauty and simplicity of Harberger's formula are probably to blame, to some extent at least, for the preponderance of partial equilibrium studies of the costs of agricultural protection until the late 1980s, compare Table 3. General equilibrium analysis was less common because of its greater complexity and computational requirements, but when it was used it invariably indicated considerably higher costs of protection than were found by partial equilibrium methods, as noted before. Now we have seen, however, that general equilibrium analysis can be formulated and implemented just as simply as its partial equilibrium counterpart. The main advantage of the general equilibrium approach is that it takes the response of nonagricultural output to farm trade liberalization into account and explicitly assumes a time horizon long enough for all farm inputs to have been gainfully re-employed outside agriculture. The comparison between the simple calculations based on the two methods confirms the substantial downward bias of the short-run partial equilibrium
estimates apparent from Table 3. In this light, it seems reasonable to conclude that the total cost of agricultural protection in Europe and elsewhere is higher than has been commonly thought on the basis of short-run partial equilibrium analyses.

2.3. Trade and growth

This is not the end of the story. Increased macroeconomic efficiency through free trade increases the output that can be produced from given inputs, and is, therefore, tantamount to technical progress.

To see this, suppose that output is proportional to capital in a broad sense (as in Romer, 1986). Then output depends solely on the existing stock of capital and on the efficiency with which it is used in production, as shown in Appendix B:

\[ \text{Output} = \text{efficiency} \times \text{capital}. \quad (5) \]

Put differently, output depends simply on the quantity and quality of capital. By "efficiency" is meant the overall efficiency of resource allocation in the economy. Therefore, all improvements in efficiency count, including those resulting from domestic price reform, foreign trade liberalization, privatization, education, research and development, and possibly even macroeconomic stabilization.

Moreover, if saving is proportional to output and equals gross investment, that is, net investment plus depreciation, then we have

\[ \text{Growth} = \text{saving rate} \times \text{efficiency} - \text{depreciation}. \quad (6) \]
More precisely, the rate of economic growth equals the multiple of the saving rate and the efficiency of capital use less the depreciation rate.

By implication, all improvements in efficiency, including farm trade liberalization, result not only in a higher level of output by equation (3), but also in a higher rate of growth of output by equation (6). This increase in growth is permanent. Specifically, the mechanisms that prevented increased efficiency and increased saving from stimulating growth permanently in the models of Harrod and Domar and Solow are absent here because the production function (5) exhibits constant returns to capital. In the neoclassical growth model, on the other hand, trade liberalization is equivalent to a technical innovation that increases the rate of growth of output as the economy moves from one steady-state growth path to another, higher path. This adjustment process may take a long time in the Solow model, thus making it difficult to distinguish empirically from the Harrod-Domar-Romer version of the endogenous-growth model employed above. The result that trade reform stimulates economic growth can thus be viewed either as a long-run property of endogenous growth or as a medium-term attribute of exogenous growth. Therefore, agricultural trade liberalization, like trade liberalization in general, will increase the level and growth of total output over time, even though output may decrease in the short run because of the time it takes for exfarmers, farm workers, and middlemen to learn new skills and to find profitable employment outside agriculture.

How large are the potential dynamic output gains from freer trade? Suppose that farm protection is reduced to one-fourth of its present level, from 80% to 20%. Such liberalization by 75% lowers the ratio of domestic to world market prices from 1.8 to 1.2, decreasing the distortion from 0.44 to 0.17. This could increase the level of total output gradually by about 2½% in the European
Union once and for all, that is, by the difference between the starred estimate of a static output gain of 2.8% in Table 4 and the estimate of 0.4% above it in the table. Hence, if the efficiency index $E$ was 0.33 before (corresponding to a capital/output ratio of 3), it will be 0.338 after the liberalization. At higher price elasticities, the potential static output and efficiency gains can be larger. In the EFTA countries, and especially in Norway and Finland where current farm support is highest relative to GDP (except in Iceland, an EFTA member that has not yet reported the full cost of its farm protection to the OECD), the static output gains from reducing agricultural protection by 75% could be higher than in the European Union, perhaps in the neighborhood of 3% of GDP or more.

Table 5. Dynamic output gains from agricultural trade as a function of the saving rate and the efficiency of capital

<table>
<thead>
<tr>
<th></th>
<th>$E = 0.334$</th>
<th>$E = 0.338$</th>
<th>$E = 0.339$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(17% liberalization)</td>
<td>(75% liberalization)</td>
<td>(100% liberalization)</td>
</tr>
<tr>
<td>$s = 0.15$</td>
<td>$\Delta g = 0.1%$</td>
<td>$\Delta g = 0.1%$</td>
<td>$\Delta g = 0.1%$</td>
</tr>
<tr>
<td>$s = 0.2$</td>
<td>$\Delta g = 0.1%$</td>
<td>$\Delta g = 0.2%^*$</td>
<td>$\Delta g = 0.2%$</td>
</tr>
<tr>
<td>$s = 0.25$</td>
<td>$\Delta g = 0.1%$</td>
<td>$\Delta g = 0.2%$</td>
<td>$\Delta g = 0.2%$</td>
</tr>
</tbody>
</table>

Source: Author's computations based on equation (6).

Note: $s =$ saving rate. $E =$ efficiency of capital. $\Delta g =$ growth bonus in percent.

Assuming a saving rate of, say, 20% of total output, the liberalization of farm trade by 75% could be expected to increase the rate of growth of total output per head by 2% by equation (6), other things being equal, compare the starred entry in Table 5. That would mean an increase in economic growth per capita of about one-tenth under normal circumstances (e.g., from 2.0% to 2.2% per year).
Higher saving and investment rates, larger price elasticities, and more ambitious liberalization could produce even greater growth effects. If these numbers are indicative of the results that would emerge from detailed empirical case studies of the consequences of agricultural trade liberalization, it seems reasonable to conclude that continued trade restrictions may be expensive indeed, at least as long as the slump in output during the adjustment period is not too deep and long.

2.4. Macroeconomic aspects of agriculture

The potential macroeconomic gains from agricultural trade liberalization reviewed above bring farm problems and policies inevitably into the sphere of macroeconomic policy.

This is obvious as far as fiscal affairs are concerned. Persistent government budget deficits and the associated accumulation of public debt have been a major macroeconomic concern in many European countries for years. The governments of Europe would be in a better position to come to grips with their fiscal problems if expenditures on agricultural transfers were reduced. After all, agriculture has absorbed about 70% of the European Union budget in recent years. Moreover, by lowering food prices and thus increasing the purchasing power of households, farm trade liberalization in Europe would create scope for either reduced government spending on social services or increased taxation or both. Therefore, farm policy reform would strengthen the fiscal position of European governments.

2.4.1. Agriculture, money, and exchange rates

The public finance argument can be extended to the field of monetary affairs and inflation control. Consider a government confronted by the real or
imagined need to devalue the national currency to strengthen the competitiveness of its export and import-competing industries and to bolster the balance of payments but reluctant to do so for fear of increased inflation. The Nordic countries, among others, have found themselves in this predicament repeatedly over the years. Suppose, furthermore, that there is considered to be limited elbow room to accompany the devaluation by fiscal and monetary restraint, because public spending cuts are unpalatable and taxes and interest rates are deemed to be too high already. Then what can be done?

One way out of the dilemma is to boost aggregate supply by, for example, yes, liberalizing farm trade. The resulting decrease in food prices can offset the inflationary effect of devaluation on domestic consumer prices and hence also on wages. That way it is, in principle, possible to devalue the currency if urgent need arises without generating a spiral of price and wage increases. The decline in the purchasing power of households through devaluation is then compensated by increased purchasing power through a more efficient allocation of resources and lower prices. Put differently, freer trade drives a wedge between the wage earnings of households and the wage costs of enterprises. Unlike devaluation, lower food prices through increased competition and lower tariffs strengthen the purchasing power of households without adding to the wage costs of firms. In some cases, therefore, farm policy reform can conceivably even be a substitute for, rather than a complement to, devaluation.

Consider next a central bank that faces loud demands for lower interest rates in order to stimulate the economy, and hesitates to do so for fear of increased inflation. Then the Governor can say: there is a better way. Let us rather bring food prices down through farm trade reform. Then consumer prices, or at least inflation, will come down and interest rates will follow. Let us, in other words,
increase real money supply by deflating prices through structural supply-side reforms in agriculture and elsewhere without increasing the money supply in circulation, and thus bring interest rates down without igniting inflation. Through this channel, in other words, the price level can be lowered without reducing the quantity of money.

This is why agricultural policies, and structural reforms in general, including labor market reforms, belong on the agenda of central banks and, by implication, of the International Monetary Fund.

Some numbers may throw light on the magnitudes involved. Roughly a sixth of the average household budget in the European Union is spent on food, mostly European. Therefore, if food prices in Europe were lowered by a third (say, from 1.8 to 1.2) and world market prices rose by a fifth (say, from 1.0 to 1.2), thus eliminating the present 80% discrepancy between home and world market prices on average, then consumer prices in Europe could fall by almost 6%, other things being equal. Real money supply, purchasing power, and ultimately employment would increase correspondingly. Alternatively, a partial liberalization by 60% could lower food prices by 20% and consumer prices by 3%. In either case, with exchange rates floating against the rest of the world, European interest rates would probably fall enough to stimulate investment at home and to strengthen the response of employment and output.

**Box 3. Devaluation without inflation: The case of Iceland**

Iceland has experienced more inflation since the 1950s than any other OECD country except Turkey. From 1955 to 1993, consumer prices in Iceland increased by 23% a year on average. A lax exchange rate policy during most of this period played an important part in this development. A typical devaluation cycle began with a downswing in the fisheries, followed by pressure on the government to
devalue the króna to restore profitability to the fishing industry that accounts for more than a half of export earnings. Without adequate monetary, fiscal, and financial restraint to contain inflation, repeated devaluation fuelled a persistent wage-price spiral that was not broken until 1992, perhaps only temporarily. Even so, the real exchange rate remains too high for the Icelandic economy to be able to break loose from its excessive dependence on fish by developing a profitable, viable, and broadly based export industry. Icelandic exports have been stagnant at about one-third of GDP since the early 1970s, while the share of world exports in world output has increased by a half. The authorities are reluctant to devalue the króna mainly because they fear this would trigger a new wave of inflation.

Yet inflation could be averted by accompanying the necessary devaluation by structural change: by imposing fishing fees on boat owners to encourage an efficient and fair reduction of a fishing fleet that has grown much too large in view of the maximum allowable catch (see Gyfason, 1992) and, yes, by liberalizing agriculture. Imports comprise about 40% of consumer expenditure. A 10% devaluation, therefore, needs to be accompanied by a 7% decrease in domestic prices for the consumer price index and the purchasing power of wages to remain unchanged. This could be done by reducing domestic food prices by 27% (that is, from 400% to a little less than 300% of world market prices on average) as food accounts for about a fourth of consumer expenditure on domestically produced goods and services. A more comprehensive liberalization of agriculture leading to, say, a 50% reduction of domestic food prices (from 400% to 200% of world prices) would similarly create scope for a 20% devaluation or thereabouts without inflation, other things being equal. Exports could then take off without a need for domestic expenditure to be restrained commensurately to keep inflation in check.
This prescription for aggregate supply management is most plainly derived from a purely neoclassical framework where aggregate supply is independent of price and where aggregate demand is derived from the quantity theory of money (Figure 4). Farm trade reform will probably bear fruit more slowly than monetary operations because money can be issued more quickly than prices can be reduced in rigid markets, but its effects will most likely last longer. Unlike monetary expansion, aggregate supply stimulus through trade reform is compatible with stable prices.

The same argument applies to labor market rigidities: their removal would lower production costs and prices and interest rates, and thus increase employment, output, and investment gradually.

One further point needs to be reiterated in this context. Because an overprotected, inefficient agriculture imposes unnecessarily high food prices on consumers and thus restricts their purchasing power, it depresses the demand for labor as well. This is because trade reform is equivalent to technical progress in that it allows more output to be produced by given inputs, compare equation (5). Despite the transitional increase in unemployment that can be expected from farm trade liberalization, as occurred in New Zealand, for example, such reform will release new purchasing power and thus ultimately stimulate aggregate demand for goods and services and reduce joblessness over time. The high and persistent unemployment in Europe since the late 1970s increases the urgency of agricultural policy reform.

Econometric estimates of the macroeconomic general equilibrium effects of dismantling the Common Agricultural Policy seem to support this link. According to the OECD (1988), consumer prices would decline by almost 2% because of lower agricultural prices; total employment would increase by almost 6% while agricultural employment would drop by nearly 12%; and total
output would rise by almost 4% while agricultural production would decrease by nearly 6%. These results abstract from delays and adjustment costs.

At last, we need to consider the link between exchange rates and the CAP. Because the CAP revolves around an elaborate system of variable levies and subsidies intended to maintain not only high but also uniform agricultural prices throughout the Union in order to avoid trade distortions, there was considered to be a need to shield the system from exchange rate fluctuations. This was done by adjusting administered prices in inverse proportion to exchange rate changes against the European Currency Unit (ECU), the unit of account in agricultural pricing. However, farmers in countries whose currencies appreciated were understandably reluctant to reduce their prices to conform to a common price level. Moreover, because domestic and foreign food products are close substitutes, devaluation tended to increase farm prices at home more fully and more quickly than many other prices. This increased resistance against full adjustment of food prices to exchange rates, and led to the establishment of an elaborate mechanism of Monetary Compensatory Amounts (MCAs) intended to accommodate price differences among member countries and thus to prevent trade distortions (IMF, 1988).

Under the European Monetary System (EMS), the pressure on farm prices and compensatory payments has been reduced. This is not to say that the CAP per se necessitates fixed exchange rates or a common currency in Europe. Yet, it seems that a radical liberalization of the CAP would remove an important constraint on the European Union's choice between fixed and flexible exchange rates in the future should the Union's current plan for a common currency fail.
2.4.2. Central and Eastern Europe

The European Union now faces an important opportunity and challenge to bring the Central and Eastern European countries into the mainstream of European affairs where they belong. It would be unfortunate if, at this crucial juncture in its history, Central and Eastern Europe were deprived of a chance to grow and prosper through increased exports among other things. The expansion of trade is a prerequisite for necessary restructuring and rapid growth, and possibly also for lasting political stability in the region. Therefore, the European Union and the EFTA countries must open their borders to increased trade with Central and Eastern Europe, not only in manufacturing goods, but also in farm commodities, textiles, and services. Agriculture is especially important here, for three main reasons.

First, in view of their history as important exporters of agricultural goods and of the notorious inefficiency of their agriculture under central planning, the Central and Eastern European countries can be expected to increase their farm output substantially in the years ahead (see Hamilton and Winters, 1992). Accounting for about 10% to 20% of GDP and up to 30% of employment, agriculture remains relatively more important in Central and Eastern Europe than in Western Europe (see World Bank, 1993). The contribution of agriculture to trade is also considerably larger in Eastern Europe than in the West: in 1989, farm exports averaged 11% of total merchandise exports in Central and Eastern Europe, ranging from 3% in Albania to 23% in Hungary (Anderson, 1991). Therefore, a take-off of export-led growth in Central and Eastern Europe requires farm import liberalization in Western Europe, and thus a reorganization of the CAP far beyond the reforms of May 1992. Second, without adequate market access for their farm goods in which they have natural and historical comparative advantages, the Central and Eastern European countries...
may be led to embark on a premature and excessive reindustrialization that may strain their already severely polluted environment. As their economies develop, however, the role of agriculture will diminish gradually there as in Western Europe. Third, the additional cost imposed by the entry of the Central and Eastern European countries into the European Union in the first or second decade of the next century, or perhaps even sooner, would almost surely bankrupt the CAP in its present form (see CEPR, 1992).

The integration of the Central and Eastern European countries into the mainstream of the European economy, and ultimately into the European Union, provides an independent and important justification for restructuring the CAP (see Josling, 1979). Political leaders must confront special interests at home by replacing aid by trade for the benefit of Europe as a whole. The potential gains from eliminating remaining inflation differentials and reducing inflation in Europe further through a common currency are certainly important, but they are probably not large compared with the gains from further liberalization of trade, especially in agriculture, as is necessary to achieve an integrated Europe, peaceful and prosperous for a long time to come. The continued exclusion of the Central and Eastern European countries from the European Union’s common agricultural market would not suffice to immunize the Union from the consequences of the re-emergence of Central and Eastern Europe as a major agricultural exporter, however, because the resulting decline in farm commodity prices in the world market would jack up the direct and indirect cost of maintaining the CAP as it is.

2.4.3. Environmental protection

Because the natural environment is partly a public good, and because it involves substantial externalities, environmental preservation is a public
concern. This consideration brings the maintenance and strengthening of rural communities within the purview of public policy. This link has sometimes been used as an argument for agricultural support.

However, according to Winters (1989-90) and Anderson (1992a, 1992b) among others, farm protection has been counterproductive in this regard. First, by raising farm output and land prices, agricultural protection has encouraged intensive cultivation and construction in rural areas at the expense of both visual amenity and public access. Second, because it is widely and correctly perceived as unsustainable at present levels, agricultural support encourages current over-exploitation of land with gradual soil erosion as a result; farmers will, in Winters's words, "make hay while the sun shines." Third, because farming is relatively capital- and energy-intensive, price support stimulates the use of chemical fertilizers and energy, including oil, and thus tends to increase pollution. On all three counts, therefore, rather than harming the environment, lower prices of farm goods and of land following agricultural trade liberalization seem likely, on the contrary, to help promote environmental preservation.

Hence, in so far as farm policies are appropriate instruments of environmental protection, reduced price support seems to be the way to go. The most efficient way of strengthening rural communities, however, is not through farm support but rather through regional assistance that is not tied to specific activities. As noted by Johnson (1991, Chapter 11), the population of rural communities in Western Europe and North America has not declined with agriculture in this century because most exfarmers have found new jobs at home or nearby. Moreover, the gradual decline of employment in agriculture conceals substantial flows into and out of the farm labor force, in part presumably because generous farm support induces entry by new labor and
capital into agriculture. This means that net migration of labor out of agriculture would be considerably more rapid under less extravagant farm policies, without gross migration from agriculture necessarily being affected.

Most importantly, however, it can be argued that education and human services in rural areas need and deserve public support on the grounds that the single most significant cause of low farm incomes is lack of schooling, skills, and other human resources (see Johnson, 1991, Chapter 12). Price support is not well suited to reducing income differentials that result primarily from discrimination in education opportunities. This is perhaps the most important reason why agricultural protection should, in part at least, be converted to improved education and infrastructure in rural areas, and why Ministries of Agriculture should perhaps be incorporated into Ministries of Education and Culture to secure a balanced and equitable distribution of public support for education and culture between regional communities and other areas.

### 2.4.4. Economic development

Before concluding, we need to consider the consequences of the Common Agricultural Policy for developing countries, many of which rely on farm exports for much of their foreign exchange earnings.

By restricting foreign access to their markets and by overproducing agricultural goods, the European nations depress food prices in world markets, as noted before. According to the OECD (1987), a unilateral across-the-board reduction by 10% of the protection afforded by the CAP would increase the world market prices of most commodities by 0.6% (for sugar) to 2.9% (for milk). These results are based on partial equilibrium models, and thus probably understate the real effects.
Long-run general equilibrium analysis yields higher estimates of the price and income effects of farm trade liberalization on developing countries. If, for example, the industrial countries liberalized their farm policies enough to increase world market prices by 10%, then the output gain to the developing countries would amount to 1% to 2% of their GDP according to Loo and Tower (1989). This is not to say, however, that the rest of the world would gain uniformly from a liberalization of the CAP because some countries would lose from it, including Japan, Korea, and Pakistan, for example. Several studies reviewed by the IMF (1988) lead to similar conclusions. A complete liberalization of farm trade in Europe would raise world market prices up to 28% (for dairy products), for instance.

The IMF (1988) also reports empirical evidence that the CAP destabilizes world commodity prices substantially by insulating European markets from external commodity price fluctuations without countercyclical stock management by the EU.

And then, to conclude, there is the difficult question of narcotics: Would it not be easier to induce poor farmers in the forests of South America and Asia to produce food rather than drugs if they were enabled to sell their produce at fair prices in free and open agricultural markets in Europe?

3. Conclusion

European agriculture is a macroeconomic concern. The costs of the Common Agricultural Policy have been and remain huge. The average estimate of the total transfers from consumers and taxpayers to farmers and landowners through the CAP extracted from empirical studies undertaken in the 1980s suggests a gross cost of about 2% of European GDP and a deadweight loss equivalent to about 1% of GDP.
These figures are almost surely too low, however, because they are based on short-run partial equilibrium analyses that do not reflect the long-run consequences of the implicit discrimination that agricultural protection involves against other parts of the economy. When assessed by general equilibrium techniques, the long-run gains from transferring labor, capital, and other resources from agriculture to industry, trade, and services where productivity is higher can easily reach 3% of GDP in the long run, with a corresponding reduction in joblessness over time. Furthermore, freer trade in farm products is likely to increase economic growth, possibly permanently.

In assessing the full cost of agricultural protection in Europe and elsewhere it is important, in other words, to include not only the welfare lost through price distortions along the lines suggested by Harberger, as has been common in applied work, but to consider also the output foregone in the economy as a whole in the time-honored tradition of Smith and Ricardo and the dynamic growth effects suggested by Harrod, Domar, Solow, and Romer. Moreover, we must also take the international ramifications of Europe's agricultural policy into account to arrive at a complete empirical assessment of its current cost.

D. Gale Johnson hits the nail on the head in his brilliant book, *World Agriculture in Disarray*:

"The fact that several studies done by different groups of researchers arrive at much larger negative effects of agricultural protection than had been derived from partial equilibrium studies requires that we revise the general view that the welfare or real income losses from protection are so small that they need to be given little weight. The questions raised by the new studies make it incumbent on policy-makers to give serious attention to reconsidering the potential gains and losses from agricultural protection. The potential losses in income and employment revealed by the recent studies are
large and should no longer be ignored in discussion of agricultural policies.” (Johnson, 1991, page 230)

Nor should these potential gains and losses be ignored in current debate of macroeconomic problems and policies in Europe. Extending the macroeconomic debate in this direction will not be easy, however. Resistance to farm reform, and even to rational debate about farm policy issues, seems to be deeply rooted in national attitudes and sentiments. Agricultural issues tend to be charged with emotion. In many European families, the mere discussion of farm policy reform is viewed as an attack upon their work and way of life. In some cases, the impassioned reactions of farmers are more agri than cultural. This is unfortunate, but feelings are facts, too. Even so, economists cannot permit their analyses and advice to be unduly restrained by political expediency or special interests.
Table A1. Share of agriculture as a percentage of total employment in OECD countries, 1870-1990\(^4\)

<table>
<thead>
<tr>
<th>Country</th>
<th>1870</th>
<th>1960</th>
<th>1990</th>
</tr>
</thead>
<tbody>
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<td>...</td>
<td>8.5</td>
<td>2.8</td>
</tr>
<tr>
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<td>...</td>
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</tr>
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<td>3.4</td>
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<td>New Zealand</td>
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<td>14.6</td>
<td>10.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>...</td>
<td><strong>21.6</strong></td>
<td><strong>7.5</strong></td>
</tr>
</tbody>
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\(^4\)When the figure for 1990 is not available, the latest available one is recorded instead.
Table A2. Share of value added in agriculture as a percentage of GDP in OECD countries, 1960-1990

<table>
<thead>
<tr>
<th>Country</th>
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<th>1990</th>
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<tr>
<td>United States</td>
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<td>Denmark</td>
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<td>New Zealand</td>
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<tr>
<td><strong>Total OECD</strong></td>
<td><strong>7.2</strong></td>
<td><strong>2.7</strong></td>
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</tbody>
</table>

Source: OECD, *Historical Statistics.*
### Table A3. Output per worker in agriculture as a percentage of GDP per worker in OECD countries, 1960-1990

<table>
<thead>
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<th>Country</th>
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</thead>
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<td>Switzerland</td>
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<tr>
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</tr>
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<td>Australia</td>
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<tr>
<td>New Zealand</td>
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<tr>
<td>Average OECD</td>
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<td>59</td>
</tr>
</tbody>
</table>

Sources: Appendix Tables A1 and A2.
Appendix A

Let the relationship between domestic and world market prices be given by

\[ \pi = (1 - c)\pi^* \]  \hspace{1cm} (A1)

where \( \pi \) and \( \pi^* \) are the relative prices of industrial and agricultural goods at home and abroad and \( c \) is a constant that reflects the extent of the initial price distortion (\( 0 < c < 1 \)). Geometrically, the distortion parameter \( c \) reflects the angle between the two relative price lines where they cross at point E in Figure 2 in the text. Farm trade liberalization reduces or eliminates the distortion, thus decreasing domestic agricultural prices relative to industrial ones, so that \( \pi \) increases to \( \pi^* \).

National output, measured in industrial goods, is

\[ Y = I + \left( \frac{1}{\pi^*} \right)A \]  \hspace{1cm} (A2)

where \( I \) and \( A \) represent industrial and agricultural output.

The production possibility frontier is described by the convex function

\[ A = F(I) \]  \hspace{1cm} (A3)

where \( F' < 0 \) and \( F'' < 0 \). Profit maximization requires

\[ F'(I) = -\pi^* \]  \hspace{1cm} (A4)

at the free-trade point \( F \) in the figure and, likewise, \( F'(I) = -\pi \) at the initial autarky point \( E \).

The increase in industrial output from \( E \) to \( F \) is approximately
\[ \Delta I = -F''^{-1}(I)(\pi^\ast - \pi) = -F''^{-1}(I)c\pi^\ast \] (A5)

The approximate decrease in agricultural output is obtained by evaluating a second-order Taylor expansion of equation (A3) around point E in the figure:

\[ \Delta \lambda = F'(I)\Delta I - \frac{1}{2} F''(I)(\Delta I)^2 \] (A6)

The approximate increase in total output from E to F is found by substituting from equation (A6) into equation (A2) after taking first differences on both sides of the latter at given world market prices. This gives

\[ \Delta Y = \Delta I + \left( \frac{1}{\pi^\ast} \right) \left[ F'(I)\Delta I - \frac{1}{2} F''(I)(\Delta I)^2 \right] = -\frac{1}{2\pi^\ast} F''(I)(\Delta I)^2 \] (A7)

By squaring equation (A5) and substituting the result into equation (A7) we obtain

\[ \Delta Y = mc^2 \] (A8)

where \( m \) denotes the multiple \( \frac{1}{2}(F^/F'') \).

This is equation (3) in the text. The output gain from trade liberalization thus depends solely on the shape of the production possibility frontier and the magnitude of the initial price distortion. The multiplicative factor can be expressed as \( m = \frac{1}{2}b \) where \( b = F^/F'I \) is the elasticity of industrial production with respect to its relative price.

Consider this production possibility function, for example:
\[ A = q \left( a - \frac{1}{1+\frac{1}{b}} \right) ^{1+\frac{1}{b}} \]  

(A9)

where \( q, a, \) and \( b \) are positive constants. The slope of the function at point \( F \) is

\[ \frac{\partial A}{\partial I} = F' (I) = -q l^b = -\pi^* \]  

(A10)

so that

\[ I = \left( \frac{\pi^*}{q} \right)^b \]  

(A11)

The price elasticity of industrial output is fixed at \( b \) anywhere along the frontier. The corresponding price elasticity of agricultural output, \( (\partial A / \partial \pi^*)(\pi^*/A) \), equals \(-b\pi^*I/A\), and varies inversely with the share of agriculture in total output.

The increase in industrial production as its relative price at home rises from \( \pi \) to \( \pi^* \) is

\[ \Delta I = \left( \frac{1}{q} \right)^b b\pi^*b - 1 (\pi^* - \pi) = \left( \frac{\pi^*}{q} \right)^b b\pi^*b - 1 c\pi^* = bcI \]  

(A12)

The corresponding decrease in domestic agricultural production is

\[ \Delta A = -ql^b \Delta I + \frac{1}{2b} ql^b b - 1 (\Delta I)^2 = -ql^b b c I + \frac{1}{2b} ql^b b^2 c^2 I^2 \]  

(A13)

The resulting increase in total output is found by substituting from equations (A12) and (A13) into equation (A2):
\[
\frac{g}{1 + g} = \frac{1}{2} \left( \frac{1}{\frac{\text{I}}{\text{Y}}} \right) \text{bc}^2
\]  

(A14)

Here \( g = \Delta \text{Y}/\text{Y} \) is the proportional increase in output from E to F in Figure 2 (with initial output as a base), I/Y is the share of industry (i.e., manufacturing, construction, trade, and services) in total output after the structural adjustment has been completed, and \( b \) is the elasticity of industrial production with respect to its relative price, \( b = \frac{\text{F}'}{(\text{F}' \text{I})} \), from equation (A11). If multiplied through by \( \text{Y} \), equation (A14) becomes identical to equation (A8).

Equation (A14) has the following interpretation. The more severe the initial distortion \( c \), the larger is the correction that needs to be made and, hence, the greater will be the gain in output. The greater the elasticity of industrial production to its relative price \( b \), the greater will be the response of total output to trade reform. The more ambitious the structural adjustment undertaken, the larger is the share of industry \( I/Y \) at the end of the day and, hence, again, the greater will be the gain in total output from agricultural trade liberalization. This equation can be used to assess the potential strength of the empirical link between trade liberalization and the ensuing expansion of total output \( g \) in general equilibrium for given estimates of \( I/Y \), \( b \), and \( c \), as in the text (see Gyfason, 1993).

Productivity in agriculture, reflected by the parameter \( q \) above, has been assumed to remain unchanged thus far. Assume now that farm productivity increases when agricultural trade is liberalized (see Box 2), according to

\[
\frac{\Delta q}{q} = kc
\]  

(A15)
where \( k \) is a positive constant. The greater the initial farm trade distortion \( c \), the greater the resulting proportional increase in agricultural productivity. By similar arithmetic as above, total output can be shown to increase further with increased farm productivity by

\[
\frac{g}{1 + g} = \frac{1}{2} \left( \frac{1}{Y} \right) b \left( \frac{\Delta q}{q} \right)^2 \tag{A16}
\]

This expression describes the expansion of output from point F to point G in Figure 3, whereas equation (A14) describes the increase in output from point E to point F in the figure. The total increase in output from E through F to G is found by adding equations (A14) and (A16) by using equation (A15):

\[
\frac{g}{1 + g} = \frac{1}{2} \left( \frac{1}{Y} \right) b (1 + k^2) c^2 \tag{A17}
\]

With this addition, the multiple \( m \) in equation (3) in the text equals the multiple \( \frac{1}{2} (F^' / F^'')(1 + k^2) \).

To take another example, consider an economy where agriculture is characterized by decreasing returns to labor use, so that

\[
A = q \ln (1 + L_A) \tag{A18}
\]

where \( \ln (1 + L_A) \) is the natural logarithm of (one plus) employment in agriculture. There are constant returns to labor use in industry:

\[
I = hL_I \tag{A19}
\]

where \( L_I \) is employment in industry and the output-input coefficient \( h \) is a positive constant.
The exogenously given labor force $L$ is fully employed in agriculture and industry:

$$L = L_A + L_I$$  \hspace{1cm} (A20)

Equations (A18), (A19), and (A20) imply the following production possibility frontier:

$$A = q \ln \left(1 + \frac{L}{h} - 1\right)$$  \hspace{1cm} (A21)

with $F' = -q[h(1+L)-1]^{-1} < 0$ and $F'' = -q[h(1+L)-1]^{-2} < 0$ as required for convexity. The first-order condition for maximum profit is

$$\frac{\partial A}{\partial I} = F'(I) = -\frac{q}{h(1+L)-1} = -\pi^*$$  \hspace{1cm} (A22)

so that

$$I = h(1+L) - \frac{q}{\pi^*}$$  \hspace{1cm} (A23)

The reaction of industrial output to an increase in its relative price is

$$\Delta I = \frac{q}{\pi^*} (\pi^* - \pi) = \frac{q}{\pi^*} c\pi^* = \frac{q}{\pi^*} c$$  \hspace{1cm} (A24)

The corresponding price elasticity of industrial production is

$$b = \frac{\partial A}{\partial \pi^*} \frac{\pi^*}{I} = \frac{\partial A}{\partial \pi^*} \frac{\pi^*}{\pi^*} I = \frac{q}{\pi^*} I = \frac{q[h(1+L)-1]}{qI} = \frac{h(1+L_A)}{I}$$  \hspace{1cm} (A25)
The price elasticity of industrial output is not fixed here as in the preceding example, but varies inversely with the output. The price elasticity of agricultural output is also variable, and equals -q/A. The smaller and more productive the farm sector, the more responsive it is to price incentives.

The reaction of total output to an increase in the relative price of industrial output (i.e., a decrease in the relative price of agricultural goods) can be found by substituting the above values of $F' = -q[h(1+L) - I]^{-1}$ and $F'' = -q[h(1+L) - I]^{-2}$ and the square of equation (A24) into equation (A8). This operation, with equation (A25), gives equation (A14) as before. Moreover, by adding technical progress on top of trade liberalization through equation (A15), we obtain equation (A17) again.

**Appendix B**

Let output be produced by labor L and capital K according to a Cobb-Douglas production function, $Y = AL^aK^{1-a}$, where the accumulated technical knowledge A is tied to the capital stock by $A = EK^{a(1-b)}$ and E reflects efficiency (compare Romer, 1986, 1989), and where employment is related to the capital stock by $L = K^b$ with $0 < b < 1$. Then output is proportional to the capital stock:

$$Y = EK \quad \text{(B1)}$$

This Harrod-Domar-Romer type of aggregate production function with constant returns to capital conforms to the stylized facts behind the neoclassical growth model of Solow. First, the capital/output ratio, $K/Y$, is constant in the long run for given E. Second, average labor productivity, $Y/L$, rises over time because $\Delta L/L = b\Delta K/K = b\Delta Y/Y < \Delta Y/Y$. Third, real wages w increase over
time with productivity because $w = aY/L$. Fourth, real interest rates $r$ are
constant in the long run because $r = (1-a)Y/K$. Fifth, wage income plus interest
equal output: $wL + rK = Y$. None of these standard properties is violated by the
constant-returns-to-capital production function (B1).

If saving $S$ is proportional to output and equals gross investment, i.e., $I = \Delta K + dK$ where $d$ is the depreciation rate, then $S = sY = I = \Delta K + dK = \Delta Y/E + dY/E$ for given $E$, so that

$$g = sE - d$$  \hspace{1cm} (B2)

where $g = \Delta Y/Y$. Increased efficiency $E$ thus results not only in a higher level of
output by equation (A14), but also in a permanently higher rate of growth of output by equation (B2).
References


